

PERSPECTIVES on Science and Christian Faith

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In This Issue ...

Reading Scripture and Nature: Pentecostal Hermeneutics and Their Implications for the Contemporary Evangelical Theology and Science Conversation

Kepler and the Laws of Nature

Sediment Transport and the Coconino Sandstone: A Reality Check on Flood Geology

Design or the Multiverse?

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

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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 submitted for publication.
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Civil Discourse and the ASA

Jennifer Wiseman



Jennifer Wiseman

If you don't have something nice to say about someone, then don't say anything at all." This was the wise admonition often given to my siblings and me by our mother during our childhood. Perhaps this is a bit simplistic — after all, Jesus did not always say “nice things” about everybody — but for the rest of us it should at least be the starting point in our conversations about viewpoints differing from our own, and especially about those who hold them.

Yet as I write this, our nation is reeling from the mindless rampage of a gunman who shot a US Representative and several other citizens who were peacefully assembled with her. Though the perpetrator was obviously troubled in many ways, many people are soul-searching the possibility that our nation's political discourse has become too negative and verbally abusive, driving some on the edge to violence and many others to unproductive divisions. Even our media serves as a vehicle for polarization rather than an objective marketplace for news and ideas.

What does this have to do with an organization focused on science and Christian faith, namely the ASA? Quite a lot. The state of national discourse on science and religious belief is also, by some measures, at a low point. This can be attributed to many possible drivers. For one, science education, at least in the USA, currently leaves many without even a basic understanding of scientific history, methods, and current knowledge. This leads to a vulnerability of belief: if a trusted religious authority figure speaks erroneously on a scientific issue, and conflates this error with a theologically disputable “biblical view,” how can an uninformed Christian citizen discern what to believe?

The scientific community has also contributed to poor discourse, both by the extreme polemics offered by a few popular authors who conflate science with an antireligious manifesto, and by a much larger

segment of the scientific community that simply does not quite understand the concerns and beliefs of a significant segment of the largely religious public, from whom they need support.

We do not know each other either: outside the ASA, many Christians have never known a scientist, and vice versa. In some Christian circles, we have also lost touch with the diversity of Scripture-honoring views held throughout the centuries that are relevant to scientific understanding today. Christian “camps” and labels have developed around certain philosophical stances: “Creation Science,” “Theistic Evolution,” “Intelligent Design,” “Darwinism,” and “BioLogos,” to name a few regarding origins. Then there are the “camps” on issues that inform policy and behavior as well: Why is the climate changing, and what should we do about it? Does God call us to lifestyle change for the sake of the environment? When does human life begin? Is embryonic stem cell research ever a good thing? How much should we care and do about the welfare and suffering of other species? How should we use our technology? Are our institutions run in honorable ways? Finding like-minded fellow believers on any of these themes can be refreshing. Yet well-informed and stimulating cross-discussion and debate are critical for the health of an open society, especially for Christians, as we believe there is truth to be found through honest discourse. Sadly, some Christian groups seem to have also fallen into the national abyss of name-calling and disrespect, not just of viewpoints but also of the people who hold them.

Within the ASA, we discuss all kinds of issues regarding the relationship of science and Christian faith. Now is the time to reaffirm *how* we conduct our discourse, and where and why. Now, more than ever, ASA members need to model to the church and to the world what civil, even loving, discourse can look like. Why? Because Jesus said that the way others will know that we are his disciples is by our

Guest Editorial

Civil Discourse and the ASA

love for one another. How do you love someone who espouses views you believe are wrong or even harmful? By accurately representing those views, as respectfully as possible, while clearly advocating an alternative. By seeking to understand viewpoints outside of our own comfort zone, and by getting to know and even bless people who hold them.

Here are some ideas for how ASA members can make a godly impact on discourse within our faith community and our nation(s) as a whole:

- Model a healthy and informative tone on Internet blogs, Facebook, and chat rooms. Be *present* as a voice on these forums where many turn for discussion; it is here where we can be salt and light! (Try our “ASA Voices” blog to start!) When others lash out with name-calling or simplistic dismissal of unpopular views, be the one to offer a viewpoint with clarity and respect, never denigrating another person.
- Always affirm that what binds Christians together is our united allegiance to Jesus Christ as our one and only Savior. Affirm that many Christians who share a complete devotion to Christ hold differing views on modern science and related Scripture.
- That said, do courageously offer differing opinions and clearly promote them if they serve to uplift the church and the world. Discipleship sometimes means taking courageous stances that go against the world’s grain or even church tradition.
- Outside the church, discussions on “science and religion” can be opportunities to “provide a reason for the hope that is within you, with gentleness and respect” (1 Peter 3:15). It is not “religion” that saves people, it is a Person, Christ the Lord. Keep an eye toward whether our discourse helps or hinders people from seeing the Lord.
- Support efforts of secular groups toward positive discourse, such as the “Dialogue on Science, Ethics, and Religion” program of the AAAS.
- Affirm the intrinsic value of people to God. We believe that each person, though fallen, is made in God’s image. Treat them that way in our discourse.
- St. Paul offers a helpful model. Before speaking to others on Mars Hill, he first took time to learn the beliefs of his audience and to find common ground.
- The prayer of St. Francis offers this godly yearning: Seek not so much to be understood as to understand.

In the aftermath of the current shooting tragedy in the USA, President Obama has advised the nation, as we engage in discourse, to speak to each other “in a way that heals, not a way that wounds.” Let’s take that advice to heart as we model strong, respectful, and truly helpful dialogue on our faith in Christ and our scientific study of God’s marvelous creation.

Jennifer Wiseman

Council President, American Scientific Affiliation



In This Issue

In addition to the usual book reviews and letters to the editor, this spring issue of *PSCF* contains four major articles ranging in topic from theology and history to geology and cosmology.

1. Theologian Amos Yong (Regent University) argues that an emphasis on the work of the Holy Spirit could serve as a correction to the concordism evident in some evangelical thought.
2. Examining Kepler’s celestial physics, astronomer and historian of science Owen Gingerich (Harvard-Smithsonian Center for Astrophysics) discusses the historical development of the expression “laws of nature” and makes a careful distinction between ontological and epistemological laws of nature.
3. Timothy Helble, a hydrologist with the National Weather Service, challenges the interpretation of sediment transport rates used in flood geology.
4. Ronald Larson, a chemical engineer (University of Michigan), argues that the anthropic reasoning often employed in scientific appeals to a “multiverse,” is a double-edged sword.

Two essay book reviews follow. Robert Kaita (Princeton University) analyzes the personal and public aspects of the faith of scientists interviewed in Elaine Ecklund’s recent book. Nancey Murphy (Fuller Theological Seminary) assesses the role of philosophy of science in theological reflection as described in Gijsbert van den Brink’s book.

Announcement of a Technology Theme Issue:

In my last editorial, I welcomed submissions for a special theme issue on responsible technology. Jack Swearngen has graciously agreed to serve as co-editor. A formal call for papers can be found on page 54 of this issue.

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Reading Scripture and Nature: Pentecostal Hermeneutics and Their Implications for the Contemporary Evangelical Theology and Science Conversation

Amos Yong



Amos Yong

This article recommends that more intentional focus on the theological character of the biblical message that involves the work of the Holy Spirit can be helpful in resisting the concordism, prevalent in some evangelical circles, that insists on harmonizing Scripture with science. Help in developing such an interpretive approach can be found, surprisingly, in Pentecostal Bible-reading practices. Our case study of Pentecostal hermeneutical sensibilities opens up space for a reading of nature that is complementary with a reading of Scripture. The objective is to invite evangelical Christians to develop a theology and hermeneutic of nature that sustains the scientific enterprise even while registering Pentecostal perspectives, especially in the dialogue between theology and science.

Many conservative evangelicals are concordists when it comes to their views regarding how the Bible relates to modern science.¹ What this means is that they assume that the plain sense of Scripture, rightly understood, should be confirmable by and harmonizable with—be in concord—rather than contradict the findings of modern science, correctly interpreted. When applied to the creation narrative in the book of Genesis, however, such expectations are challenged, and many conservative evangelicals feel as if they have to opt for what the Bible says (that God created the world in six days) rather than what science says (that the world has evolved over a long period of time). This explains, in large part, the popularity of creationism—the idea that scientific evidence can be marshaled in support of the biblical account—among conservative evangelicals not only in North America but also, increasingly, around the world.²

Insofar as many Pentecostals consider conservative evangelicals their allies and agree with them about the authority, infallibility, and even inerrancy of the Bible, to the same degree many Pentecostals also presume a concordist hermeneutic along with the accompanying young-earth view of the world. This explains, at least in part, why many Pentecostals are creationists who are suspicious, at best, about the theory of evolution. But what if concordism is itself a modern concoction, developed by modernists—including conservative

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Article

Reading Scripture and Nature

evangelicals—who feel as if they need to adapt the explanatory power of modern science to interpret the Bible, resulting, paradoxically and ironically, in a scriptural method of interpretation that is itself at odds with a biblical self-understanding? What if the concordist privileging of modern scientific modes of reference and causality is out of sync with the way that Scripture presents itself? Might application of concordist assumptions about science do violence to (at worst) or miss the point of (at best) the Scriptures in general and the Genesis creation narrative in particular?

Others have provided very convincing responses urging against adoption of such concordist presuppositions.³ In this article, I want to add to these arguments from a specifically Pentecostal perspective. In brief, I will suggest, negatively, that Pentecostal hermeneutical instincts and sensibilities should lead them to question, even reject, concordism, especially in its creationist manifestations, since that is inconsistent with their own instinctive approaches to Scripture; put positively, I will present a rudimentary argument for a Pentecostal theological hermeneutic that reads the book of Scripture soteriologically—i.e., primarily as a theological book focused on God’s redemptive work in the world—while remaining capable of acknowledging and even benefitting from modern disciplinary perspectives, even modern science. If this is true, then the result is that evangelical Christians can seek to engage existentially with the realities pointed to by the Scriptures, while being less concerned about what the relevant secular or scientific disciplines may or may not say about such matters.

I will make my case in three steps, corresponding to the three major sections of this article, by arguing that (1) Pentecostal biblical interpretation (hermeneutics), our case study, is fundamentally soteriological and pneumatological, that is, focused on the ongoing redemptive work of the Holy Spirit, rather than merely historical; (2) such a soteriological and pneumatological way of reading the Bible can be appropriately applied to the Genesis narrative as well, resulting in a more expansive theology of creation than that produced by concordism in its creationist guises; and (3) the result will be a distinctive contemporary contribution to the Christian understanding of the “two books” of God’s revelation, Scripture and creation/nature, one that preserves the integrity of

both the life in the Spirit and the modern scientific enterprise but yet provides an overarching theological narrative that can hold the two together.⁴ We will conclude with some brief reflections on how such an approach to Scripture might be helpful, especially for evangelicals who wish to make peace with modern science.⁵

This Is That! Pentecostal Biblical Hermeneutics—A Case Study

In order to appreciate Pentecostal hermeneutical views, let us focus first on how Pentecostals have read the book of Acts. Modern historical criticism, of course, has debated about the historicity of Acts. Since Luke presents the Acts narrative as derivative from consultation with the relevant eyewitnesses (Luke 1:1–4; cf. Acts 1:1), on modernist historiographical terms, the reported events either happened as indicated or they did not. Modernist readings thus are presented either *in faith*, believing that since the Bible is the inspired Word of God, Acts is accurate regardless of its believability, or *in skepticism*, countering that there are too many inconsistencies in the text or that the fantastic nature of what is described suggests there are ideological motivations or other reasons for what now appears as a largely mythic or legendary, rather than more strictly historical, document.

On this issue, at one level, Pentecostals are modernists and read their Bibles in faith as the inspired, infallible, and often, inerrant Word of God, even if they may never have heard of these terms. This is in part because the earliest Pentecostals at the turn of the twentieth century came mostly from the Holiness movement and carried over their commonsense realist approach to the Scriptures.⁶ Yet at the same time, if their other commonsense realist cousins, the fundamentalists, were interested in defending the historical veracity of the biblical claims, Pentecostals were more motivated pragmatically by what the Bible meant for their day-to-day lives.⁷ Hence, it was not so much that Pentecostals dismissed the historical dimensions of the biblical accounts, but that they collapsed the presumed distinction between the scriptural text and its contemporary readers. For them, what was important was not so much what happened back then, as it was how the back-then and the here-and-now were connected.

Pentecostal scholar Rickie Moore has highlighted the difference this Pentecostal approach makes for biblical interpretation.⁸ Whereas the historical-critical methodology long prominent in the guild of biblical scholarship measures the historicity of the Bible against modernist canons of plausibility, a Pentecostal hermeneutics highlights instead the uniqueness of biblical history vis-à-vis any contemporary generation of readers or interpreters. So whereas modern historical criticism emphasizes the objectivity of the text over and against the interpreter, Pentecostals observe instead the “this is that” — our or my experience (this) is equivalent to the reality accomplished in the lives of the biblical characters or anticipated by them (that) — character of the Bible in relationship to its readers. If modern interpreters approach the Bible as a historical document containing objective truths (facts) about the world (the past, in the case of historical references), Pentecostals view the Scriptures as a narrative that invited its readers and hearers to receive, inhabit, and participate in the world of God. And while modern approaches emphasize the critical distinction between what the text meant in its original context (which was the task of the biblical critic to uncover), as opposed to how such meanings might be applied to our contemporary lives (the task of the homilist), Pentecostal approaches see first and foremost the *rhema* or living and revelatory Word of God making demands on each generation of readers in a way that collapsed the horizons of what the text pointed to and that of the text’s later readers.

In short, Pentecostal hermeneutics emphasizes not the historicity of the biblical accounts but its capacity to open up possibilities for contemporary readers and hearers by the power of the Spirit.⁹ Scripture’s purpose is not primarily to give us truthful or factual knowledge about the past (Pentecostals assume this commonsensically without making much of it); rather, Scripture “is useful for teaching, for reproof, for correction, and for training in righteousness, so that everyone who belongs to God may be proficient, equipped for every good work” (2 Tim. 3:16–17). The goal, thus, is not merely “head knowledge” about what happened but “heart knowledge” that leads to sanctification, participation in the divine life, union with God — in short, reception of the salvation of God made available through Christ by the Holy Spirit. None of this is to deny that the historical dimensions of the Acts narrative are unimportant; it is simply to affirm that Pentecostals read Acts not merely as

history but as *salvation history*, i.e., not merely as a historical document about what happened but as a literary-theological document about what may and even should happen.

Of course, the wider theological academy has also been discovering that the Bible can and should be read theologically and soteriologically rather than merely historically and that the line between history and theology is much more blurred than assumed within the modernist framework. Thus, many other scholars have come to recognize, even appreciate, the theological nature of the Acts narrative.¹⁰ But Pentecostals have, from the very beginning, read Acts as having ongoing and contemporary relevance, as seen in the doctrine of initial evidence of the baptism in the Holy Spirit, which the first Pentecostal generation found as normatively portrayed in the second Lukan volume.¹¹ While the details of this doctrine can be debated, my point is that it has been precisely this specific interpretive approach that historically has set apart Pentecostal readings of Acts in particular and of the Bible in general from those in non-Pentecostal and noncharismatic ecclesial traditions. And it has been precisely such a “this-is-that” hermeneutic which nurtured Pentecostal contributions to the theological reading of the Acts narrative.¹²

Now modernists might cringe at such an approach, asserting that it does violence to the Bible simply because it allows for the interpreter to assert too much of his or her own self-understanding into the biblical narrative. Pentecostals can respond on at least three levels. First, modernist interpreters should not presume that their own rationalistic, positivistic, and historicist perspectives do not influence their readings of Scripture. Second, it is not so much that our subjectivities are inserted into the biblical narrative — after all, a hard-and-fast distinction between *exegesis* (a taking out of the text) and *eisegesis* (a reading into the text) is a modern concoction anyway — but that our subjectivities are themselves interrogated directly by the Spirit’s witness through the biblical text. Last but not least, such an approach is consistent with the broader apostolic witness for whom the events narrated in the Bible are never mere facts of what happened but are always signs of God’s intentions and purposes in the world.

The Johannine notion of miraculous signs, for example, supports this understanding.¹³ From a modernist perspective, the implausibility of such

Article

Reading Scripture and Nature

accounts as historical events demands other explanations. Yet this ignores the Johannine self-understanding, which insists that the miraculous works of Christ were recorded for the explicit purpose that the gospel's readers "may come to believe that Jesus is the Messiah, the Son of God, and that through believing you may have life in his name" (John 20:31). Pentecostals have approached the Acts narrative precisely in that spirit. The focus has never been on a historical apologetic for the textual accounts happening in all particulars as described. Rather, the motivation has always been to invite hearers (Pentecostals are people who privilege the oral testimony) of the Word to experience the power of God for themselves. It is not so much what God has done in the past that matters, but what counts is that the past intersects with the present.

Critics might insist that such a Pentecostal hermeneutic presumes the historicity of the events described in Acts, otherwise why might Pentecostals assume that such remains possible in their lives today?¹⁴ At one level, this is true: insofar as Acts purports to be about what did happen, as we have earlier noted that the author himself tells us, to that degree the Pentecostal commonsense realist presumes the historicity of the narrative fairly. At this level, I would go further to affirm that the various historiographical methods can be helpful in illuminating the nature of the world behind the text, even to the point of supporting—complementing, to use my term—Pentecostal faith.¹⁵ However, the presumption of historicity is not equivalent to embracing a historical-critical hermeneutic as the sole or major interpretive lens for understanding Acts in particular or the biblical narrative in general. Instead, as I have suggested, Pentecostals have often ignored (at worst) or at least had a diffident relationship with (at best) historical criticism in favor of literary and narrative models focused less on what the Bible meant then on its present application.¹⁶ In short, they have never privileged a historical approach to the Bible, opting always instead for a salvation history reading that locates them in relationship to the saving and eschatological work of God.

In the end, however, my claim is that such a "this-is-that" approach to the Bible is not really distinctive of Pentecostalism. As a restorationist movement, Pentecostals have long participated in Reformation traditions that have sought to return to and retrieve

the apostolic example for Christian life. Pietist movements of all sorts, baptistic traditions, and Wesleyan-Holiness Christians in all of their various streams—each of these and more have established hermeneutical practices that focus on the relevance of the apostolic experience for contemporary Christian faith.¹⁷ What Pentecostals add to the mix, more specifically, is the emphasis on the work of the Holy Spirit: in particular, how the Spirit empowered the people of God as recorded in the Scriptures and how that same empowerment is available to Christians in all post-biblical times. Might this pneumatological twist that highlights how the Holy Spirit enables our participation in the biblical message be helpful for a reading of the Bible as a whole and perhaps even the Genesis narrative more particularly?

This Is That! A Pneumatological Hermeneutics of the Creation Narratives?

I now want to suggest that the pneumatological "this-is-that" hermeneutic as applied to the Acts narrative can also profitably illuminate a reading of the creation narrative, a reading that would help conservative evangelicals overcome the concordist assumptions behind the scientific creationist model. To do so, we will need to see first what best describes the genre of the creation narratives, and then how amenable Genesis 1–2 is to such a re-reading.

There are probably three dominant types of interpretations of the creation narratives, which I call the scientific, mythological, and literary-theological views.¹⁸ There are inevitable overlaps between these views, even as there are profound differences among those who may be classified within each type. But in brief, the first two are modern approaches, the former insisting that the inerrancy of the Bible means that the book of Genesis, rightly interpreted, must be compatible with modern science, rightly understood, and the latter countering that the incompatibility between the plain sense of the first chapters of the Bible and modern science means that the former cannot be understood literally or scientifically, and thus should be interpreted either spiritually or mythically (with, except on occasions, no pejorative intentions behind the last designation). These two views often characterize conservative evangelicals or scientific creationists on the one side who view

the first book of the Bible as ancient science, and liberal Christians or theistic evolutionists on the other side who view this same text as ancient myth.

The third approach, however, is both the most elastic and perhaps also inclusive of the most ancient readings of Genesis, under my definition. This would include not only moral, spiritual, and allegorical interpretations of Genesis prevalent during the first Christian millennium (which inevitably read the Hebrew Bible in general figuratively and typologically in the light of New Testament or christological revelation), but would also include various literary interpretations increasingly popular across the broader theological academy. I would locate my own inclinations within this last trajectory of interpretation, especially its emphasis on how the Genesis narrative should be understood in its ancient Near Eastern context on the one hand, and from a salvation history perspective on the other.¹⁹ With regard to the former, Genesis should be understood as presenting ancient Israel's theology of the one creator God who, in contrast to the pagan deities of the Mediterranean world, overcomes the primeval chaos (the *tohuwabohu* of Gen. 1:2) by the word of his *ruah*.²⁰ The latter refers to the broader theological horizons of the biblical canon, first the covenantal framework within which God the creator enters into relationship with Israel,²¹ and then the founding incarnational and Pentecostal events of the Christian Scriptures.

While widely divergent in many ways, interpreters and exegetes who hold to a literary-theological approach to Genesis 1–2 in general reject attempts to harmonize the creation accounts—there are two accounts: 1:1–2:4, and the rest of Gen. 2—with modern science. Instead of telling us *how* the world was created, Genesis informs us *that* the world was made by a God who seeks to enter into covenant with human creatures. Thus, this ancient text need not be made to conform to modern scientific theories; instead, it is about human existence, history, spirituality, and relationality—i.e., it is anthropological, theological, and soteriological rather than scientific.²² Put narratively and canonically, Genesis is also about the God who redeems and renews the creation as a whole, as well as its creatures, in spite of its fallen character.

I suggest, then, that Pentecostals in particular and Christians in general can read the creation narratives of Genesis as they do the historical narratives of

Acts: in the light of the soteriological work of the Holy Spirit. While Acts presents itself as a history of the early Christian movement, the historicity of the narrated events is less the point than the invitation to enter into, receive, and inhabit the saving work of God in Christ through the Spirit. Similarly, while Genesis presents itself as a story of the creation of the world, its historicity—or, in this case, its scientific accuracy—is also less the point than its invitation to enter into a covenantal relationship with the creator God. If the pneumatological this-is-that hermeneutic enables readers to participate in God's redemption of the world through the Church, then might not this also hold forth promise for a pneumatological reading of the Genesis story that enables participation in God's creative activity as well? Now while modern scholarship would differentiate the genre of Acts from that of Genesis—an important distinction in various respects—both are narratives, theologically and soteriologically, of divine activity in the past that have relevance for faithfulness to the divine covenant and to participation in the salvation history of God's work in the present.

Paul Elbert is a Pentecostal scholar who has begun to provide such a reading of the Genesis narrative that highlights the work of the Holy Spirit.²³ Elbert observes that the *ruah* of God “swept over the face of the [primordial] waters” (Gen. 1:2), and from there he correlates the Spirit's work in divine creation with the Spirit's communication through ancient Near Eastern linguistic patterns and rhetorical conventions. At one level, Elbert's is a sophisticated reading of the Genesis account in its ancient Near Eastern context; at another level, however, his interpretation depends to some degree on concordist presuppositions. The result, refracted through Elbert's Pentecostal lens, is a prophetic view of Genesis 1 that both anticipates contemporary experimental scientific findings and provides apologetic confirmation for the truthfulness of the Bible's creation story. While not necessarily opposed to Elbert's reading, I am also not enthused about it, since I think that Pentecostals, in particular, are motivated intuitively less by scientific apologetics than by personal testimony.²⁴ Put otherwise, Pentecostal sensibilities are dependent not on correlating Scripture with scientific data (or Scripture with historical research) but on identifying the “that” of what the Bible points to as anticipating the “this” that the Spirit of God continues to accomplish today.²⁵

Article

Reading Scripture and Nature

Given these commitments, I suggest that a more viable theological reading of Genesis would, at a minimum, indicate participation in the creative and redemptive work of the Spirit along the following lines. First, the pneumatological “this-is-that” recognizes that the Spirit empowers the creation’s response. The Spirit not only hovers over the watery chaos but also enables the Word of God to be spoken, which in turn brings forth the creation’s responses. Thus, “God said, ‘Let the earth put forth vegetation: plants yielding seed, and fruit trees of every kind on earth that bear fruit with the seed in it.’ And it was so. The earth brought forth vegetation: plants yielding seed of every kind, and trees of every kind bearing fruit with the seed in it” (Gen. 1:11–12). Then later, “God said, ‘Let the earth bring forth living creatures of every kind: cattle and creeping things and wild animals of the earth of every kind’” (Gen. 1:24). What happens next is that the biblical author says, “And it was so,” before saying, “God made the wild animals of the earth of every kind, and the cattle of every kind, and everything that creeps upon the ground of every kind. And God saw that it was good” (Gen. 1:25). In short, these jussive and passive imperatives throughout the Genesis 1 account invite participation of the earth and its creatures, and they actively respond to that invitation.²⁶ These aspects of the creation narrative resonate with contemporary experiences of the Spirit’s empowering work.

Secondly, Genesis 1–2 is meant, not to provide scientific details about the formation of the earth, but to illuminate the purposes for which God created the world. These include, of course, humanity as the apex of creation—in which the breath of God is given (Gen. 2:7)—now charged to care for the world. Thus, human beings participate not only as co-creators with God, in the sense of responding to God’s creative image, but also as partners with the divine providence over all things.²⁷ God also said to *ha adam*: “have dominion over the fish of the sea and over the birds of the air and over every living thing that moves upon the earth” (Gen. 1:28). Read theologically and soteriologically, then, the creation narratives invite humanity to exercise moral responsibility, even a degree of spiritual oversight, over the creation and its creatures, in relationship to God.

Last but not least, read also canonically, the original creation narrative provides a template for and foreshadows the redeemed creation that is promised

later in the Hebrew Bible as the “Day of Yahweh” and in the New Testament as the new heavens and earth.²⁸ Read from the perspective of the active work of the Spirit in the world, we now live between the times—between the original creation and the new creation—albeit yet still imbued with the same *ruah* of God. The difference here, amidst the fallen yet already-but-not-yet-fully-actualized new creation, is that now we “who have the first fruits of the Spirit, groan inwardly [with the creation] while we wait for adoption, the redemption of our bodies” (Rom. 8:23). In short, the creative work of the divine *ruah* begun prior to the appearance of *ha adam* continues to the present and anticipates the sanctifying and redemptive work of the Spirit of Christ in the future. While declared good, the creation is still incomplete, and human creatures are not only part of what needs renewal, but also are potentially the ones who herald, through their groans, cries, and prayers inspired by the Spirit, that renovative work.²⁹

These brief considerations invite us to think theologically about the creation instead of scientifically. Just as Acts tells us what happened in order to enable us to inhabit the eschatological gospel story in the footsteps of the earliest Christians, so Genesis tells us what happened in order for us to participate in the creative-redemptive work of the *ruah* of God amidst the chaos and sin of the world. Further, if Acts provides a theological perspective on salvation history that neither requires nor denies historical-critical scholarship, then Genesis similarly provides a theological perspective on the creative and redemptive works of God that is neutral with regard to the various modern scientific analyses, theories, or conclusions (all of which, by the way, are still being negotiated within the scientific community). There is a difference: with regard to Acts, while there is a literary dimension to Acts, it still presents historical perspectives on what happened in the earliest Christian communities, so much so that historical-critical scholarship has more direct relevance for understanding the earliest followers of the Messiah; but with regard to Genesis, the literary dimension is predominant, with the result that the historical events behind the text are minimally accessible, if not excluded altogether, and to such a degree that the results of modern science are not immediately correlatable with the biblical account. But still, in either case, the concerns are less about how God

has created, orchestrated, or ordered the world and its events than about what God has intended to accomplish through the divine creative and redemptive activity.

Thus, Christians in general and conservative evangelicals in particular are free to allow historical-critical scholarship to run its course (or even to adopt or adapt historical-critical methods vis-à-vis Acts) in order to understand first-century Mediterranean history on the one hand, even as they are free to allow scientific inquiry to proceed or to engage in scientific inquiry themselves (although not so directly vis-à-vis the Genesis narrative) in order to understand the history of the world on the other hand. However, Christians certainly do not have to master the methods or results of either historical criticism or of the natural sciences, nor do they have to adjudicate the disputes within these fields of inquiry in order to hear from, receive, or participate in the Word of God as mediated through the Scriptures in general or Genesis and Acts in particular. In fact, we need historical critics and natural scientists precisely in order to provide some perspective on these texts so as to prevent any of us from reading into the Bible or making it say whatever we want. When issues are still contested, we should pause to consider that any particular interpretation tied to such debates needs to be held loosely, rather than dogmatically.

The Books of Scripture and of Nature: Toward a Hermeneutics of Science

The preceding prepares the way for seeing how a pneumatological perspective can contribute to the ancient tradition that came to distinguish between the books of Scripture and of nature as two complementary sides of the same coin.³⁰ By this, I mean that Scripture, read in faith, provides us with the theological significance of nature, understood on its own terms. Thus there are two levels of importance, although each level has its own integrity. If concordism insists that Scripture and science are, or should be, about the same thing, then the Scripture-nature complementarity that I am suggesting says that the Scriptures provide a higher-level set of meanings for scientific findings without undermining the integrity of science or its methods. In order

to see this, we will give a brief overview on the history of the two books metaphor before turning to more contemporary applications.

While Augustine was one of the first of the early church fathers to call nature a book,³¹ the basic idea goes back even further and certainly has seen major developments since the fifth century.³² The Christian tradition has perennially appealed to the Scriptures with regard to thinking about the revelatory power of the creation: “The heavens are telling the glory of God; and the firmament proclaims his handiwork” (Ps. 19:1), and, in the New Testament, “since the creation of the world his eternal power and divine nature, invisible though they are, have been understood and seen through the things he has made” (Rom. 1:20). There are other scriptural allusions, for example, to the sky being like a scroll (Isa. 34:4 and Rev. 6:14), which have lent themselves to the emergence of the metaphor of the book of nature.

During the patristic and especially medieval periods, then, Scripture and nature were interpreted in the light of each other. Following the dominance of Augustine and the neo-Platonic worldview, however, the visibility of the natural world was thought to point clearly toward the invisible things of the spiritual world. Hence, the interpretation of nature’s symbolism was multileveled, parallel to that of Scripture, although both were considered revelatory instruments of the character and works of God. Hugh of St. Victor (1078–1141) understood that nature revealed God’s power, wisdom, and goodness, and that attendance to the message of nature enabled participation in the sanctification and redemption of nature itself, so that in Christ, the world would be completed, reconciled with and returned to God.³³

The Renaissance, Reformation, and early modern periods, however, saw major shifts in the Christian understanding of the book of nature.³⁴ First, the medieval conviction about nature’s revelatory powers was expanded so that nature illuminated not just theological truths (like Scripture) but also could be expected, if properly mined (or interpreted), to disclose the secrets of the creation itself.³⁵ Second, the medieval four-fold sense of interpretation—literal, moral, allegorical, and spiritual—was increasingly abandoned, especially among the magisterial Reformers, in favor of the literal sense.³⁶

Article

Reading Scripture and Nature

Correspondingly, the clarity of nature was understood, not in terms of its universal accessibility (as was held during the first millennium), but as enabled by the emergence and use of the empirical methods of early modern science that brought the causal mechanisms of nature into plain view.³⁷ Third, the Reformers' insistence on interpreting Scripture directly, rather than relying on authorities favored the growing class of elite scientists, who also urged the importance of engaging nature directly (experientially and experimentally) rather than relying on the discoveries of their ancestors. Last but not least, if Jesus' mention of the Scriptures and the power of God (Matt. 22:29) was an oblique reference to the two books, as Francis Bacon (1561–1626) took it to be,³⁸ then not only did the book of nature require its own distinctive methods of interpretation, but the identification of the powers of nature also suggested that nature was less a set of facts to be uncovered than a web of processes and potentials to be mastered and deployed.³⁹

The result during early modernity, at least in part, was the emergence of the scientific method as the key to unlocking the book of nature. Whereas the medieval schoolmen distinguished ontological and divine causality from cosmological or creaturely causality—for instance, that God is the first or primary cause of all there is, while creatures are valid secondary causes—the early modern scientists began to focus their expertise on tracing the efficient and material causes operating in nature. As the scientific enterprise has continued to unfold over the last few hundred years, various disciplines have attempted to secure primacy of place, but each has defended itself against the encroachments of others. Contemporary science is thus characterized by a vigorous interdisciplinarity (in which the lines between disciplines are blurred) and multidisciplinary (featuring collaborative inquiry between two or more disciplines), both of which combine to illuminate the natural world.

Non- or antireligious scientists might conclude that the revelatory power of the book of Scripture has been entirely eliminated by that of the book of nature and its scientific methods. Concordists who insist on the harmonization of the Bible and science have sought to restore the authority of the book of Scripture but go about it erroneously: by legitimizing its credentials on the basis of modernist

assumptions about science. On the one hand, this is understandable, given the explanatory power of modern science—who would not want to affirm truths consistent with the most powerful fount of knowledge produced by the modern world? But on the other hand, concordists overlook the fact that the scientific method's focus on the book of nature means that its purview is by definition limited to the natural world. This means that science is not equipped to make metaphysical or religious claims, and it is only by transgressing these boundaries that science (or book of nature experts) can render or adjudicate such claims. In short, concordists have to stretch science beyond its boundaries in order to harmonize Scripture with it.

I suggest that Pentecostals can contribute to a contemporary theology of the two books by developing its pneumatological imagination in ways that adapt both premodern and modern understandings.⁴⁰ In the following, I sketch two basic trajectories for a Pentecostal reconsideration of the relationship between the books of Scripture and of nature. First, recognizing that the *ruah of God* both hovered *over* the primeval chaos and yet was dynamically at work as the breath *within* the creatures of the world, we can posit a pneumatological theology of creation that understands the Spirit to be present and active *over* and *within* history and creation, even while illuminating both worlds to human minds. Such illumination, however, is by nature theological, soteriological, and eschatological (related to God's final salvation of the world), providing a perspective on history's and nature's ends as intended by God. Second, what the history of Christian thought has called the interpretation of nature, Pentecostals call discernment. But whereas theologians or scripturalists will discern (exegete) the books of Scripture and nature theologically and soteriologically, others will discern (interpret) the nature and history of the world from their respective disciplinary perspectives. The theological discernments (readings) inevitably will go beyond the nontheological interpretations, but that neither delegitimizes the latter nor undermines the possibility for complementary perspectives to emerge.⁴¹

The preceding discussion invites us to think analogically about the relationship between theology, concerned with the book of Scripture, and contemporary science, concerned with the book of nature.

The multi- and interdisciplinary character of the sciences require discursive practices that depend on peculiar methodological presuppositions, cultural practices, and institutional arrangements.⁴² If the work of the Spirit was to harmonize the many tongues on the Day of Pentecost so as not to eliminate their differences but to declare the wonders of God (Acts 2:11), then might it not be possible for the same Spirit today to harmonize the many discursive practices of the various theological, natural, and human sciences so as not to eliminate their differences but to exalt the glory, power, and goodness of God?⁴³

This means, then, that Christians can proceed in faith to suggest overarching theological interpretations of both books, while recognizing that the many disciplines also have their integrity, methods, and contributions. Therefore, historians might interpret the events of history (i.e., early Christianity of the book of Acts) in ways that complement Pentecostal and Christian understandings, even as scientists might interpret the events of nature (i.e., the events of natural history behind the Genesis account) in ways that complement theological and soteriological perspectives. Concordism would insist that theological, historical, and scientific interpretations all proceed at the same level, and I believe this is a mistake. Instead, I suggest that the view of the two books as complementary is distinctively theological and does not need to claim either historical or scientific expertise in these respective domains. Thus historical-critical approaches and natural scientific methods can proceed to do their work. From a theological point of view, the truth will ultimately be complementary, even if, “For now we see in a mirror, dimly” (1 Cor. 13:12). This is based on the nature of historical and scientific inquiry, which revises itself over time as each engages in the honest search after the truth and deploys the methods at its disposal.

