PERSPECTIVES on Science and Christian Faith

JOURNAL OF THE AMERICAN SCIENTIFIC AFFILIATION

In this issue . . .

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

VOLUME 56, NUMBER 1 **MARCH 2004**

Perspectives on Science and Christian Faith

Perspectives on Science and Christian Faith (ISSN 0892-2675) is published quarterly for $35 per year by the American Scientific Affiliation, 55 Market Street, Ipswich, MA 01938-0668. Phone: 978-356-5656; Fax: 978-356-4375. E-mail: asa@asa3.org; www.asa3.org

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

Manuscript Guidelines

The pages of *Perspectives on Science and Christian Faith (PSCF)* are open to contributions dealing with the interaction between science and Christian faith in a manner consistent with scientific and theological integrity. Papers published in *PSCF* do not reflect any official position of the American Scientific Affiliation.

1. Address all manuscripts (except Book Reviews) to: Roman J. Miller, Editor, 4956 Singers Glen Rd., Harrisonburg, VA 22802. E-mail: millerrj@rica.net Submissions are typically acknowledged within 10 days of their receipt.
2. Authors must submit **3 paper copies** (double spaced) for review purposes (an original and two copies) and **1 electronic copy** submitted on a DOS formatted floppy disk or as an email attachment. Typically 2–3 anonymous reviewers critique each manuscript submitted for publication.
3. Use endnotes for all references. Each note must have a unique number. Follow *The Chicago Style Manual* (14th ed., sections 15.1 to 15.426).
4. If possible, include graphics (electronic file preferred) that enhance the theme of the paper. Figures and diagrams not in electronic format should be clear, black and white, line ink drawings or glossy photographs *suitable for direct reproduction*. Provide captions separately.

ARTICLES are major treatments of a particular subject relating science to a Christian position. Such papers should be at least 8 manuscript pages in length, **but not more than 6000 words**, excluding endnotes. An abstract of 50–150 words is required. Publication for such papers normally takes 9–12 months from the time of acceptance.

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

NEWS & VIEWS are short commentaries on current scientific discoveries or events, or opinion pieces on science and faith issues. Lengths range **from 200 to 1500 words**. Submissions are typically published 3–6 months from the time of acceptance.

YOUNG SCIENTISTS' CORNER contains varied autobiography submissions as well as notices of special interest to science undergraduate and graduate students and young science professionals who are entering the workforce. Submissions are encouraged and typically published 3–6 months from the time of acceptance.

BOOK REVIEWS serve to alert the readership to books of interest and provide a valuable source for reference. Readers are encouraged to review books in their scientific fields which have implications for the Christian faith. Guidelines for book reviewers and a list of books available for review are available from the Book Review Editor: **Richard Ruble, 212 Western Hills Dr., Siloam Springs, AR 72761 or E-mail: ruble@tcainternet.com** The viewpoints expressed in the books reviewed, and in the reviews themselves, are those of the authors and reviewers respectively, and do not reflect an official position of the ASA.

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

ART EYES SCIENCE portrays original, unpublished items that integrate art, science, and faith. Submissions may be in any art form that can be depicted in a print journal and may include poetry, musical score, drawings, photography, short prose, or meditative thoughts. Submissions with text must be less then 300 words. Three paper copies and one electronic copy (Word document for text, JPG or TIFF for visual) of the item are to be sent to the editor for peer review prior to publication.

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

The View from Shepherd's Knoll ...

When the Paradigm Shifts ...

When long-held values, ideologies, understandings, and ways of envisioning lose their grip and become replaced with new, radically different ways of thinking, we call this transformation a paradigm shift. Thomas Kuhn in his classic treatise, *The Structure of Scientific Revolution*, described this phenomenon by pointing out that advancements in science occur with revolutions driven by agents of change in which "one conceptual world view is replaced by another." A paradigm shift shakes our world causing us to see reality differently!