Of course, biblical and theological interpretations should be consistent with the various historical and scientific consensus⁴⁴—that is what we would expect if all truth were ultimately theologically funded. But given the fallibility and finitude of all human knowing—in things theological as well as in things historical and scientific—it may be that the desired complementarity does not arrive, either because of a lack of consensus in one or more fields of inquiry,

or because of contradictory perspectives within or across disciplines. In the case of the former, when no consensus has been achieved, biblical and theological accounts should be tendered provisionally, perhaps sufficiently vaguely so as to be consistent with alternative historical or scientific theories under adjudication (regardless of what happens),⁴⁵ or with the recognition that later findings may warrant revisitation of the issues. In the case of the latter, if contradictions persist, this simply means that those working on contrary sides of the issue need to be open to further researching the matter and to revising their position as appropriate (while being cognizant that the complexity of some disagreements may not yield complementary resolution even in their lifetime). Yet in all of these cases, those interested in the theology and science dialogue or those working in the sciences can rely on the Spirit’s illumination in their endeavors, which is negotiated variously in their immediate confessional community, in wider communities of faith, amidst their disciplines, and within the backdrop of the broader scientific community.⁴⁶

Conclusion

My goal in this article has been twofold: to encourage fellow Pentecostals to develop their own hermeneutical approach both to the book of Genesis and to the book of nature, and to show how such an approach informed by interpretive instincts derived from reading their canon-within-the-canon, the book of Acts, can contribute to the wider, especially evangelical, discussion about the relationship between the Bible and science, between the book of Scripture and that of nature. Such will be a narrative and theological approach that sees the work of the Spirit in history and in creation without denying the validity and even helpfulness of other interpretive methods. If this is possible, then conservative evangelicals can extricate themselves from the kind of concordism that requires harmonization of a literal reading of Genesis 1–2 with modern science. Instead, evangelicals should mine their “this-is-that” view of the Bible as God’s living Word so that the goal is not merely an intellectual understanding of what happened (which is illuminated by historiographical and scientific inquiry) but a practical and saving knowing of how we can inhabit the eschatological world of God in Christ, by the power of the Holy Spirit.

Article

Reading Scripture and Nature

In short, a pneumatological view of the books of Scripture and of nature sees both books as comprehensible in faith, by the Spirit. Yet while such a pneumatological or pneumatological hermeneutic reads both Scripture and nature in Christ according to the saving intentions of God, it also leaves space for “natural” —i.e., scientific and historical—renditions of the same realities. But just as the realities of the first century cannot be exhausted by historical-critical analysis, so neither can the realities of the formation of the world be exhausted by scientific analyses. In fact, it is also inevitably the case that such “natural” approaches will always be subject to what Paul Ricoeur calls the “conflict of interpretations,” since it is in the nature of historical and scientific inquiry to continually revise its conclusions as more and more data come into clearer light.⁴⁷ On the other hand, light is being shed, however gradually and inexorably, so that historical-critical analysis can certainly enlighten the realities of the first century, even as science can also just as certainly elucidate the realities of the history of the world. Yet amidst the ongoing inquiries, evangelicals can expect that the “this” of our experiences relates to the soteriological “that” of the realities described in Scripture, even while the latter are being studied either with historical-critical tools (Acts) or scientific ones (Genesis).

This takes nothing away from such scientific and historical investigations, since these unveil the natural mechanisms and historical conditions operative in the long formation and history of the world. Simultaneously, evangelicals believe that they are in but not merely of the world, so that whatever else science and history might suggest, there is also the saving work of the Spirit that is present and active. Of course, in this scenario, there is minimal possibility for apologetics as traditionally conceived in either direction: it is impossible either to verify or to falsify Christian faith except eschatologically. On the other hand, it may also be practically impossible to either verify or falsify some historical claims or some scientific theories, even in the long run. But that devalues neither historical nor scientific work, even as the implausibility of classical apologetics does not minimize evangelical commitments. This curiously paradoxical situation is, however, indicative of the life of the Spirit, whose “wind blows where it chooses, and you hear the sound of it, but you do not know where it comes from or where it goes” (John 3:8). ≈

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Notes

¹I use “conservative evangelicals” in this article to include fundamentalists, fully recognizing that there are differences between evangelicalism and fundamentalism. For purposes of this article, however, the ideological, theological, and presuppositional divergences are less germane than are the similarities and what binds folk in this arena together (against common perceived enemies). This is especially the case in terms of how many Pentecostals would understand themselves vis-à-vis the wider cultural issues. Still, for an overview of the spectrum of conservative evangelical views about science, see my essays, “God and the Evangelical Laboratory: Recent Conservative Protestant Thinking about Theology and Science,” *Theology and Science* 5, no. 2 (2007): 203–21, and “Science and Religion: Introducing the Issues, Resolving the Debates—A Review Essay,” *Christian Scholar’s Review* (forthcoming).

²For the growth and expansion of creationism worldwide, see Michael Roberts, *Evangelicals and Science* (Westport, CT: Greenwood Press, 2008), 167–77.

³E.g., Paul H. Seely, “The First Four Days of Genesis in Concordist Theory and in Biblical Context,” *Perspectives on Science and Christian Faith* 49, no. 2 (1997): 85–95; and Denis O. Lamoureux, *Evolutionary Creation: A Christian Approach to Evolution* (Eugene, OR: Wipf and Stock, 2008).

⁴My colleague Wolfgang Vondey rightfully reminds me that Pentecostals generally are less interested in books, metaphorically understood—whether of Scripture or of nature—than in engaging a living and self-revealing God (whether through the Bible or the creation). Yet I also think the ancient and venerable two books metaphor is helpful for Pentecostals to negotiate their own hermeneutical options vis-à-vis modern science, and thus will retain that verbiage and conceptualization in this article. For Vondey’s own considerations about a Pentecostal theology of revelation, see his *Beyond Pentecostalism: The Crisis of Global Christianity and the Renewal of the Theological Agenda* (Grand Rapids, MI: Eerdmans, 2010), chap. 2.

⁵Here, I am playing off the title of, and thereby see my essay as an ally to, Darrel R. Falk's excellent *Coming to Peace with Science: Bridging the Worlds between Faith and Biology* (Downers Grove, IL: InterVarsity Press, 2004).

⁶Bradford McCall, "A Contemporary Reappropriation of Baconian Common Sense Realism in Renewal Hermeneutics," *PNEUMA: The Journal of the Society for Pentecostal Studies* 32 (2010): 223–40.

⁷The pragmatic character of Pentecostal spirituality is richly portrayed by Grant Wacker, *Heaven Below: Early Pentecostals and American Culture* (Cambridge, MA: Harvard University Press, 2001).

⁸The following summarizes Rickie D. Moore, "Deuteronomy and the Fire of God: A Critical Charismatic Interpretation," *Journal of Pentecostal Theology* 7 (1995): 11–33, a must-read for any Pentecostal reflection on biblical hermeneutics; see also Moore, "Canon and Charisma in the Book of Deuteronomy," *Journal of Pentecostal Theology* 1 (1992): 75–92.

⁹This is both a historical claim about the now century-old Pentecostal movement and a normative claim about how Pentecostals understand their relationship to the Bible going forward, as summarized in Kenneth J. Archer, *A Pentecostal Hermeneutic for the Twenty-First Century: Spirit, Scripture and Community*, *Journal of Pentecostal Theology Supplement series* 28 (New York: T&T Clark, 2004).

¹⁰A summary of the trends over the last half century has been provided by François Bovon, *Luke the Theologian: Fifty-Five Years of Research (1950–2005)*, 2d rev. ed. (Waco, TX: Baylor University Press, 2006).

¹¹This story is told by James R. Goff Jr., *Fields White unto Harvest: Charles F. Parham and the Missionary Origins of Pentecostalism* (Fayetteville, AR: The University of Arkansas Press, 1988), esp. chap. 3; see also some of the chapters in part I of Gary B. McGee, ed., *Initial Evidence: Historical and Biblical Perspectives on the Pentecostal Doctrine of Spirit Baptism* (Peabody, MA: Hendrickson Publishers, 1991).

¹²E.g., Roger Stronstad, *Spirit, Scripture, and Theology: A Pentecostal Perspective* (Baguio City, Philippines: Asia Pacific Theological Seminary Press, 1995). My own proposals are in the following books: *The Spirit Poured Out on All Flesh: Pentecostalism and the Possibility of Global Theology* (Grand Rapids, MI: Baker Academic, 2005); and *In the Days of Caesar: Pentecostalism and Political Theology* (Grand Rapids, MI: Eerdmans, 2010).

¹³E.g., Leon Morris, *Jesus is the Christ: Studies in the Theology of John* (Grand Rapids, MI: William B. Eerdmans, 1989), chap. 2; and Raymond F. Collins, *These Things Have Been Written: Studies on the Fourth Gospel*, *Louvain Theological and Pastoral Monographs* 2 (Grand Rapids, MI: William B. Eerdmans, 1990), chap. 10.

¹⁴This has been most forcefully registered by John C. Poirier in his articles (with B. Scott Lewis), "Pentecostal and Postmodernist Hermeneutics: A Critique of Three Conceits," *Journal of Pentecostal Theology* 15, no. 1 (2006): 3–21; and (independently), "Narrative Theology and Pentecostal Commitments," *Journal of Pentecostal Theology* 16, no. 1 (2008): 69–85. While I am appreciative of Poirier's concerns, I find his emphases on historicity puzzling in the light of the above discussion. Further, he neither engages substantively with Pentecostal scholars who have discussed the contested issues (e.g., Rickie Moore, Walter Hollenweger,

Scott Ellington, Mark Cartledge, James K. A. Smith, myself) nor with the wider hermeneutical debates on especially narrative hermeneutics, resulting in a monolithic and inaccurate understanding of the latter. Most problematic, Poirier makes too many false assumptions—e.g., about authorial intention as being central to hermeneutics, about hermeneutics being either objective or subjective, about narrative hermeneutics being opposed to the historical-critical method or being based on opposed ontologies, about the links between quantum physics and postmodern hermeneutics—with the result that his discussions of the scientific, philosophical, or theological issues are inconsistent and not coherent. A more substantive response to Poirier's arguments, however, will have to await another occasion.

¹⁵For example, by Gordon Fee, Robert Menzies, Max Turner, or many other Pentecostal and charismatic exegetes working in the wider biblical studies arena. My colleague, Graham Twelftree, has long engaged in critical dialogue with the Jesus Seminar scholarship, and deploys historical-critical tools to argue for fairly traditional Pentecostal conclusions with regard to miracles and exorcisms, among other classical Pentecostal phenomena.

¹⁶This is, of course, a very general claim, given, as indicated in the previous endnote, the many that have expertly deployed historical-critical tools in their exegetical work. Yet I believe that literary and narrative methods resonate more with Pentecostal sensibilities than do historical-grammatical approaches. Scholars as widely divergent as Walter J. Hollenweger, Roger Stronstad, Clark Pinnock, John Christopher Thomas, Larry McQueen, among many others, have argued these points.

¹⁷For more on the complementary hermeneutics of Baptists, Pietists, Wesleyans, and Pentecostals, see Yong, "The 'Baptist Vision' of James William McClendon, Jr.: A Wesleyan-Pentecostal Response," *Wesleyan Theological Journal* 37, no. 2 (Fall 2002): 32–57.

¹⁸These do not map very well onto the three views in David G. Hagopian, ed., *The Genesis Debate: Three Views on the Days of Creation* (Mission Viejo, CA: Crux Press, 2001), which is limited to conservative evangelical options: 24-hour-day view, day-age view, and framework view.

¹⁹Narrative is a type of literature that includes a wide range of genres, as described by George W. Coats, *Genesis, with an Introduction to Narrative Literature* (Grand Rapids, MI: William B. Eerdmans, 1983), 5–10. My claim is that Pentecostals, in particular, and Christians, in general, inhabit such texts theologically rather than merely observe them discursively.

²⁰Predominant here is Susan Niditch, *Chaos to Cosmos: Studies in Biblical Patterns of Creation*, *Scholars Press Studies in the Humanities* 6 (Chico, CA: Scholars Press, 1985). See also Joan O'Brien and Wilfred Major, *In the Beginning: Creation Myths from Ancient Mesopotamia, Israel and Greece*, *American Academy of Religion Aid for the Study of Religion series* 11 (Chico, CA: Scholars Press, 1982).

²¹E.g., Bruce K. Waltke, with Cathi J. Fredricks, *Genesis: A Commentary* (Grand Rapids, MI: Zondervan, 2001), 55–78; C. John Collins, *Genesis 1–4: A Linguistic, Literary, and Theological Commentary* (Phillipsburg, NJ: P&R Publishing, 2006); and John H. Walton, *The Lost World of Genesis One: Ancient Cosmology and the Origins Debate* (Downers Grove,

Article

Reading Scripture and Nature

IL: IVP Academic, 2009). Note that for Walton, the seven days of creation functionalize and inaugurate the cosmic temple within and upon which Yahweh sits enthroned. A recent book that grapples seriously with the theological nature of Genesis is R. W. L. Moberly, *The Theology of the Book of Genesis* (Cambridge: Cambridge University Press, 2009).

²²As argued, e.g., by Thomas L. Brodie, *Genesis as Dialogue: A Literary, Historical, and Theological Commentary* (Oxford: Oxford University Press, 2001).

²³Paul Elbert, "Genesis 1 and the Spirit: A Narrative-Rhetorical Ancient Near Eastern Reading in Light of Modern Science," *Journal of Pentecostal Theology* 15, no. 1 (2006): 23–72.

²⁴My main question concerns Elbert's claim (if I understand him correctly) that the Genesis creation narrative has a prophetic character, one anticipating the experimental findings of modern science that in effect confirm the truthfulness of the creation myths. But this is like saying that, after I reconstruct a historical event based on very few original sources, and my descendants later find other sources that corroborate my reconstruction, this then leads me to label my original reconstruction as prophetic. I do not think this is the best way of treating the Genesis narratives.

²⁵Is Pentecostal hermeneutics thereby fideistic? No more or no less than other Christian approaches to the Bible. But, whereas the faith of conservative evangelicals would be compromised if Genesis were not vindicated by modern science, I would say that Pentecostal hermeneutics is falsifiable if the works of the Spirit described in the Scriptures were to cease and no longer occur as part of Pentecostal spirituality.

²⁶See Michael Welker, "What is Creation? Rereading Genesis 1 and 2," *Theology Today* 48 (1991): 56–71.

²⁷See Philip J. Hefner, *The Human Factor: Evolution, Culture, and Religion* (Minneapolis, MN: Fortress Press, 1993), esp. chap. 2, and *passim*.

²⁸See Warren Austin Gage, *The Gospel of Genesis: Studies in Protology and Eschatology* (Winona Lake, IN: Carpenter Books, 1984).

²⁹A much more lengthy discussion of the preceding paragraphs can be found in my *The Spirit of Creation: Modern Science and Divine Action in the Pentecostal-Charismatic Imagination* (Grand Rapids, MI: William B. Eerdmans, 2011), chap. 5.

³⁰This complementarity between the two books is associated, in my mind, to that which goes under the same label as applied to explaining the relationship between theology and science. Complementarity in the theology and science arena refers to the idea that each provides valid insights into the one world which we inhabit, and which should at least be noncontradictory, if not also convergent in some respects. My use of the term is informed by, among other sources, James E. Loder and W. Jim Neidhardt, *The Knight's Move: The Relational Logic of the Spirit in Theology and Science* (Colorado Springs, CO: Helmers and Howard, 1992), especially section 1; Edward Mackinnon, "Complementarity," in W. Mark Richardson and Wesley J. Wildman, eds., *Religion and Science: History, Method, Dialogue* (New York: Routledge, 1996), 255–70; and (a succinct exposition), Alister E. McGrath, *Science and Religion: An Introduction* (Malden, MA: Blackwell, 2010), 165–74.

³¹Augustine, *Contra Faustum Manichaeum*, 32.20; see Augustine, *Answer to Faustus, a Manichean*, in Roland Teske, trans., *The Works of Saint Augustine: A Translation for the 21st Century* Part I, vol. 20 (Hyde Park, NY: New City Press, 2007), 422.

³²The most complete discussion, and certainly now the standard account, is the four-volume work by Jitse M. van der Meer and Scott Mandelbrote, eds., *Nature and Scripture in the Abrahamic Religions: Up to 1700*, 2 vols., Brill's Series in Church History 36 (Boston, MA: Brill, 2008), and *Nature and Scripture in the Abrahamic Religions: 1700–Present*, 2 vols., Brill's Series in Church History 37 (Boston, MA: Brill, 2008).

³³On Hugh's theology of nature, see Constant J. Mews, "The World as Text: The Bible and the Book of Nature in Twelfth-Century Theology," in Thomas J. Heffernan and Thomas E. Burman, eds., *Scripture and Pluralism: Reading the Bible in the Religiously Plural Worlds of the Middle Ages and Renaissance*, Studies in the History of Christian Traditions 123 (Boston, MA: Brill, 2005), 95–122.

³⁴A book-length discussion is found in Peter Harrison, *The Bible, Protestantism and the Rise of Natural Science* (Cambridge: Cambridge University Press, 1998).

³⁵Kenneth J. Howell, *God's Two Books: Copernican Cosmology and Biblical Interpretation in Early Modern Science* (Notre Dame, IN: University of Notre Dame Press, 2002).

³⁶This despite the strategic protestations of Galileo, in his letter to the grand duchess Christina, that Scripture remained ambiguous, subject to various interpretations (when compared with nature); see Stillman Drake, trans., *Discoveries and Opinions of Galileo* (Garden City, NY: Doubleday Anchor Books, 1957), 173–216.

³⁷With regard to the transformation of the two books metaphor in the early modern period, I have been helped by the overview of G. Tanzella-Nitti, "The Two Books Prior to the Scientific Revolution," *Perspectives on Science and Christian Faith* 57, no. 3 (2005): 235–48; but the interpretation is mine and Tanzella-Nitti should not be held responsible for it.

³⁸Steven Matthews, "Reading the Two Books with Francis Bacon: Interpreting God's Will and Power," in Kevin Killeen and Peter J. Forshaw, eds., *The Word and the World: Biblical Exegesis and Early Modern Science* (New York: Palgrave Macmillan, 2007), 61–77, at 67.

³⁹See Peter Harrison, "Reinterpreting Nature in Early Modern Europe: Natural Philosophy, Biblical Exegesis and the Contemplative Life," in Kevin Killeen and Peter J. Forshaw, eds., *The Word and the World: Biblical Exegesis and Early Modern Science* (New York: Palgrave Macmillan, 2007), 25–44, esp. 33–8.

⁴⁰I present the details of such a pneumatological imagination in my book, *Spirit-Word-Community: Theological Hermeneutics in Trinitarian Perspective* (Burlington, VT: Ashgate, and Eugene, OR: Wipf and Stock, 2002), part II. Many of my claims in this article are grounded in my views about epistemology and interdisciplinarity argued at (some would say, exhausting) length in this earlier volume.

⁴¹I see my theological approach to the two books as consistent with what is suggested by others who have contributed to this journal—e.g., Angus J. L. Menuge, "Interpreting the Book of Nature," *Perspectives on Science and Christian Faith* 55, no. 2 (2003): 88–98; Walter R. Thorson, "Hermeneutics for Reading the Book of Nature: A Response to Angus

Menuge," *Perspectives on Science and Christian Faith* 55, no. 2 (2003): 99–101; and George L. Murphy, "Reading God's Two Books," *Perspectives on Science and Christian Faith* 58, no. 1 (2006): 64–7. Menuge and Thorson agree that nature is also interpreted, but they differ over whether intelligent design is to be read scientifically (Menuge) or theologically (Murphy). I tend to agree that contemporary intelligent design is by and large a theologically funded project (here standing with Murphy, who sees ID as a natural theology) while also seeing that in some cases, discussion of some of the corollary issues such as function are more strictly scientific (so here, open to Menuge's claims about the scientific engagement of nature).

⁴²See Frederick Grinnell, *Everyday Practice of Science: Where Intuition and Passion Meet Objectivity and Logic* (Oxford: Oxford University Press, 2009), esp. part I.

⁴³See Yong, "Academic Glossolalia? Pentecostal Scholarship, Multi-Disciplinarity, and the Science-Religion Conversation," *Journal of Pentecostal Theology* 14, no. 1 (2005): 63–82.

⁴⁴Philip Clayton, *Adventures in the Spirit: God, World, Divine Action* (Minneapolis, MN: Fortress Press, 2008), esp. chap. 3, argues convincingly, about how theology's engagement with the sciences needs to recognize what can be said within scientific constraints. Thus, for example, the spherical nature of the earth confirmed by science dictates that intimations of a flat earth in the scriptural accounts need to be reinterpreted. I take this as meaning that science is not supremely authoritative, but that when engaging specifically with the sciences, theologians need to understand that specific context and thus have to accommodate themselves, at least in part, to that field of discourse.

⁴⁵Thus, for example, theological interpretations should be potentially compatible with both intelligent design and theistic evolution, perhaps even with progressive and young-earth creationisms, all of which are currently being negotiated within evangelical Christianity. To affirm this of *theological* interpretation is not to say that each of these are equal options in the science classroom—in that arena, other experts with more than just theological interests need to adjudicate the issues. This is, in part, what it means to retain the integrity of disciplines rather than either to reduce any to others or to subsume all under theology, as it was during the medieval period. For further discussion of these matters, see my *The Spirit of Creation*, esp. chaps. 2 and 5.

⁴⁶For instances of such interconfessional and interdisciplinary inquiry, see Amos Yong, guest ed., "Pentecostalism, Science, and Creation: New Voices in the Theology-Science Conversation," a collection of six articles in *Zygon: Journal of Science and Religion* 43, no. 4 (2008): 875–989; Amos Yong, ed., *The Spirit Renews the Face of the Earth: Pentecostal Forays in Science and Theology of Creation* (Eugene, OR: Pickwick Press, 2009); and Amos Yong and James K. A. Smith, eds., *Science and the Spirit: A Pentecostal Engagement with the Sciences* (Bloomington, IN: Indiana University Press, 2010).

⁴⁷Paul Ricoeur, *The Conflict of Interpretations: Essays in Hermeneutics*, ed. Don Ihde (Evanston, IL: Northwestern University Press, 1974).

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Kepler and the Laws of Nature

Owen Gingerich

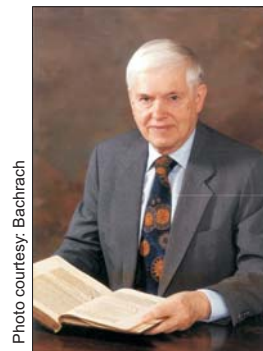


Photo courtesy: Bachrach

Owen Gingerich

Kepler is famous for his three laws of planetary motion, but he never assigned a special status to them or called them laws. More than a century and a half passed before they were singled out and ordered in a group of three. Nevertheless, he believed in an underlying, God-given rationale to the universe, something akin to laws of nature, and as he matured he began to use the word archetype for this concept. Most physicists today have, quite independently of religious values, a feeling that deep down the universe is ultimately comprehensible and lawful. Such ultimate laws are here called ontological laws of nature. In contrast, what we have (including Kepler's third law, for example) are human constructs, epistemological laws of nature. Belief in the existence of deep ontological laws is an implicit leap of faith. Science, insofar as it assumes the reality of mathematical laws, operates with a tacitly theistic assumption about the nature of the universe. Such insights provide a strong hint for answering Einstein's most serious inquiry: Why is the universe comprehensible?

In 1609, the same year in which Galileo and others began to use the telescope for astronomical purposes, Johannes Kepler published his *Commentary on the Motions of Mars*, a book today generally cited by its short title, *Astronomia nova*. But that abbreviated title conceals its real challenge to the Aristotelian order of things. Kepler's work was truly the "new astronomy," but the title goes on, "based on causes, or celestial physics," and it was the introduction of physics into astronomy that was Kepler's most fundamental contribution.

Aristotle's *De coelo*, "On the heavens," which dealt with the geometrical motions in the heavens, was the province of astronomy professors. However, it was his *Metaphysics* that concerned the fundamental reasons for the motions—Aristotle implied that it was the love of God that made the spheres go round¹—and *Metaphysics* was the property of the philosophy professors. Kepler unified this dichotomy, demanding physically coherent explanations as to why planets sometimes went faster than at other

times. He realized that when Mars was closest to the sun, it went fastest in its orbit. It seemed to him unreasonable that the earth, on the contrary, would always travel at the same speed regardless of its distance from the sun. And when he got that straightened out, he single-handedly improved the accuracy of predicted positions by an order of magnitude. You may have thought that finding the elliptical shape of Mars' orbit made the major leap forward in accuracy. Wrong! It was getting the earth's orbit positioned correctly. His teacher Michael Maestlin criticized him for

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The seeds for "Kepler and the Laws of Nature" were planted in an ASA-sponsored talk at the AAAS meeting in Boston in 2008, and blossomed at a Euresis seminar in San Marino in 2009.

Article

Kepler and the Laws of Nature

mixing up physics and astronomy,² but it was this insight that drove Kepler to his major breakthroughs. And that approach laid the essential framework for René Descartes and Isaac Newton.

Kepler's celestial physics pointed the way to a lawful universe that could be understood in terms of underlying physical principles. Kepler is rightly famous for his three laws of planetary motion, but he never called them laws; they were not specially singled out and ordered as a group of three until 1774 in J.-J. Lalande's *Abrégé d'astronomie*, something probably conceived by the French astronomer himself. Nor did Kepler use the expression "laws of nature," and neither, for that matter, did Galileo. In fact, "laws of nature" in the modern sense did not come about until the philosophical inquiry starting from first principles as elaborated by Descartes. Let me first situate the origins of Kepler's laws within the larger framework of his discoveries and his cosmology, and then reflect on the construction of the modern concept of laws of nature.

Kepler's Discoveries and His Cosmology

In October of 1600 the young Kepler, who had lost his job as a high school teacher due to the Counter-Reformation, arrived in Prague from the Austrian provinces to work as an apprentice to Tycho Brahe, the greatest observational astronomer the world had yet known. Kepler's working notebook, which still survives, seems to show that he had not got off to a good start. The opening page of triangles and numbers is crossed off.³ No doubt Christian Longomontanus, the senior staff assistant, looked over Kepler's shoulder and remarked, "Young man, we have a much easier way to do that here!" Sure enough, on the second page the problem is attacked using precepts from Tycho's manuscript handbook of trigonometric rules.

Nevertheless, Kepler had not come to his new post totally unprepared. Kepler owned a second-hand copy of Copernicus' major work, the *De revolutionibus*, and at the university in Tübingen he had sat with his mentor, Michael Maestlin, and together they examined a previously highlighted section of the book.⁴ It was the chapter in which Copernicus inquired as to what was the center of the universe, the sun itself or the center of the earth's orbit (which

were two different points because of the earth's eccentrically positioned circle). The marginal annotation from the previous owner pointed out that Copernicus did not answer the question (although for practical reasons, Copernicus used the center of the earth's orbit as a convenient reference point). Maestlin added a further brief note to Kepler's copy, which is how we know that they discussed this point in particular. Clearly, Kepler favored using the sun, a physical body, rather than an empty geometrical point as the center of the universe. Thus in Prague, armed with this prior discussion, Kepler gained Tycho's permission to use the sun itself as the reference point for the study of Mars.

Asking what is the precise center of the universe may seem like a trivial question, particularly because this pair of choices seems so irrelevant today. But for Kepler's era, and for understanding his remarkably different approach to fundamental problems facing him, this was an extraordinarily pivotal question, and one that gives significant insight into his own special genius. As stated in my opening paragraph, Kepler was focused on physical causes, quite contrary to Maestlin and his other professors. He knew that, according to Aristotle and his geocentric cosmology, the earth was solidly fixed, and heavenly motions derived their action from the outside in, the starry firmament spinning once a day and inputting its basic motion into the planets including the sun and moon. But in the Copernican system it was the distant stars that were solidly fixed, so that the motions had to be generated from the inside out, in particular from a spinning sun. Hence, it was essential for Kepler's physical understanding of the cosmos that the sun itself had to be the reference point, and not some empty spot in space. This might, at first glance, seem like some strange fantasy on Kepler's part—Maestlin probably thought so—but in the event, it was absolutely essential, for this proved to be the major step toward making the prediction of planetary positions an order of magnitude more accurate.

In tandem with Kepler's physical treatment of the sun was his physical treatment of the earth. If the earth was propelled in its orbit by some magnetical force from the rotating sun, then the earth should travel more swiftly when it was closer to the sun (at its perihelion) in January and more slowly at its aphelion in July. It was well known that summer

(in the northern hemisphere) is a few days longer than winter because the sun seems to be moving more slowly then, but for Copernicus this was simply a perspective effect caused by the earth's eccentrically placed orbit. For Kepler, half of this unequal length of the seasons was a perspective effect, while the other half was caused by the earth's differing speed in its orbit. This meant changing the eccentricity and therefore the position of the earth's orbit, a radical step that had the unexpected consequence of eliminating the most egregious errors in predicting the places of Mars! (Because the apparent places of Mars depend on the positions of our observing platform, that is, the earth, then fixing the positions of the earth has an immediate effect on the predicted positions of Mars as seen from the earth.)

Kepler was to call it "the key to the deeper astronomy," and it was the climax to the first two-thirds of the *Astronomia nova*, the part he had completed even before he stumbled onto the ellipse. This paved the way for what we call his "law of areas" and what we identify as one of the most fundamental physical laws, the conservation of angular momentum. For Kepler, at this point it was essentially a working hypothesis, and not at all clearly stated: "*Now the elapsed time, even if it is really something different, is certainly measured most easily by the plane area circumscribed by the planet's path.*"⁵ The smooth motions of a clock's hands convert time into geometry, but Kepler's swept-out areas are something different, and very difficult to model with a mechanical device. Kepler had arrived at this point by assuming that the speed of a planet in its orbit was inversely proportional to its distance from the sun, a statement that indeed works at the perihelion and aphelion. But a handful of one-dimensional distances (from his assumed inverse distance rule) does not yield a two-dimensional area. Kepler was a good enough geometer to realize that there was a problem here, but as a physicist he seemed to have thought, "Behold! It is a miracle!" and marched bravely on.

Eventually, from his degree-by-degree calculations of the motion of Mars around the sun, Kepler saw that the orbit of Mars had to bend in from its circular shape for the area rule to hold, and from these tedious calculations, he suddenly awoke as if from a deep sleep (as he himself expressed it).⁶ He realized that everything would work if the orbit was, in fact, an ellipse with the sun at one focus. It was

a brilliant surmise on his part, motivated by his search for physical causes. He might have called his intuitive idea "the law of distances," that is, the speed of a planet in its orbit should be inversely proportional to its distance from the sun, but he thought in terms of archetypes, mostly geometrical, and not in terms of laws. His "law of distances" and the notion that a planet had to be pushed in its orbit was a chimera, of course, but nevertheless, the result was a stroke of genius. And ultimately, in his *Epitome of Copernican Astronomy* (1620), he got the speed relationship just right, in the modern form of conservation of angular momentum. Decades later, Newton would remark that Kepler had merely guessed that the orbit was an ellipse, implying that he, Newton, had gone farther by proving it.⁷ Kepler's was a guess, but an inspired guess!

For those who think of Kepler primarily in terms of his three laws, it might seem he spent the years between the *Astronomia nova* (1609) and the *Harmonice mundi* (1619) simply treading water. In many ways, they were difficult years for Kepler: his wife and his most cherished child died, his patron Rudolph II also died, Kepler relocated from Prague to the more provincial Linz, and shortly thereafter the immensely destructive Thirty Years' War began. But during this period, he responded to Galileo's astonishing telescopic observations, prepared the theoretical treatise on the optics of telescopes, wrote a little discourse that is considered a foundational work in mineralogy, composed a pioneering precursor to the integral calculus, wrote on chronology and on comets, and prepared the first volume of his *Epitome*.

Then, in 1619, Kepler's great but idiosyncratic work on cosmology, his mind's favorite intellectual child, appeared. Within its dense texture of geometry, astronomy, astrology, and cosmic music, *The Harmony of the World* contains near the end a mathematical gem, what today we call Kepler's third law. For Copernicus, the qualitative relationship between the size of a planet's orbit and its period of revolution was an aesthetic prize, one of the most important reasons for his rejection of the traditional geocentric cosmology. Copernicus exclaimed, "Only in this way [the heliocentric arrangement] do we find a sure bond of harmony between the movement and magnitude of the orbital circles."⁸ For Kepler, it was a life-long quest to convert this qualitative agree-

Article

Kepler and the Laws of Nature

ment into a quantitative expression: *the ratio that exists between the periodic times of any two planets is precisely the ratio of the sesquialter power of the mean distances*, i.e., $P_1/P_2 = (a_1/a_2)^{3/2}$. “The die is cast,” Kepler wrote, “and I am writing the book. Whether it is read by my contemporaries or by posterity matters not: let it await a reader for a hundred years, as God Himself has been ready for a contemplator for six thousand years!”⁹

Kepler did not call this relationship a law. The first to call it a law was Voltaire, in his *Elements of the Philosophy of Newton* (1738). He also stated concerning the area rule that

This Law inviolably observed by all the Planets ... was discovered about 150 Years ago by Kepler ... The extreme Sagacity of Kepler discovered the Effect, of which the Genius of *Newton* has found out the Cause.¹⁰

As indicated at the beginning of this article, it was not until 1774 that all three of Kepler’s mathematical rules for planetary orbits were sorted out and designated as laws.¹¹ Kepler himself never assigned a special status to these three rules. Nevertheless, he believed in an underlying, God-given rationale to the universe, something akin to laws of nature, and as he matured, he began to use the word archetype for this concept. He did not use “archetype” in his *Mysterium cosmographicum* of 1596, and apparently only once in his *Astronomia nova* (1609), but when he reprinted the *Mysterium* in 1621, he added a footnote stating that the five regular polyhedra (on which he based his spacing of the planetary orbits around the sun) are the archetype for that arrangement.¹² Subsequently he elaborates,

The reason why the Mathematics are the cause of natural things is that God the Creator had the Mathematics with him as archetypes from eternity in their simplest divine state of abstraction, even from quantities themselves ...¹³

In his *Harmony of the World* (1619), Kepler had expressed it similarly:

For shapes are in the archetype prior to their being in the product, in the divine mind prior to being in the creature, differently indeed in respect of their subject, but the same in the form of their essence.¹⁴

In other words, Kepler believed that, at the deepest level, the mathematical structures of the universe were God-given. This is, I believe, equivalent to say-

ing that, as part of ontological reality, there are laws of nature that hold our universe together.

Today physicists seem almost unanimous that the universe operates on the basis of fundamental laws of nature. There are some deep-down, essentially inviolable, rules that govern the working of nature, whether or not we can actually find or recognize them. In other words, the universe is, at bottom, fundamentally lawful. These are what I shall refer to as “ontological laws.” As far as the history of humankind is concerned, this is a relatively modern concept. From primitive times, the universe was seen as capricious. The idea that the universe is lawful undoubtedly stems from the theological origins of the concept of “laws of nature,” and ultimately from the idea that Kepler surely espoused, that the universe has the ultimate coherence of an intelligent Creator.

I would wager that most physicists have, quite independently of religious values, a gut feeling that deep down the universe is rational and lawful, ultimately comprehensible, and that with careful observation and experimentation our results more and more closely approach this ontological reality. In other words, the holy grail of scientific research is finding the deep ontological laws of nature. However (as I will argue), what we have actually got are human constructs, epistemological laws of nature. In defense of this view, I cite Einstein’s comment regarding scientific constructs:

The sense experiences are the given subject-matter. But the theory that shall interpret them is man-made. It is the result of an extremely laborious process of adaptation: hypothetical, never completely final, always subject to question and doubt.¹⁵

The Construction of the Modern Concept of Laws of Nature

It was during the decades-long interval between Kepler’s archetypes and the selecting out and designation of his three laws of planetary motion that our contemporary usage of “law of nature” developed. Let me review briefly the findings of scholars such as John Henry and Peter Harrison concerning the modern origins of this expression.¹⁶

According to these scholars, our modern notion of “laws of nature” derives from the writings of

Descartes. In 1619, after a day of intense concentration followed by a triad of vivid dreams, the French philosopher took the path of being his own empirical architect for a complete theory of nature. This he built from fundamental principles of matter and motion, beginning with *cogito, ergo sum*. Nevertheless, as he considered the notion of fundamental laws governing the universe, he eventually realized that he could not find an ultimate a priori origin of motion. Hence, he could only propose that motion was part of God's initial creation. Thus the conception of "laws of nature" was at its root theological in origin, just as Kepler's archetypes had sprung from an intensely theological context.

In the English language, the concept of "laws of nature" arose through the work of Robert Boyle and Newton. Boyle wrote in 1674 (in echo of Descartes) that

The subsequent course of nature, teaches, that God, indeed, gave motion to matter; but that, in the beginning, he so guided the various motion of the parts of it, as to contrive them into the world he design'd they should compose; and establish'd those rules of motion, and that order amongst things corporeal, which we call the laws of nature. Thus, the universe being once fram'd by God, and the laws of motion settled, and all upheld by his perpetual concourse, and general providence; the same philosophy teaches, that the phenomena of the world, are physically produced by the mechanical properties of the parts of matter; and, that they operate upon one another according to mechanical laws.¹⁷

More famously, the idea of laws of nature stemmed from Newton and his *Philosophiae naturalis principia mathematica* (1687). Virtually at the outset of the *Principia*, Newton proposed three laws of motion, and later in the volume (in Book 3), he set forth a mathematical description of gravitation that has been universally referred to as the law of gravitation—for example, in the closing sentence of Charles Darwin's *On the Origin of Species*—even though Newton never referred to it as such. Newton introduced gravitation in a series of propositions, and he mentioned it as a principle, but he never called it a law nor set it down as a formula such as we find in modern textbooks, i.e.,

$$F = GmM/r^2,$$

where F is force, G is the constant of universal gravitation, M and m are the masses of two gravitating bodies

and r is the distance between them. It is in this section of his book that Newton made his sole nod to Kepler's celestial mechanics, attributing to him the relationship we now call Kepler's third law.

These two laws, Kepler's third law and Newton's law of gravitation, afford the opportunity of probing a little more deeply into the epistemological nature of such "laws of nature." Kepler's third law essentially gives us a first approximation for sampling the strength of the sun's gravitational effect at different distances. If gravity could be abruptly turned off, each planet would assume a straight path and fly off tangent to its present orbit. But with gravity in action, at a specified distance from the sun, there is a certain amount of bending of a planet's trajectory. With just the right speed, the trajectory will be bent into a circle around the sun; thus, at that distance, the period of the planet is automatically established if the orbit is to be a circle. Likewise, an elliptical orbit samples the strength of the sun's gravitational effect at different distances because the planet's trajectory carries it closer and then farther from the sun. This calculation requires the limit concepts of the differential calculus, and is worked out in Book 1 of Newton's *Principia*. Kepler's third law is easier mathematically but more restrictive (requiring circular orbits as an approximation). Nevertheless, it did provide a path for Newton to show that the strength of gravity varied inversely with the square of the distance, that is, by $1/r^2$. Newton probably never read Kepler's *Astronomia nova* nor *The Harmony of the World*, but he could have found Kepler's P^2/a^3 relationship in his well-thumbed copy of Nicholas Mercator's *Institutionum astronomicarum* (1676).

One consequence of Newtonian physics is to show that Kepler's third law is actually only an approximation. P^2/a^3 is *not* a constant, for this ratio depends on $(M + m)$ where M is the mass of the sun and m the mass of the planet. Because M is overwhelmingly larger than m , the differing masses of the planets makes rather little difference, and in the solar system, P^2/a^3 is approximately constant. However, in other applications, the $(M + m)$ dependency is critical. What we learn here is that Kepler's third law is not really a law after all, but just a convenient (and valuable) approximation. It is a man-made representation of the universe, but decidedly limited when the $(M + m)$ dependency is omitted.

Article

Kepler and the Laws of Nature

In the same way, we could inquire whether the law of gravitation is a fundamental law of nature, or something of a man-made invention. We could, for example, examine how Newton invented the basic ideas of the integral calculus to establish what distance to use in coping with a sphere, or how he used experimental pendula to establish the equality between gravitational and inertial mass. We could also turn to Einstein to show how the general relativistic solution of gravitation solved the problem of the advance of perihelion of Mercury, a conundrum that defeated Newtonian gravitation. Today, with the further puzzle of dark energy, we realize that the law of gravity is still an unresolved mystery, and the laws of nature we have so far found are man-made constructions based on a far-from-complete understanding of nature herself. In that sense, we could call these laws of nature “epistemological laws.”

God’s Agenda

Laws such as Kepler’s, or Newton’s famous laws of motion, can be classed as epistemological statements based on what we have gleaned observationally. Most scientists will, after a little contemplation, agree that these laws are man-made, but they will likely add that such formulations are approaching some deeper, inviolate laws of nature that exist whether or not we fully comprehend them. These can be called “ontological statements,” referring to the fundamental nature of the universe itself, how it really is. And this is where an implicit leap of faith occurs.

For Boyle and Newton, as well as for Descartes, laws of nature as a concept grew from theological roots and the notion of Divine Law. In delineating the history of the concept, Oxford’s Peter Harrison has concluded that today, science, insofar as it *assumes* the reality of mathematical laws, operates with a tacitly theistic assumption about the nature of the universe. The mere existence of this underlying rationality of the universe, its deep ontology, points toward a divine creative reality that we can label as “God’s agenda.”

The British physicist/theologian John Polkinghorne reasons along the same lines when he writes that we must

face the fact that science is privileged to explore a universe that is both rationally transparent and rationally beautiful in its deep and accessible

order ... Something profound is going on in science’s exploration of our deeply intelligible universe that calls for metascientific illumination.”¹⁸

These insights provide a strong hint for answering Einstein’s most serious inquiry: Why is the universe comprehensible?

What else does this view purchase for the religious understanding of the world in which we find ourselves? Some events that seem totally incredible to those of us who take seriously the world’s stability and dependability, such as the resurrection of Jesus after his crucifixion and entombment, can be seen, not as rare suspensions of the laws of nature, but as the intersection of a more fundamental spiritual universe with the physical universe embedded in it—a physical universe in which the ontological laws of nature always hold, but which is only a subset of the total reality. It is a matter of faith that such a spiritual universe exists, and by the same token, also a matter of faith to deny its existence. ~

Notes

¹Aristotle, *Metaphysics*, Book XII, chap. 7.

²Maestlin to Kepler, 21 September 1616 (O.S.), *Johannes Kepler Gesammelte Werke* 17 (Munich: Verlag, 1955), 187 (lines 25–30).

³See James Voelkel, *The Composition of Kepler’s Astronomia nova* (Princeton, NJ: Princeton University Press, 2001), 100–1. The page in Kepler’s workbook is partially transcribed in *Johannes Kepler Gesammelte Werke* 20/2 (Munich: Verlag, 1998), 18, but the drama of the crossed-out part is entirely missing. The page is reproduced in Owen Gingerich, *The Eye of Heaven: Ptolemy, Copernicus, Kepler* (New York: Springer, 1993), 335.

⁴See Owen Gingerich, *The Book Nobody Read: Chasing the Revolutions of Nicolaus Copernicus* (New York: Walker, 2004), 163–5.

⁵William Donahue, trans., *Kepler’s Astronomia nova* (Cambridge: Cambridge University Press, 1992), 468 (from the beginning of chap. 47).

⁶*Ibid.*, 543 (from the beginning of chap. 56).

⁷Newton to Halley, 20 June 1686, *The Correspondence of Isaac Newton*, II, p. 436.

For as Kepler knew the Orb to be not circular but oval and guest [sic] it to be Elliptical, so Mr. Hook without knowing what I have found out since his letters to me, can know no more than that the proportion was duplicate *quam proximè* at great distances from the center, & only guest it to be so accurately and guest amiss in extending that proportion down to the very center, whereas Kepler guest right at the Ellipsis. And so Mr. Hook found less of the Proportion then [sic] Kepler of the Ellipsis.

- ⁸Nicolaus Copernicus, *De revolutionibus* (Nuremberg: 1543), Book 1, chap. 10.
- ⁹Johannes Kepler *Gesammelte Werke* 6 (Munich: Verlag, 1940), 290 (the Introduction to Book 5 of *Harmonice mundi*). The third law is found in Book 5, chap. 3, p. 302.
- ¹⁰Curtis Wilson, "Kepler's Laws, So-Called," *Newsletter of the Historical Astronomy Division of the American Astronomical Society* (May 1994).
- ¹¹J.-J. LaLandé, *Abrégé d'Astronomie* (Paris: 1774), p. 201, paragraph 467.
- ¹²Kepler, *Mysterium cosmographicum* (1621), chap. 2, note no. 4 to the second edition, A. M. Duncan, trans., *Johannes Kepler: Mysterium Cosmographicum: The Secret of the Universe* (New York: Abaris Books, 1981), 103.
- ¹³*Ibid.*, chap. 11, note no. 2 to the second edition, p. 125.
- ¹⁴From the beginning of Kepler's introduction to Book I of the *Harmonice mundi*; Kepler, *The Harmony of the World*, trans. E. J. Aiton, A. M. Duncan, and J. V. Field (Philadelphia, PA: American Philosophical Society, 1997), 9–10.
- ¹⁵A. Einstein, *Ideas and Opinions* (New York: Bonanza Books, 1954), 323–4.
- ¹⁶John Henry, "Metaphysics and the Origins of Modern Science: Descartes and the Importance of Laws of Nature," *Early Science and Medicine* 9, no. 2 (2004): 73–114; Peter Harrison, "The Development of the Concept of Laws of Nature," chap. 2 in Fraser Watts, ed., *Creation: Law and Probability* (Aldershot, England: Fortress Press with Ashgate Publishing, 2008), 13–36.
- ¹⁷Robert Boyle, *About the excellency and grounds of the mechanical hypothesis, some considerations* (London: 1674).
- ¹⁸John Polkinghorne, *Science and the Trinity: The Christian Encounter with Reality* (New Haven, CT: Yale University Press, 2004), 64–5.



Launches New Publication

God and Nature (G&N) is an electronic-only publication, featuring a new article twice a month.

Less technical than *Perspectives on Science and Christian Faith* but featuring more depth and breadth than the *Newsletter of the ASA and CSCA*, *G&N* is accessible to a much broader audience. The articles are particularly engaging to students and younger scientists.

The initial focus is to describe innovative research by Christians in science. Additionally, it includes human-interest stories, such as being a Christian in academia, work-life balance, and mentoring undergraduates.

The first article "How was Galileo converted?" recounts the work of ASA Fellow Owen Gingerich. Read this and each subsequent article at www.asa3.org/godandnature.

Thomas Burnett, a Mirzayan Fellow at the National Academy of Sciences in Washington, DC, is editing *God and Nature*. Thomas has a degree in philosophy from Rice University and conducted his doctoral studies in the History of Science at the University of California, Berkeley.



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Sediment Transport and the Coconino Sandstone: A Reality Check on Flood Geology

Timothy K. Helble



Timothy K. Helble

The origin of a graphical procedure developed by a prominent Flood geologist to estimate the water depth and current speed associated with deposition of cross-bedded sandstones during a global Flood is examined. It is shown how this graphical procedure was used to estimate a widely quoted depth and speed of Flood waters said to be responsible for depositing the Coconino Sandstone and other Grand Canyon sandstones in a matter of days. Simple calculations are then performed to show that sediment transport rates much greater than anything reasonably associated with this estimated water depth and current speed would still be grossly insufficient to deposit the Coconino in a matter of days.

Flood geology—an effort by young earth creationists (YEC) to prove a global Flood was responsible for depositing all or most of Earth’s fossil-bearing sedimentary rock layers—is rejected by mainstream geologists. Probably the best one-sentence summary of their objections to Flood geology was published by the National Academy of Sciences:

The belief that Earth’s sediments, with their fossils, were deposited in an orderly sequence in a year’s time defies all geological observations and physical principles concerning sedimentation rates and possible quantities of suspended solid matter.¹

Mainstream geologists validate this statement through their normal course of work and have provided innumerable independent lines of evidence indicating Earth’s stratigraphic record was formed by complex processes over “deep time.” In the past, mainstream geologists have generally not responded to Flood geology to avoid the appearance of granting legitimacy to young earth creationism.

However, due to the impact that aggressive YEC ministries are having on the American public, mainstream geologists are beginning to realize a more organized response is needed.²

Several Christians have made concerted efforts to explain the errors of Flood geology and have alluded to the problem of sediment transport. Citing a graphical procedure presented by prominent Flood geologist Steve Austin in *Grand Canyon: Monument to Catastrophe* for estimating Flood current velocities said to be necessary to deposit cross-bedded sandstones,³ Greg Neyman qualitatively explained how sediment transport in a year-long Flood would be insufficient to form a single, conspicuous sedimentary formation in Grand

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Article

Sediment Transport and the Coconino Sandstone: A Reality Check on Flood Geology

Canyon known as the Coconino Sandstone.⁴ Also in reference to the Coconino Sandstone, Davis Young stated that “no flood of any size could have produced such deposits of sand.”⁵ Alan Hayward pointed out that the volume of Earth’s Phanerozoic (542 million years ago to present) layers “alone comes to 654 million cubic kilometers, whereas the total amount of water on Earth is less than 1,400 million cubic kilometers.” Thus, he argued, the Flood would be “a rich, creamy mud, in which no fish life could possibly survive.”⁶ The usual YEC response to such critiques is to state that they reflect “uniformitarian bias” or “the different starting point” of the “secular scientist” or “evolutionist.”

Hill and Moshier recently described the basic tenets of Flood geology and provided several biblical arguments against it before presenting numerous evidences contradicting the young-earth view of Grand Canyon.⁷ After a summary of geologic evidence against the young-earth view of Grand Canyon, this article uses a simple quantitative approach based on Neyman’s explanation of the sediment transport problem to finalize its case against Flood geology. The “different starting point” response is circumvented by beginning with Austin’s graphical procedure. It is then shown how Austin’s own data,

references, and arguments, when taken to their logical conclusion, refute the Flood geology interpretation of the Coconino Sandstone without any additional information or assumptions from “uniformitarian geology.”

Grand Canyon Geology Review

The right side of figure 1 is a simplified stratigraphic section of Grand Canyon showing the position of each named formation. The following brief overview presents only a fraction of the independent lines of evidence pointing towards great age for the rocks of Grand Canyon. This overview draws heavily on geoscientists’ papers in *Grand Canyon Geology*.

In *Grand Canyon: Monument to Catastrophe*, Austin classifies rocks from the Proterozoic eon (2.5 billion years to 542 million years old) as “pre-Flood/Creation week,” Paleozoic era (542 million years to 251 million years) as “early Flood,” Mesozoic era (251 million years to 65.5 million years) as “late Flood,” and Cenozoic era (65.5 million years to present) as “post Flood.”⁸ Austin uses the 150-day point mentioned in Gen. 7:24 and 8:3 to define the boundary between the early and late Flood periods.⁹ This is essentially the same classification of layers as the

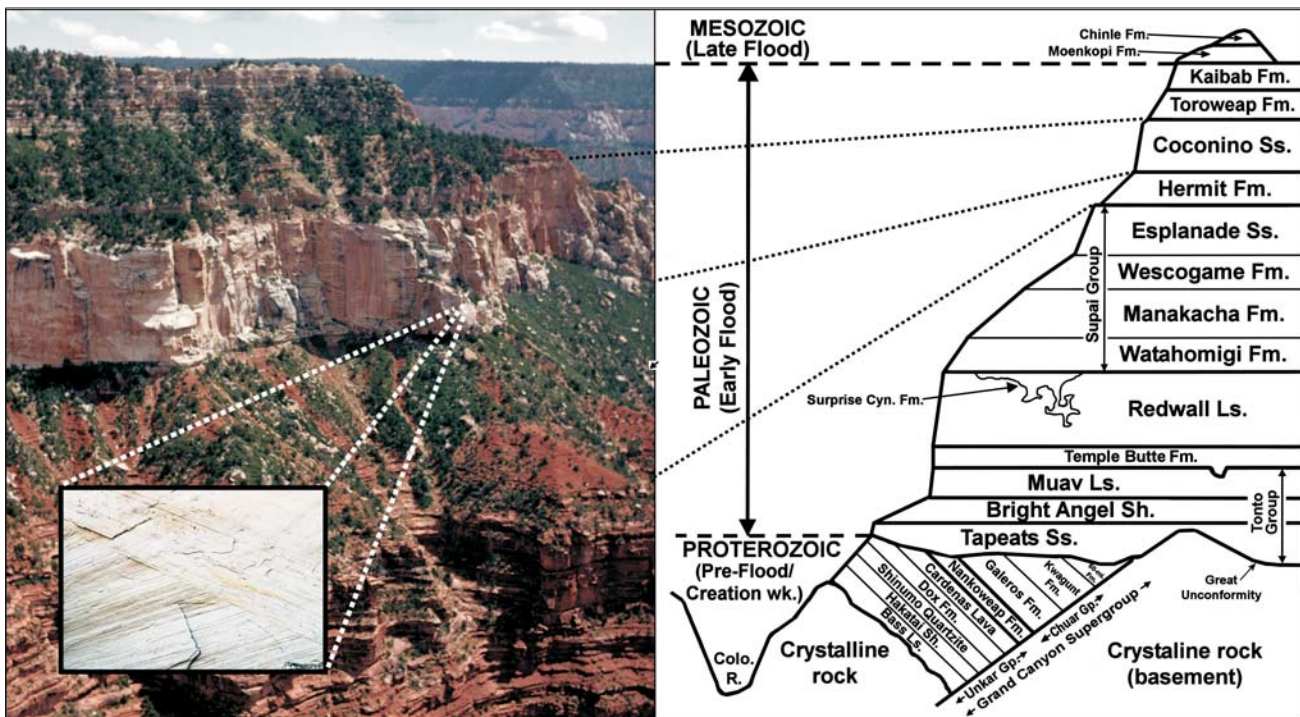


Figure 1. Photograph of Coconino Sandstone alongside simplified stratigraphic section of Grand Canyon, with inset showing the cross-bedding seen throughout the formation. The left portion of stratigraphic section shows geologic eras to which layers are assigned and corresponding timing for deposition by the global Flood according to Austin, *Grand Canyon: Monument to Catastrophe* (1994). Photograph by Tim Helble, inset photo courtesy USGS, graphic after Hill and Moshier (2009).

one used in *Earth's Catastrophic Past*, the new two-volume compilation on Flood geology said to be an update to Whitcomb and Morris' *The Genesis Flood*.¹⁰ Only the Proterozoic (pre-Flood/Creation week) and Paleozoic (early Flood) layers, separated by a clearly visible break known as the Great Unconformity, are visible within Grand Canyon.

Proterozoic Rocks

Grand Canyon's Proterozoic (late Precambrian) rocks consist of (1) igneous and metamorphic rock, sometimes referred to as the crystalline basement, and (2) overlying, tilted sedimentary layers known as the Grand Canyon Supergroup. Because the crystalline basement and the Grand Canyon Supergroup are below the "Cambrian/Precambrian" (Paleozoic/Proterozoic) boundary, they are written off by most Flood geologists as "pre-Flood/Creation week" rocks formed early in the creation week or during the seventeen centuries between Creation and the Flood (using the Ussher timeline). However, abundant evidence exists that the sequence of Proterozoic rock seen in Grand Canyon formed over more than a billion years of Earth history.

The **crystalline basement** consists of metamorphic rock such as schist and gneiss with numerous igneous intrusions. Minerals and structures of the metamorphic rock indicate that sedimentary rock was brought slowly from the surface to depths of 20 to 25 km, squeezed laterally numerous times by thrusting and folding, and brought back up to depths of about 10 km.¹¹ These depths were not based on biased guesswork—laboratory experiments are increasing geologists' understanding of how different shapes and combinations of minerals reveal the metamorphic history of rock under various pressure-temperature conditions.¹² Igneous intrusions such as granite exhibit mineral structures consistent with slow cooling at depths much greater than where they are found today. Given the depths at which pressure and temperature would have affected metamorphic rock now terminating at the Great Unconformity, it is clear that some 6 miles (10 km) of this rock was removed before the Grand Canyon Supergroup was deposited. This subduction, lateral squeezing, uplift, and subsequent erosion clearly required far more than seventeen centuries.

The **Grand Canyon Supergroup** layers total about 13,000 feet (4,000 m) in thickness, but because

they are tilted, highly faulted, and then planed off more or less horizontally at the Great Unconformity, only about 2,000 vertical feet (600 m) are exposed in a given area in the eastern Grand Canyon. Formations in the Grand Canyon Supergroup reflect a variety of depositional settings, including low energy flow (with accompanying ripple marks), mudflat, subaqueous delta, floodplain, tidal flat, shallow subtidal to intertidal, tide/wave affected shoreline, and high energy flow environments. Numerous beds with mud cracks and raindrop imprints are found, indicating long exposure to the atmosphere before subsequent burial. Buried channels can be found in several formations, indicating periods of erosion before subsequent burial. Most also have beds of stromatolites—colonies of blue-green algae (cyanobacteria) in shallow water which built up through the trapping of fine sediments. Some of the evidence for great age of specific formations in the Grand Canyon Supergroup includes the following:

- The **Shinumo Quartzite** consists of sandstones and quartzite (quartz grains solidly cemented with silica).¹³ The time required for quartz sand to accumulate and siliceous cement to fill the space between grains to form a substantial layer of erosion-resistant quartzite would be much too long to fit in any young-earth scenario.
- The **Cardenas Lava** has been dated at 1070 ± 70 million years using the Rubidium-Strontium (Rb-Sr) method.¹⁴ Instead of a single lava flow, the Cardenas is a series of basaltic flows with interbedded sandstone layers, which alone would require more than seventeen centuries to form.
- The **Galerus Formation** consists of four members totaling over 4,200 feet (1,300 m) in thickness, each consisting of varying proportions of shale, siltstone, limestone, dolomite, and sandstone. The lowest member—the Tanner Member—fills in recognizable paleotopography cut into the underlying Nankoweap Formation. Quartz grains in sandstone beds of the third member—the Carbon Canyon Member—are set in carbonate, silica, hematite, or chlorite cement or clay matrix, which in itself would indicate a long, diverse history of deposition and lithification.¹⁵
- The **Kwagunt Formation** includes a dolomite layer with karst features (e.g., cavities, dissolution features), some of which in turn are filled with sandstone and other sedimentary rock. This means enough time elapsed for (1) formation of hardened

Article

Sediment Transport and the Coconino Sandstone: A Reality Check on Flood Geology

limestone, (2) infusion of limestone with magnesium to become dolomite, (3) development of karst features in dolomite through interaction with weak carbonic acid in ground water, and (4) cementation (lithification) of sand and other sediments that worked their way into the solution features to form “rock inside rock.”¹⁶ A large block of this karsted dolomite is integrated into the overlying Sixtymile Formation,¹⁷ meaning that enough time elapsed for it to be uplifted, broken off in a landslide, and integrated into a new sediment matrix which then lithified into solid breccia.

Paleozoic Layers

The Paleozoic (early Flood) layers in Grand Canyon span from the Tapeats Sandstone up through the Kaibab formation and are estimated by Austin to total about 4,000 feet in thickness.¹⁸ Paleozoic formations in Grand Canyon reflect a variety of depositional settings, including deep marine, shallow marine, tidal channel, tidal flat, beach, nearshore river valley, floodplain, braided river, and eolian (wind-driven dune) environments. Some of the evidence for great age of specific Paleozoic layers includes the following:

- The **Tapeats Sandstone** has mostly beds of pebbles and coarse sand at its base just above the Great Unconformity.¹⁹ This is not what one would expect as the first deposits of a catastrophic global Flood.
- The **Bright Angel Shale** has beds with abundant trace fossils. These indicate a relatively stable environment and plenty of time for each layer to be colonized and reworked by trilobites and primitive burrowing animals without being immediately crushed under the weight of higher layers.²⁰
- The **Muav Limestone** consists mainly of beds of limestone and dolomite of varying thickness.²¹ The difference in composition between the fine-grained Bright Angel Shale and carbonates of the overlying Muav Limestone is sufficient to cause several major Grand Canyon springs (e.g., Roaring Springs) to issue at their contact.²²
- The **Temple Butte Formation** fills numerous channels eroded into the top of the Muav Limestone which are up to 100 feet (30 m) deep and 400 feet (120 m) wide in eastern Grand Canyon. The formation becomes a continuous layer up to 450 feet (140 m) thick to the west. Several marine fossils not found in underlying formations suddenly appear here, including those of gastropods; crinoids;

rare corals; small conodonts (eel-like creatures); and armored, plate-mouthed fish known as placoderms.²³

- The **Redwall Limestone** consists of nearly pure carbonate rock with structure, composition, and fossil content contradicting the idea that it originated as pure calcium carbonate sediments “introduced over the Canyon at the same time the Flood waters became hot from the fountains of the great deep.”²⁴ The Thunder Springs Member of the Redwall is famous for its alternating light and dark bands of fossil-rich chert and carbonate rock.²⁵ Such numerous, long, and continuous beds of alternating composition are inconsistent with a single catastrophic flood event.
- The **Surprise Canyon Formation** consists of sandstone, siltstone, conglomerate, and carbonate rock filling erosional valleys and karst features (e.g., caves) in the Redwall Limestone. The erosional valleys form a stream network which becomes wider and deeper in a westerly direction, with the deepest measuring 401 feet (122 m).²⁶ Rocks (clasts) in the conglomerate were derived from the Redwall Limestone, showing that the Redwall was already solid when the Surprise Canyon Formation was deposited.²⁷ YECs often state how erosional features would be seen in layers if thousands or millions of years passed before deposition of higher layers,²⁸ and the Surprise Canyon and Temple Butte Formations supply excellent examples of this.
- The **Supai Group** is an incredibly complex series of four formations: the Watahomigi, Manakacha, Wescogame Formations and the Esplanade Sandstone. Shoreline, continental (including eolian), and shallow marine deposition environments are represented, alternating numerous times. Vertebrate footprints have been found in the Wescogame Formation and Esplanade Sandstone.²⁹
- The **Hermit Formation** has filled-in channels in its sandstone units with structures commonly associated with point bars in meandering streams. Some buried channels in the Hermit actually cut downward into the Esplanade Sandstone of the Supai Group, indicating deposition was interrupted by a long period of erosion. Vertebrate footprints have also been found.³⁰
- The **Coconino Sandstone** (fig. 1, left) is between 65 to 600 feet (20 to 180 m) thick in Grand Canyon and up to 1000 feet (300 m) thick at its southern

boundary on the Mogollon Rim, near Pine, Arizona. The Coconino is composed of cliff-forming, fine-grained, well-rounded quartz sand and small amounts of feldspar, cemented primarily with silica. Irregular cross-bedded sets at an average angle of 25° with thickness up to 66 feet (20 m) can be seen in all exposures (fig. 1, inset).³¹ These angled cross beds are truncated by horizontal to slightly dipping planar surfaces which can typically be traced for hundreds of meters. At least five of these planar surfaces exist in the Coconino wall in figure 1, not counting top and bottom contacts with the Toroweap and Hermit Formations. Origin of such planar surfaces in sandstones is still debated, but they are likely some type of erosional feature, because they truncate multiple cross beds. Shorter, “second order” angular surfaces truncate individual cross beds (fig. 1, inset) in a manner associated with migration of small dunes on the upwind and downwind sides of larger, complex dunes.³² Presence of small pull-apart structures; several types of slump features; small-scale stratification; and low-relief wind ripples as seen in large, broken-off pieces of cross strata are further collective evidence for eolian origin of the Coconino.³³

Excavations in modern-day dunes reveal the same complex cross beds and other eolian indicators seen in the Coconino.³⁴ Fossil trackways made by ancient five-toed vertebrates have also been found at several locations, as have spider and millipede tracks and raindrop imprints.³⁵ To support his case for aqueous deposition of the Coconino, Leonard Brand showed that amphibians in a water tank could leave footprints in fine sand, but his experiments made no attempt to simulate the flow velocities and extreme sediment accumulation rates proposed by YECs in their global Flood scenarios.³⁶ Any argument for aqueous deposition would have to address all of the evidence for eolian deposition and explain the multiple truncations of irregular cross beds and “second order” surfaces by long, “first order” planar surfaces, while remaining consistent with sediment transport rates required to form the Coconino in a matter of days.

- The **Toroweap Formation** has indicators of a variety of depositional environments, including eolian, tidal/mudflat, and shallow marine and also has beds of evaporites (deposits of minerals slowly precipitated from salt water concentrated by solar evaporation) in some locations.³⁷

- The **Kaibab Formation** reflects a complex depositional history involving several alternations between subtidal and shallow marine environments, and also includes some evaporites. Fossil colonies of one brachiopod species—*Peniculauris bassi*—have been found in exposed bedding planes in their life position (concave up), some with their delicate spines still attached.³⁸

Mesozoic Layers

Mesozoic (late Flood) layers resting on top of the Kaibab Formation to the north and east of Grand Canyon start with the Moenkopi and Chinle Formations. There is evidence that up to 5,000 feet (1500 m) of Mesozoic layers existed above the Kaibab Formation well before Grand Canyon was formed. These layers were eroded away from the immediate vicinity of Grand Canyon in association with late Cretaceous (100–65 million years ago) uplift of the region, but still exist as a series of cliffs and plateaus leading up to higher terrain to the north known as the Grand Staircase. Of special note here is the existence of dinosaur footprints and fossils (including nests) in numerous Mesozoic layers.³⁹

Cenozoic Layers

Cenozoic (post Flood) layers are found in the highest part of the Grand Staircase in central Utah and surrounding areas. Of special note here is the Green River Formation, which consists of thin couplets of dark organic and light inorganic layers known as varves which record six million years of lake deposition.⁴⁰

Sedimentation Rates As Addressed By Flood Geologists

Even in the face of overwhelming geologic evidence that Grand Canyon’s rock layers were not deposited by a single Flood, committed YECs will still be unmoved, because the driving force for them is not science, but a particular approach to biblical interpretation. However, others such as Christians who are undecided about the age of the Earth issue may be persuaded to accept the old age position if they are shown how sediment transport rates would have to be absurdly high to deposit some 4,000 feet of layers in less than half a year, as explained in the remainder of this article.

Flood geologists have written many papers and articles arguing for rapid deposition of various

Article

Sediment Transport and the Coconino Sandstone: A Reality Check on Flood Geology

sedimentary formations by a global Flood. However, they generally avoid the quantitative aspects of sediment transport with respect to deposition of Earth's fossil bearing layers, possibly because they have not been taken to task on the subject in a peer-reviewed journal, pro-YEC or mainstream. Flood geologists do address sedimentation rates in other contexts when it can be done in a way that appears to support Flood geology. For example, citing a recent paper on formation of conglomerates in the Crimean Peninsula of the Black Sea, Berthault stated,

An investigation of sedimentary formation on the Crimean Peninsula (Lalomov, 2007) concluded that the current velocities derived from sedimentary particle analysis would have resulted in the deposition of the entire sedimentary sequence in a very short period of time, rather than the millions of years implied by a stratigraphic analysis using the geological timescale.⁴¹

However, while Lalomov believed the time to transport sediment forming the conglomerate was dramatically shorter than what he thought might be assumed on the geologic time scale, his approximate calculations showed the duration of sedimentation could be estimated to be on the order of tens of years.⁴² This would still be much too long to fit in the global Flood scenario which requires individual formations to be deposited in "a matter of days" as argued by YECs.

For more popular consumption, Andrew Snelling of Answers in Genesis presented a slide at two "Answers for Darwin" conferences (February 2009) with the following:

Answers from Geology? Yes!

- ❖ The average thickness of fossil-bearing sedimentary layers on all the continents is approximately 1,500 meters (5,000 feet).
- ❖ The average sedimentation rate today measured over a *one year* period is c. 100 meters per 1,000 years (0.1 meters per year).
- ❖ The average deposition rate in a modern flash flood measured over *one hour* is c. 1,000 meters per year (c. 0.1 meters per hour).
- ❖ In *one minute* in a modern flash flood the sedimentation rate can be even much higher.
- ❖ Thus 1,500 meters of sediment could easily have accumulated in 5–8 months during the Flood year at flash flood rates.⁴³

Snelling's slide seemed to be readily accepted by conference attendees, but its implications stagger the

imagination. Here the global Flood is portrayed as the equivalent of innumerable side-by-side, front-to-back flash flood events, somehow overlapping such that sediment was simultaneously deposited over nearly three-fourths of the Earth's current land surface,⁴⁴ followed immediately by an equally enormous number of flash deposition events over the same areas, followed by another and another until an average of 1,500 meters has accumulated in five to eight months.⁴⁵ Snelling did not specify the source of sediment for such a continuous global depositional event. Clearly, sediment just deposited in one area could not be eroded for deposition in a down-current area; otherwise little or no net accumulation would take place across the globe.

The high vertical sediment accumulation rates called for by Flood geology have been frequently criticized. For example, Weber stated "... the Flood must have been violently dumping several meters' worth of sediment per day"⁴⁶ and Neyman came to a similar conclusion.⁴⁷ Using Austin's 4,000 foot thickness for the "early Flood" strata and "early Flood" duration of 150 days yields an accumulation rate of 27 feet per day or 1.1 feet per hour. This may not sound too implausible if one's focus is narrowed to a local area and a short time interval. However, if Flood geology is valid, sediment and fossils would not rain down *vertically* from space—they would have been transported *laterally* from one area to the next. When one considers the math of *lateral* sediment transport necessary to form 4,000 feet of sedimentary strata in 150 days over hundreds of thousands of square miles, the implausibility of Flood geology becomes easier to comprehend. This will be illustrated in the following sections using the graphical procedure from *Grand Canyon: Monument to Catastrophe* as a starting point.

A Flood Geology Procedure for Underwater Sand Waves

Mainstream geology has provided compelling evidence for eolian deposition of the Coconino Sandstone. However, desert sand dunes could not exist during a global Flood. Therefore, Flood geologists have expended considerable effort arguing for aqueous origin of the Coconino and against the desert sand dune interpretation.

The overarching goal of *Grand Canyon: Monument to Catastrophe* was to build a case for interpreting

Grand Canyon's layers from the Tapeats Sandstone up to the rim as "early Flood" deposits. Austin needed a way to explain how cross-bedded sandstones in several Grand Canyon formations could be deposited by strong water currents during the Flood. To achieve this, he developed a graphical procedure to illustrate a relationship between underwater sand-wave height, water depth, and water velocity. This procedure, consisting of two side-by-side graphs, was presented as figure 3.12 in *Grand Canyon: Monument to Catastrophe* (fig. 2).

The source for the left-hand graph in figure 2 was equation 2.20 in John R. L. Allen's classic text *Physical Processes of Sedimentation*:

$$H = 0.086d^{1.19}$$

Where: H = the sand wave height in meters

d = water depth, $0.1 \leq d \leq 100$ meters⁴⁸

Allen empirically derived this relationship through observations taken in large laboratory flumes. This equation expressed sand-wave height as a function of water depth. However, Austin needed to express water depth as a function of sand-wave height, since he sought to find the depth of Flood waters responsible for producing cross beds of a known height, which he equated to underwater sand-wave height. Therefore, he solved Allen's equation for depth to obtain: $d = 7.86H^{0.084}$

A plot of this equation became the left-hand graph of Austin's flood velocity estimation procedure (fig. 2).

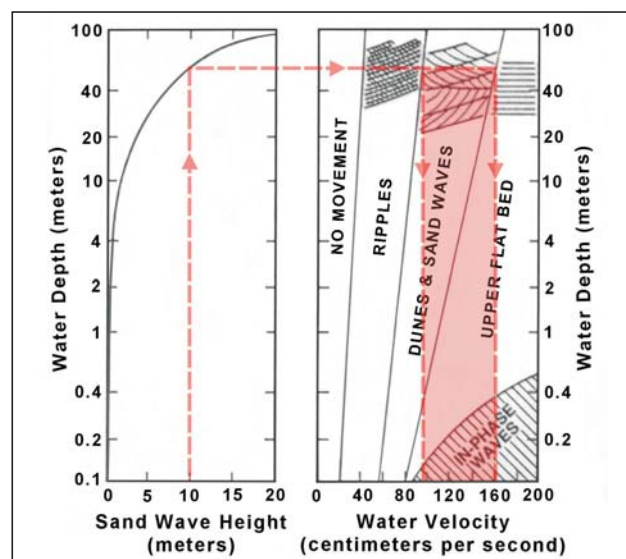


Figure 2. Double graph procedure for estimating the water depth and range of current velocity required to produce sandstone cross beds of a specified height. After Austin, *Grand Canyon: Monument to Catastrophe*, figure 3.12.

Next, a way was needed to relate various types of sediment bed forms created in flowing water—e.g., ripples, dunes and sand waves, and flat beds—to water depth and velocity. Austin found what was needed in figure 8 of a 1980 paper by D. M. Rubin and D. S. McCulloch.⁴⁹ This figure was actually two side-by-side graphs—each a semi-log plot of bed phase as a function of depth and velocity. Both graphs were compilations of data from several sources, including Rubin and McCulloch's own observations of sand waves on the floor of San Francisco Bay, which were taken with side-scan radar. The left-hand graph in Rubin and McCulloch's figure 8 was for a range of sand grain size from 0.19 to 0.22 mm and the right-hand graph was for a range of 0.35 to 0.60 mm. Austin selected the left graph—the one for a very narrow range of sand grain size—even though the Coconino is composed of fine sand (0.125 to 0.25 mm), and sandstones in the Supai Group include sand grains up to medium size (0.25 to 0.50 mm).⁵⁰ A redrawn version of Rubin and McCulloch's graph with depictions of bedforms in appropriate areas and the horizontal (velocity) axis expanded from about 160 cm/sec to 200 cm/sec became the right-hand graph in Austin's Flood velocity estimation procedure as shown in figure 2.