As Christians, committed to the way of Jesus, we have experienced a similar life-changing experience that has transformed our very way of thinking and doing. In foretelling the word of the Sovereign Lord, Ezekiel describes the mechanism of such a paradigm shift: "I will give you a new heart and put a new spirit in you; I will remove from you your heart of stone and give you a heart of flesh. And I will put my Spirit in you and move you to follow my decrees and keep my laws" (Ezekiel 36:26–27, NIV). In the New Testament, such a paradigm shift is called salvation and is descriptive of the agency of God's grace that transforms our being and recreates us in the image of Jesus.

Such a change profoundly alters understandings and relationships in our lives. Evidence of this transformational paradigm shift is that we walk in the light and honor Jesus instead of continuing to stumble in the darkness serving ourselves. This paradigm shift is not a self-reformation but a divine transformation of our being. Does such a personal change affect our work in science? I believe the answer is a resounding, yes! Many of the articles within the pages of this journal have been written because scientists have encountered the transcending Creator in their investigation of the natural world. May we continue to apperceive and explore the wonders God has wrought! ✦

Let's honor the Divine Paradigm Shifter!

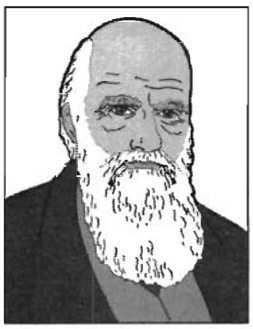
Roman J. Miller, *Editor*

In This Issue

Two outstanding new features can be found in this issue of *PSCF*. First, due to the generosity of an anonymous donor, each issue in 2004 will be expanded by a set of eight pages. Consequently instead of a normal 72-page issue, we will be printing an 80-page issue. A second feature is a new section found in the final journal pages called, "Art Eyes Science." Readers are encouraged to submit original art pieces that illuminate the connection or integration of Christian faith and thereby continue this section in future issues.

In the Articles section, we begin with Denis Lamoureux who argues that popular perceptions of Charles Darwin have missed important theological understandings. Del Ratzsch visits the intelligent design debate and suggests that design may enhance and enrich naturalistic science. Walter Thorson proposes agreements and disagreements between intelligent design and "Thorsonian naturalism." Finally, Robert Boomsma frames the embryonic stem cell controversy with a Reformed Christian perspective.

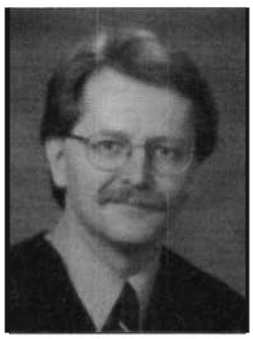
The Communications section features two Davids. David Wilcox considers genetic and paleoanthropological information in understanding Adam, while David Wollert uses complexity theory to provide insights into the church. Book reviews, Letters, and "Art Eyes Science" sections follow. Finally the last page contains information about membership in our society. Maybe you will be moved to share that page with colleagues who would be interested in joining us.



Charles Darwin

Theological Insights from Charles Darwin

Denis O. Lamoureux



Denis O. Lamoureux

Regrettably, both secularists and numerous evangelical Christians have painted a dark and sinister picture of the religious implications of Charles Darwin's theory of biological evolution. This has led to a cultural myth that sees him as one of the modern apostles of unbelief. However, the primary historical literature reveals that Darwin was thinking theologically throughout his career and that his reflections were sophisticated. In particular, he dealt with the religious themes of intelligent design in nature, the problem of pain, and Divine sovereignty over the world. Theological insights from Charles Darwin are valuable in understanding the challenges that biological evolution presents to religion.

Is the association of Darwin with unbelief a popular cultural myth that has been thoughtlessly propagated throughout society today?

In his acclaimed best-seller *The Blind Watchmaker* (1986), the inimitable Richard Dawkins writes: "I could not imagine being an atheist before 1859, when Darwin's *Origin of Species* was published. ... Darwin made it possible to be an intellectually fulfilled atheist."[1] Today, secularists and many evangelical Christians agree with Dawkins in suggesting that the father of the theory of biological evolution is a chief apostle of modern atheism.[2] However, is this actually the case? Or is the association of Darwin with unbelief a popular cultural myth that has been thoughtlessly propagated throughout society today?