Before providing instructions on how to use figure 2, Austin mentions that cross beds also exist in sandstones of the Kaibab Formation and Supai Group. He then states that the cross beds of the Kaibab Formation and Supai Group suggest an underwater sand-wave height of "ten meters (33 feet)," while those in the Coconino "could easily be 18 meters (60 feet) high."⁵¹

Austin explains how to use his double graph procedure using an assumed underwater sand-wave height (H) of 10 meters. First, a line is drawn upward from the 10-meter point on the horizontal (sand-wave height) axis of the left-hand graph until it intersects the curve $d = 7.86H^{0.084}$, as shown in figure 2. In reference to this intersection point, Austin states "the logarithmic scale on the vertical axis indicates that the sand wave formed in water at a depth of 54 meters (180 feet)."⁵² Next, a line is drawn from the intersection point across into the right-hand graph until it intersects the left and right boundaries of the "Dunes and Sand Waves" zone. Austin focused on the "Dunes and Sand Waves" zone in the right-hand graph because his goal was to estimate water

Article

Sediment Transport and the Coconino Sandstone: A Reality Check on Flood Geology

velocities consistent (in his view) with the cross bed pattern in Grand Canyon sandstones. Vertical lines are then drawn downward from the left and right intersection points. Austin states the left vertical line indicates the minimum current velocity associated with 10 meter sand waves forming at a depth of 54 meters was 90 cm/sec (3 ft/sec). Similarly, the right vertical line indicates a maximum current velocity of 155 cm/sec (5 ft/sec).⁵³ The shaded area in figure 2 covers the possible range of current velocities that would form dunes and sand waves at a depth of 54 meters.

Austin points out how the graph shows that if the water velocity was too slow (i.e., less than 90 cm/sec), only ripples would form and if the current was too fast (i.e., greater than 155 cm/sec), flat beds would form. Neither ripples nor flat beds would produce any kind of cross-bedding pattern. In other words, the water current must be fast enough to form sand waves, but not too fast so as to keep them from forming. It should be noted that at still higher flows in shallow rivers, upper flat beds give way to upstream migrating bedforms known as in-phase waves or antidunes. If river flow increases still further, antidunes disappear and chutes and pools form. However, Rubin and McCulloch indicate that antidunes and chutes and pools are unlikely under natural conditions in deep water (such as that envisioned by Austin during the Flood) except possibly when turbidity currents occur.⁵⁴

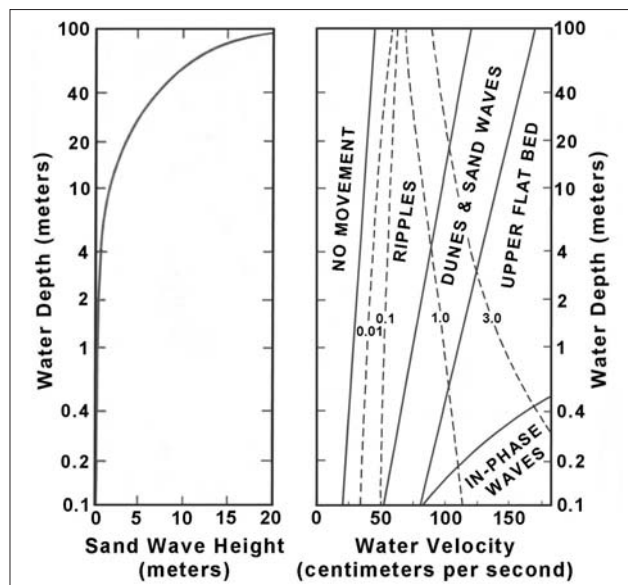


Figure 3. Illustration of how Austin's double graph procedure in *Grand Canyon: Monument to Catastrophe* would appear if it had incorporated the left-hand graph in Rubin and McCulloch's figure 12.

The 90 to 155 cm/sec output from Austin's demonstration of his double graph procedure in *Grand Canyon: Monument to Catastrophe* appears to have taken on a life of its own in young-earth circles. The author has been able to find these two numbers and/or the procedure itself used in ten different locations on the web, some of which are recent posts,⁵⁵ three other YEC books,⁵⁶ two YEC videos,⁵⁷ two secular journal articles (Russian),⁵⁸ and one YEC journal article.⁵⁹ The double graph procedure was also presented by Andrew Snelling at the previously mentioned "Answers for Darwin" conferences along with the following slide:

Answers from Geology – Sandstones The Coconino Sandstone

- ❖ Averaging 315 feet (96 meters) thick and covering an area of at least 100,000 sq. miles (260,000 sq. km) the sandstone layer contains at least 10,000 cubic miles (42,000 cubic km) of sand.
- ❖ Where do we see today 10,000 cubic miles of sand being spread over at least 100,000 sq. miles moving at 3–5 miles per hour?⁶⁰
- ❖ NOWHERE!
- ❖ But during the Flood this sandstone would have been deposited within just a few days!

Snelling clearly recognized that deposition of all of Grand Canyon's sedimentary rock layers during a year-long Flood would require each layer to be formed in a matter of days. Using a few simple calculations, the next section will show how this leads to a severe challenge for Flood geology.

The Reality Check

When YECs draw on material from the mainstream science community, other information that contradicts the young earth position can often be found in the same cited references. This was the case in Rubin and McCulloch's paper where another graph exists—their figure 12—with the same horizontal and vertical axes as the graph used in *Grand Canyon: Monument to Catastrophe*. Rubin and McCulloch's figure 12 was for a range of sand grains from 0.13 to 0.25 mm, which is more representative of the Coconino, so it would have been a better choice to use in Austin's procedure. Figure 3 shows how the double graph procedure would have appeared had it used Rubin and McCulloch's figure 12, left-hand graph.

The right-hand graph of figure 3 contains some new information, which leads to a major challenge

for Flood geology. Similar to figure 2, figure 3 has solid lines separating the zones of no movement, ripples, dunes and sand waves, upper flat bed, and in-phase waves, but it also includes four dashed curves. These curves represent sediment transport rates of 0.01, 0.1, 1.0, and 3.0 kilograms per second per meter (kg/sec/m).⁶¹ None of these curves pass through the dunes and sand waves zone at the 54-meter level, but one might draw a fifth curve in the upper right area which does, to represent a sediment transport rate of perhaps 6 or 9 kg/sec/m. However, this really is not necessary for purposes of this article. We can assume a sediment transport rate ten times higher than 3.0 kg/sec/m and perform a few simple volumetric calculations to find out if this exceptionally high rate could move enough sand to form the Coconino Sandstone in a matter of days. Thirty kg/sec/m is a substantial sediment transport rate, corresponding to a rate of 1.8 metric tons per linear meter of the boundary (perpendicular to the flow) per minute. This is almost 1.0 cubic meter per minute, assuming a sand density of 1900 kg/m³.

In *Grand Canyon: Monument to Catastrophe*, Austin asks "From where did the sand come, which forms Grand Canyon sandstones?" After addressing this question for other Grand Canyon sandstones, he provides a map (fig. 4, left) showing the area covered by the Coconino Sandstone and "its correlating sandstones" to the east and estimates they cover

200,000 mi² (520,000 km²) and have a volume of 10,000 mi³ (42,000 km³). Austin then states,

Cross beds within the Coconino Sandstone (and the Glorieta Sandstone of New Mexico and Texas) dip toward the south, indicating that the sand came from the north. Along its northern occurrence, the Coconino rests directly on the Hermit Formation. This formation has a finer texture than the Coconino and would not be an ample erosional source of sand grains for the Coconino.

Thus, we cannot look underneath the Coconino for a colossal quantity of sand, we must look northward. However, in southern Utah, where the Coconino thins to zero, the underlying Hermit Formation (and its lateral equivalent, the Organ Rock Shale) continues northward. No obvious, nearby source of Coconino sand grains is known. A very distant source area must be postulated.⁶²

With this information, we are almost ready to perform a few simple calculations to see if enough sand could be transported to form the Coconino in a matter of days. However, we still need to know (1) the length of the boundary between the source and depositional areas across which sand would be transported, and (2) the time available for transport before the next higher layer would be deposited. For the boundary length, we will agree with Austin that the sand was transported from the north and assume the boundary was the northern edge of the present-day Coconino

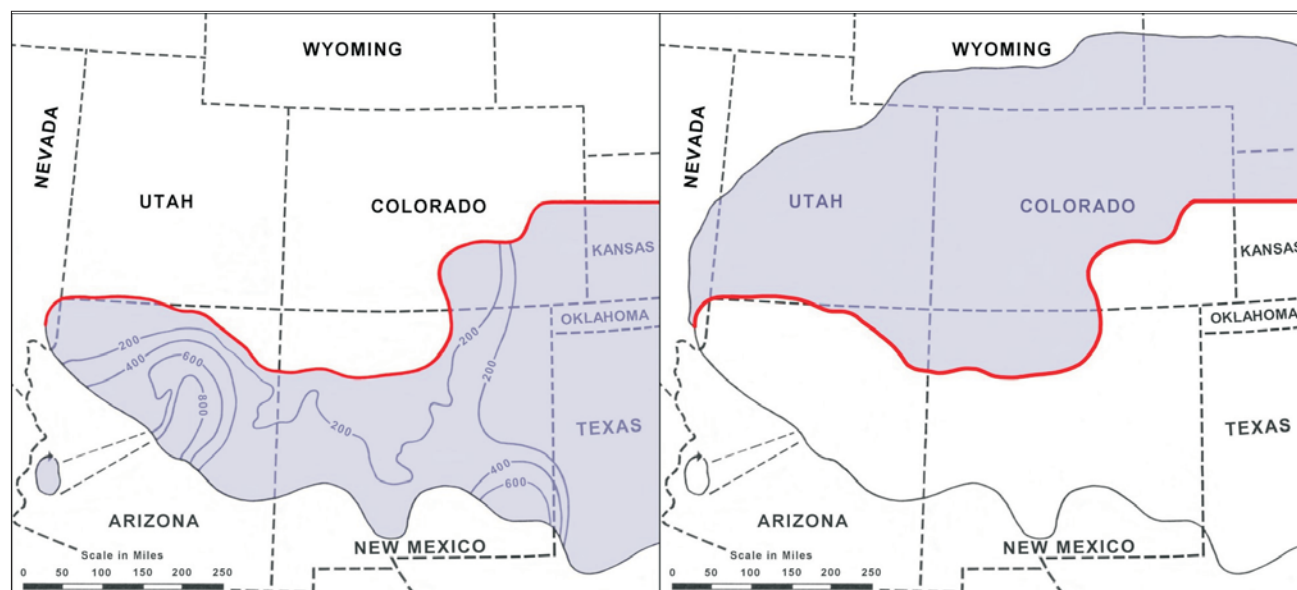


Figure 4. Left: Area covered by the present day Coconino Sandstone and correlated sandstones to the east as described in *Grand Canyon: Monument to Catastrophe*, with northern boundary highlighted. Contour lines indicate sandstone thickness in feet (After Austin, 1994). Right: Hypothetical area to the north covered by perfectly pre-positioned sand (in terms of both timing and location during the Flood), ready to be transported south across the boundary by flood currents into the area of the present day Coconino and its correlated sandstones.

Article

Sediment Transport and the Coconino Sandstone: A Reality Check on Flood Geology

Sandstone and its correlated sandstones to the east as shown in figure 4 (left). The length of this curving boundary is about 1,600 km (1,000 mi). Providing the most generous scenario for Flood geology, we then assume that all of the sand to be transported southward was perfectly positioned in an area immediately to the north of the boundary at just the right time during a global Flood, as hypothetically illustrated in figure 4 (right). We further assume all sand being transported to the south would cross the boundary perpendicularly, even though we know it is curved.

Assuming that massive reservoirs of loose sediment destined to form most of the Earth's sedimentary layers existed before a global Flood may seem far fetched, but it appears this has been considered in young-earth circles. According to a 1994 paper by six well-known Flood geology proponents, such reservoirs could have already existed, ready to be redistributed by a global Flood. The authors explain this assumption as follows:

We have three reasons for this position: (1) Biologically optimum terrestrial and marine environments would require that at least a small amount of sediment of each type had been created in the creation week; (2) Archean (probable pre-Flood) and Proterozoic sediments contain substantial quantities of all types of sediments; and (3) It may not be possible to derive all the Flood sediments from igneous and/or metamorphic precursors by physical and chemical processes in the course of a single, year-long Flood.⁶³

In this statement, the six authors appear to be conceding the Flood would not be able to erode enough pre-Flood rock to produce all the sediment needed to form all of the "early" and "late Flood" sedimentary rock layers.

If we assume that plenty of sand were ready and available for transport from the north into the present-day area of the Coconino Sandstone and that all of the Paleozoic layers were deposited during the 150-day "early Flood" period, then we would need a rough estimate for how many days would be available to deposit the Coconino. If we also assume that the vertical accumulation rate for each "early Flood" layer was the same as the Coconino, we could make our estimation by finding a place where the thickness of all "early Flood" layers has been measured and then dividing up the 150 days in proportion to each layer's thickness. Instead, we will just use the

average thickness for the Coconino from Snelling's presentation slide—315 feet—and Austin's estimate for the total thickness of the "early Flood" strata—4,000 feet. The number of days (T_c) to transport enough sand southward across the boundary to form the Coconino is then determined using the simple ratio $T_c / 150 \text{ days} = 315 \text{ ft} / 4,000 \text{ ft}$, which yields $T_c = 11.8 \text{ days}$ (rounded up to twelve days in favor of Flood geology). This would leave 138 days for the other "early Flood" layers.

Of course, other layers cover larger or smaller areas than the Coconino, so each layer would have its own "up-current" boundary and time available for deposition.⁶⁴ However, depositing all "early Flood" layers at any location on Earth is under the total time constraint of 150 days, so the above approach is sufficient for estimation purposes. In the following first set of computations, we will use this information to compute how much sand could be transported across the boundary into the present-day area of the Coconino Sandstone.

For a sediment transport rate of 30 kg/sec/m, what mass of sand would cross a 1-meter section of the northern boundary in one day?

$$\frac{30 \text{ kg}}{\text{sec-m}} \times \frac{3600 \text{ sec}}{\text{hour}} \times \frac{24 \text{ hour}}{\text{day}} = 2.6 \times 10^6 \text{ kg/day-m}$$

For a sediment transport rate of 30 kg/sec/m ($2.6 \times 10^6 \text{ kg/day/m}$), what mass of sand would cross the entire 1,600 km boundary in twelve days?

$$\frac{2.6 \times 10^6 \text{ kg}}{\text{day-m}} \times 1.6 \times 10^6 \text{ m} \times 12 \text{ days} = 5.0 \times 10^{13} \text{ kg}$$

For a sediment transport rate of 30 kg/sec/m, what volume of sand would cross the 1,600 km boundary in twelve days? (Assume that the density of sand is 1,900 kg/m³—the range given in textbooks for sandstone is 2,000–2,600 kg/m³, so 1,900 kg/m³ is good for loose sand. Note: a lower density is more favorable to Flood geology.)

$$5.0 \times 10^{13} \text{ kg} \times \frac{1 \text{ m}^3}{1,900 \text{ kg}} = 2.6 \times 10^{10} \text{ m}^3 = 26 \text{ km}^3$$

To form the Coconino in Austin's Flood scenario, 42,000 km³ of sand would need to be transported across the 1,600 km long northern boundary in twelve days. However, the volume just calculated—26 km³—is only about 1/1,600 of the required amount. This corresponds to about 2.2 km³/day, so it would

take about fifty-two years to move enough sand across the boundary to form this layer at a sediment transport rate of 30 kg/sec/m (42,000 km³/2.2 km³/day ≈ 19,000 days ≈ 52 years).

A second way to demonstrate the problem posed to Flood geology by sediment transport is to calculate the rate needed to move 42,000 km³ of sand across the 1,600 km boundary in twelve days. The computations are straightforward as shown below.

What total volumetric rate in m³/sec would be required to move 42,000 km³ of sand across any boundary in twelve days?

$$\frac{4.2 \times 10^4 \text{ km}^3}{12 \text{ days}} \times \frac{10^9 \text{ m}^3}{1 \text{ km}^3} \times \frac{1 \text{ day}}{86,400 \text{ sec}} = 4.1 \times 10^7 \text{ m}^3 / \text{sec}$$

What sediment transport rate in m³/sec/m would be required to move 42,000 km³ of sand across the 1,600 km boundary in twelve days?

$$4.1 \times 10^7 \text{ m}^3 / \text{sec} \times \frac{1}{1.6 \times 10^6 \text{ m}} = 25 \text{ m}^3 / \text{sec} / \text{m}$$

What sediment transport rate in kg/sec/m would be required to move 42,000 km³ of sand across the 1,600 km boundary in twelve days?

$$25 \text{ m}^3 / \text{sec} / \text{m} \times \frac{1900 \text{ kg}}{\text{m}^3} = 4.8 \times 10^4 \text{ kg} / \text{sec} / \text{m}$$

These calculations indicate a slab of sand 25 m high, 1,600 km wide, and 1,000 km long would have to be continuously sliding southward across the boundary at one meter per second to form the Coconino Sandstone in twelve days. This corresponds to a sediment transport rate of 4.8 × 10⁴ kilograms (48 metric tons) per second per meter!

Grand Canyon: Monument to Catastrophe and several YEC books and websites depict cross bed formation as occurring through a series of sand waves formed by water flow, with each wave advancing through erosion of sand grains from the top and deposition on the down-current surface of the wave.⁶⁵ However, what has just been computed amounts to something very different—a continuously moving sand slab almost half as high as the 54-meter water depth estimated using Austin’s double graph procedure. If it were possible for such a regional-scale sand slab to slide southward into the area of the present-day Coconino sandstone in twelve days, formation of sand waves and cross-beds would obviously be precluded.

Were Calculations Rigged Against Flood Geology?

An initial reaction to these findings might be to suspect that the calculations were set up to produce results unfavorable to Flood geology. Actually, at least nine assumptions were made in favor of the YEC position.

1. **Optimal positioning of 10,000 cubic miles of sand at the right time.** By assuming that the hypothetical area of sand was immediately north of the present-day area of the Coconino Sandstone at just the right time during the Flood, it could be assumed that sand began crossing the boundary into its present-day area at the earliest possible time.
2. **Length of border crossed by “sustained unidirectional currents.”** Recall the curved 1,600 km northern boundary in figure 4 and Austin’s use of the phrase “sustained unidirectional currents.” Since sand would not horizontally compress, the true straight-line boundary, perpendicular to the moving sand slab, would be about 1,300 km long. Taking this factor alone into account, the sand slab would have to be 1600/1300 = 1.2 times as high.
3. **30 kg/sec/meter — a very generous sediment transport rate.** Recall how Austin used Rubin and McCulloch’s graph for a sand grain size range of 0.19 to 0.22 mm in his Flood velocity estimation procedure. He stated that his procedure applied to all Grand Canyon sandstones, not just the Coconino. However, such a narrow size range is unrealistic for any of those formations, since they all contain at least some coarser sand. Rubin and McCulloch’s figure 8, right-hand graph was for sand grains ranging from 0.35 to 0.60 mm, and could be used to show that a sediment transport rate of 3 kg/sec/m would exist in currents of about 135 cm/sec in the “Dunes and Sand Wave” section at a depth of 54 meters.⁶⁶ This indicates that a sediment transport rate of 30 kg/sec/m was more than generous to Flood geology for the first set of computations.
4. **Deposition not delayed by period of scouring at onset of the Flood.** Deposition of “early Flood” sediments was assumed to begin on day one of the Flood, starting with the Tapeats Sandstone. However, Flood geologists say that the Flood began with a period of scouring of “pre-Flood/Creation Week” rock before deposition of “early Flood” layers began.⁶⁷ Setting aside a portion of

Article

Sediment Transport and the Coconino Sandstone: A Reality Check on Flood Geology

the 150-day “early Flood” period for this scouring would affect both sets of calculations in directions unfavorable to Flood geology.

5. **Crossing northern boundary equated with depositing the entire Coconino.** Computations were simply presented in reference to sand crossing the 1,600 km northern boundary. No time was allocated for redistribution of sediments according to the contours in figure 4 (left). Since the Coconino is thickest today at its *southern* boundary, impossibly deep sand would have to continue sliding south, well past its current northern boundary. No attempt was made here or in any YEC literature to numerically simulate how a regional-scale sand slab could move into a new area in a matter of days, especially when the height of the sand slab is at least half the depth of the depositing water.
6. **10,000 cubic miles appears to be a low volume estimate.** Simple multiplication of the Coconino’s average thickness of 315 feet by its stated area (with correlating sandstones) of 200,000 square miles yields a volume of 11,932 cubic miles. Taking this factor alone into account, the sand slab would have to be $11,932/10,000 = 1.2$ times as high.
7. **No accounting for portion that was eroded away.** The Coconino does not lens out to zero thickness along a substantial portion of its boundary. Instead, much of its southern edge is marked by steep cliffs of the Mogollon Rim. A substantially greater original volume for the Coconino would affect both sets of calculations in directions unfavorable to Flood geology.
8. **No break in deposition allocated for the channel fill formations.** Continuous sediment transport was assumed in allocating time for deposition of the Coconino and other Grand Canyon formations. Allowing time for erosion of channel networks to be filled by the Temple Butte and Surprise Canyon Formations would leave less time for deposition during the Flood.
9. **Recent YEC efforts to attribute additional layers to Flood deposition were not considered.** Some Flood geologists have argued for including layers above Austin’s “late Flood” and below his “early Flood” layers as Flood deposits. For example, Austin and Wise now consider the Sixty-Mile Formation, the highest formation in the Proterozoic Grand Canyon Supergroup, to be an “early Flood” layer.⁶⁸ If the criteria of Oard and Froede were applied,⁶⁹ the entire 13,000 ft (4,000 m) thick

Grand Canyon Supergroup would be considered “early Flood” layers.⁷⁰ Considering any Proterozoic layers to be “early Flood” layers would reduce the number of days allocated to form the Coconino and other Paleozoic layers, further compounding the problems for Flood geology.

Without these nine assumptions, it can be seen how the computed height of the southward moving “sand slab” might easily exceed the depth of water (54 meters) that is supposed to have deposited Coconino sediments in the first place.

Tsunami Transport?

Perhaps recognizing that normal sediment transport processes could not form entire sandstone layers across the globe in a matter of days, Austin invokes repeated tsunamis, triggered by catastrophic movement of lithospheric plates during a global Flood, as mechanisms for transporting huge amounts of sand. In *Grand Canyon: Monument to Catastrophe*, Austin cites Coleman:

In shallow oceans, tsunami-induced currents have been reported, on occasion, to exceed 500 cm/sec, and unidirectional currents have been sustained for hours ...

Such an event would be able to move large quantities of sand, and, in its waning stages, build huge sand waves in deep water. A tsunami provides the best modern analogy for understanding how large-scale Grand Canyon cross beds form. We can imagine how the Flood would cause similar sedimentation in strata of Grand Canyon.⁷¹

Three significant problems exist with such appeals to tsunami currents. First, checking Coleman’s text reveals some selective quoting—many of his key points actually mediate against Austin’s case, including the following:

- Nowhere does Coleman cite tsunami currents as unidirectional. He divides tsunamis into two parts—an on-surge and an off-surge. The on-surge primarily plays a softening-up role, affecting *already deposited* shallow water sediment. After the on-surge, an off-surge occurs with a down slope rush of the piled up water which shifts sediments seaward. Note how Coleman described tsunamis as affecting *already deposited* sediment—not as sediment carriers.
- Coleman cites tsunamis as possible causes for building up sequences of chaotic sediments in

shallow water. Sedimentary rock comprising chaotic sediments appears very different from the nonchaotic, fine-grained, cross-bedded sandstones such as the Coconino.

Second, tsunamis are not an efficient mechanism for global sediment transport. Tsunamis are caused by earthquakes, volcanic eruptions, or landslides deep below the ocean surface and travel at speeds up to 970 km/hr (600 mi/hr). However, they are barely perceptible in the open ocean. It is only when they reach shallow coastal waters that their wave velocity diminishes and their wave height increases until they surge onshore and cause massive destruction of near-shore areas. Also, underwater environments do not always experience massive movements of sand when a tsunami strikes. For example, while the tsunami of December 26, 2004, substantially rearranged areas of underwater sand near some Indo-Pacific islands, scuba divers who were underwater when it struck reported sudden currents and reduced visibility, but they were not suddenly buried by tons of sand.⁷²

Third, Flood geologists need to keep their arguments consistent with the very data they are presenting. Austin developed his double graph procedure to estimate the currents necessary to form sand waves and high-angle cross beds in sandstone layers. He concluded that the layers could be formed by "sustained unidirectional currents of 90 to 155 centimeters per second" (2 to 3.5 mi/hr) in "deep water."⁷³ Immediately following this, Austin suggests that tsunami currents on the order of 500 cm/sec are "the best modern analogy for understanding how large-scale Grand Canyon cross beds form." However, currents anywhere close to 500 cm/sec are clearly outside the velocity range of Austin's double graph procedure (fig. 2).

Daniel Barnette and John Baumgardner have suggested that strong cyclonic water gyres circulated at high latitudes with velocities on the order of 40 to 80 m/sec (90 to 180 mi/hr) during the Flood.⁷⁴ In what was probably an attempt to reconcile the rather slow current speeds specified by Austin as necessary to form the cross-bedded Coconino Sandstone and the far stronger global currents proposed by Barnette and Baumgardner, John Morris stated,

Now we know from observation that water generally moves much more rapidly on the surface than it does at depth. In order for water at a 100-foot depth to move at three to five feet per second,

it must be moving at a much greater velocity on the surface.⁷⁵

To explain the discrepancy between the huge volume of the Coconino Sandstone and the minimal amount of sand that could be transported in twelve days by 90 to 155 cm/sec currents, YECs might argue along similar lines by suggesting that a high speed, sediment-laden slurry flowed above a much slower, less turbid water layer consistent with formation of sand waves. However, this explanation would fail at a number of levels, including the following:

- Rubin and McCulloch specified that velocities used in their study were full water column averages of measurements taken near the surface, at mid-depth, and near the bottom.⁷⁶ While water velocity is known to decrease with depth, near-surface and near-bottom velocities differing by a factor of 50 are not hydraulically realistic.
- The high water velocities suggested by Barnette and Baumgardner are not physically realistic. Barnette and Baumgardner stated that they were seeking to find "the hydraulic mechanism that was able to transport millions of cubic kilometers of sediment" and "distribute it in widely dispersed layers." However, their mathematical formulation made two assumptions: (1) viscosity of the Flood waters was zero; and (2) density did not need to be accounted for. Both of these assumptions would be invalid for sediment-laden slurries necessary to deposit the Paleozoic (early Flood) and Mesozoic (late Flood) formations in "a matter of days."⁷⁷
- Even if it were possible for a high-density slurry to remain above a less dense, much slower water layer, the sediment would not get to where it is needed at the bottom.

Interestingly, some YECs argue that most sediment transport occurred near the bottom. To explain how dinosaur fossils and footprints could exist in Flood deposits, Oard maintains that "rapid sedimentation would have occurred early in the Flood, especially in deeper, calmer areas" and that circulating gyres proposed by Barnette and Baumgardner would cause local drops in sea level, providing a "powerful force to create the temporary, yet extended, exposures of newly laid Flood sediments."⁷⁸ Any pause in the Flood, to expose freshly laid sediments to the atmosphere and to allow floating/swimming dinosaurs to walk ashore, leave footprints, lay egg nests, and die, only compounds the problem for Flood geology

Article

Sediment Transport and the Coconino Sandstone: A Reality Check on Flood Geology

because it requires even more absurd average sediment transport rates to make up for the lost deposition time. Several other young earth/Flood geology arguments similarly collapse in the light of the sediment transport problem.

No matter what mechanism one might invent for transporting sediment during the global Flood, including Austin's recently proposed submarine liquefied sediment gravity currents,⁷⁹ it should be realized that the absurdly high sediment transport rates needed to deposit a regional-scale layer such as the Coconino Sandstone in a matter of days will always be at odds with the slow water velocities and gradual sediment transport rates needed to form even the most basic cross-bedding structures.

Implications and Conclusion

A few simple calculations have illustrated how the Flood geology interpretation of the Coconino Sandstone is completely untenable. The National Academy of Science captured the essence of the matter when they stated that Flood geology "defies all geological observations and physical principles concerning sedimentation rates and possible quantities of suspended solid matter." These findings would seem to be a good illustration of Francis Collins' statement in *The Language of God*:

But the claims of Young Earth Creationism simply cannot be accommodated by tinkering around the edges of scientific knowledge. If these claims were actually true, it would lead to complete and irreversible collapse of the sciences of physics, chemistry, cosmology, geology, and biology.⁸⁰

There is nothing particularly unique about the Coconino Sandstone or the sequence of Paleozoic strata in Grand Canyon—sandstones are common across the globe and total thickness of "early Flood" strata is much greater in other areas. For example, as Daniel Wonderly pointed out, the total thickness of sedimentary rock in the Appalachian Mountains of eastern West Virginia and western Virginia is between 20,000 to 35,000 feet.⁸¹ Forming those layers in the 150-day "early Flood" period would require sediment transport rates substantially greater than anything calculated in this article.

Flood geologists seem to need fantastically huge sediment transport rates when it is convenient for their explanations, but at other times during the

same global Flood, they need slow rates to allow for intricate features such as complex cross beds and vertebrate footprints. It becomes clear that Flood geology is not just another way of, as frequently maintained by YEC leaders, "looking at the same data and coming to different conclusions." It also becomes clear that the YEC ministries are placing Christians in the unfair position of having to choose between biblical authority and straightforward reasoning from observation of God's created world.

Flood geologists are currently involved in multi-year activity known as the Flood Activated Sedimentation and Tectonics (FAST) project, with several papers anticipated for publication in the near future.⁸² There is no doubt these papers will present more "evidence" for aqueous or catastrophic Flood deposition for various sedimentary formations, including the Coconino Sandstone.⁸³ Rather than endlessly sparing with YECs over whether a specific formation indicates aqueous/catastrophic or gradual deposition (or both), it might be more profitable to focus on the sediment transport problem, which is the Achilles' heel of Flood geology. Flood geologists' recent efforts to engage in mainstream science are laudable. However, the sediment transport problem will prevent their central thesis from ever being accepted in the scientific community and the reason for this should be understood in the Christian community.

Acknowledgments

The author would like to credit Greg Neyman, maintainer of the "Answers in Creation" website, as originator of the idea that "90 to 155 cm/sec water currents" could never transport anywhere near enough sand to form the Coconino in a few days. The author would also like to thank Carol Hill for her encouragement to write this article and for her review of the first draft.

Notes

¹National Academy of Sciences, *Science and Creationism: A View from the National Academy of Sciences*, 2d ed. (Washington, DC: National Academy Press, 1999), 8, http://books.nap.edu/catalog.php?record_id=6024 (accessed June 6, 2010).

²For example, at the 2005 annual meeting of the Geological Society of America (GSA), a session was held entitled "Is it Science? Strategies for Addressing Creationism in the Classroom and the Community." See http://gsa.confex.com/gsa/2005AM/finalprogram/session_16171.htm (accessed Dec. 8, 2010).

- ³S. A. Austin, ed., *Grand Canyon: Monument to Catastrophe* (Santee, CA: Institute for Creation Research, 1994), 33–5.
- ⁴G. Neyman, "Creation Science Rebuttals *Creation Magazine*: Coconino Sandstone (Startling Evidence for Noah's Flood)," www.answersincreation.org/coconino.htm (accessed June 6, 2010).
- ⁵D. A. Young, "The Discovery of Terrestrial History," in H. J. Van Till, R. E. Snow, J. H. Stek, and D. A. Young, *Portraits of Creation: Biblical and Scientific Perspectives on the World's Formation* (Grand Rapids, MI: Eerdmans, 1990), 73.
- ⁶A. Hayward, *Creation and Evolution: The Facts and Fallacies* (London: Triangle, 1985), 122.
- ⁷C. A. Hill and S. O. Moshier, "Flood Geology and the Grand Canyon: A Critique," *Perspectives on Science and Christian Faith* 61, no. 2 (2009): 99–115.
- ⁸Austin, *Grand Canyon: Monument to Catastrophe*, 57.
- ⁹*Ibid.*, 77.
- ¹⁰A. A. Snelling, *Earth's Catastrophic Past* (Dallas, TX: Institute for Creation Research, 2009), 707–11, 751–61.
- ¹¹K. E. Karlstrom, B. R. Ilg, M. L. Williams, D. P. Hawkins, S. A. Bowring, and S. J. Seaman, "Paleoproterozoic Rocks of the Granite Gorges," in S. S. Beus and M. Morales, eds., *Grand Canyon Geology* (New York: Oxford University Press, 2003), 26.
- ¹²*Ibid.*, 36; and D. A. Young and R. F. Stearley, *The Bible, Rocks, and Time* (Downers Grove, IL: InterVarsity Press, 2008), 337–40. Actually, this is covered in basic geology textbooks, e.g., see J. Grotzinger, T. H. Jordan, F. Press, and R. Siever, *Understanding Earth*, 5th ed. (New York: W. H. Freeman and Company, 2007), 141–7.
- ¹³J. D. Hendricks and G. M. Stevenson, "Grand Canyon Supergroup: Unkar Group," in Beus and Morales, eds., *Grand Canyon Geology*, 45–6.
- ¹⁴E. H. McKee and D. C. Noble, "Age of the Cardenas Lavas, Grand Canyon, Arizona," *Geological Society of America Bulletin* 87 (1976): 1188–90.
- ¹⁵T. D. Ford and C. M. Dehler, "Grand Canyon Supergroup: Nankoweap Formation, Chuar Group, and Sixtymile Formation," in Beus and Morales, eds., *Grand Canyon Geology*, 59–62.
- ¹⁶*Ibid.*, 62–5.
- ¹⁷*Ibid.*, 72–3.
- ¹⁸Austin, *Grand Canyon: Monument to Catastrophe*, 67.
- ¹⁹L. T. Middleton and D. K. Elliott, "Tonto Group," in Beus and Morales, eds., *Grand Canyon Geology*, 92–4, 101.
- ²⁰*Ibid.*, 94–5, 103–4.
- ²¹*Ibid.*, 95–6, 104–5.
- ²²National Park Service, *Water Resources Management Plan* (Grand Canyon National Park, 1984), 15–6.
- ²³S. S. Beus, "Temple Butte Formation," in Beus and Morales, eds., *Grand Canyon Geology*, 107–14.
- ²⁴Austin, *Grand Canyon: Monument to Catastrophe*, 72.
- ²⁵S. S. Beus, "Redwall Limestone and Surprise Canyon Formation," in Beus and Morales, eds., *Grand Canyon Geology*, 115–23. According to Beus, the chert layers originated as bryozoan-rich wackestones (a specific type of sandstone) and mudstones which became silicified.
- ²⁶G. H. Billingsley and E. D. McKee, "Pre-Supai Valleys" in E. D. McKee, "The Supai Group of Grand Canyon," *U.S. Geological Survey Professional Paper* 1173 (1982): 139, <http://pubs.er.usgs.gov/usgspubs/pp/pp1173> (accessed June 6, 2010). See also G. H. Billingsley, "Paleovalleys in the Surprise Canyon Formation in Grand Canyon, Chapter C" in G. H. Billingsley and S. S. Beus, eds., "Geology of the Surprise Canyon Formation of the Grand Canyon, Arizona," *Museum of Northern Arizona Bulletin* 61 (1999): 23.
- ²⁷S. S. Beus, "Megafossil Paleontology of the Surprise Canyon Formation, Chapter E" in Billingsley and Beus, eds., "Geology of the Surprise Canyon Formation of the Grand Canyon, Arizona," 69.
- ²⁸Andrew Snelling, *Answers Academy, The Rocks Cry Out: The Earth Is Young! Taught by Terry Mortenson*, Answers in Genesis, 2009, video. www.answersingenesis.org/media/video/ondemand/aa-rocks-cry/aa-rocks-cry (accessed November 2, 2010).
- ²⁹R. C. Blakey, "Supai Group and Hermit Formation," in Beus and Morales, eds., *Grand Canyon Geology*, 136–62.
- ³⁰*Ibid.*, 147–9.
- ³¹L. T. Middleton, D. K. Elliott, and M. Morales, "Coconino Sandstone," in Beus and Morales, eds., *Grand Canyon Geology*, 171–5.
- ³²*Ibid.*, 176–7.
- ³³*Ibid.*, 171–4.
- ³⁴E. D. McKee, "Sedimentary Structures in Dunes" in E. D. McKee, "A Study of Global Sand Seas," *U.S. Geological Survey Professional Paper* 1052 (1979): 199, <http://pubs.er.usgs.gov/usgspubs/pp/pp1052> (accessed June 6, 2010).
- ³⁵L. T. Middleton, D. K. Elliott, and M. Morales, "Coconino Sandstone," in Beus and Morales, eds., *Grand Canyon Geology*, 165–71.
- ³⁶L. R. Brand, "Fossil Vertebrate Footprints in the Coconino Sandstone (Permian) of Northern Arizona: Evidence for Underwater Origin," *Geology* 19 (1991): 1201–4. The current in Brand's water tank was 8 cm/sec.
- ³⁷C. E. Turner, "Toroweap Formation," in Beus and Morales, eds., *Grand Canyon Geology*, 180–95.
- ³⁸R. L. Hopkins and K. L. Thompson, "Kaibab Formation," in Beus and Morales, eds., *Grand Canyon Geology*, 196–211.
- ³⁹YECs propose it was possible for freshly deposited areas of sediment to be exposed long enough for dinosaurs that managed to stay afloat for months during the Flood (e.g., on debris) to walk ashore, lay eggs, and/or be buried by subsequent onslaughts of Flood sediments—e.g., see M. J. Oard, "Dinosaur Tracks, Eggs, and Bonebeds," in M. J. Oard and J. K. Reed, *Rock Solid Answers* (Green Forest, AR: Master Books, 2009), 245–58.
- ⁴⁰This is disputed by YECs, who argue that multiple runoff events during a year could cause more than one couplet to appear each year, e.g., see M. J. Oard, "Do Varves Contradict Biblical History?" in Oard and Reed, *Rock Solid Answers*, 125–48.
- ⁴¹G. Berthault, "Time Required for Sedimentation Contradicts the Evolutionary Hypothesis," *Creation Research Society Quarterly* 46, no. 4 (2010): 266; and A. V. Lalomov, "Reconstruction of Paleohydrodynamic Conditions during the Formation of Upper Jurassic Conglomerates of the Crimean Peninsula," *Lithology and Mineral Resources* 42, no. 3 (2007): 277.
- ⁴²A. V. Lalomov, Personal Communication, 2010. Lalomov also informed me that Berthault characterized his findings better than the Russian-to-English translation in the *Lithology and Mineral Resources* article.
- ⁴³Video: *Answers for Darwin – Refuting 200 Years of Evolution*, The Word for Today, 2009.