This paper reviews the central religious beliefs of Charles Darwin and presents evidence from the primary historical literature that deals with his theological reflections on evolutionary theory. To the surprise of many, Darwin not only contributed to science a brilliant theoretical outline for biological origins, but his thoughts regarding the religious implications of evolution are profound and provide valuable insights to theology.

Denis O. Lamoureux *is an assistant professor of science and religion at St. Joseph's College, University of Alberta. His appointment is the first Canadian tenure-track position in this discipline. He holds three earned doctoral degrees – dentistry, theology, and biology. Lamoureux asserts that if the limits of both evangelical Christianity and evolutionary biology are respected, then their relationship is not only complementary, but also necessary. He is a member of the executive council of the Canadian Scientific and Christian Affiliation, and a Fellow of the American Scientific Affiliation. Recently retired from dentistry, Lamoureux continues to suffer from the idolatrous practice this profession encourages as he boasts a single digit handicap!*

The Early Years (1809–1831)

Charles Darwin was born 12 February 1809 and raised in a comfortable British setting surrounded by a variety of religious and philosophical beliefs.[3] His physician father Robert was a "free thinker on religious matters" and at best a "nominal" Anglican.[4] Darwin's mother Susannah came from a devout Unitarian family and attended church with her children. Sadly, she died when Charles was only eight years old. Thereafter, his older sisters assisted in raising him and brought him to Anglican services.[5] Darwin received an education from an Anglican day school, and in his autobiography refers to religious beliefs that are typical of a child. He writes:

> I remember in the early part of my school life [1818–1825] that I often had to run very quickly to be in time, and from being a fleet runner was generally successful; but when in doubt I prayed earnestly to God to help me, and I well remember that I attributed my success to prayers and not to my quick running, and marveled how generally I was aided.[6]

As a teenager, Darwin read his grandfather Erasmus' *Zoonomia,* or the *Laws of Organic Life* (1794–1796), which presented a deistic God creating life through an evolutionary process.[7] He notes that the book had little effect on him at that time, but believes

that its positive light on evolution opened the way for serious consideration of this view of biological origins.

After a failed attempt at studying medicine in Edinburgh, Darwin entered Christ College, Cambridge in 1828 to study theology. His intention was not so much religious as practical—his father insisted. Dr. Darwin recognized that his son lacked direction and this way he would at the least receive an education befitting a proper young British gentleman. There is little evidence to suggest Charles had a passionate faith at that point in his life, though he recalls: "I did not then in the least doubt the strict literal truth of every word in the Bible."[8] Darwin completed the divinity program in 1831, but decided not to be ordained as a minister. Yet, Cambridge gave him a purpose. He fell in love with science. His views on origins were typical of the early nineteenth century. He accepted that the earth was old, though catastrophic flood events still played a part in geology for understanding various surface features (e.g., gravel beds, erratic rocks, etc.). Darwin was also a progressive creationist,[9] believing in the immutability (unchangeability) of species, and maintaining that God intervened to create life at different points in geological history.

Darwin's view of nature was steeped in the categories of British naturalist-theologian William Paley.

More specifically, Darwin's view of nature was steeped in the categories of British naturalist-theologian William Paley. His *Evidences of Christianity* (1794) and *Natural Theology* (1802) were required reading at Cambridge in the early 1800s, and Darwin claimed that studying these works were the only valuable part of his education. Well known for the watchmaker argument,[10] Paley held that the universe features: (1) Intelligent Design[11]—the beauty, complexity and functionality of nature ultimately reflect the mind of the Creator; (2) Perfect Adaption—each and every detail found in the world fits perfectly in its place; and (3) Beneficence—the creation is very good. Looking back on his career, Darwin recognizes in 1871:

> I did not at that time trouble myself about Paley's premises; and taking these on trust I was charmed and convinced by the long line of argumentation ... I was not able to annul the influence of my former belief, then almost universal, that *each* species had been purposely created; and this led to my tacit assumption that *every detail* of structure, excepting rudiments, was of some special, though unrecognized, service.[12]

It is important to emphasize that Paley's understanding of design is both static and conflated to the notion of perfect adaptability. That is, *each* and *every detail* in the world had some specifically designed purpose, with the exception being rudimentary structures such as mammary glands in males. Consequently, there was no room for mal-adapted structures or creatures, especially evolving ones, in God's good and perfectly ordered creation.