Article

Sediment Transport and the Coconino Sandstone: A Reality Check on Flood Geology

- ⁴⁴S. Boggs Jr., *Principles of Sedimentology and Stratigraphy* (Upper Saddle River, NJ: Pearson Prentice Hall, 2006), xvii. According to this reference, “nearly three fourths of Earth’s land surface and most of the ocean floor is covered by sedimentary rock and sediments.”
- ⁴⁵Some Flood geologists appear to hold that Flood deposition occurred over a longer duration—e.g., Austin, *Grand Canyon: Monument to Catastrophe*, 77.
- ⁴⁶C. G. Weber, “The Fatal Flaws of Flood Geology,” *Creation/Evolution* 1 (1980): 24–37.
- ⁴⁷G. Neyman, Creation Science Book Review, “*Grand Canyon: Monument to Catastrophe*, Chapter 4: A Creationist View of Grand Canyon Strata,” www.answersincreation.org/bookreview/monument/c4.htm (accessed June 6, 2010).
- ⁴⁸J. R. L. Allen, *Physical Processes of Sedimentation* (London: Unwin University Books, 1970), 78. Ironically, Allen cites the Coconino as being eolian in origin on page 115 of this book. Allen has since replaced *Physical Processes of Sedimentation* with *Principles of Physical Sedimentology* (Caldwell, NJ: The Blackburn Press, 1985), but equation 2.20 was not included in the new book.
- ⁴⁹D. M. Rubin and D. S. McCulloch, “Single and Superimposed Bedforms: A Synthesis of San Francisco Bay and Flume Observations,” *Sedimentary Geology* 26 (1980): 207–31.
- ⁵⁰McKee, “Ancient Sandstones Considered to be Eolian” in *A Study of Global Sand Seas*, 199; Middleton, Elliott, and Morales, “Coconino Sandstone,” in Beus and Morales, eds., *Grand Canyon Geology*, 171; and R. C. Blakey, “Supai Group and Hermit Formation,” in Beus and Morales, eds., *Grand Canyon Geology*, 140.
- ⁵¹Austin, *Grand Canyon: Monument to Catastrophe*, 34.
- ⁵²The 54-meter “depth” obtained by reading the graph may strike the scientifically trained reader as excessive precision, but it was actually calculated from the equation in Allen’s *Physical Processes of Sedimentation* solved for depth. The reader of *Grand Canyon: Monument to Catastrophe* is not informed how this was done.
- ⁵³Austin, *Grand Canyon: Monument to Catastrophe*, 34–5.
- ⁵⁴Rubin and McCulloch, “Single and Superimposed Bedforms: A Synthesis of San Francisco Bay and Flume Observations,” 224.
- ⁵⁵The ten URLs are as follows (all accessed June 6, 2010):
From the Answers in Genesis website:
 1. www.answersingenesis.org/articles/am/v3/n3/transcontinental-rock-layers;
 2. www.answersingenesis.org/tj/v11/i1/sedimentation_reply.asp;
 3. www.answersingenesis.org/articles/am/v3/n4/fast-furious;
 4. www.answersingenesis.org/creation/v15/i1/flood.asp (This article assumes a sand-wave height of 20 meters, which yields a velocity range of 95 to 165 cm/sec)
From the Creation Ministries International (CMI) website (formerly on the Answers in Genesis website, but transferred over to the CMI website after the two ministries split):
 5. <http://creation.com/cmi-presents-geological-misinformation>;
 6. <http://creation.com/the-indoctrinator>
From other young earth creationist websites:
 7. www.kolbecenter.org/wilder.geocolumn.pdf;
 8. http://creationanswers.net/newsletters/newslet00_02/crans_v3.1.0402.pdf;
 9. http://creationwiki.org/Coconino_sandstone_was_deposited_underwater_%28Talk.Origins%29;
 10. www.sedimentology.fr/ (click on “Paleohydraulics” in the left margin).
- ⁵⁶Morris, *The Young Earth*, 101; Snelling, “What Are Some of the Best Flood Evidences?” in *The New Answers Book* 3, 289; and Snelling, *Earth’s Catastrophic Past*, 506–8, 1081.
- ⁵⁷Video: *Answers for Darwin – Refuting 200 Years of Evolution*, The Word for Today, 2009; and Video: *Grand Canyon: Testimony to the Biblical Account of Earth’s History*, Answers in Genesis, 2009.
- ⁵⁸G. Berthault, “Analysis of Main Principles of Stratigraphy on the Basis of Experimental Data,” *Lithology and Mineral Resources* 37, no. 5 (2002): 445 and G. Berthault, “Sedimentological Interpretation of the Tonto Group Stratigraphy (Grand Canyon Colorado River),” *Lithology and Mineral Resources* 39, no. 5 (2004): 507.
- ⁵⁹G. Berthault, “Time Required for Sedimentation Contradicts the Evolutionary Hypothesis,” *Creation Research Society Quarterly* 46 (Spring 2010): 266. (Berthault never attributes Austin for combining the plot of Allen’s equation with Rubin and McCulloch’s graph to form the double graph procedure).
- ⁶⁰This apparently reflects some confusion in units—Snelling was using Austin’s double graph for a sand-wave height of 20 meters. This yields a velocity range of 95 to 165 cm/sec, which is about 3.1 to 5.4 ft/sec or 2.1 to 3.7 mi/hr. At some point, Snelling began stating the range was 3 to 5 mi/hr when it was really 3 to 5 ft/sec.
- ⁶¹A sediment transport rate of 1 kilogram per second per meter is 1 kilogram of sand crossing a 1 meter long line perpendicular to the direction of flow (in the horizontal plane) every second. A good way to visualize this is to consider a meter stick on the ground with a pile of sand on one side. If the sediment transport rate was 1 kg/sec/m, one kilogram of sand (or a little over ½ liter, assuming a sand density of 1900 kilograms per cubic meter) would be crossing the meter stick every second.
- ⁶²Austin, *Grand Canyon: Monument to Catastrophe*, 36.
- ⁶³S. A. Austin, J. R. Baumgardner, D. R. Humphreys, A. A. Snelling, L. Vardiman, and K. P. Wise, “Catastrophic Plate Tectonics: A Global Flood Model of Earth History,” Proceedings of the Third International Conference on Creationism, 1994, <http://static.icr.org/i/pdf/technical/Catastrophic-Plate-Tectonics-A-Global-Flood-Model.pdf> (accessed June 6, 2010).
- ⁶⁴Lateral sediment transport required to form the Tapeats Sandstone in a matter of days would be especially problematic for Flood geology, since YECs often point out how it is part of the Sauk Megasequence, which covers much of North America—e.g., see A. A. Snelling, “Transcontinental Rock Layers: Flood Evidence Number 3,” www.answersingenesis.org/articles/am/v3/n3/transcontinental-rock-layers (accessed June 6, 2010).
- ⁶⁵Austin, *Grand Canyon: Monument to Catastrophe*, 33. See also G. Berthault, “Analysis of the Main Principles of Stratigraphy on the Basis of Experimental Data,” www.sedimentology.fr/ (accessed June 6, 2010); and A. A. Snelling and S. A. Austin, “Startling Evidence for Noah’s Flood: Footprints and Sand ‘Dunes’ in a Grand Canyon

- Sandstone," www.answersingenesis.org/creation/v15/i1/flood.asp (accessed June 6, 2010).
- ⁶⁶Rubin and McCulloch, "Single and Superimposed Bedforms: A Synthesis of San Francisco Bay and Flume Observations," 218.
- ⁶⁷Snelling, *Earth's Catastrophic Past*, 707, 713–21 and Austin, *Grand Canyon: Monument to Catastrophe*, 45–7. Flood geologists often cite scouring of the Channeled Scablands in eastern Washington by the Lake Missoula flood and Glen Canyon Dam spillways during the 1983 flood as examples of how this would occur (see Austin, *Grand Canyon: Monument to Catastrophe*, 46–7, 104–7).
- ⁶⁸S. A. Austin and K. P. Wise, "The Pre-Flood/Flood Boundary: As Defined in Grand Canyon, Arizona and Eastern Mojave Desert, California," in R. E. Walsh, ed., *Proceedings of the Third International Conference on Creationism* (Pittsburgh, PA: Creation Science Fellowship, 1994), 37–47.
- ⁶⁹M. Oard and C. Froede Jr., "Where is the Pre-Flood/Flood Boundary?" *Creation Research Society Quarterly* 43, no. 1, (2008): 24–39. The precise words of the authors were "Based on these revised criteria, we would favor the placement of the (Pre-Flood/Flood) boundary near or at the contact between the igneous and metamorphic basement rocks and the overlying sedimentary rocks, whether Precambrian or Phanerozoic." Setting aside the sediment transport problem for the moment, the problem with counting the Grand Canyon Supergroup as Flood layers is that some 13,000 feet of strata would have to be deposited, tilted, and then mostly eroded away (except for where they can be found today in eastern Grand Canyon) during the early phase of the global Flood.
- ⁷⁰At the close of the Sixth International Conference on Creationism on August 6, 2008, Andrew Snelling gave a presentation entitled "The Creation Model: Its Past, Its Present and Its Necessary Future," which included a slide with the following as one of its sub-bullets: "Even nearly five decades after *The Genesis Flood* we still have no comprehensive model of earth history explaining the geologic (strata and fossil) record that includes general agreement on Creation Week rocks, pre-Flood/Flood and Flood/post-Flood boundaries."
- ⁷¹Austin, *Grand Canyon: Monument to Catastrophe*, 35 quoting from P. J. Coleman, "Tsunami Sedimentation," in R. W. Fairbridge and J. Bourgeois, eds., *The Encyclopedia of Sedimentology* (Stroudsburg, PA: Dowden, Hutchinson and Ross, 1978), 828–31. During a presentation entitled "Catastrophic Plate Tectonics" at the 2009 Seattle Creation Conference in Mukilteo, WA, Steve Austin stated that the tsunamis were caused by magnitude 8 to 9 earthquakes during the global cataclysm (see www.nwcreation.net/videos/Catastrophic_Plate_Tectonics.html, accessed June 6, 2010).
- ⁷²A. Desiderato, "I Was One of the Lucky Ones. I Lost Nothing," UCLA Center for Southeast Asian Studies Newsletter, posted February 12, 2005, www.international.ucla.edu/cseas/article.asp?parentid=20716 (accessed June 6, 2010); "American Diver Underwater During Catastrophe," posted December 29, 2004, www.cnn.com/2004/US/12/28/tsunami.diver/index.html (accessed June 6, 2010); G. S. Stone, "Tsunami and Coral Reefs: Extent of the Damage," *New England Aquarium Member's Magazine* 39, no. 1 (Winter 2006): 9–11, www.neaq.org/documents/conservation_and_research/global_change/aqualog_tsunami.pdf (accessed June 6, 2010).
- ⁷³Austin, *Grand Canyon: Monument to Catastrophe*, 34–5.
- ⁷⁴D. W. Barnette and J. R. Baumgardner, "Patterns of Ocean Circulation over the Continents during Noah's Flood," in R. E. Walsh, ed., *Proceedings of the Third International Conference on Creationism* (Pittsburgh, PA: Creation Science Fellowship, 1994), 76–88. See also R. Prabhu, M. F. Horstmeier, and W. Brewer, "Ocean Circulation Velocities over the Continents during Noah's Flood," in A. A. Snelling, ed., *Proceedings of the Sixth International Conference on Creationism* (Pittsburgh, PA: Creation Science Fellowship and Dallas, TX: Institute for Creation Research, 2008), 247–54.
- ⁷⁵Morris, *The Young Earth*, 101.
- ⁷⁶Rubin and McCulloch, "Single and Superimposed Bedforms: A Synthesis of San Francisco Bay and Flume Observations," 217.
- ⁷⁷Barnette and Baumgardner disregarded fluid density because they assumed that the simplified 2D equations could be used to describe flow in both the atmosphere and oceans and disregarded viscosity because the equations assumed an ideal fluid. These simplifying assumptions made the equations fairly easy to solve (see Barnette and Baumgardner, "Patterns of Ocean Circulation over the Continents during Noah's Flood," 78).
- ⁷⁸M. J. Oard, "Dinosaur Tracks, Eggs, and Bonebeds," in Oard and Reed, *Rock Solid Answers*, 246–7.
- ⁷⁹S. A. Austin "Submarine Liquefied Sediment Gravity Currents: Understanding the Mechanics of the Major Sediment Transportation and Deposition Agent during the Global Flood" (paper presented at the Fourth Creation Geology Conference, Cleveland, GA, July 28–30, 2010), www.cedarville.edu/event/geology/2010_proceedings.pdf (accessed Dec. 9, 2010).
- ⁸⁰F. S. Collins, *The Language of God* (New York: Free Press, 2006), 173–4.
- ⁸¹D. E. Wonderly, *Neglect of Geologic Data – Sedimentary Strata Compared to Young Earth Creationist Writings* (Hatfield, PA: Interdisciplinary Biblical Research Institute, 2006), 40, www.asa3.org/ASA/resources/Wonderly2006.pdf (accessed June 6, 2010).
- ⁸²L. Vardiman, "A FAST Summer in the Grand Canyon and Wyoming," *Acts & Facts* 36, no. 8 (2007): 6. www.icr.org/article/fast-summer-grand-canyon-wyoming/ (accessed June 6, 2010).
- ⁸³For example, see J. H. Whitmore and R. Strom, "Sand injectites at the base of the Coconino Sandstone, Grand Canyon, Arizona (USA)," *Sedimentary Geology* 230 (2010): 46–9; S. P. Cheung, R. Strom, J. H. Whitmore, and P. Garner, "Occurrence of Dolomite Beds, Clasts, Ooids and Unidentified Microfossils in the Coconino Sandstone, Northern Arizona" (paper presented at the annual meeting of the Geological Society of America, Portland, OR, October 18–21, 2009), http://gsa.confex.com/gsa/2009AM/finalprogram/abstract_161247.htm (accessed June 6, 2010); J. H. Whitmore and R. Strom, "Petrographic Analysis of the Coconino Sandstone, Northern and Central Arizona" (paper presented at the annual meeting of the Geological Society of America, Portland, OR, October 18–21, 2009), http://gsa.confex.com/gsa/2009AM/finalprogram/abstract_159012.htm (accessed June 6, 2010).



Ronald Larson

Article

Design or the Multiverse?

Ronald Larson

The effort to explain the “fine-tuning” of our universe by appealing to a “multiverse” of many universes from which our universe is selected for observation by our existence within it, is a double-edged sword. I argue that this line of “anthropic” reasoning implicitly depends on acknowledgment of “apparent design” in the universe, and in principle, in biological evolution as well. Scientists wishing to avoid entanglement of science with religious concepts should consider leaving both “anthropic” reasoning and “design” within the realm of metaphysics, rather than bringing either of them into mainstream physical science.

In the last couple of decades, physics journals have begun publishing articles containing “anthropic reasoning.”¹ Anthropic reasoning attempts to explain why physical constants governing our universe seem to be “fine-tuned” to allow the existence of life. Such reasoning typically presumes the existence of a plethora of universes—collectively known as the “multiverse”—each universe governed by different values of physical constants or even different physical laws. It is then reasoned that the only properties that an “observer” in a universe could ever measure would be those that permit the observer to exist in that universe. Hence, the properties of a universe such as ours only *appear* to be “fine-tuned” to support intelligent life. Huge numbers of other universes with properties that are not fine-tuned also exist, but go unobserved. Arguments such as this have been advanced by Andrei Linde,² John Barrow

and Frank Tipler,³ and others. An example described by Garriga et al. involves the density of “dark energy” in the universe, which is governed by the so-called “cosmological constant.”⁴ The value of this constant appears to be more than a hundred orders of magnitude smaller than what it is expected to be based on quantum mechanics. It has been suggested that anthropic selection may help account for this deviation from what might be expected a priori.

To make anthropic reasoning quantitative (and hence more scientific), one must specify the *a priori* probabilities of the various constants of nature, and the *conditional* probability that intelligent life will emerge which is capable of “observing” a universe characterized by those constants. These probabilities then enter a *Bayesian* inference calculation, which, in principle, might allow one to explain why we observe the physical constants that we do, given the fact that intelligent life must exist within the universe in which the observations are made. (Bayesian inference is a statistical method for adjusting the probability that a particular hypothesis is true by using “new” information that was not used to obtain the initial “a priori” probability. For example, suppose that half the population of the USA vote Democratic and half vote Republican, and that half of the Republicans support a “flat

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tax,” but no Democrats do. If I learn that a randomly chosen person in the population does *not* support a flat tax, then I can use Bayesian inference to update the probability of this person being a Democrat from 50% to 66.7%.)

It is worth noting that there are multiple foundational problems that bedevil anthropic reasoning (such as how to define an “observer”⁵) and even if these are overcome, there are good reasons to doubt that the probabilities needed to carry out the Bayesian inferences can ever be made accurate enough to be of value to science. Nevertheless, it is argued that, despite the difficulties, anthropic reasoning involves only material entities and physical laws, and so qualifies as science,⁶ albeit at its speculative edge.

Anthropic Reasoning and Design

Anthropic reasoning is controversial among both theistic and atheistic scientists, and raises a host of difficult questions for both camps.⁷ Here, I wish to point out the potential that such reasoning has to upset entrenched positions regarding the validity of the notion of “design,” both in the laws of physics and in the biological world. Viewed optimistically, perhaps the emergence of anthropic reasoning may offer a way to move toward more constructive interactions among scientists with differing religious and metaphysical perspectives.

Most modern scientists tend to reject the validity of “design” as a principle of science, for one of two reasons. Some atheists, such as Richard Dawkins, believe that science *can* address the possibility of “design” in the universe, and in fact, has already shown that design is absent. Thus, Dawkins’ book *The Blind Watchmaker* is subtitled “How the Evidence of Evolution Reveals a Universe without Design.”⁸ Oddly enough, in accepting design as a topic suitable for scientific inquiry, Dawkins puts himself in the same camp with his archrivals, the intelligent design theorists, who also hold that design can be addressed scientifically, but, *contra* Dawkins, conclude that the universe *does* show evidence of design.⁹ Most scientists, however, seem to regard “design” as a concept that science does not, or should not, address.

Anthropic reasoning within science has the potential to upset these entrenched positions, in that

anthropic reasoning accepts that some attributes of our universe appear to be highly improbable, and that science should try to explain this. However, this is a position also taken by advocates of intelligent design.

Thus, I argue here that whoever takes anthropic reasoning to be scientific will have difficulty maintaining the claim that design, or at least *apparent* design, is nonscientific. For example, in a recent book *The Cosmic Landscape*,¹⁰ renowned string theorist Leonard Susskind argues that anthropic reasoning is in the vanguard of physics and cosmology, and he gives his book the provocative subtitle, “The Illusion of Intelligent Design.” Note that, if it were somehow possible to demonstrate that there is only one universe, then the “apparent design” (or “illusion of design”) addressed by anthropic reasoning would become evidence of *real* design. This could, of course, be avoided by asserting that the existence of the multiverse must be accepted as a *scientific certitude* that no evidence could ever refute. However, in that case, the multiverse would become an untestable concept (not “falsifiable”), and therefore would fail to satisfy an important criterion for a scientific hypothesis. Thus, anthropic reasoning “opens the back door” to design, and there does not seem to be a principled way to boot it back out.

Anthropic Reasoning and Design in Biology

Anthropic reasoning brings the design argument not only back into physics and cosmology, but even back into biology. To see why, we note that the Bayesian calculus used in anthropic reasoning contains *both* the a priori probabilities of various physical constants (putatively derivable from some ultimate physical theory), and the conditional probabilities for the emergence of intelligent life, given those a priori probabilities. Let us initially simplify matters greatly by assuming that we have only one physical constant to explain—call it λ —which we shall assume takes on an improbable value in our universe. To be more concrete, let us assume that the a priori probability distribution for λ is given by a Gaussian:

$$P_{\lambda}(\lambda) = \frac{1}{\sqrt{2\pi\sigma_{\lambda}}} \exp\left(-\frac{(\lambda - \lambda_0)^2}{2\sigma_{\lambda}^2}\right) \quad (1)$$

Article

Design or the Multiverse?

and that the value of λ that we observe, λ_{obs} , might be far from the a priori most probable value λ_0 .

Now let us define the *conditional* probability density $P_e(IL|\lambda)$ for the evolution of intelligent life that is able to make physical measurements in the cosmos (i.e., an “observer”), given a particular value of λ . $IL = 1$ for the presence of an intelligent observer in that universe, and $IL = 0$ for the absence of one. Here, I will ignore the many obstacles to formulating this probability, such as how to decide what constitutes an “observer,” how to weight this probability for the number of such “observers” in a given universe, etc. The goal is not to defend such reasoning but only to see its consequences. Let us assume that this function is also a Gaussian in λ , for $IL = 1$; that is,

$$P_e(IL = 1|\lambda) \propto \exp\left(-\frac{(\lambda - \lambda_e)^2}{2\sigma_e^2}\right) \quad (2)$$

(We use a proportionality since $P_e(IL|\lambda)$ need not integrate to unity, and its pre-factor is irrelevant in what follows.) Now we ask, what value of λ is most likely to be observed? Conceptually, this can be determined by first generating a large number of universes randomly according to the distribution $P_\lambda(\lambda)$, and then weighting them by the conditional probability density function $P_e(IL = 1|\lambda)$. The probability that an intelligent observer will measure a given value of λ is then the product of these two probabilities:

$$P_{obs}(\lambda) = P_e(IL = 1|\lambda)P_\lambda(\lambda).$$

The value of λ most likely to be observed is obtained by maximizing the above product of probabilities by differentiating the product with respect to λ and setting this differential to zero. This yields the most likely observed value λ_{obs} :

$$\frac{\lambda_{obs} - \lambda_e}{\sigma_e^2} = -\frac{\lambda_{obs} - \lambda_0}{\sigma_\lambda^2} \text{ or } \lambda_{obs} = (\lambda_e \sigma_\lambda^2 + \lambda_0 \sigma_e^2) / (\sigma_\lambda^2 + \sigma_e^2) \quad (3)$$

Thus, λ_{obs} is a weighted mean of the individual optimal values λ_0 and λ_e of the two functions $P_e(IL = 1|\lambda)$ and $P_\lambda(\lambda)$. The relative weighting given to the values of λ_0 and λ_e is controlled by the inverses of the variances of their respective distributions. The narrower distribution dominates the value of λ_{obs} chosen. If life can evolve almost equally well under a very wide range of values of λ , and the value of λ has a preferred

a priori value, then $\sigma_\lambda^2 \ll \sigma_e^2$ and λ_{obs} will be close to the a priori most likely value; i.e., it will not be affected much by anthropic considerations. However, if the emergence of intelligent life requires a very precisely tuned value of the physical constant, which would otherwise be free to range over a very wide range of values with nearly equal probability, then $\sigma_e^2 \ll \sigma_\lambda^2$ and λ_{obs} will be close to the value λ_e , implying that anthropic considerations will dominate the value of λ that is selected.

In some cases, we may observe a value of some property that lies far away from the value of that property that is a priori most likely. An example of this might be the value of the cosmological constant cited earlier. In this case, an anthropic argument would hold that the observed value is pushed away from the a priori most likely value by anthropic considerations. Suppose we observe a value $\lambda = \lambda_{obs}$ that is far out on the tail of the Gaussian distribution function $P_\lambda(\lambda)$. The above equations imply that it is on the opposite side of the distribution function for $P_e(IL = 1|\lambda)$. The explanation for this is straightforward. Anthropic selection explains the improbability of the observed value of λ by arguing that a rare value of this physical parameter is needed for life to evolve. So λ is pushed away from the value that is *a priori* most likely, in order to enhance the *conditional* probability that intelligent life emerges. Since the *a posteriori* probability reflects both of these probabilities, a compromise is struck whereby a lower-than-optimal likelihood for the conditional probability for life to emerge is accepted to keep the a priori probability of a given value of λ from becoming too low. One can show from the above optimization that the probability density for life to emerge in a universe with $\lambda = \lambda_{obs}$ is a factor

$$\exp\left\{-\frac{1}{2}\left[(\lambda_0 - \lambda_e) / \left[\sigma_\lambda \left(\frac{\sigma_\lambda}{\sigma_e} + \frac{\sigma_e}{\sigma_\lambda}\right)\right]\right]^2\right\}$$

times the probability density under the most favorable conditions for life (i.e., when $\lambda = \lambda_e$). This factor is much less than unity if σ_e is comparable to σ_λ and

$$|\lambda_0 - \lambda_e| \gg \sigma_\lambda.$$

We can easily extend the argument to a set of several fine-tuned constants $\{\lambda_i\}$, where $i = 1, 2, \dots, N$. If each of these has a Gaussian a priori distribution function and if the conditional probability $P_e(IL = 1|\{\lambda_i\})$ is

a product of Gaussian functions for each λ_i , then optimization with respect to each λ_i yields an equation similar to Eq. 3 for each value of λ_i . The conditional probability $P_e(IL = 1 | \{\lambda_i\})$ will then be a product of Gaussians $P_e(IL = 1 | \lambda_{i,obs})$.

From the foregoing, it follows that intelligent life has a relatively low probability to evolve in the most likely observed universe if even one of the fine-tuned variables has a distribution $P_{e,i}(IL = 1 | \lambda_i)$ whose breadth $\sigma_{i,e}$ is similar to $\sigma_{\lambda,i}$ of the corresponding distribution function $P_{\lambda,i}(\lambda_i)$, and for which the difference between $\lambda_{0,i}$ and $\lambda_{e,i}$ is much greater than either $\sigma_{i,e}$ or $\sigma_{\lambda,i}$. The reason is that, in this case, there is no single value of λ_i that has both a high *a priori* probability and a high *conditional* probability. Thus, the chosen optimal value of λ_i is one that compromises between the degrees of improbability of the two functions. We then must settle for a universe whose constants make intelligent life improbable in any single universe, in order to keep the observed constants of the universe from being even more improbable than they are. This suggests that if the observed constants are improbable ones, then the evolution of intelligent life might be similarly improbable.

Of course, since we have little idea what these probability functions actually are, we can draw only the conclusions that (1) anthropic reasoning entails *the potential* that intelligent life might be extremely improbable in a typical “observable” universe such as ours, and that (2) this probability is entangled with the probability distribution for the constants of the universe. *Thus, if there is “apparent design” in the values of the physical constants, anthropic reasoning leads us to suspect that there might be “apparent design” in biology as well.* This result should not be surprising. Since biology already recognizes natural selection as an explanatory principle, the introduction of a second selection principle, namely anthropic selection, means that there will be a trade-off between the two. Hence, once anthropic reasoning enters science, *natural selection ceases to be the default explanation for biological complexity.* Steps in the evolution from molecules to humans that might have low probabilities for occurrence by natural selection are then candidates for explanation by anthropic reasoning—i.e., they occurred because without them, we would not be here to ponder that fact. These improbable steps would appear to have happened

“by design” rather than by natural selection, just as the physical constants of the universe appear to have values that were chosen “by design.” Bayesian calculus is required to adjudicate the relative explanatory roles of natural selection and anthropic selection in biology.

Anthropic Reasoning and Design in Science: Joined at the Hip?

For those who wish to banish the idea of design from science, then, anthropic reasoning is a double-edged sword. While one can always assert that any indications of design are only evidence of *apparent* design, the acceptance of even “apparent design” as a *scientific* principle is a step that has unpleasant implications for some. A hint of this can be seen in a recent writing by science writer Amanda Geffer in the *New Scientist*:

Discussing the fact that the universe appears fine-tuned for our existence, Weinberg told Dawkins: “If you discovered a really impressive fine-tuning ... I think you’d really be left with only two explanations: a benevolent designer or a multiverse.”

Weinberg went on to clarify that invoking a benevolent designer does not count as a genuine explanation, but I was intrigued by his either/or scenario. Is that really our only choice? Supernatural creator or parallel worlds? ...

But to suggest that if this theory [of the multiverse] doesn’t pan out our only other option is a supernatural one is to abandon science itself. Not only is it an unfounded leap of logic, it suggests intelligent design offers as valid an explanation as a cosmological theory does, and lends credence to creationists’ mistaken claim that the multiverse was invented to serve as science’s get-out-of-God-free card.¹¹

For Christians, the increasing popularity of anthropic reasoning within science also raises challenges. There are reasons to believe that the universe is much larger than we can observe, and there are reasons derived from cosmology and string theory to hint that different physical constants might apply in very remote portions of our universe or in other universes. Moreover, there are no definitive scriptural or doctrinal statements that would rule out God creating a vastly larger universe or even parallel universes. Thus, it does not appear to be wise to deny even the

Article

Design or the Multiverse?

possibility of a multiverse. Yet it seems unwarranted, and likely detrimental to the Christian worldview, to assert dogmatically that evidences of design must be taken only as evidences of *apparent* design and cannot be real design. To do so would be to accept an unscriptural dogma that God is obliged to create an infinity of universes with random properties, rather than just one that he chooses to make with designed properties. Thus, many Christians and other theists are likely to see evidence of “apparent design” as suggestions of at least the possibility of real design, while atheists will resist this inference and find recourse in the multiverse.

Empirical science may not be able to settle this disagreement because both viewpoints—theistic design and anthropic selection—allow infinitely many *potential* universes. In the former viewpoint, our universe is designed by God and the others may not be real, while in the latter, it is the other universes that must be real while the “design” of our universe is only apparent. Since neither God nor the other universes can be observed, it seems doubtful that empirical science can, by itself, decide between these views.


Can't We All Just Get Along (at Least in Science)?

Perhaps a helpful analogy to see a way forward is to consider how the concept of purpose, or teleology, is dealt with by scientists. Even atheists sometimes use language that suggests purpose, as in “the heart’s purpose is to pump blood.” A prickly Darwinist might insist on restating this as “the heart evolved because by pumping blood it oxygenates tissue more thoroughly, allowing organisms possessing it to survive and propagate their genes more effectively.” This clumsy formulation is unneeded, even by the atheist, if he simply re-interprets “purpose” as “apparent purpose.” Shorthand references to “purpose” need not offend atheistic scientists who recognize that ultimate reality must be left to metaphysics, not science, to address. If “purpose” is not a scientific concept, but “apparent purpose” can still be recognized in biological organs, then perhaps “design” is also best left as a metaphysical or theological concept, while allowing that the natural world might display “apparent design.” In this way, science can construct theories that cope with empirical

or “apparent” realities, while leaving questions of ultimate reality to metaphysics, where the vigorous contest for ultimate truth can continue unabated. Such a pragmatic approach already seems to be followed by nondogmatic scientists when dealing with other ontologies that some materialists consider non-existent, such as objective morality, free will, or personhood.

Such a pragmatic separation of science from metaphysics was advocated by Catholic scientist Pierre Duhem, who wrote

... to make physical theories depend on metaphysics is surely not the way to let them enjoy the privilege of universal consent ... If theoretical physics is subordinated to metaphysics, the divisions separating the diverse metaphysical systems will extend into the domain of physics. A physical theory reputed to be satisfactory by the sectarians of one metaphysical school will be rejected by the partisans of another school.¹²

The metaphysical disputes feared by Duhem are clearly on display in areas of science where evidence of “apparent design” can be found. Attempts by partisans of either camp to obtain decisive victory for their metaphysical position on design in science is likely to lead to continued warfare, not only between theistic and atheistic camps, but even within each of these camps. For all parties, then, a Duhemian approach might be a welcome avenue for maintaining unity within science, while allowing vigorous debate to continue in the arena of metaphysics. 

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for



Robert Kaita

Essay Book Review

Establishing a Meaningful Dialog

Robert Kaita

SCIENCE VS. RELIGION: What Scientists Really Think by Elaine Ecklund. New York: Oxford University Press, 2010. 240 pages. Hardcover; \$27.95. ISBN: 9780195392982.

I have always been uncomfortable with terms like “elite.” It probably draws from the mantra of “equality in the sight of God” that I heard from childhood, and the egalitarian ideals of the American society in which I was raised. That being said, I recognize that scholars in a relatively small number of institutions of higher education appear to have a disproportionately large influence in training our future leaders, and in shaping the perception the public has of their disciplines. These individuals thus constitute a powerful “elite,” and it is critically important to understand them.

In *Science Vs. Religion: What Scientists Really Think*, Elaine Ecklund takes on this daunting task. As a member of that group, I have encountered those who are unsympathetic to my faith in Christ. On the other hand, hostility toward my beliefs is not as widespread as many Christians might think. I was thus especially interested in finding out if she also discovered this from her much broader sampling of my colleagues.

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Ecklund reports that nearly half of the scientists she interviewed claimed some kind of religious affiliation. While this is personally encouraging, she also points out that this is not widely appreciated within the scientific establishment and the public at large. It has profound implications for how to establish a meaningful dialog between the two communities, and Ecklund’s book serves a particularly valuable role in explaining how this might be accomplished.

The book is divided into two sections, which cover the personal and public aspects of the topic. The first is entitled “Crossing the Picket Lines: The Personal Faith of Scientists.” Ecklund uses its chapters to put her extensive survey results in context by providing anecdotes of individuals in two groups. To start with, Ecklund describes those scientists who do not profess any religious beliefs, and the reasons she uncovers are not surprising. There are many who feel that “science trumps religion,” and this certainly is not new. As Laplace purportedly told Napoleon concerning God, “he had no need for that hypothesis.” Then there are those who have had bad experiences with organized religion in the past, or simply feel that it is foreign or unimportant. Such attitudes are not unique to scientists, and it is particularly telling that only ten percent of those interviewed felt that an increase in education always leads to a decrease in religious commitment.

For scientists who fall into either of these categories, Ecklund points out that they need to understand why nearly half of their colleagues do not feel the same way. Communicating with them as believers as well as peers will be foreign and difficult. Because the challenge is similar, it is a critical step toward establishing the means by which science can be communicated to the general public.

The second group Ecklund addresses consists of those who profess a faith of some kind. For scientists without any religious beliefs, there is no dichotomy between their lives at work and home. In contrast, those who practice a religion of some kind have to deal with the public stereotype embodied in the title of the book. A common reaction is to have what Ecklund calls "closeted faith." Scientists avoid conflict at work because nobody there knows about their beliefs, and they avoid conflict in their faith community because nobody there knows what their work is. The challenge Ecklund poses to these scientists is to take on the problem squarely. She begins with the premise that those in this group see no conflict between science and religion because they continue to practice both. She encourages them to take the time and effort to communicate this as a "boundary pioneer." She uses this term because of the leading role scientists who practice a religion can play in fostering a dialog between the two communities of which they are a part.