The *HMS Beagle* Voyage (1831–1836)

Darwin boarded *HMS Beagle* with these assumptions about nature on 27 December 1831. He also came with Christian beliefs and recalls:

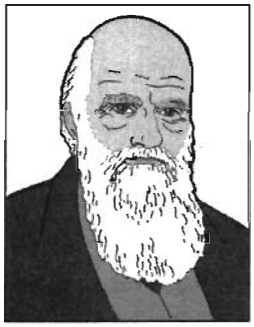
> Whilst on board the *Beagle* I was quite orthodox, and I remember being heartily laughed at by several of the officers (though themselves orthodox) for quoting the Bible as an unanswerable authority on some moral point. I suppose it was the novelty of the argument that amused them.[13]

More significantly for the development of his science, Darwin embarked with the first volume of Charles Lyell's newly published *Principles of Geology* (1830–1833), which set down the foundations of modern geology. Soon after arriving in South America, his field experience of the region led him to embrace fully uniformitarian geology. Darwin boasts: "I am proud to remember that the first place, namely, St. Jago, in the Cape Verde Archipelago, which I geologised, convinced me of the infinite superiority of Lyell's view over those advocated in any other work known to me."[14]

Uniformitarianism did not extend to Darwin's biology, however. Late in the voyage, he was still an anti-evolutionist, arguing in a perfect Paleyan fashion, that evolution was "a supposition in contradiction to the fitness which the Author of Nature has now established."[15] Nine months before returning to England, Darwin remained a progressive creationist. He writes: "The one hand has surely worked throughout the universe. A Geologist perhaps would suggest that the periods of Creation have been distinct & remote the one from the other; that the Creator rested in his labor."[16]

In the last entry of the *Beagle Diary*, Darwin's acceptance of intelligent design is obvious:

> Amongst the scenes which are deeply impressed on my mind, none exceed in sublimity the [Brazilian] primeval forests ... [for they] are temples filled with the varied productions of the God of Nature. No



Charles Darwin

Article

Theological Insights from Charles Darwin

> one can stand unmoved in these solitudes, without feeling that there is more in man than the mere breath of his body.[17]

Throughout the famed trip, Darwin believed in a Creator. Not only did nature profoundly impact him by reflecting design, but this God intervened to create life at different points in geological history.

First Period of Religious Reflection (1836–1839)

HMS Beagle docked in Falmouth, England, on 2 October 1836 after a five-year voyage around the world. During the next few years Darwin entered his first period of intense theological reflection. As he recalls: "I was led to think much about religion."[18] This was also the time that he formulated his theory of biological evolution. To be sure, evolutionary theory has significant religious implications, and Darwin recognized them. In this period he rejected whatever Christian faith he had. Regarding the Old Testament, he reveals:

> I had gradually come by this time, to see that the Old Testament from its manifestly false history of the world, with the Tower of Babel, the rainbow as a sign, etc., etc., and from its attributing to God the feelings of a revengeful tyrant, was no more to be trusted than the sacred books of the Hindoos, or any barbarian.[19]

With a growing appreciation for the regularity of natural processes, Darwin also dismissed the New Testament and its record of miracles. In a positivistic fashion, he argues:

> The more we know of the fixed laws of nature the more incredible do miracles become ... the men at that time [first century] were ignorant and credulous to a degree almost incomprehensible by us."[20]

Concluding this period, Darwin confesses: "I came to disbelieve in Christianity as a divine revelation."[21]

Though Darwin rejected the personal God of Christianity, he remained a firm believer in a Creator. More specifically, he renounced theism and espoused deism.[22] During the late 1830s, Darwin outlined a theory on the origin of life, including humanity, that did not require the dramatic Divine *interventions* of progressive creation, and he based his model entirely on *providential* natural laws.[23] That is, he envisioned God creating living organisms indirectly through physical processes. Excerpts from his scientific notebooks reveal this distinction in God's activity:

> Astronomers might formerly have said that God ordered each planet to move in its particular destiny—In the same manner God orders each animal with certain form in certain country. But how much more simple & sublime power [to] let attraction act according to certain law; such are inevitable consequences; let animals be created, then by the fixed laws of generation. ... Man in his arrogance thinks himself a great work worthy of the interposition of a deity, more humble & I believe truer to consider him created from animals.[24]

Darwin at this time also began formulating the foundations of evolutionary psychology, and he cast his theory within a theological framework. For example, he argues that a "philosopher" (i.e., natural philosopher, or better "scientist") errs if he "says the innate knowledge of creator <is> has been/implanted in us (?individually or in race?) by a separate act of God, & not as a necessary integrant part of his most magnificent laws, which we profane in thinking not capable to produce every effect of every kind which surrounds us."[25] According to Darwin, not recognizing God's "sublime power" and the "inevitable consequences" of the "magnificent laws" of evolution was to "profane" the Creator. Clearly, evolutionary theory, as first formulated, was not atheistic.

On the Origin of Species (1859)

During the late 1830s, Darwin scratched out in his scientific notebooks a deistic theory of evolution. But it would take twenty years before he made this view of origins public, and a dozen more years after that before Victorian England would read that humanity was also created through evolution.[26] In November 1859, *On the Origin of Species* was released, and all 1,250 copies were quickly sold. It included seven unapologetic and positive references to the "Creator."[27]

According to Darwin, not recognizing God's "sublime power" and the "inevitable consequences" of the "magnificent laws" of evolution was to "profane" the Creator. Clearly, evolutionary theory, as first formulated, was not atheistic.

Staunchly opposed to the science-of-the-day (progressive creation), Darwin defends:

> Authors of the highest eminence seem to be fully satisfied with the view that each species has been independently created. To my mind it accords better with what we know of the laws impressed on matter by the Creator, that the production and extinction of the past and present inhabitants of the world should have been due to secondary causes like those determining the birth and death of the individual.[28]

Darwin's rejection of interventionism and his acceptance of providentialism in this passage is clear.[29] God creates life, both in the womb and on the earth, through natural laws that he ordained. In other words, Darwin's view of evolution in the famed 1859 work was teleological.[30] This natural process had a goal or final outcome. That is, it had a plan and a purpose rooted in the Creator. Darwin did not embrace today's popular understanding of evolution (atheistic/dysteleological) of a process run merely by chance and irrational necessity.

Darwin did not embrace today's popular understanding of evolution (atheistic/dysteleological) of a process run merely by chance and irrational necessity.

God's part in the evolutionary process is further seen in the well-known final sentence of the *Origin of Species*:

> There is grandeur in this view of life, with its several powers, having been originally breathed into a few forms or into one; and that, whilst this planet has gone on cycling according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved.[31]

This passage in the second edition of the *Origin* in 1860, and right up until the sixth and final edition in 1872, is even more specific. It includes the phrase "originally breathed by the Creator."[32] Interestingly, Darwin somehow fails to recognize his own interventionism in the origin of the first few forms or form of life.[33] But the evolutionary laws were definitely God's laws, and there is even a hint of their revelatory character in that the world created by evolution has a "grandeur" since life is "most beautiful and most wonderful." Therefore, it is a regrettable myth indoctrinated throughout modern society and evangelicalism that Darwin's *Origin* is associated with atheism. Those who have actually read the famed book know that such a belief betrays the historical evidence.[34]

Second Period of Religious Reflection (1860–1861)

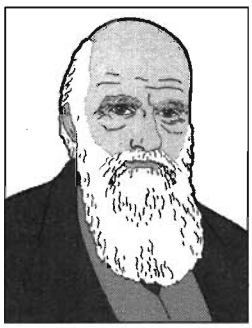
Soon after the publication of the *Origin of Species*, Darwin entered a second period of intense theological reflection. His professional colleagues raised important issues, and he dealt directly with the religious themes of intelligent design, the problem of pain, and Divine sovereignty.