The final chapter in Ecklund's discussion of personal faith is entitled "Spiritual Entrepreneurs." Those in this category "call themselves spiritual, but not religious in the traditional sense." They constitute over twenty percent of the scientists interviewed; the same percentage is present for those calling themselves atheists. Ecklund observes a tendency of such "spiritual" scientists to be more engaged in volunteering and less concerned about "policing the boundaries between science and religion." This could make them unexpected "allies" with those from more conventional faith backgrounds.

The second section of the book is entitled "Society and Broader Publics." Ecklund begins with the most direct way scientists engage the American public, that is, by teaching students in their classrooms. In chapter 5, "Suppression or Engagement," she frames what they are doing according to two different "cultural scripts." One emphasizes suppression of any discussion of science and religion, often because it

is thought to be simply irrelevant. The other seeks engagement, but it can take different forms. Under the title, "Religion Is an Important Public Issue: Positive Environmental Push," Ecklund mentions a psychologist who summarizes his motives by saying, "Students ought to think about what science contributes and what it cannot contribute to knowledge." This is in contrast to a biologist she interviewed, who felt that it was his "moral responsibility to actively protect the authority of science from the intrusion of religion." Such sentiments are included under the title, "Religion Is a Threat That Must Be Addressed: Negative Environmental Push."

The next two chapters effectively elaborate on these themes by taking the reader inside the major research universities that were the focus of Ecklund's study. In chapter 6, she notes that many scientists subscribe to one of several models for the university. First, there is the "Model of Opposition," in which "religion ought to be viewed in opposition to scientific reasoning." Another is the "Model of Secularism," in which "universities ought to be bastions of secularism." Evidence for both appeared earlier in the book, and the obstacles they pose for the believer are clear. Perhaps more subtle are the challenges posed by the "Model of Pluralism," in which "universities ought to foster pluralism." Ecklund presents the essence of the problem on page 99 when she writes the following:

[I]t seems, ironically, that those scientists I interviewed who most prize the vision of the university as committed to plurality are actually the most opposed to the entrée of diverse religious views into the fabric of the intellectual life of universities ... Talking about religion at all ... just invites a fight. Scientists wondered aloud how, if religion is to be brought into the university, it could ever be discussed in a civil manner.

She effectively argues that such sentiments, rather than allowing for genuine pluralism, suppress a critical part of what makes scientists of faith who they are.

Ecklund provides a set of contrasting models in chapter 7, lived by the "boundary pioneers" she introduced before. One is the "Model of Nurture," in which "universities ought to nurture students—including spiritually—in their formative years." The next is the "Model of Legitimacy," in which "universities ought to extend legitimacy to religion as a subject of study." The last model she proposes is the

Essay Book Review

Establishing a Meaningful Dialog

“Model of Connected Knowledge,” in which “universities ought to support the connection of religious knowledge to other forms of knowledge.” The practical manifestations of these models on the research university campus are in such contrast that it would hardly be possible to bring the adherents of each together in constructive dialog, let alone between these scientists and the public at large.

In chapter 8, which is entitled “What Scientists Are Doing Wrong That They Could Be Doing Right,” Ecklund points out that “contrary to the predictions of some, religion does not seem to be going away,” and reminds us that only a very small minority in the academy are openly hostile to it. Only when scientists appreciate this fact can they heed her call, as the title of her last chapter puts it, to “shatter myths” and move “toward dialog.”

If I find any fault in Ecklund’s book, it is that there could have been more about how scientists approach the questions they address. The faith of the scientists is nuanced, as Ecklund accurately portrays, but so should their responses be to the “hot-button” issues of the day. For example, she finds that none of the scientists she interviewed, regardless of whether or not they were religious, thought that “intelligent design” (ID) had any scientific merit. Ecklund’s primary discussion of this is in a lengthy footnote in chapter 2. The “high profile” she admits ID has, especially with the controversies in Kansas and Pennsylvania occurring at the time she was collecting her data, suggests that it should have had more discussion in the book proper.

On the question of whether ID is science, it would have been interesting to hear the responses of scientists to ancillary questions such as “Do you think there are open questions in the theory of evolution?” This could help separate those who have a genuine concern for keeping the idea of *deus ex machina* out of science, from others who subscribe to a “scientism” that could be ultimately just as detrimental to the scientific enterprise. For them, the theory of evolution provides a triumphant demonstration that scientists no longer have to “hypothesize a designer.” If scientists are unaware of a natural explanation at present for a particular phenomenon, so the argument goes, there is no doubt that one will eventually be discovered. I was concerned about this problem when Ecklund refers to scientists who call evolution the “best theory ... for the origins of life on earth.” The

theory of evolution, in fact, deals with the *diversity* of life on earth. How it began is the purview of the far less developed field of abiogenesis, and a widely accepted theory has yet to be formulated for the origin of living organisms that could subsequently evolve. At best, this confusion is carelessness, and at worst, it represents the kind of overstepping of bounds that represents a philosophical rather than a scientific position. People of faith can sense this, and would have every reason to be uncomfortable.

To be fair, Ecklund does address the problem in the very blunt comments of one of the biologists she interviewed. On page 132, she writes the following:

[The biologist] said rather strikingly that he is “really pissed off at [his] colleagues for behaving like scientists, for behaving so arrogantly in response to [religious challenges to science.]” Then I asked him to tell me what specifically he thinks his colleagues could be doing better. [He said], “I would want them to try to sell science on its true merits, which is the skeptical improvement of all knowledge. That’s what science is all about—resting on the evidence. And the evidence is never perfect. Every fact can be overturned, and we all know this. But when it comes to talking publicly about creationism ... suddenly evolution is a fact, Darwin is completely right.”

This encapsulates one of the toughest and most important messages to scientists who want to communicate to the public, and it makes Ecklund’s book a timely and practical guide for us. If we really believe that our job is the “skeptical improvement of knowledge,” and “every fact can be overturned,” we have an obligation to explain this to nonscientific audiences.

Instead of getting angry when we hear “evolution is just a theory,” as some of us are wont to do, we can quote the statistician George Box. As he put it, “All models are wrong, but some are useful.”¹ We should then explain why that is the case, and frankly tell what the limits of our knowledge are. Such a winsome approach reflects a humility that is able to break the barrier that the arrogance of our community has created. It allows us to convey the excitement of pursuing the “unanswered question” rather than the “unquestioned answer,” and enables the dialog that Ecklund encourages all of us to join. ~

Notes

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Nancey Murphy

Relations between Theological and Scientific Methodologies

Nancey Murphy

PHILOSOPHY OF SCIENCE FOR THEOLOGIANs: An Introduction

by Gijsbert van den Brink, trans. Chris Joby. Frankfurt am Main: Peter Lang, 2009. 299 pages. Hardcover; \$72.95. ISBN: 3631569513.

If a theological curriculum has space for a course on relations between theological and scientific methodologies, this is a perfect textbook. Van den Brink provides a nearly flawless account of the history of philosophy of science beginning with the logical positivists and logical atomists in the 1920s and '30s, through the neopositivists (with particular attention to Karl Popper's critical rationalism), and ending with the 1970s, when study of the history of science produced more realistic accounts of scientific methodology, and lively debates among a few brilliant thinkers—particularly Paul Feyerabend, Thomas Kuhn, and Imre Lakatos. Van den Brink's account of the ferment in the 1970s rightly gives attention to recognition of the "theory-ladenness" of data, and the shift from foundationalism to holism, first postulated as the Duhem-Quine thesis that theories never confront experimental results alone, but only as a network of theories and assumptions. Kuhn's *Structure of Scientific Revolutions* provided historical evidence that entire "paradigms" are, in fact, challenged and replaced as a whole.

Van den Brink follows this historical account with an examination of the implications of each era in philosophy of science for the claim that theology be considered a science. The logical positivist and atomist accounts of science clearly

ruled theology "unscientific." However, as philosophy of science became more sophisticated, it became increasingly difficult to maintain that there are sharp differences between theology and the sciences. He then examines two attempts to argue for the scientific status of theology: Wolfhart Pannenberg's and my own, and follows with his own Kuhnian approach.

While I find van den Brink's text by and large insightful and judicious, I believe he has not adequately represented Pannenberg's work in *Theology and the Philosophy of Science*. Van den Brink

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Her first book, *Theology in the Age of Scientific Reasoning* (Cornell, 1990) won the American Academy of Religion award for excellence. She is author or co-author of nine other books, including *Anglo-American Postmodernity: Philosophical Perspectives on Science, Religion, and Ethics* (Westview, 1997); and *On the Moral Nature of the Universe: Theology, Cosmology, and Ethics* (Fortress, 1996). Her most recent books are *Bodies and Souls, or Spirited Bodies?* (Cambridge, 2006); and *Did My Neurons Make Me Do It? Philosophical and Neurobiological Perspectives on Moral Responsibility and Free Will* (Oxford, 2007).

She has co-edited eleven volumes, including *Philosophy, Science, and Divine Action* (Brill, 2009); *Downward Causation and the Neurobiology of Free Will* (Springer, 2009); and *Evolution and Emergence: Systems, Organisms, Persons* (Oxford, 2007).

Her research interests focus on the role of modern and postmodern philosophy in shaping Christian theology, on relations between theology and science, and on relations among philosophy of mind, neuroscience, and Christian anthropology.

Essay Book Review

Relations between Theological and Scientific Methodologies

claims that Pannenberg intended to follow Kuhn's lead, and (following earlier critiques by Wentzel van Huyssteen) that he ultimately failed by clinging at a decisive point "to a by now outdated view of Popper" (p. 171).

On my reading of Pannenberg, he is indebted to Kuhn, but specifically for showing the inadequacies of Popper's methodology. Yet he recognizes, with van den Brink, that earlier stages of philosophy still have positive contributions to make. What Pannenberg takes from Popper is the recognition that empirical conclusions can be disconfirmed by future experience. This endorsement of Popper's position on the "anticipatory" character of knowledge is quite important when Pannenberg turns to the role of Jesus' resurrection as an anticipation of the end of history.

The philosopher to whom Pannenberg is most indebted is Stephen Toulmin. Pannenberg proposes that theories are to be criticized on the basis of how well they account for all available data. Pannenberg addresses the relation between the natural and human sciences and, following Wilhelm Dilthey, maintains that the distinctive task of the human sciences is understanding meaning, which is brought about by placing human phenomena as parts within the larger whole to which they belong. This being the general method of the human sciences, Pannenberg argues, there is no real difference between the methods of the human and natural sciences—explanation in both can be understood as provision of a new frame of reference within which the previously unintelligible event now becomes intelligible. Toulmin described explanation as making sense of previously unintelligible observations, not only through the construction of hypotheses, but also in the construction of "ideals of the natural order" that are used as paradigms to make nature intelligible. Thus Toulmin's understanding can be applied to all types of explanation: they all function by placing the fact to be explained in a context in which it can be understood as meaningful. Theology is a "science of God" when it investigates religious traditions to see to what extent their conceptions of the whole of reality are able to account for all currently available aspects of reality. The criteria for judging between theological traditions are parsimony, coherence, and accuracy.

My use of Lakatos's philosophy for understanding theological methodology was based on my judgment that his criterion of empirical progress

(requiring that modifications of a research program allow at least occasionally for the prediction and discovery of novel facts) united into one the various *desiderata* such as parsimony, coherence, and accuracy. Pannenberg noted that his *Theology and the Philosophy of Science* was written too early to have taken Lakatos's work into account, and that he would have used it himself if it had been available.¹

I suppose that because van den Brink's book was sent to me for review it is expected that I comment on his criticism of my work. Van den Brink's account of Lakatos's philosophy and my use of it is accurate and insightful. Unfortunately, however, he repeats a criticism of my work by Van Huyssteen to the effect that my account of communal discernment, which I propose as a criterion for judging the authenticity of religious experience, being specifically Christian, prevents any dialogue among religions. Thus I opt for "theological isolation," leading to "a (typically Anabaptist?) ghetto-theology, which serves only to confirm ... one's own point of view" (p. 190). Van Huyssteen claims that instead we need "transcommunal" criteria that transcend the boundaries of a specific faith community.

This criticism, however, completely misunderstands the brilliance of Lakatos's work. One aspect of the theory-ladenness of data recognized by the philosophers of the 1970s is that *internal* to each paradigm or research program are *theories of instrumentation* that serve as criteria for recognizing data relevant to that program. So I proposed Christian discernment as an analogue for a theory of instrumentation for authenticating data within Christian research programs (and I drew here from New Testament, Reformed, Catholic, Quaker, and Pentecostal sources, not just Anabaptist). Lakatos recognized the difference between *internal* criteria for validating data and a criterion for evaluating *competing research programs as a whole* according to their ability to make progress according to their own internal criteria. In Van Huyssteen's term, this is a "transcommunal" criterion that nonetheless leaves it to the various programs (scientific and theological) to determine their own appropriate sources of data.

For his own account of theological methodology, van den Brink gives up on a normative account of scientific method and settles for description in the light of Kuhn's work. He may well be right that Kuhn's vaguer notion of paradigms and the history

of their replacement over time is easier to apply to theology than Lakatos's more sharply defined concept of a research program. However, both Pannenberg and I want to retain the normative bite of a methodology.

Now, having gotten through the obligatory criticisms, I would like to situate van den Brink's book in its historical context and describe where the discussion of theology and philosophy of science ought to go next. I believe that van den Brink, Pannenberg, and I are among a larger group of scholars who have indeed contributed to an understanding of theology in the light of the best account of knowledge available at the time, which we took to be the philosophy of science of the 1970s. But we should not expect the development of epistemology to end there. Within that bit of history, Feyerabend had the last word: one can describe how science, at its best, works, and he believed that Lakatos had done so. However, the problem Lakatos could not solve was this: It can be shown that one research program is more progressive than its rival—at the present time—but one cannot know that the rival will not, at some future date, become progressive, while the earlier winner degenerates. Thus, no assurance can be given that scientists should abandon a degenerative program; Lakatos's methodology did not, in fact, have the normative bite that Pannenberg and I were looking for.

Van den Brink is aware of the recent writing of Alasdair MacIntyre, and includes his account of tradition-constituted rationality in his overview of the development of holist epistemology. There is one piece of MacIntyre's writing (which van den Brink does not cite) that makes a crucial link between philosophy of science and MacIntyre's later work on the adjudication between competing traditions of enquiry: in "Epistemological Crises, Dramatic Narrative, and the Philosophy of Science,"² he explains why the conversation in philosophy of science did not progress after the 1970s. MacIntyre raises against Kuhn the very problem that Feyerabend raised against Lakatos, and argues that what Kuhn failed to see regarding the Copernican revolution was the narrative connections between the Ptolemaic and Copernican paradigms. The crucial factor is that from the point of view of the Copernican system, it was possible to *explain why* the Ptolemaic system failed, and failed *just at the point it did*. This created a permanent "gain in intelligibility," not only explaining the astronomical phenomena equally well,

but also an episode in the history of science—the Ptolemaic program's failure to progress beyond a certain point.

So MacIntyre's work is a decisive step beyond the Kuhn-Lakatos-Feyerabend stalemate in philosophy of science. It incorporates the insight from Lakatos that it is only by looking at how a research program or tradition changes over time that it can be evaluated, and from Kuhn the insight regarding the role of authoritative texts and social practices in science. MacIntyre went on to apply these insights to the problem of relativism in ethics. A progressive tradition of moral enquiry is one that has the ability not only to overcome its own internal epistemological crises, but also to explain other traditions' crises in its own terms—while the reverse is not the case.

So now we have a new resource for understanding theological rationality. We can continue to employ our favorite philosophy of science for accounts of theological rationality within the Christian tradition, but then focus on the tradition rather than the theological research program or paradigm when it comes to the contest with naturalist traditions or other religions. No special pleading is needed to justify the use of our own authoritative texts or our own particular epistemic practices (such as discernment). However, we then need to engage in the ambitious project of showing that Christianity has resources to overcome its own epistemological crises, and to see whether it also has the resources to explain other traditions' inability to resolve their own. MacIntyre has shown that this is indeed possible with traditions of moral enquiry; he claims to have shown that the Enlightenment tradition of "traditionless reason" was unable to avoid moral relativism because it cut itself off from any account of ultimate reality.

In conclusion, I enthusiastically endorse van den Brink's insightful book, and hope that this review will encourage all fans of "philosophy of science for theologians" to incorporate MacIntyre's insights into further exploration of the topic of theological rationality.

Notes

¹Wolfhart Pannenberg, in *Beginning with the End: God, Science, and Wolfhart Pannenberg*, ed. Carol Rausch Albright and Joel Haugen (Chicago, IL: Open Court, 1997), 430.

²*Monist* 60 (1977): 453–72.

Perspectives on Science and Christian Faith

special issue on

Responsible Technology and Issues of Faith

Perspectives on Science and Christian Faith announces a forthcoming special issue on “Responsible Technology and Issues of Faith” to be co-edited by Arie Leegwater and Jack C. Swearengen. We favor having a balance of theoretical-reflective articles, weighing normative principles which should guide sustainable technological development, with a number of case studies in which responsible technology is practiced.

Manuscripts that address the following topics are especially welcome:

- Broad themes: Responsibility and sustainability in technological practice
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ETHICS

MEDICAL ETHICS AND THE FAITH FACTOR: A Handbook for Clergy and Health-Care Professionals by Robert D. Orr. Grand Rapids, MI: Eerdmans, 2009. 474 pages, glossary, case reference index. Paperback; \$30.00. ISBN: 9780802864048.

This book is immanently practical, wise, and clearly written by an experienced clinician. Orr begins with an overview of essential and standard terms and concepts that is remarkably comprehensive for its twenty-five pages. This can quickly help clergy and health care providers get up to speed on the most influential concepts and usual vocabulary to express and consider ethical decisions in clinical practice. At appropriate points, Orr matter-of-factly references religious perspectives, modeling openness to such concerns, but not requiring agreement with his Christian convictions in order to gain from the book.

The bulk of the handbook is composed of one-page cases, each followed by two pages structured as discussion, recommendations, follow-up, and comment. The first section of case accounts vividly catalogs examples of decisions in regard to failure of heart, lungs, kidneys, eating, brain, and mind. The second section of scenarios addresses complications of cultural and religious beliefs, the neonatal period, children, reproductive technology, pregnancy, and organ transplantation.

The book is not exhaustively argued; rather, it expresses the direct and summary counsel of someone who has experienced and thought deeply. For example, there has been extensive discussion of whether intravenous hydration is a basic good akin to giving water to the thirsty and hence always required, or whether it is more a medical treatment that, as a treatment, is optional. Orr acknowledges that there has been discussion, and that the consensus is that intravenous hydration is a treatment; he then proceeds to work through several specific cases on that basis. I think he is right, but I note that the book is not designed to thoroughly describe and evaluate such debates. One will not be able to trace and weigh in the book all the lines of distinction and debate relevant to a particular case, granted that this brevity is supplemented by related cases and that an appendix with cross references to yet more relevant cases is included. The overall experience is like having a well-informed and trustworthy physician assist one with clarifications and sound focused advice, as one works through often convoluted matters of life and death decision.

While there are 131 scenarios, there could never be enough cases described to cover all the relevant details and vagaries of actual clinical practice. One could not depend on this handbook to provide a write-up for each situation one will encounter, but there are enough examples here to orient clinicians and pastors to the standard vocabulary and approaches most often encountered. This unique blend of accessible, clear, practical, thoughtful, and on-point advice is highly recommended. I plan to use this book as one of the required readings for a course I teach in seminary, a course designed to prepare pastors

for many of the clinical situations they will face with their parishioners, and also for another course that trains future physicians in medical school for such encounters with their patients. It is not often that I see both groups served so well in one book.

Reviewed by James Peterson, R. A. Hope Professor of Theology and Ethics, McMaster Divinity College and Faculty of Health Sciences, McMaster University, Hamilton, ON L8S 4K1.

AUTONOMY AND FOOD BIOTECHNOLOGY IN THEOLOGICAL ETHICS by Cathriona Russell. New York: Peter Lang, 2009. 290 pages. Paperback; \$54.95. ISBN: 9783039118380.

Does Christian theology bring a distinctive to the ethics of food biotechnology? In response, Cathriona Russell describes her Christian autonomy approach that emphasizes the moral capacity of the person as "the receiver of God's self-revelation and as a creature destined for ... salvation in divine fellowship." In this book, divided into four major chapters, the author advances Christian autonomy as a philosophical reflective approach to transgenics, environmental issues, and nature in general. The table of contents helpfully details the major topics in each chapter, giving the reader guidance in finding subjects of interest. A four-page index in the back, while identifying major themes and writers, could have profitably been expanded with more detail. The fourteen page bibliography covers essential works consulted by the author in preparing her manuscript.

In the first chapter, the author describes transgenic technology as used in plants and animals for food production. Her response to the use of this technology is cautious and largely pessimistic. She fails to portray the benefit of this technology, but rather sees biotechnology only in a negative light. In contrast, she argues that sustainability is a virtuous alternative approach that can be integrated into environmental ethics. She is not clear on how her understanding of sustainability can practically substitute for biotechnology in effective food production, but leaves that issue to the reader's imagination.

In the second chapter, Russell further clarifies her understanding of Christian autonomy by describing the contribution of three theological sources: divine command, Christian communitarianism, and natural law. In assessing the contribution of divine command or revelation of Scripture, her Christian autonomy approach separates faith and salvation from moral obligation. Consequently, moral obligation is justified philosophically rather than theologically. The described Christian autonomy approach is "open" to the insights of Divine morality but is not bound by it, since Christian texts are "esoteric and inaccessible outside of Christian contexts" (p. 80). Christian communitarianism is a social philosophy which "suggests" that life is grounded in an ecclesial community. The community is a qualified hermeneutical one, that is, it provides interpreters, not necessarily of Scripture, but of global issues that lead to environmental virtue ethics (p. 89). Thus the author comments that "ecclesial communitarianism focuses not so much on the Word of

Book Reviews

God in Scripture, but on the Word of God in community" (p. 91). This communitarianism is a guard against individualism and is an alternative to deontological or consequential approaches to ethics. Finally, natural law gives full status to creation and attributes human rationality as a moral guide. Reason is the authority that weighs the sources for natural law approaches (p. 122). Russell says that her Christian autonomy approach contains five dimensions: (1) informs our sensibility to what is good for human flourishing (p. 132); (2) is relevant to motivation for our actions and ultimate meaning; (3) has heuristic potential in morality since tradition provides cautionary fences; (4) integrates insights from faith tradition and human sciences; and (5) relativises moral insights (pp. 132–4).

Chapter three describes environmental theologies and the practice of stewardship. She describes theocentrism as a religious attitude toward the cosmos as God's creation. Using Rom. 8:19–23 (NRSV) "for the creation awaits with eager longing for the revealing of the children of God ... in hope that the creation itself will be set free from its bondage to decay ..." and providing a new reading of Jesus' ministry, the author points to a salvation promised for all creation. From the Christian autonomy perspective, the author interprets stewardship as service, rather than as domination or co-creation (p. 91). This understanding of stewardship can lead us to sustainability that is compatible with Christian ethics.

In the fourth chapter, the author examines and critiques several theological perspectives on nature: the systematic theology of Wolfhart Pannenberg, the natural law ethic of Michael Northcott, and the virtue ethic of Celia Deane-Drummond. In each case, she summarizes the perspective and critiques it from her Christian autonomy understanding. Finally, a short conclusion after the fourth chapter restates the essence of Christian autonomy.

Initially, I was very interested in this book; the title seemed intriguing and held promise for hidden treasures. However, I soon became weary of the pedantic and ambiguous verbiage used by the author. Rather than stating ideas forthrightly, she frequently obscures them with theological jargon, making the ideas inaccessible to non-theologians. In many ways, the book reads like a dissertation rather than an apologetic for a theological approach to bioethics. The title is misleading in that the "food biotechnology" portion is almost exclusively described in chapter 1 and not seriously revisited elsewhere in the book. A more accurate title would simply be "Autonomy in Theological Ethics." The arrangement of the chapters seems to be disjointed. For most readers who are trying to understand "Christian autonomy," defining and describing this view in the beginning would have been helpful. Then applying that articulated view to transgenic biotechnology (chap. 1) would provide more clarity for the reader as she did for environmental theologies (chap. 3) and theologies of nature (chap. 4). Granted, the author does briefly comment about her "Christian autonomy" view in the Introduction, but does not describe it adequately (pp. 11–2). The scholarly awareness of the author is commendable. From my perspective and understanding, she accurately depicted the perspectives of numerous theologians and bioethicists. The extensive bibliography,

which cited over 180 references, contained most of the important readings for this topic.

I conditionally recommend this book for general reading. If you are seriously interested in theological ethics, then this book is worth your consideration and should be on your reference shelf. If you are interested in the ethics of food biotechnology but are not a theologian, the first chapter gives a review of some of the issues involved in biotechnology, but does not clearly provide an ethical framework to reflect on these issues. If you are interested in environmental ethics but are not conversant in theological ethics, you will struggle to get through the material in this book. In the latter case, borrow the book from your library instead of buying it. Finally, if you are interested in medical ethics, this book does not directly describe those issues. However, the ideas of "Christian autonomy" as described by the author can be applied to biomedical situations.

Reviewed by Roman J. Miller, Professor of Biology, Eastern Mennonite University, 1200 Park Road, Harrisonburg, VA 22802.



HISTORY OF SCIENCE

THE STRANGEST MAN: The Hidden Life of Paul Dirac, Mystic of the Atom by Graham Farmelo. New York: Basic Books, 2009. 539 pages. Hardcover; \$28.95. ISBN: 9780465018277.

Finally! In the past, I have read many books concerning the development of quantum theory, both technical and historical, and though I have read much concerning Bohr, Einstein, Heisenberg, Pauli, and others, and even personal reflections by them, rarely is there even a glimpse into the personal life of Paul Adrien Maurice Dirac. For so many years, his astounding achievements have been shrouded in mystery to me. Having waited a long time for such a book, this one did not disappoint. The book is replete with references to original material with which the author weaves together a cogent story. I will mostly try to recount some of the highlights.

Dirac was indeed a strange man. He was born (in Bristol, England, in 1902) to a Swiss father (Charles) and an English mother (Flo), and though I had known of his difficult childhood, I was shocked to find out how much his father mistreated him in many subtle ways. For example, at dinner he was made to eat alone with his father, and to speak only French though "he had no talent for languages" (p. 5), while two siblings, a brother Felix and a sister Betty were allowed to speak English with his mother. He did not like French, and his father made any request dependent on how well he did in French, so as a consequence, he did not say much. That became a habit which persisted throughout his life. He is sometimes known as the master of understatement. His father was an "unforgiving" teacher of languages (p. 5), which undoubtedly had something to do with the practice, but it is not clear why Dirac was singled out.

Dirac had an obvious talent for math and science, and as a consequence, he followed his brother into the engineering program at the University of Bristol (p. 28).

His extraordinary abilities ultimately led him into a mathematics program (p. 47), and finally, when offered a sufficient stipend, he was able to go on to Cambridge for a doctorate in theoretical physics (p. 53). There we read of such things as how he became the expert in Einstein's relativity theory while still a student and how he became close friends with Peter Kapitza, a Russian student in experimental physics, through the "Kapitza Club" (p. 66), a weekly seminar for the post-graduate students following a good dinner. We then see how Dirac's sympathy for the communist movement arose, as Hitler came to power in Germany. Throughout, Dirac continued to be an emotionally detached loner in his physics and in his private life, though he was deeply moved by the suicide of his brother Felix (p. 78) who always felt inadequate in the face of his demanding father and his overachieving brother.

Gradually, we are brought through Dirac's unfolding life, how he practically reinvented quantum theory on his own while others were working it out on the continent. We read how he traveled to Europe, meeting the most famous physicists of the time and taking his place among them, and how he puzzled out the so-called "Dirac equation," which was a first success in uniting quantum theory with special relativity. In this latter context, Dirac as much as predicted antimatter. In his twenties he was already one of the most important physicists on the planet, and in turning down offers elsewhere, such as Manchester and Chicago, a special lectureship at Cambridge was eventually arranged for him to keep him there (p. 158). By the time he was 30, he was named Lucasian Professor (p. 207), the chair that Isaac Newton once held, and that is presently occupied by Stephen Hawking. Shortly after, in 1933, Dirac was awarded the Nobel Prize in physics (p. 234), the youngest theoretician up to that time to receive the award. We also follow his personal life, how he enjoyed making trips to Russia, and how he began studying Russian amid some infatuation for Rho Gamow, the wife of the well-known George Gamow (p. 250). We further read how he met his wife Margit, née Wigner, on a trip to Princeton (p. 253). She was the sister of the famous Hungarian mathematician Eugene Wigner who worked at Princeton at that time. Margit was the outgoing socialite who gave Dirac balance.

There are many other things of interest in this volume, for example, how Dirac's view of mathematics was essentially platonic, and how he thought the concept of God was vague. An interesting exchange with his Russian teacher (after Rho) is revealing on this score. She thought mathematics had been invented, while Dirac thought it had "always existed," and had been "discovered" by humans. When she asked, "Doesn't that mean that it was created by God?" his answer was, "Perhaps animals knew a little mathematics" (p. 252). For Dirac, his physics was always led by his mathematics.

In his later years, influenced by his wife and the desire to find a warmer climate, Dirac moved to Florida State University (FSU) in Tallahassee, Florida, where their daughter Mary's husband Tony (Colleraine) had been given tenure in the physics department (p. 390). Having worked at FSU myself in the late eighties, on a personal note, I immensely enjoyed reading how my former boss, Joe Lannutti, worked on wooing Dirac to the campus, even though, as the book says, FSU was "known best not

for its physics department but for its student parties and the high quality of its football team" (p. 389), a statement I cannot deny. Dirac, of course, brought instant notoriety in accepting the position of "Visiting Eminent Professor" in 1971 (p. 390). I also enjoyed learning more about Dirac's "eccentric" assistant, Leopold Halpern, who took me under his wing while I was in Tallahassee. Halpern became a close friend to Dirac, taking him on canoe trips up the Wakulla river, causing Margit to worry when they arrived home later than expected (p. 397). After a somewhat prolonged illness during which Halpern jockeyed with Margit over whether homeopathic or traditional medicine would be administered, Dirac died in Tallahassee in 1984 (pp. 410-3).

To quote Freeman Dyson concerning what made Dirac's work so unusual:

The great papers of the other quantum pioneers were more ragged, less perfectly formed than Dirac's. His great discoveries were like exquisitely carved marble statues falling out of the sky, one after another. He seemed to be able to conjure laws of nature from pure thought—it was this purity that made him unique. (P. 428)

With this assessment, I concur. As important as Dirac's contributions are in physics, seeing them in context was a rare treat. Apart from Dirac's actual contributions to physics, a lot of what I have summarized above was new to me. Before reading this book, I had only the barest sketch of the man, Dirac, but now I have a much clearer picture of him as well as an understanding of how he interacted (or didn't) with the rest of the physics community. And indeed, the strangeness of his personality certainly emerges in this work as the title suggests. Because of the rarity of information on Dirac, and because of how well the book is written, for a theoretical physicist like myself, this was every bit as intriguing and difficult to put down as any fast-moving novel.

You may have noticed that little has been said of Dirac's posture toward God and/or religion, as would be suitable in a review for this journal. The reason is that neither played much of a role in the book, nor in Dirac's life in general. His father was raised a Catholic, and did apparently rediscover the religion of his youth after Felix died, but religion had little influence on Dirac, particularly in view of his dislike for his father. Dirac did write a few notes concerning religion, faith, and belief, in early 1933, but in these he said the notion of God was "rather vague and ill defined" and thus difficult to discuss rigorously (p. 221). Later in life, he once surprised colleagues by suggesting that the question "Is there a God?" was "one of the five most important questions in contemporary physics" (p. 401), although he went on to suggest that in order to make the notion more precise, we would need to understand what a world with a God and one without a God would look like (p. 402), and then approach the question empirically. He followed up, in almost a nod to intelligent design, by saying "If future scientists demonstrated that the creation of life is overwhelmingly unlikely, then, in his opinion, this would be evidence for the existence of God" (p. 402). On the other hand, he was very critical of organized religion and thought it "the height of arrogance for any group of people to claim that they alone know the truth" (p. 402). So as Halpern later wrote, "there was 'no

Book Reviews

trace of religiosity' in Dirac" (p. 402). No wonder he paid very little attention throughout his life to science/religion questions. Nevertheless, Dirac holds a central place in the development of modern physics; if you are at all interested in the history of physics, and particularly in twentieth-century physics, I would highly recommend this book as an absolute must read.

Reviewed by Donald N. Petcher, Department of Physics, Covenant College, Lookout Mountain, GA 30750.



NATURAL SCIENCES

INSIDE THE HUMAN GENOME: A Case for Non-Intelligent Design by John C. Avise. New York: Oxford University Press, 2010. 222 pages including notes, glossary, index. Hardcover; \$19.95. ISBN: 9780195393439.

Many of the readers of *PSCF* have heard this interesting story: a Harvard student sits in the office of the chaplain and confesses that he just does not believe in God. The chaplain responds, "Well, tell me about this God you don't believe in. I probably don't believe in him either." The veracity of the tale is dubious, but its lesson is centrally important, whether one is considering aspects of the divine or merely contemplating a challenging new idea. Which god are we confessing or rejecting or blaspheming? Which theory are we addressing or debunking? With whom are we agreeing or disagreeing? Readers of this book would do well to keep such questions before them as they consider Avise's ideas, which vary from the profound to the pedestrian, depending on the target of analysis.

Avise's project is twofold. His goals, spelled out repeatedly throughout the concise but frequently redundant text, can be discerned from this characteristically blunt remark on page 65, in a section entitled "Errors and Forgiveness":

A proverbial sentiment is that "To err is human, to forgive is divine." If the kinds of harmful mutations described above are to be attributed to an intelligent and otherwise revered agent (i.e., an omnipotent deity), then the popular phrase needs revision: "to err is divine, to forgive is human." Few people would blame a loving and all-powerful God for purposefully inventing deleterious mutations; that would be blasphemous.

Avise's first goal is to detail the myriad ways in which the human genome—in function and in architecture—is an exemplar, not of intelligent design, but of its apparent opposite: a "Byzantine contrivance" with features that were "accumulated stepwise by sloppy tinkering forces" (p. 74). Mere proneness to occasional disastrous mutation would not establish that conclusion, but Avise takes his case much further and to greater effect, pointing to fundamental features of the organization of the human genome that encourage and even facilitate dysfunction on various scales.

One full chapter examines various aspects of genomic complexity, ending with a focus on the peculiar fact that many of the genes controlling mitochondrial function are housed in the mitochondria themselves. This arrangement

is inefficient and fraught with danger (genetic material is housed next to a prolific generator of mutagenic reactive oxygen species), and Avise labels it "downright ludicrous." He notes that common descent nicely explains this design, but his chief aim is not to promote evolutionary explanation. It is to point out "logical problems" with the argument that genomes evince design by a wise and benevolent "supreme intelligence."

Another chapter describes the multitudinous repetitive elements that characterize the human genome, including hundreds of thousands of mobile elements that account for fully one third of every person's genetic endowment. These elements wreak havoc in several ways, causing malfunctions via effects ranging from subtle alterations in gene expression to catastrophic destabilization of whole chromosomal regions. Avise adds that many of these effects probably remain unaccounted for: mobile elements are particularly active in germ cells, and their action is expected to kill embryos very early in development. He notes that some mobile DNA elements have apparently been put to good use during evolution, but concludes that their huge numbers result in a genome that is "grotesquely infested with parasitic elements" (p. 130). Importantly, Avise asserts that the disorders arising from such features of the human genome are not merely "aberrations from a genetic blueprint of optimal design" (p. 127). They are outcomes to be expected in the presence of that grotesque infestation.

And so it goes. Avise's case is very strong. The human genome does seem to me to be a "genomic jungle" and a "Byzantine contrivance." Its imperfections are legion, and they are caused by "universal architectural flaws." These failures cannot be dismissed as minor glitches that have marred an initially perfect creation, nor can they be effectively described as necessary precursors to—or byproducts of—designed features or necessary functions. Avise concludes that "inevitable imperfection" is better established than irreducible complexity.

These challenges to intelligent design thought, along with some clear and well-written descriptions of evolutionary theory, are the strongest contributions of the book, and make it a worthwhile read for those interested in questions of design and optimization in biology. But do Avise's challenges refute, or weaken, design arguments? Surely the book undermines any rosy story of a benevolent designer carefully crafting a masterwork of exquisite design, but that is a caricature of many of today's design proposals. Avise is fair on this point, claiming mostly to shift attention onto flaws and evident failures of design and focusing on the concept of a loving and omnipotent God as the Designer. Nevertheless, the book should not be taken as a new or particularly effective rebuttal to typical claims of intelligent design theorists.

Avise's second project, however, is less successful and less valuable. Having shown that the human genome's deep flaws lead to widespread suffering and death, he moves to conclude that this fact brings some significant resolution to Christianity's struggle with the problem of evil, arguing (as have Francisco Ayala and others before him) that "evolution by natural causes emancipates religion from the shackles of theodicy" (p. 157). How does evolution accomplish this? On page 158, he answers,

No longer need we blame a Creator God's direct hand for any of these disturbing empirical facts. Instead, we can put the blame squarely on the agency of insentient, natural evolutionary causation.

This reasoning will strike many readers of *PSCF* as basically flawed. While some may agree that natural causation rules out the work of God's "direct hand," the suggestion that this shifts responsibility away from him completely, does not follow. After all, one need not wield a weapon with one's own hands to be held culpable for a crime. I suspect that most Christians would agree with me that there is little if any distinction between causing pain and standing by while it is caused by someone or something else. Blame-shifting just does not help: once we confess an omnipotent deity with the means to intervene, we put that deity right back on the hot seat of theodicy. Perhaps Avise has a different god in mind when he seeks to absolve the divine. In any case, assessing his success requires identifying this god a priori.

Avise has argued successfully against the proposal that the human genome is an example of excellent design, or even a product of a little bit of optimization, and his case is worth examining. And while his attempt to bring some peace to the struggles between evolution and some sectors of Christendom is a decent thing, few of us would have thought that the problem of evil could be so easily dispatched.

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ROUTES OF LEARNING: Highways, Pathways, and Byways in the History of Mathematics by Ivor Grattan-Guinness. Baltimore, MD: The Johns Hopkins University Press, 2009. xii + 372 pages, with index. Paperback; \$35.00. ISBN: 9780801892486.

Ivor Grattan-Guinness has enjoyed a long and illustrious career as a prominent historian of mathematics. Since 1970, after receiving his doctorate in history of science, he has authored several large books and numerous articles, and he has edited both a massive two-volume survey work (*Companion Encyclopedia of the History and Philosophy of the Mathematical Sciences*) and a work containing extensive primary source material (*Landmark Writings in Western Mathematics, 1640–1940*). In addition, he has delivered hundreds of invited addresses worldwide, been an editor for several important journals in the history of science and mathematics, founded and edited *History and Philosophy of Logic*, and held high offices in professional organizations related to history of mathematics.

Grattan-Guinness's special interests and scholarly output lie mainly in the history of calculus (foundations and physical applications), mathematical logic, and foundations and philosophy of mathematics. While his primary focus has been nineteenth- and twentieth-century European mathematics, some of his writings treat earlier developments and other cultures, such as Greek geometry, and he has also written a general work on the history of mathematics. His entry into the field of history of mathematics was, as was my own and others', prompted by dissatisfaction with the way undergraduate mathematics is typically

taught—with little reference to central motivating questions and almost no discussion of its historical development or human involvement. This experiential background manifests itself in Grattan-Guinness' keen interest in the meaning and use of history of mathematics, in his passion to make history of mathematics serviceable to mathematics educators.

Routes of Learning reprints (occasionally, revises) some of Grattan-Guinness's earlier articles. These go back as far as 1972, but the book is certainly not a *best of career* reproduction, showcasing what he has been engaged with over the last forty years. In fact, very few of the eighteen chapters touch on the topics for which Grattan-Guinness is best known. None deal with the history of mathematical physics, calculus, analysis, mathematical logic, set theory, or foundations of mathematics, except in an incidental or illustrative manner. *Routes of Learning* has instead a more philosophical or epi-mathematical bent, containing reflective essays on the value and use of history of mathematics and its connections with matters somewhat off the beaten path.

The book begins with an introductory autobiographical piece on how Grattan-Guinness came to the field of history of mathematics, a field he wryly categorizes, with regret, later in the book (chap. 6) as being "too mathematical for historians and too historical for mathematicians" and "both too historical and too mathematical for philosophers," undoubtedly along with everyone else. Nevertheless, interest in history of mathematics has increased over the last half century, if the rise of the field as a bona fide profession (documented in chap. 3) is any indication.

Part 1: Highways in the History of Mathematics explores various historiographic issues, broadly considered. The questions it implicitly takes up in seven essays are the following: What is history of mathematics, and how does it differ from mathematical heritage? Who should (and does) do history of mathematics? Whom and what is it for? How is it related to mathematics? to the history of science? Does mathematics develop historically in qualitatively different ways from physics and other sciences? Does it include revolutions and radical paradigm shifts or only convolutions (Grattan-Guinness's term for a more complex sort of change)?

Part 2: Pathways in Mathematics Education looks at ways history of mathematics can enrich and inform mathematics education. Grattan-Guinness discusses this in general terms, but he also investigates specific fields and topics (Greek geometric algebra, number concepts and computational procedures, calculus), and he sketches out a history of mathematics course he once developed for teachers.

Part 3: Byways in [the History of] Mathematics and Its Culture traces the multifaceted relations connecting mathematics and religion, and the various numerological ties linking mathematics and music. We will say more about this section shortly.

Part 4: Lollipops is a peculiar supplement tacked on to the end of the book. It consists of one ten-page chapter, devoted to an exposition of *Four Pretty but Little-Known Theorems Involving the Triangle*. This might be of some interest to mathematics educators, but little hinges on it from a historical or philosophical perspective.

Book Reviews

Taken together, the essays in this book give the reader a good picture of what has motivated Grattan-Guinness's tireless work as a historian of mathematics. It presents the author's personal viewpoint on a number of historiographic and interpretative issues that have been debated by historians of mathematics over the last generation or so. The book is rich in references and allusions to historical topics that Grattan-Guinness has spent a lifetime researching, but at times one wishes he would share more of the wealth of his knowledge to flesh out off-hand comments or bare-bones assertions not readily comprehended by outsiders, such as the claim that Descartes' algebraic geometry was not coordinate geometry (p. 199) or that Piaget misunderstood Bertrand Russell's program (p. 207). However, for those interested in Grattan-Guinness's take on the topics under consideration here, this volume provides them with an easily accessible source.

Back now to the book's less-traveled byways, what some might consider oddball connections between mathematics and religion. Readers of this journal might be more interested than most in Grattan-Guinness's essays on mathematics and religion or mathematics and numerology/Freemasonry. One essay details numerological features of the music of Mozart and Beethoven, while two longer essays are devoted to connections between mathematics and different Christian traditions (here called "the Christianities"). Noting that this topic remains largely outside the pale of normal historians' interests, Grattan-Guinness makes a case for why it deserves more attention than it has been given.

His main focus in the first of these essays is the influence of mathematics through special numbers and shapes on Christian sacred writings, doctrines, and architecture. The second essay explores the decreased linkage between mathematics and religion since the time of the Enlightenment (with certain notable exceptions), attributed to the secularization of mathematics and science in Western cultures. Grattan-Guinness finds this public silence by mathematicians on religion somewhat puzzling, however, since debates over the relation of science and religion have never completely disappeared, and he wonders whether further historical research into the phenomenon would clarify or modify our picture of this development. He recognizes to some extent that there still are Christian mathematicians and educators, particularly in English-speaking countries, who desire to give a greater role to Christian faith in their work. The annotated *Bibliography of Christianity and Mathematics* edited by Gene Chase and me in 1983 is cited in a footnote, but he nevertheless seems unaware of the Association of Christians in the Mathematical Sciences, which has been in existence in the USA since 1977 and has had an online presence since 2004. While he recognizes that many mathematicians now and earlier have held private religious beliefs, he asserts that this has had no real impact on their view of mathematics or its practice.

Grattan-Guinness is fascinated by the possible mystic connections between faith and mathematics, but he lacks sympathy for those who would embrace closer connections between the two: "My own logical stance is, God save us from religions [i.e., organized faiths], especially the aggressive ones" (p. 242). This negative attitude notwithstanding, those taking a different approach to this

topic will still want to read what Grattan-Guinness has to say about it, for not much has been written on Christianity and mathematics from a scholarly historical viewpoint.

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PHILOSOPHY & THEOLOGY

BELIEF: Readings on the Reason for Faith by Francis S. Collins, ed. San Francisco, CA: HarperCollins, 2010. 352 pages. Paperback; \$19.99. ISBN: 9780061787348.

Francis Collins wants you to believe in God, not in any particular religious tradition's understanding of God—it would seem—just the general concept of God. And he is persuaded that you are more likely to believe in God if you can first believe that it is not irrational to do so.

Collins has both experience and credibility to make this argument, despite his repeated protestations in this volume that he is neither theologian nor philosopher and therefore an unlikely editor of a collection of readings on the rationality of belief. Currently the director of the National Institutes of Health and former director of the National Human Genome Research Institute, Collins wrote *The Language of God: A Scientist Presents Evidence for Belief*, a 2006 memoir of his own intellectual journey from atheism to Christian theism, which subsequently became a *New York Times* bestseller. In other words, people are reading Francis Collins, and they are specifically reading his thoughts on the existence of God. HarperCollins was thus wise to publish *Belief*.

Who has been buying and reading *The Language of God*? Are they atheists or agnostics who are genuinely interested in hearing how one of their own came to faith? Are they wavering believers who have been jolted by the assault of the new atheism over the past decade? Or are they devout believers in God whose own confidence in their faith is bolstered by the testimony of a celebrated, respected, and highly educated scientist? I suspect that a significant majority of Collins' readers represents that third demographic. In an era in which scientists often carry the authority of a secular priesthood, Collins' conversion story has had a salutary effect, particularly for his fellow evangelical Christians, many of whom have believed themselves increasingly marginalized in American culture.

Whoever has been buying *The Language of God*, this new volume is explicitly directed at a market of unbelievers, specifically those who have given up on the rationality of faith. To make the argument, Collins amasses a collection of readings from a few historic but mostly contemporary philosophers, theologians, and other writers. They are an impressive and varied array of voices, including quite a few who were alive and active in the early twenty-first century. These include N. T. Wright, Annie Dillard, the Dalai Lama, Os Guinness, John Stott, Desmond Tutu, Elie Wiesel, Tim Keller, John Polkinghorne, Art Lindsley, Keith Ward, Madeleine L'Engle, Alister McGrath (who assisted in the selection of readings), Hans Küng, Paul Brand, Alvin Plantinga, and Antony Flew. It is interest-

ing, given Collins' own credentials and the nature of the objections he is attempting to counter, that Polkinghorne is the only recognized scientist on this list. (McGrath has scientific credentials but is recognized primarily as a theologian.)

If one adds to this list of contemporary authors those whose voices spoke primarily or solely in the twentieth century (C. S. Lewis, Thomas Merton, Elton Trueblood, Dorothy Sayers, Mother Teresa, Dietrich Bonhoeffer, Martin Luther King, Viktor Frankl, Mahatma Gandhi, and G. K. Chesterton), the tilt of this volume toward recent voices becomes very plain. The historical "contributors" include two ancient Greeks (Plato and Aristotle), three medieval theologians (Augustine, Anselm, and Aquinas), and two Enlightenment philosophers (Locke and Pascal), all of whom, it may be noted, are in the Western tradition. As a historian, I would be gratified had more historic voices been introduced, but I understand the logic of this selection in the light of what would appeal to a contemporary audience.

The contributors are largely Christian but not entirely so, which is one of the confusing aspects of this book. Is Collins arguing for theism broadly understood? If so, his inclusion of the Greeks, of a couple of Jewish authors (Frankl and Wiesel), and a couple of "Eastern" religious leaders (Gandhi and the current Dalai Lama) makes sense. But they are not well integrated. For instance, the chapters are arranged by topic (e.g., "Faith and the Problem of Evil and Suffering," "The Harmony of Science and Faith," and "The Irrationality of Atheism") except for the one simply labeled "Voices from the East." Do Gandhi and the Dalai Lama have nothing to contribute to any of these topics? And where are the voices from the South? Africa and Latin America (as well as the Middle East and East Asia) are entirely missing from this volume.

Or does he want to bring his readers specifically to some kind of monotheism? Why no Muslim authors then? And Gandhi and the Dalai Lama might be considered monotheistic only by stretching the term beyond its usual boundaries. But if the goal is broad monotheism, then why is the list so heavily populated with Christians? Truth be told, Collins is writing primarily to American and British readers, and it is obvious that he is hoping to introduce them to at least an elementary Christian theism, which is particularly evident in how the essays he has chosen address issues of suffering, justice, and truth. And that is all well and good, given who he is. His book might have greater coherence had he simply said so, and then organized his readings to lead to that conclusion.

Having said that, his choices are, for the most part, good. Some are classics and familiar, but others I had not previously encountered and enjoyed. Most are short enough to be readable, accessible enough to be appreciated by an educated layperson, and provocative enough to stimulate further thinking. Yes, I have offered my quibbles about who is in and who is not, and others will have their own; Collins acknowledges this. But since his primary goal is to present a rational basis for belief, the readings are directed toward that aim. And, depending on the particular intellectual objection that a reader may have toward faith, there will likely be a reading that will address it. Will this volume persuade anyone to believe

in God, like Lewis's *Mere Christianity* did for Collins (and others)? It is doubtful. But if it eliminates an obstacle or two, if it encourages a few to dig more deeply, if it mitigates a little the shrill voices of atheism in our culture, perhaps it will constitute at least a minor contribution to a long, long conversation.

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SCIENTIFIC AND PHILOSOPHICAL PERSPECTIVES IN NEUROETHICS by James J. Giordano and Bert Gordijn, eds. New York: Cambridge University Press, 2010. 374 pages. Paperback; \$50.00. ISBN: 9780521703031.

Giordano is a Fellow of the Centre for Philosophical Psychology, University of Oxford; and Gordijn, a professor of ethics and secretary of the European Society for Philosophy of Medicine and Health Care. Their eighteen-chapter anthology contains reflections and beliefs involving the conceptualization and application of neuroethics to our ever present desire to live longer, healthier, or even enhanced, earthly lives.

The book states that it is written for researchers and graduate students in neuroscience and bioethics; however, without a sound and extensive knowledge base in the discipline of philosophy, including recognition of the ideas, terminology, and historical contexts of the world's greatest philosophers, a reader would be trudging through the chapters with a dictionary, encyclopedia, and/or internet access in order to appreciate what Walter Glannon describes in the afterword as "fascinating perspectives on multiple dimensions of basic and applied neuroscience." Upon acquiring or having some semblance of the necessary background knowledge in biology, neurology, psychology, sociology and philosophy (the forte of the branch of medicine called psychiatry), the reader will find that the book is a compilation of opinions or statements that were presented as factual, but were, in several cases, specious or at least subject to argument.

The introduction states that the purpose of the book is to examine three core questions: the direction of neuroscientific inquiry, how neuroscience has, to date, affected scientific and philosophical ideas, and what the potential ethical issues are now and in the future. After slowly, painstakingly, and diligently reading the book, I still cannot answer these questions any differently than I would have before I read the book. What I can say is that I have refreshed my undergraduate learning related to epistemology, empiricism, ontology, Kant, material reductionism, Cartesian interactionism, exigency, interiority, heuristic, hermeneutics, deontic logic, idealism, emergentism, physicalism, reductionism, and phrenology; all of these I had to research on my own as the book has no glossary to assist the reader. I can also say that I learned a new word, "exjuvantibus," which means making an inference about a disease cause from an observed response to treatment.

The book was divided into four domains: (1) the history of neuroscience, chapters 1-3; (2) issues of ethics, chapters 4-8; (3) development of neurotechnology, chapters 9-14; and (4) neuroethics in the worldview, chapters 15-18. Each chapter has its own contributor or

Book Reviews

contributors. The credentials, degrees, or qualifications of the contributors are not included; therefore readers must again either do their own research or depend on a previous knowledge of the authors. The contributions are all over the place in presentation, ranging from simple statements such as defining a nerve cell to very complicated discussions of neuroimaging techniques. The reader is constantly having to reset reading pace—from trudging through tedious discussions of “details” to racing past what seems obviously simple.

What was missing of greatest importance for the titled themes was any succinct or memorable discussion of the purpose of life. This teleological discussion is absolutely necessary in any discussion of ethics as it pertains to human health and well-being. The book covered topics ranging widely from medical interventions for pain, paralysis, and brain injury, all the way to aesthetic enhancements and the potential to engineer a “super mind”; yet what was missing was a forthright discussion of the commonly accepted principles of health-care ethics and, most importantly, the essence of faith, hope, and love in directing humankind in the pursuit of knowledge and ultimate wisdom. I end by saying that I do respect the contributors for their knowledge and effort.

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ABSENCE OF MIND: The Dispelling of Inwardness from the Modern Myth of the Self by Marilynne Robinson. New Haven, CT: Yale University Press, 2010. 158 pages, index. Hardcover; \$24.00. ISBN: 9780300145182.

Marilynne Robinson, the brilliant and admired writer of award-winning novels, joins a long line of distinguished thinkers from a variety of disciplines who have challenged the aggressive reductionism of scientific materialists. Those who have read her three novels, *Gilead*, *Home*, and *Housekeeping*, are already keenly aware that Robinson is one of the best writers of our time, certainly one of the most theologically attuned. But she has also written on a variety of topics, including a sharp critique of modern thought in her anthology of essays *The Death of Adam* (1998, 2005). In the spring of 2009, she delivered the prestigious Dwight H. Terry Foundation Lectures on Religion in the Light of Science and Philosophy at Yale University—the same lecture series that gave us John Polkinghorne’s *Belief in God in an Age of Science* (1998)—published in 2010 as *Absence of Mind*.

Robinson’s argument is simultaneously clear in its contours, subtle in its nuance, and elegant in its unfolding. She takes on vintage positivism for excluding from its model of reality “whatever science is (or was) not competent to verify or falsify” (p. xii). By banishing metaphysics in favor of reductionistic materialism, positivism and the modernist consensus it has helped to forge are cut off from the rich insights not only of the religious narrative but also of the classical and humanist traditions. The result is a very truncated conversation about what it means to be human. Claiming to speak with the authority of science, the current crop of science popularizers and new atheists has done little to enrich the conversation and has

produced a conceptually derivative and unsatisfactory “parascientific” literature.

Robinson is especially critical of how parascientists from both the neo-Darwinian and Freudian camps explain away the mystery of human consciousness without accounting for the reality of lived experience. Why do they do this? In part, it is because modern intellectuals can only account for the stubborn persistence of faith by resorting to what Robinson calls a “polemic against the mind” (p. 74). Faith is a delusion of the mind, so parascientists must argue that the mind is not to be trusted. “The experience and testimony of the individual mind,” she contends, “is to be explained away, excluded from consideration when any rational account is made of the nature of human being and of being altogether” (p. 22). And what “great new truth” are we given to replace the pervasive errors in previous thought, particularly those that assumed the God of traditional Western religions? We are told that the world is “a creature of accident, that it has climbed Mount Improbable incrementally and over time through a logic of development, refinement, and elaboration internal to itself and sufficient to account exhaustively for all the complexity and variety of which reality and experience are composed” (pp. 22–3). Anything smacking of human exceptionality is sheared from serious consideration, and the very idea that we ever imagined that humankind held a special place in the universe is viewed as preposterous. Such an unsatisfying view, based as it is on a “hermeneutics of condescension” (p. 14) that discounts felt experience as mere subjectivity, is grossly and arrogantly dehumanizing.

Early on, Robinson suggests that an honest inquirer into the nature of religion would do well to “spend an afternoon listening to Bach or Palestrina, reading Sophocles or the Book of Job” (p. 14). Doing so, it would seem, might make it very hard to take the parascientific project seriously. But clearly there are very bright people who do. The pervasive persistence of faith should not be dismissed as a delusion, but what are we to say about the stubborn resistance to interiority and mystery in the name of reductionism? In recent years, a number of very good books have attempted to address this question. *Absence of Mind* may well be one of the best of the lot, in large part because of rich sentences such as, “Subjectivity is the ancient haunt of piety and reverence and long, long thoughts” (p. 35). Robinson’s argument that reality, as experienced by the mind, is infinitely more complex, mysterious, and intriguing than the flat, parascientific dogma, as dished out by the materialist monists, is eloquently convincing.

Reviewed by Donald A. Yerxa, senior editor of Historically Speaking, Boston, MA 02215; editor-designate of Fides et Historia and Professor of History Emeritus, Eastern Nazarene College, Quincy, MA 02170.

PAUL IN ECSTASY: The Neurobiology of the Apostle’s Life and Thought by Colleen Shantz. New York: Cambridge University Press, 2009. 267 pages. Hardcover; \$85.95. ISBN: 9780521866101.

Theologian Colleen Shantz wrote *Paul in Ecstasy* to draw attention to religious experiences such as visions or revelations. Shantz believes that these experiences define an im-

portant “feature of Paul’s life and impetus to his thought.” She convincingly demonstrates that religious ecstasy is rarely taken up as a category of Pauline studies—and when it is addressed, it is done so using negative terms. This oversight troubles her because she believes strongly that the pervasive bias against religious ecstasy as a legitimate phenomenon worthy of study has diminished our capacity to fully understand Paul’s writings. If *experience* is not recognized as a valid construct to explore, Shantz believes we lose the ability to ask important questions regarding Paul’s ministry, such as, “How did Paul come to know this?” and “What kind of knowledge is it that arises out of (bodily) experience?” Past as well as contemporary New Testament scholarship has emphasized “what Paul said” with a premium placed on knowledge that could be put into words, sacrificing Paul’s experience of religious ecstasy, which does not lend itself to language-based descriptions.

The book appears to have originated from a doctoral thesis. In its current form, it still reads like a dissertation. Although the book is clearly an academic work written with a theologically informed audience in mind (e.g., there are over 900 references cited), those within the scientific community would appreciate a discussion of how cognitive neuroscience can be brought into the discussion to elucidate Pauline studies.

A number of books that attempt to integrate divergent bodies of literature, such as science and religion, tend to fall into one of two categories: books that lack theological rigor yet possess a strong scientific foundation, or books that articulate deep theological insights, but sacrifice scientific rigor. *Paul in Ecstasy* does not fit either of these two extremes. This theologically rich book does an excellent job of bringing in credible studies and models from brain science (mostly from neurology and cognitive neuroscience). The book stretched me in terms of my theological background and language preparation; however, I could comprehend enough of the arguments to come away with a deep appreciation for what the author is trying to communicate.

The book contains an introduction followed by five chapters. The introduction sets the stage for studying Paul’s ecstatic experiences by drawing upon “neurological, exegetical, and social anthropological perspective approaches” (p. 18). Chapter one dissects our cultural bias against religious ecstasy and attempts to understand why biblical commentators (particularly Protestant scholars) ignore or downplay its significance. Paul’s dramatic conversion experience, according to Shantz, is frequently used as a “catchall” by systematic theologians to lump together several other ecstatic experiences described in the scriptures. Chapter two explores other disciplines that have taken a more accepting and inquisitive view of religious ecstasy. The author turns her attention to cognitive neuroscience and neurology. *PSCF* readers will feel drawn into the debate at this point, since scientific methodologies and research are brought to bear on the topic and integrated with biblical constructs. We also learn what kinds of experiences are regarded as religious ecstasy: speaking in tongues, visions and/or revelations, ecstatic prayer (Rom. 8:23, 26), sign and wonders, and Paul’s ascent account (2 Cor. 12).

Chapter three addresses specific types of ecstasy (e.g., visions) along with their corresponding scriptural passages. Shantz’s exegesis leads to several interesting conclusions one such being that ecstatic speech was much more prevalent in Paul’s day than what is currently communicated by New Testament scholars. Chapter four looks at the practice of ecstasy within social groups. The question “How is religious ecstasy controlled and interpreted within communities?” becomes a central focus. Chapter five is brief and is used to summarize points made earlier. Shantz also makes it clear that the “aim of this study has not been to replace conventional ways of reading Paul with some sort of neurological reading ... but rather to suggest that we make a greater attempt to add experience” to our discussion.

PSCF readers should appreciate her attempt to use relevant scientific findings to broaden important theological questions that affect how scripture can be interpreted. *Paul in Ecstasy* could serve as a model for other scholars to tackle interesting questions concerning how religious Scripture intersects with scientific knowledge. *PSCF* readers will be aware that over the past thirty years an enthusiastic and refreshing movement has emerged to support serious, thoughtful scholarship on the interplay between science and theology. Shantz’s book is a welcome addition to this genre.

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RELIGION & BIBLICAL STUDIES

HOW GOD ACTS: Creation, Redemption, and Special Divine Action by Denis Edwards. Minneapolis, MN: Fortress Press, 2010. xiv + 207 pages. Paperback; \$27.00. ISBN: 9780800697006.

Edwards is an Australian Roman Catholic theologian who has long been engaged in the science and theology dialogue. In brief, he defends the notion of “special divine action,” albeit within a noninterventionist model. In other words, God does act to create and redeem the world, but neither by breaking in upon creation from the outside nor by overturning, disrupting, or bypassing the laws of nature. Instead, if creation itself is understood as the kenotic “self-bestowal of God,” then God both enables and empowers evolutionary emergence and creaturely autonomy to flourish in and through the chance and lawful processes of the world.

At first glance, Edwards’s thesis might seem counter-intuitive: if God works according to and within the limits of creaturely processes, then how can he insist that God also acts “especially” to redeem the world? Part of Edwards’s response is to say that talk about “special divine action” is warranted when specific effects—e.g., the emergence of life—are intended by God as outcomes of the world’s evolutionary history. Another aspect of his reply is that divine noninterventionism therefore occurs through secondary causes (God as primary and ontological cause is an ancient notion in the western theological and philosophical tradition). Once we understand that God acts through secondary causation, then Edwards’s

Book Reviews

argument can be situated within the broader framework of his trinitarian theology of creation—as exemplified in his *Jesus and the Cosmos* (Paulist, 1991), *The God of Evolution: A Trinitarian Theology* (Paulist, 1999), and *Breath of Life: A Theology of the Creator Spirit* (Orbis, 2004) among other single-authored and edited volumes—that has been forged over the last twenty years in dialogue with a wide range of theologians and natural scientists.

How God Acts thus presumes both the long (13–14 billion year) evolutionary history of the world and the broad biblical narrative of the Christ event that includes the Incarnation, ministry, death, and resurrection of Jesus—the whole Christ-Event, as Edwards says—and his subsequent giving of his Spirit in saving, redeeming, and deifying transformation. Thus, the last few chapters of the book unpack God’s special actions of resurrection (especially of Christ), redemption from (original) sin, final (eschatological) fulfillment, and responses to prayers of intercession. In the case of the resurrection of Jesus, for example, the emergence of life from out of death is already immanent within the evolutionary process. Jesus’ coming back to life from the dead is thus comprehensible as the initial representation of the ontological transformation of the created order *from within* (rather than occurring from without, transcendently), which effectively transforms creatures through the post-Easter experiences of the disciples and their bearing witness to the risen Christ. Thus Christ is the sacrament and first fruits of salvation in which creation, beginning with the disciples, participates and, through such participation, experiences redemptive transformation now in anticipation of the final consummation. Similarly, intercessory prayer enables humanity’s participation in the creative and redemptive work of God, allows for us to share what matters with God, and is a means through which we entrust ourselves to God and express our desire for God and for God’s will to be done. Thus God answers prayers variously through interfacing with us as secondary causes who carry out or effect God’s will in the world.

We might anticipate various responses to *How God Acts*. Those who emphasize the hermeneutical character of discerning God’s special acts—in other words, that any claims to special divine action can be made only in faith, given certain theological presuppositions about God and about the nature of God’s relationship with and to the world—would not appear to have to make any major adjustments to their views. Some of the participants in the theology and science dialogues on divine action might complain that Edwards does not seem to consider proposals of divine action based on God’s communicating information to the world (as opposed to God’s energetic interface with the world). A third group of more evangelically inclined Protestants might be put off by Edwards’s reliance on Karl Rahner as his major theological dialogue partner throughout the volume.

But all in all, I recommend this book because its author writes clearly and accessibly (including to interested lay people), he is informed about the debates and about what is at stake, and his proposal strives to be faithful to the biblical witness and the Christian faith even while attempting to do justice to the nature of the universe as understood by modern science. The pastoral sensitivity reflected in Edwards’s ecological theology—including *Jesus the Wisdom of God: An Ecological Theology* (Orbis, 1995) and *Ecology*

at the Heart of Faith (Orbis, 2006)—is here also exemplified. Students and scholars will benefit from this book, even if in different ways.

Reviewed by Amos Yong, J. Rodman Williams Professor of Theology, Regent University School of Divinity, Virginia Beach, VA 23464.



RELIGION & SCIENCE

SUBJECTIVITY, OBJECTIVITY, AND INTERSUBJECTIVITY: A New Paradigm for Religion and Science by Joseph A. Bracken. West Conshohocken, PA: Templeton Press, 2009. 234 + xiv pages. Paperback; \$27.95. ISBN: 9781599471525.

The stated aim of this book is to contribute a new framework for understanding subjectivity, objectivity, and intersubjectivity in the dialog between religion and science. The book approaches this goal using as a guide the traditional metaphysical problem of the One and the Many—and in particular, Alfred North Whitehead’s approach to this problem. According to Bracken, Whitehead focused on self-constituting subjects of experience rather than enduring substances as the most really existing things in the universe (p. 5). However, Bracken criticizes Whitehead’s metaphysics for remaining committed to philosophical atomism (p. 5). The main theoretical orientation of the book then is that a corrected Whiteheadian metaphysic can help resolve some of the problems that emerge at the intersection of religion and science by providing a new framework for understanding the natural world and our knowledge of it (p. 6).

In the first seven chapters, Bracken highlights several threads running through the history of philosophy that are in some way connected with objectivity, subjectivity, and intersubjectivity and the problem of the One and the Many. Chapter one discusses the late medieval shift to nominalism and the way that this opened the door for subjectivity in philosophy and the natural sciences. Chapter two presents Descartes and Locke as moving this turn toward the subject forward in the early modern era by focusing epistemology on the knowing subject and the process by which it comes to know the world. Chapter three discusses Berkeley, Hume, Spinoza, and Leibniz in regard to their views of matter, substance, and the natural world. Chapter four deals with Kant’s view that sense experience is structured by *a priori* categories and his Analogies of Experience. The fifth chapter discusses post-Kantian transcendental idealism, focusing on Fichte, Schelling, and Hegel, and explains how each philosopher can be seen to be responding to Kant’s fortification of the Cartesian turn to the subject. Chapter six describes what Bracken takes to be attempts by Kierkegaard, Levinas, and Buber to overcome systems thinking. And finally, chapter seven looks at Heidegger’s metaphysics, which takes events rather than things as most fundamental.

The remaining four chapters (not counting the conclusion) take on contemporary topics in philosophy of science and theology. Chapter eight examines the doctrine of the Trinity, arguing for an interpretation on which the interrelation [*perichoresis*] of persons in the Trinity serves as a model for understanding the relationship between con-

crete individuals in the natural world. Bracken argues that this helps explain how existent things separately retain their individuality while remaining part of a larger universe. Chapter nine discusses self-organizing systems in relation to the theories of Ervin Laszlo and Stuart Kauffman. Chapter ten argues that a Whiteheadian view of the part/whole relationship can be used to come to terms with contemporary field theories in physics and biology. Finally, chapter eleven addresses the fruitfulness of the concept of a block universe as a beginning point for understanding time and eternity and God's relationship to the created universe. The theme that unites these divergent topics seems to be emergence—how it is that the whole can be more than the sum of its parts and how it is that individual elements remain part of a larger whole without losing their individuality. Bracken presents these questions as applications of the traditional problem of the One and the Many.

The strength of the book lies in its use of Whitehead's metaphysics to frame established problems and entrenched debates in a new way. This is much more true of the second half of the book because of its focus on contemporary topics rather than on history of philosophy. For instance, in chapter seven, there is a very interesting extended comparison of the respective metaphysical theories of Whitehead and Heidegger. Furthermore, chapter nine contains an illuminating discussion of how Whitehead's theory of actual occasions can be used to complement Kauffman's work on self-organizing systems (pp. 151–2).

The main drawback of the book is that the breadth of its scope within such a confined length prevents deep exposition of any one topic and leads to a sense of lack of focus. Throughout the book, Bracken brings a number of disparate problems in widely divergent contexts under the broad heading of "The One and the Many." Yet these topics do not often cohere very well, and the interconnections between them are sometimes merely assumed rather than explained. More could have been done to motivate the use of the One and the Many as the locus for discussing issues that emerge at the interface of science and religion. This drawback is reflected in the coverage of the topics in individual chapters. The presentation of much of the historical material in chapters one through six tends to be derivative and is not connected explicitly enough to the aim of the book. Of the topics expounded in chapters seven through eleven, the reader is often left desiring a deeper and more sustained discussion. Finally, the subtitle of the book promises "a new paradigm for religion and science," suggesting a new theoretical or methodological perspective for understanding the relationship between science and religion. Yet the book fails to significantly engage contemporary debate on the latter relationship, because it does not clearly enough define the problem that it is trying to solve.

Despite these flaws, the book sketches a unique theoretical approach to understanding a number of diverse topics that are currently of interest to religious believers—especially Christians—who are engaged in reflection on contemporary science. It could well be used as a text for discussion in upper-level undergraduate courses—for instance, in doctrine of creation or perspectives on science classes—provided that it be supplemented with

texts that more explicitly address the relationship between faith and reason, religion and science, and the ongoing conversation between proponents of science and religion.

Reviewed by Joel A. Schickel, Department of Philosophy, University of Dayton, Dayton, OH 45469.

DECODING THE LANGUAGE OF GOD: Can a Scientist Really Be a Believer? by George C. Cunningham. New York: Prometheus Books, 2010. 247 pages. Paperback; \$18.00. ISBN: 9781591027669.

Francis Collins' *The Language of God: A Scientist Presents Evidence For Belief* (2006) dropped like a bomb on the American scene. When has a scientist of such national prominence given his "personal testimony" and offered a case for Christian faith, and how he relates this faith to his scientific life? *The Language of God* appeared at a time when the so-called "new atheists," R. Dawkins (2006), S. Harris (2006), D. Dennett (2006), and C. Hitchens (2007), were prominent in the media. That flood continues.

It was a field day for reviewers, bloggers left and right, Christians of all flavors, the press, and talk shows. After a couple of years of public discussion, things quieted down until Collins was nominated by President Obama to head the National Institutes of Health. The pundits re-emerged to consider whether the "Christian" Collins was worthy of filling the post. The *New York Times* cited his significant scientific and administrative achievements but warned readers that "praise for Dr. Collins was not universal or entirely enthusiastic," because of his book and public discussion about his conversion experience and his "evangelism." Nonetheless, he was readily sworn in as Director on August 17, 2009.

Now Cunningham, the retired chief of the Genetic Disease Branch of the California State Department of Health Services, weighs in on the discussion:

I found Collins' arguments and "evidence" that religious beliefs can be reconciled with scientific truth, unconvincing. I focus on the evidence that Collins uses to support his belief that Jesus Christ is the creator God who desires fellowship with humankind. Collins' book attempts to convince readers of two propositions: first, it is rational to believe in a personal God who desires fellowship with humans and second, this personal God is the historic Jewish teacher, Jesus. I intend to show how Collins' attempt fails and to demonstrate that no one can simultaneously accept belief in a personal God and still claim to be a logical and rational scientist without engaging in magical thinking. (P. 14)

... the arguments he uses are not rational, logical, or consistent with modern science. In truth, they are rationalizations for blind, unsupported, faith. (P. 15)

While using Collins as the prototype for believing scientists, Cunningham includes K. Miller (2007), F. Ayala (2007), D. Falk (2004), J. Roughgarden (2006), and C. S. Lewis (Collins' hero) as guilty of the same flaws.

Evangelist Cunningham asks his readers "to set aside a lifetime of cherished beliefs for a few moments and approach the discussion in this text with as open a mind as they can. To seek true knowledge one must question the

Book Reviews

unquestionable and challenge the unchallengeable" (p. 21). Perhaps know the unknowable? (Reviewer)

Cunningham argues against the core beliefs of typical evangelicals—the divinity of Jesus, the Bible as a reliable moral guide, miracles, the efficacy of prayer, and an after-life of reward and punishment—in short, against a supernatural reality (p. 25).

His chapter "From Belief to Atheism" recounts a tale of a bright, depression-era, Catholic boy brought up in the arms of the church struggling with "the idea of a personal God, virgin birth, resurrection, and to reconcile God with the existence of so much evil and the negative effects of religious excess" (p. 30). Abandoning his faith, he stopped attending mass after undergraduate school. Like Collins, he moved from a PhD program to medical school. There, Collins was challenged by the religious questions asked by his patients, but Cunningham found no answers in religion (p. 32). In 1965 he joined the California State Department of Public Health to initiate a Hereditary Defects Unit, finding opportunity "to influence the health and welfare of literally millions of newborns and their families" (p. 33).

He begins with a chapter "Evidence and Rules of Engagement" which sets forth the traditional ways that scientists go about their work. He finds Collins lacking in the use of "references, sources, clear definitions, and omitting and underanalyzing crucial evidence" (p. 35). Was Collins writing the end—all in apologetics? (No). Could he have been more careful? (Maybe). Collins is also judged lacking in terms of valid evidence—of "failing (along with the greatest philosophers and theologians in history to produce a valid logical proof of the existence of the supernatural being called God" (pp. 42–3). At one point, the author chides the Apostle Paul for misusing the word "evidence" (p. 38).

Chapter three addresses what Collins called four "particularly vexing" barriers to belief by scientists: (1) wish fulfillment (a Freudian wish for a perfect father in place of imperfect human fathers), (2) harms done by religion, (3) the existence of evil, and (4) miracles. Cunningham knocks down Collins' use of the moral argument by questioning its existence, and then suggesting that moral law might be an unintended consequence of evolution (p. 88). He errs in stating that the divine was "suddenly added into first-century humans" (p. 89). Collins is tarred with "God of the Gaps" thinking even when expressing openness to new evidence, while Cunningham offers a similar pious hope for further evidence against an interventionist deity.

The chapter "Cosmology—Origin of the Universe" finds *The Language of God* woefully deficient on the Big Bang, and anthropic coincidences.

Answering *all* the interesting questions about the universe is an impossibly high standard, but surely science has the best answers to date. Does religion provide satisfying answers ... ? The recurring answer that an incomprehensible god did it is an answer that explains nothing. It's like the answer. It's magic." (PP. 112–3)

Cunningham has a field day in "The Bible" chapter. In his Catholic youth, he was taught that the Bible was to be

interpreted by the church, not by individuals as the cafeteria Christianity offered by Protestants. He gleefully notes Isaac Asimov's quip, "Properly read, the Bible is the most potent force for atheism ever conceived" (p. 117), and notes, "It is almost certain that Paul had an attack of temporal lobe epilepsy on the road to Damascus and experienced visual and auditory hallucinations presumably sometime after Jesus' death" (pp. 125–6). Many of the usual objections are trotted out along with some modern twists of interpretation.

Chapters seven and eight pose naturalism vs. supernaturalism. *The Language of God* is found wanting along both lines. For Cunningham,

The impossibility of God, most especially a personal God, has been reduced to a point close to absolute certainty. In the end, it is the evidence and methods of science that provide satisfying natural explanations for the universe. (P. 179)

Cunningham discusses the problems of being made in the image of God. He concludes, "There is no way to communicate with an impersonal god, even if such a god exists, it is irrelevant to humans because it does not care what they do during their brief lives" (p. 222).

While I find little to commend in this work, the ASA reader may find it useful to brush up on contemporary atheistic ploys and reflect on the ever challenging place of apologetics, personal experience, Scripture, and the Holy Spirit in our witness for the Gospel.

For the Apostle Paul, "I pray that out of his glorious riches he may strengthen you with power through his spirit in your inner being, so that Christ may dwell in your hearts through faith" (Eph. 3:16–17, NIV).

Reviewed by John W. Haas Jr., Emeritus Professor of Chemistry, Gordon College, Wenham, MA 01984.

GOD'S BRAIN by Lionel Tiger and Michael McGuire. Amherst, NY: Prometheus Books, 2010. 238 pages. Hardcover; \$25.00. ISBN: 9781616141646.

Lionel Tiger is the author of several best-selling books including *The Decline of Males*, *The Pursuit of Pleasure*, and *Optimism: The Biology of Hope*. He is the Charles Darwin Professor of Anthropology at Rutgers University. Michael McGuire is the author or editor of ten books, including *Darwinian Psychiatry*. Formerly, he was a professor of psychiatry and biobehavioral sciences at the University of California at Los Angeles and editor of the journal *Ethology and Sociobiology*.

The authors state that their main reason for writing this book was their "discontent with the most salient explanations of religion's power and incidence." They acknowledge that partial explanations have been offered (religion evolved because it enhanced the survivability of religious groups while the irreligious failed to prosper, or that religious behavior helps groups to function more effectively, or even that a "God gene" somehow generates religious dogma and behavior). But the authors go on to argue that there is another possible explanation for the power of religion which needs to be further explored. For Tiger and McGuire, this explanation focuses upon the relationship

between religion and human brain function. This book is therefore devoted to answering the question: What does religion do for the human brain?

The main thesis of the book is that religion has a comforting effect on brain chemistry and body physiology. The authors explain in detail how three significant features of religion (positive socialization, rituals, and religious beliefs) are able to offset many of the effects of stress. Religion relieves stress by providing answers to otherwise unanswerable questions, by elevating self-esteem, by providing a meaningful place in this world and perhaps the next, by facilitating social relationships, by improving credibility among certain groups, and by giving meaning to the relatively mundane tasks of everyday life. The authors often use the word "brainsoothe" to describe the relationship between religion and the human brain, and one chapter even attempts to explain how a "brainsoothe score" can be determined.

The book's conclusions are mainly based on recent research in primate behavior and human neurobiology. The chapter entitled "Is Religion Monkey Business?" explains how human morality may have developed from a variety of behaviors which have been documented in chimpanzees. The chapter entitled "The Elephant in the Chapel Is in Your Skull" describes how religious socialization, ritual, and belief impact the levels of various neurotransmitters in the brain. While the information summarized in these and other chapters is supported by numerous research articles that are cited in the endnotes, it is presented in a way that even the general public can understand. The writing style is concise, interesting, and even quite entertaining at times. What could have been a technical tome in evolutionary theory and neurobiology has been transformed into an informative book that even nonscientists can comprehend.

The authors are to be commended for generally viewing the effects of religion in a positive way. Their conclusions, however, are entirely rooted in psychological, biochemical, and evolutionary forms of analysis. There is no mention of any kind of spiritual or supernatural explanation for religion's power and incidence. The title of the book, *God's Brain*, is also misleading, because in the minds of the authors, the idea of God is simply a creation of the human brain. The brain creates religion and its varied conceptions of God, and then feeds on its creation to satisfy neurological and social needs. The authors finally state unequivocally on the last page of the book that God's brain is nothing more than our brain. This is a conclusion which simply cannot be accepted by anyone who believes in a God who transcends human existence.

Reviewed by J. David Holland, Associate Professor of Life Science, Benedictine University at Springfield, Springfield, IL 62702.

MAKING SENSE OF EVOLUTION: Darwin, God, and the Drama of Life by John F. Haught. Louisville, KY: Westminster John Knox Press, 2010. 163 + xviii pages. Paperback; \$19.95. ISBN: 9780664232856.

It is an article of faith for many Americans that evolution and belief in God are incompatible. Some think that Darwin's theory threatens basic Christian faith while

others claim that it implies the impossibility of believing in a God who is involved with the world. These views are held in the teeth of the evidence: many religious believers understand and accept evolution and some have argued for a Christian understanding of it. Prominent among them has been the Roman Catholic theologian John Haught, Professor Emeritus at Georgetown University, whose previous books include *God after Darwin* and *Deeper than Darwin*.

Making Sense of Evolution: Darwin, God, and the Drama of Life is aimed at a general audience and assumes no special knowledge of science or theology. As the subtitle indicates, Haught wants to make sense not only of Darwinian evolution but also of how it fits with belief in God. Haught organizes his eleven chapters alliteratively: Darwin, Design, Diversity, Descent, Drama, Direction, Depth, Death, Duty, Devotion and Deity. The book's first set of chapters describes basic scientific concepts in a theological context. The second half discusses the Depth and Drama that result from considering Darwin's theory in the context of Deity.

In the first chapter, Darwin's scientific views and his movement from traditional Christianity to what Haught calls "scientific naturalism" are considered. Throughout the book, Haught points out ways in which the ideas that underlay this move continue to appear in today's debates. But he also emphasizes Darwin's courtesy and desire to avoid offense, in contrast to the polemics of some contemporary Darwinians. Haught points out that with natural selection, Darwin offered a scientific answer to the question of "Design," which had previously been considered theological. The critical error of both ID proponents and scientific naturalists is choosing between scientific and theological description. The old and important idea of "layered explanation," illustrated with the question of why the page you are reading exists, emphasizes that there can be multiple answers to the question of why something happens.

A failure to appreciate layered explanation is one example of scientific naturalism's lack of Depth. Insistence that natural selection and other components of evolutionary theory are the *only* explanation of life is superficial. The God who creates, following Paul Tillich, is seen as the depth of the world rather than as a cause within the world. Unwarranted assumptions about divine characteristics also skew many arguments about Diversity of life and the supposed wastefulness of evolution. Haught refers to Tillich's sermon "Holy Waste" as he points out that we have no reason to think of God as a cosmic efficiency expert. He also cites Aquinas to show that theologians long before Darwin were aware of the diversity of living things and gave reasons why God would maximize it. Critics of theology should at least learn something about it!

At the heart of Haught's connection between Darwin and Deity is Drama. *The Origin of Species*, he observes, "tells the story of a long struggle accompanied by risk, adventure, tragedy, and by what Darwin called 'grandeur.' A Christian theology of evolution locates this drama within the very heart of God" (p. 53). Theology brings out the depth and significance of evolution but does not replace the scientific account. In fact, it is largely

Book Reviews

from evolutionary science that theology has learned to see creation as “a narrative unfolding in time” (p 54). A genuine dialogue between science and theology enriches both. Haught, of course, chose Darwin to speak for evolution, and those familiar with his other work will not be surprised that he chose Pierre Teilhard de Chardin, one of the first to attempt a full-fledged theology of evolution, to speak for Deity. This Jesuit paleontologist’s understanding of Christian faith saw God involved with a world in development, a process theology. Such a theology does not simply accept, rather it demands, some kind of evolution.

The case set out here for compatibility of evolution and Christianity may not convince many of those belonging to the groups to which I referred initially. Many conservative Christians think that theologians like Tillich and Teilhard abandoned too much of fundamental Christian faith, and many militant atheists are unwilling to engage any serious theology at all. Certainly, questions can be raised about some of Haught’s arguments. For example, the extent to which Teilhard “accepts” the Darwinian understanding of evolution (p. 138) is open to question, and not only “timid theological minds” (p. 141) will object to some aspects of Teilhard’s theology. But those who are at all open-minded should be able to see in Haught’s presentation a coherent argument for the compatibility of Darwinian evolution and Christian faith.

Reviewed by George L. Murphy, Tallmadge, OH. Murphy has also reviewed this book for Reports of the National Center for Science Education, forthcoming.

RELIGIOUS IDEAS FOR SECULAR UNIVERSITIES by C. John Sommerville. Grand Rapids, MI: Eerdmans, 2009. 208 pages. Paperback; \$18.00. ISBN: 9780802864420.

Religious ideas and approaches to the individual, society, and the relationship between them, are regarded by many as, if not irrelevant, at least increasingly quaint. Church attendance in the first world is declining. More and more books and essays are being written about the post-Christian society, in which the only suitable language for public discourse is secularism. Can one credibly contend that religion has any meaningful part to play in addressing the most pressing issues of modern society?

John Sommerville thinks the answer is yes, and has written a very thought-provoking book exploring this question. The title of the book is a bit misleading—while the author’s concern is with the relationship between religious ideas and secular universities, the book is really about the relationship between a self-consciously secular society and the role of religion in it. Yet it begins and ends with the importance of universities in modern society, and of the essential role that scholarly inquiry plays in nurturing and advancing civilization. This role, contends Sommerville, cannot properly be carried out unless the secular academy listens to religious voices.

Beginning with the premise that universities over the past fifty years have moved from discovering reality to applying knowledge, Sommerville argues that the academy has lost its way. Shifting the balance from discovery to application is not bad in itself, but application should

be for human good. But what is that? Making more money? Living longer? Understanding human good is a fundamentally religious question, since it entails asking what ought to be of ultimate concern. What is worth dying for? What is the best division between family and state for the care of children? How do we delineate the ethical boundaries of genetic manipulation and enhancement of the unborn? Unfortunately, claims Sommerville, universities have confined religious thought to an academic museum, thereby narrowing debate on these and many other questions, so that only secular voices are heard.

A new paradigm for universities—and for society—is needed, and the book explores what this paradigm might look like. It will involve a shift in thinking in both what universities are for and about, and in what the proper relationship is between religion and secularism. Part of this will involve a mutual recognition of the need that each has for the other. This is particularly important for Christianity, as the author argues that it goes beyond mere coexistence with secularism to mean that one is *more* Christian for being an active participant in a secular world. The amphibious nature of being Christian entails an engagement with the world in such a way that it may rub off on others.

Sommerville makes this case from several viewpoints. For example, he contends that universities need to counter structural distortions in the news industry and that high schools need to counter our “bottom feeding entertainment industry.” It is a Christian voice that will offer a rationale for human good, without which both high schools and universities will come up short in addressing these issues. From another perspective, he argues that while most entertainment leaves you where it found you, serious art takes you to another place. Christian voices can remind a secular society that “worldly” art is not as worldly as it seems.

One cannot discuss modern secularism without discussing science. While not extensively exploring the ramifications of scientific thought in the new religious/secular paradigm, Sommerville does offer a number of provocative insights. He contends that assuming a transcendent rational perspective in judging religions would be a terrible mistake. Scientific naturalism remains too strange for anyone to live by, given our intuition that other personalities exist. It is the news media that decide who the scientific experts are that merit public consultation, and not the scientists themselves. And science cannot simply mean “truth,” since scientific discoveries of previous centuries have been superseded by new ones.

But fundamentally, this is not a book about science and religion. Rather, it is a book about scholarship and religion, with scholarship covering all of the many lines of academic inquiry used and addressed by universities. While the religious ideas discussed in the book go beyond Christianity, it is clear that the author regards Christian faith as playing a pivotal role in the development of a new relationship between the ivory tower and the sacred temple. This is a very important book for Christians to read, whether they are in science or not.

Reviewed by Robert B. Mann, Professor of Physics, Department of Physics & Astronomy, University of Waterloo, Waterloo, ON N2L 3G1.

QUESTIONS OF TRUTH: Fifty-One Responses to Questions about God, Science, and Belief by John Polkinghorne and Nicholas Beale. Louisville, KY: Westminster John Knox Press, 2009. 180 pages. Paperback; \$16.95. ISBN: 9780664233518.

John Polkinghorne is an accomplished physicist and a theologian who is ordained in the Church of England. He has written extensively (26 books) on the topic of science and religion and was awarded the Templeton Prize in 2002, among many other accolades. Nicholas Beale is a social philosopher and a long-time collaborator with Polkinghorne. He also manages the website where Polkinghorne explains his views on science and faith and answers questions. This book, *Questions of Truth*, is a clear and concise set of responses to questions about God and science. Both authors offer responses which are identified by their initials, so a couple of perspectives are provided for several of the questions. Overall, this is a helpful, though brief, introduction on addressing questions at the intersection of science and faith. It could be useful to help prepare for dialogue with skeptics, especially scientists, engineers, or other intellectuals who are familiar with modern science.

In the foreword, Nobel Prizewinner Tony Hewish emphasizes Polkinghorne's view that science and religion are not in conflict, but are in fact complementary, and that both are vital for the deepest understanding of our place in the universe. He also points out that if aspects of particle physics, for example, are nonintuitive and defy rational common sense, then we should be prepared to accept that the most profound aspects of our existence may go beyond our common-sense intuitions as well. The first chapter (Leading Questions) sets the stage by summarizing nine fundamental issues that underlie the questions and answers of the subsequent chapters. The question-and-answer format is very effective in providing maximum apologetic impact in the areas of the concept and existence of God, the universe, evolution, evil, the human being, and religion. This is followed by a conclusion and three appendices on anthropic fine-tuning, the brain and mind, and evolution. The chapters are brief so at the end of each chapter is a helpful list of books for further studies. Additional helpful resources are also found after the appendices in the endnotes, glossary, and selected bibliography.

Readers should appreciate the humility reflected throughout this work. The authors do not hesitate to admit their ignorance when it comes to areas in which there is still much to learn. They are hopeful that new areas such as complexity theory have the potential to provide additional answers in the future. They suggest that the emergence of creative behavioral patterns in complex systems encourages the idea that there are holistic laws of nature, at present unknown, for which the key concept may have more to do with "active information" than with energy. Even so, the fact that the universe is rationally transparent to science and also turns out to be rationally beautiful argues for belief in God. The authors suggest that we have an ability to see

the deep order of the world—a world shot through with signs of mind, one might say—as being indeed a reflection of the truth that the mind of the Creator

is revealed in this way. Science is then understood to be possible because the universe is a creation and we are creatures made in the image of the Creator.

Thus, they seem to be saying that the universe shows signs of being intelligently planned or engineered. As an engineer, I personally find this perspective to be intriguing and worthy of further study.

However, the authors are very careful to outline exactly what, and what does not, constitute legitimate scientific evidence for the existence of a transcendent mind. In the chapter on evolution, they are quick to appropriately emphasize the compatibility of evolutionary science and Christianity. As an engineer, it is exciting for me to consider how God is glorified by his ability to "make all things make themselves." It is even more exciting to study living systems, and in the spirit of biomimetics, begin to take baby steps in developing the technology of self-deploying and adaptive artificial systems. I would expect that many engineers relate to God at a deep level through this shared role as a creative problem solver. Thus I was somewhat troubled to come across the authors' suggestion that it is unfortunate that people think of God as a designer. They even assert that, "God is never spoken of as a 'designer' in the Bible." On the contrary, many texts could be cited, such as Psalm 139, that state that each of us was knit together by God in our mother's womb. Obviously, God's engineering capabilities and methods are well above and beyond ours, but we are made in his image and he reveals himself to us in ways that allow us to relate to him; this includes categories such as "designer." The strength of the evidence for a Christian worldview appears to be in the cumulative case. We should take care not to denigrate evidence that adds to that case, and that certain groups of people might find particularly compelling.

Reviewed by Dominic M. Halsmer, Professor of Engineering and Dean of the College of Science and Engineering, Oral Roberts University, Tulsa, OK 74171.

Letters

Neuroscience or Neuroscientism?

I found Paul Moes' article, "Minding Emotions: The Embodied Nature of Emotional Self-Regulation," Kevin S. Seybold's article, "Biology of Spirituality," and D. Gareth Jones' article, "Peering into People's Brains: Neuroscience's Intrusion into Our Inner Sanctum" (*PSCF* 62, no. 2 [2010]: 75–87, 89–98, and 122–32 respectively), to be very controversial.

Given a limited space, I will only engage Moes' and Jones' articles based on points of philosophical interest. Both Moes and Jones appeal to developments in the mainstream neuroscience (among others) to talk about aspects of the human nature.

Letters

First, Moes argues that nonreductive physicalism (NRP) is compatible with taking humans as agents who can engage in willful and responsible actions. Moreover, Moes argues that emotions (among other things) play a pertinent role in shaping the relational nature of human beings. So, for Moes, given the NRP model, top-down causation, i.e., from mental to physical, can be shown to be the case within the *closed physical system*. The question remains: what then is at stake in Moes' NRP model? Here, we need to know that the NRP model endorses three key claims: (a) ontological monism, (b) the irreducibility of the mental to the physical, and (c) the supervenience of the mental on the physical. Of all, (b) poses the greatest problem for the NRP model: If (b) is true, then it follows that mental states (e.g., emotions) are distinct states from brain states (e.g., brain activity or the firing of neurons). That means that mental states can be neither reducible nor identifiable with brain states, in that, unlike brain states which are purely physical, mental states are nonphysical states. In fact, in this sense, it is better to call Moes a property dualist rather than a nonreductive physicalist. However, my main objection is this: If Moes accepts (b) above, then his NRP model violates the causal closure principle, according to which all physical effects have sufficient physical causes. Thus, nonphysical states are excluded from the closed physical domain. If so, how then can Moes argue that mental causation/top-down causation is possible in the NRP model? Either Moes has to let go of the *causal closure principle*, in which case he can no longer be a physicalist, or he must identify mental states with brain states, in which case he can hardly be a nonreductive physicalist. But since the NRP model is based on purely philosophical commitment to physicalism, Moes' attempt to establish willful and responsible action by appealing to neuropsychology remains a nonstarter.

Second, Jones argues that neuroscience is making significant inroads into the human brain, which is believed to be the center of human thinking, intelligence, thoughts, and so forth. Since neuroscientists are gaining an insider's view of human brains via brain imaging techniques, they may soon map out the inner thoughts of people. The question remains: why should we take Jones' remarks seriously? The main problem with Jones' argument is his failure to distinguish the asymmetry between first-person perspective and third-person perspective. We all agree that neuroscience is great in giving us a third-person description of the characteristics of the human brain. But neuroscience is utterly incapable of giving us anything whatsoever of the first-person description of the phenomenal consciousness which necessarily belongs to a subject of experience, i.e., a person. It does not matter how sophisticated the brain imaging techniques are that neuroscientists use, the subjective character of the phenomenal consciousnesses (e.g., the hurtfulness of pain) or what it is like for a person to be in a pain state, cannot be captured by looking into people's brains, unless we get a first-hand report from the people themselves to learn about the content of their thoughts or the nature of their subjective experience. Contrary to Jones, we have no good reason to be afraid of advances in neuroscience when it comes to phenomenal consciousnesses. Put differently, though neuroscientists can certainly peer into people's physical brains, they can hardly peer into people's inner thought life. We can only sympathize with Jones' argu-

ment if we assume that our identity is grounded in the physical brain, the view I categorically reject, for reasons I cannot go into here.

So, both Moes and Jones failed to recognize the distinction that holds between the philosophical assumptions they each utilized to make their case on the one hand, and the empirical data they relied on to explain human nature on the other. Thus, they seem to have implicitly shifted gear from neuroscience to scientism: that is, the proper knowledge of human nature is only attainable via neuroscience.

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Reaction to September 2010 *PSCF* issue

I appreciated the September 2010 issue of *PSCF*. While I share the editor's concern about overemphasizing the origin debate (for the Christian community has more important issues to address), understanding creation's origins in the light of its destiny can affect our Christian walk. For once possessed and guided by the knowledge that everything came out of God and will return back into him (Rom. 11:36), we will respect every person either as a saint or as one on the way to sainthood.

Both Daniel C. Harlow and John R. Schneider view origins in the light of our destiny as they quote universalist texts (e.g., Rom. 8:18–32; 11:32–33; 1 Cor. 15:28; Eph. 1:10; Col. 1:20) and take them at face value. Most of us have been conditioned to read these texts in the light of the eternal damnation passages instead of reading the latter in the light of God's revealed purpose "to unite all things in him" (Eph. 1:10).

The above authors invite us to rethink original sin, and I agree. We have misread the Fall, because we failed to see how the two creation accounts are related. God revealed himself in two books: the Scriptures and nature. Nature resembles a novel as it is created (1) by the author's word, (2) within the author's mind, and (3) out of nothing. Moreover, such a narrative includes the creation of things, and of time and space in which events unfold. This intra-narrative time and space is distinct from the time in which the author lives. Creation week refers to God's own mode of existence, not to a part of the time he created.

The first creation account shows us an architect's drawing of a beautiful edifice with the surroundings perfectly landscaped, whereas the second one displays a cluttered construction site. The first account describes a novelist composing a narrative with a happy ending; the second one takes us into the first chapters of the novel in which things are going terribly wrong. The first account tells us how much time it took the author to finish his work; the second one takes us into the intra-narrative timeframe.

Adam and Eve were fallible. They were created for eternity but had failed to eat from the tree of life that represented the Lord who alone confers eternal life. As they were created in the image of God who does not take orders, they could hardly be expected to do so either.

Thus they sinned. Schneider reaches a similar conclusion by considering our evolutionary heritage.

Humanity represents a paradox: The most independent being creates an image of himself or herself, which by its very creatureliness is most dependent. God solved that problem for "he who is united to the Lord becomes one spirit with him." And once we are one with him, we share his will and independence.

But this is only a beginning, for "Creation itself will be set free from its bondage to decay and obtain the glorious liberty of the children of God," which includes the freedom to do whatever we want because God's desire has become ours. This is the perfected creation; only this creation is very good, and only this is what God viewed at the end of day six and declared to be very good (Gen. 1:31).

If you doubt, consider that if Gen. 1:20, 24 imply that day five ended with oceans teeming with swarming creatures, then day six ended with a planet densely populated by humanity, for God had commanded them to "fill the earth" and declared that "it was so."

Nothing in Genesis 1 should hinder us from pursuing studies as presented by Dennis R. Venema, according to which "our species has maintained a population size of at least several thousand individuals since our speciation from the ancestors of other apes."

As to the historicity of Adam and Eve, I agree with Daniel C. Harlow (p. 190) that a historical Adam is not essential to Paul's teaching. A literary Adam detracts nothing from my faith. And yet I prefer Collins' view of a historical "first couple," because I hope to meet them one day. Even so, a literary Adam will not wreck my enjoyment of an eternity spent in the Lord's presence.

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Response to John Collins

I refer to John Collins, "Adam and Eve as Historical People, and Why it Matters" (*PSCF* 62, no. 3 [2010]: 147-65). He refers to "several scholars" who "have made proposals consistent with the criteria" of "modern humans" "between 100,000 and 40,000 years ago ... both with and without animal 'forebears'" (p. 160), and in the footnote refers to my article, "Soteriology: Adam and the Fall," *PSCF* 49, no. 4 (1997): 252-63. While I am not dogmatic on the Adamic date I would now consider the most likely date for Adam and Eve to be at about 70,000 years ago. But I would also remind readers that some time ago now I repudiated theistic evolution in favor of old earth creationism. See Gavin McGrath, "Intelligent Design from an Old Earth Creationist Perspective," *PSCF* 58, no. 3 (2006): 252-3; "The Gap [School] in Creation," *PSCF* 59, no. 4 (2007): 318-9; "Old Earth Creationists," *English Churchman* 7779 (6 and 13 Nov. 2009): 2; and "Old Earth Creation," *English Churchman* 7782 (18 and 25 Dec. 2009): 2.

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Absolute Biblical Inerrancy Is Not Biblical

According to his recent letter (*PSCF* 62, no. 4 [2010]: 302-3), John Montgomery thinks that the spiritual revelations in the Bible cannot be separated from attached scientific and historical facts. He asks: If the scientific and historical facts, which can be checked, are not accurate, why would anyone accept the spiritual revelations which cannot be checked?

The more biblical question is this: If the scientific and historical facts, which can be checked, prove to be false, why would anyone suppose they are divine revelations? Scripture itself teaches us to check alleged divine revelations of empirical facts by means of empirical data; and if they prove empirically to be false, they should not be accepted as divine revelations (Deut. 18:22; 1 Thess. 5:21). When the science-history in Genesis 1, as an example, is checked by empirical data, it is proven by that data to be false: e.g., earth history does not begin with a primeval ocean. If we obey Deut. 18:22 and 1 Thess. 5:21, then we must conclude that the science-history in that chapter is not a divine revelation.

When the history-science of Genesis 1 is compared to ancient Near Eastern literature, it becomes readily apparent that its concepts about the natural world are ancient Near Eastern concepts; this again tells us that they are not divine revelations. The view which emerges from obeying Deut. 18:22 and 1 Thess. 5:21 and from comparing the history-science in Genesis 1 to ancient Near Eastern literature is that God, like a wise Father, has chosen to reveal himself and his will to his children in terms of *their* understanding of the natural world.

This biblical and forthright view of the science-history in the Bible is, unfortunately, excluded by the doctrine of absolute biblical inerrancy which Montgomery is espousing. In his view, the Bible *must* agree with scientific truth; therefore God cannot speak to his children in terms of *their* understanding of the natural world. Montgomery's doctrine leaves Christians with just two choices: Either set aside modern science in favor of a contrived private science or set aside the historical-grammatical interpretation of Scripture in favor of a contrived private interpretation.

In the essay which Montgomery wrote and recommends, the latter course is chosen. Rather than testing the history-science of Genesis 1 by empirical data as Scripture enjoins, his essay refers us (p. 21, note 17) to the book, *Modern Science and Christian Faith*, which gives us interpretations of Genesis 1 that at first glance harmonize the biblical statements with modern science. Unfortunately, the relevant chapters were written by an astronomer and a geologist, who understandably were oblivious to the fact that Genesis 1 reflects ancient Near Eastern "science" — from the primeval ocean of Gen. 1:2 to the rising of animals out of the ground like plants in Gen. 1:24.

The concordism found in that book and concordist interpretations in general depend upon lifting the biblical text out of its historical and biblical context, setting it back down in the context of modern science, and then having modern science determine the meaning of the words. In short, they depend upon taking the Bible out of context.

Letters

The most serious problem, however, is not that these concordist interpretations are contrary to the context, but that most evangelical laypersons can see that they are not what Scripture is really saying, and so they turn away from them to creation science. Bernard Ramm's book, *The Christian View of Science and Scripture*, sets forth the kind of concordism which Montgomery recommends, and it directly motivated Whitcomb and Morris to write *The Genesis Flood*. The creation science movement thrives on concordist re-interpretations.

Since obedience to 1 Thess. 5:21 and Deut. 18:22 demands that we reject the claim that the history-science in Genesis 1 is a divine revelation, we have no choice as Christians but to separate the history-science from the theological messages, just as we do with parables. The theological messages, because of their great contrast with the theology of the ancient Near East, stand out as glorious revelations from the true God.

¹For further explication, see my paper, "The First Four Days of Genesis in Concordist Theory and in Biblical Context," *PSCF* 49, no. 2 (1997): 85–95; www.asa3.org/ASA/PSCF/1997/PSCF6-97Seely.html

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Lamoureux' Response to Montgomery

In the Letters section (*PSCF* 62, no. 4 [2010]: 302–3), John Warwick Montgomery raises a number of concerns regarding my essay review of Greg Beale's 2008 book, *The Erosion of Biblical Inerrancy in Evangelicalism* (*PSCF* 62, no. 2 [2010]: 132–8).

Montgomery contends, "Spiritual facts ("messages of faith") cannot be placed in airtight compartments so as to separate them from secular facts (scientific and historical information)." He then asks, "If the scientific and historical material in the Bible—which can in principle be checked for accuracy—is not reliable, why should anyone accept the spiritual/faith material set forth there—which cannot be checked?"

I certainly agree with Montgomery that the science and history in Scripture can be tested for their truthfulness. For example, we can ask, "Is the structure of the universe found in the Bible in alignment with the scientific facts?" The answer is "no," because the Word of God features a 3-tiered universe. Take, for example, the wonderful kenotic hymn (Phil. 2), which most of us sing in our praise and worship on Sunday mornings. Verses 10 and 11 state: "At the name of Jesus every knee should bow, [1] in heaven, and [2] on earth, and [3] in the underworld (Greek *katachthonios*; *kata*: down; *chthonios*: subterranean world, place of the dead) and every tongue confess that Jesus Christ is Lord, to the glory of God the Father." If we use Montgomery's argumentation: since the astronomy in Phil. 2 "is not reliable, why should anyone accept the spiritual/faith material set forth there." Of course, I doubt any Christian wants to follow Montgomery and question

the Lordship of Jesus because Scripture has a 3-tiered cosmos.

A more cogent approach to this passage is simply to suggest that the Holy Spirit descended or accommodated to the level of the apostle Paul's understanding of nature. This is similar to the way that the Lord descends to our level when we are in prayer. As well, it is akin to the time Jesus poured (Greek: *kenōō*) himself out and came down to take on human flesh. In this light, we can indeed separate the inerrant message of faith (Jesus is Lord of the universe) in Phil. 2:10–11 from the incidental ancient science (3-tiered universe). And since the message is inerrant and eternal, it can be placed within a modern vessel featuring twenty-first-century scientific categories: "At the name of Jesus every knee should bow, throughout the 13.7 billion light year wide universe, and every tongue confess that Jesus Christ is Lord, to the glory of God the Father." Amen!

In fact, it must be added that the Lord Jesus himself often accommodated to his audience by employing the science-of-day. For his generation, the mustard seed was the smallest of all seeds (Mark 4:30–32), seeds die before germinating (John 12:23–24), stars are so small that they can all fall to earth (Matt. 24:29–30), Sheba is at the ends of the earth (Matt. 12:42), and Jesus spent three days and nights in the heart of the earth [i.e., the underworld] (Matt. 12:40).

In an attempt to justify that spiritual facts cannot be separated from secular facts, Montgomery asks rhetorically, "Are the death of Christ on the cross and his resurrection secular events or faith events?" Of course, the answer is both. I believe that Jesus did indeed rise physically from the dead, and that this is an actual historical event that has massive spiritual implications. The reason I hold this position is because of the literary genre. I view the Gospels as being built upon eyewitness accounts (see Richard Bauckham, *Jesus and the Eyewitnesses: The Gospels as Eyewitness Testimony* [Grand Rapids, MI: Eerdmans, 2008]). I must confess I was surprised with Montgomery's rhetorical tactic, because the context of my criticism of Beale dealt with Genesis 1 (including Beale's breathtaking proclamation that young earth creation is a "possible" interpretation for twenty-first-century Christians) and not with the New Testament. Yet, I made my position on historicity of Scripture clear in my essay review. I accept "the beginning of actual history roughly around Genesis 12, as many conservative scholars do" (p. 134).

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Editorial

Civil Discourse and the ASA	1	Jennifer Wiseman
-----------------------------	---	------------------

Articles

Reading Scripture and Nature: Pentecostal Hermeneutics and Their Implications for the Contemporary Evangelical Theology and Science Conversation	3	Amos Yong
Kepler and the Laws of Nature	17	Owen Gingerich
Sediment Transport and the Coconino Sandstone: A Reality Check on Flood Geology	25	Timothy K. Helble
Design or the Multiverse?	42	Ronald Larson

2010 Reviewers

Reviewers in 2010	47
-------------------	----

Essay Book Review

Establishing a Meaningful Dialog	48	Robert Kaita
Relations between Theological and Scientific Methodologies	51	Nancey Murphy

Book Reviews

<i>Medical Ethics and the Faith Factor: A Handbook for Clergy and Health-Care Professionals</i>	55	Robert D. Orr
<i>Autonomy and Food Biotechnology in Theological Ethics</i>	55	Cathriona Russell
<i>The Strangest Man: The Hidden Life of Paul Dirac, Mystic of the Atom</i>	56	Graham Farmelo
<i>Inside the Human Genome: A Case for Non-Intelligent Design</i>	58	John C. Avise
<i>Routes of Learning: Highways, Pathways, and Byways in the History of Mathematics</i>	59	Ivor Grattan-Guinness
<i>Belief: Readings on the Reason for Faith</i>	60	Francis S. Collins, ed.
<i>Scientific and Philosophical Perspectives in Neuroethics</i>	61	James J. Giordano and Bert Gordijn, eds.
<i>Absence of Mind: The Dispelling of Inwardness from the Modern Myth of the Self</i>	62	Marilynne Robinson
<i>Paul in Ecstasy: The Neurobiology of the Apostle's Life and Thought</i>	62	Colleen Shantz
<i>How God Acts: Creation, Redemption, and Special Divine Action</i>	63	Denis Edwards
<i>Subjectivity, Objectivity, and Intersubjectivity: A New Paradigm for Religion and Science</i>	64	Joseph A. Bracken
<i>Decoding the Language of God: Can a Scientist Really Be a Believer?</i>	65	George C. Cunningham
<i>God's Brain</i>	66	Lionel Tiger and Michael McGuire
<i>Making Sense of Evolution: Darwin, God, and the Drama of Life</i>	67	John F. Haught
<i>Religious Ideas for Secular Universities</i>	68	C. John Sommerville
<i>Questions of Truth: Fifty-One Responses to Questions about God, Science, and Belief</i>	69	John Polkinghorne and Nicholas Beale

Letters

Neuroscience or Neuroscientism?	69	Mihretu P. Guta
Reaction to September 2010 <i>PSCF</i> issue	70	Eckehart Augustiny
Response to John Collins	71	Gavin McGrath
Absolute Biblical Inerrancy Is Not Biblical	71	Paul H. Seely
Lamoureux' Response to Montgomery	72	Denis O. Lamoureux