Regarding design, Darwin had a series of exchanges with Harvard botanist Asa Gray, who was one of the first Christians in America to promote evolution.[35] In an 1860 letter to Gray, the clash between Paleyan categories and evolutionary theory began. Darwin writes:

> With respect to the theological view of the question. This is always painful to me. I am bewildered. *I had no intention to write atheistically.* But I own I cannot see as plainly as others do, and as I should wish to do, evidence of design and beneficence *on all sides of us.* ... On the other hand, I cannot anyhow be contented to view this wonderful universe, and especially the nature of man, and to conclude that everything is the result of brute force. ... I grieve to say that I cannot honestly go as far as you do about Design. I am conscious that I am in an utterly hopeless muddle. I cannot think that the world, as we see it, is the result of chance; and yet I cannot look at *each* separate thing as the result of Design. ... Again, I say I am, and shall ever remain, in a hopeless muddle.[36]

Most importantly, Darwin is clearly not an atheist at this point in his career. Of course, "evidence of design ... *on all sides of us*" and "*each* separate thing as the result of Design" was William Paley still speaking through him. His muddle, pain, and bewilderment over the issue of design can be understood in the light of these categories ingrained in his mind during his Cambridge education.

On the one hand, Darwin's theory of evolution undermined Paley's static perfection and adaption in each and every corner of the universe. For that matter, the dynamic evolutionary process was by definition incommensurable with the perfectly designed Paleyan world. As Darwin later wrote: "The old argument of design in Nature, as given by Paley, which formerly seemed to me so conclusive, fails, now that the law of natural selection has been discovered."[37] Yet on the other hand, Darwin continued to experience the impact of nature's beauty, complexity, and functionality as a scientist; and he sensed what most people perceive—there is some sort of teleological reality behind the world, like a God or Supreme Force.[38] In other words, Darwin was trapped between his Paleyan under-



Charles Darwin

[At this time, Darwin] is considering that biological variations "are without purpose, and in so far accidental." However, Darwin does not embrace an entirely dysteleological world view. He continues to believe in the existence of God, and he advances a sophisticated theological understanding of Divine sovereignty.

Article

Theological Insights from Charles Darwin

standing of intelligent design and his experience of design in nature.[39] Of course, hindsight is 20-20, and one wonders why Darwin did not consider seriously a view of intelligent design not suffocated by Paley's strict categories of design in each and every detail of the world.[40]

Darwin also dealt with the greatest challenge to theism—the problem of pain. Concisely stated, why would an all-loving and all-powerful personal God allow suffering in the world? In the same 1860 letter to Gray, he complains:

> But I own I cannot see as plainly as others do, and as I should wish to do, evidence of design and *beneficence on all sides of us.* There seems to me too much misery in the world. I cannot persuade myself that a beneficent and omnipotent God would have designedly created the *Ichneumonidae* with the express intention of their feeding within the bodies of Caterpillars, or that a cat should play with mice.[41]

Once more, a Paleyan category of nature is evident. Beneficence is everywhere throughout nature. Most feel the weight of Darwin's complaint. Why would the theistic God allow a wasp (*Ichneumonidae*) to lay its eggs in a caterpillar, and as these develop slowly, permit them to eat away the host's internal organs until its death?

In an earlier letter to J. D. Hooker, Darwin was even more explicit regarding the lack of beneficence in the living world. He writes: "What a book a Devil's chaplain might write on the clumsy, wasteful, blundering low & horridly cruel works of nature!"[42] At a personal level, Darwin was also intimately familiar with pain. Shortly after his *HMS Beagle* voyage, he contracted a medical condition that saw him suffer bouts of nausea, vomiting, dizziness, chest pains and palpitations for the rest of his life.[43] Moreover, many modern Darwin scholars speculate the suffering and eventual death of his beloved 10-year-old daughter Annie in 1851 deeply traumatized the famed British naturalist.[44] Indeed, nature was not at all like what Paley had envisioned, and it was only late in life that Darwin came to terms with the pain suffered by living creatures.

Finally, Darwin wrestled with the question of Divine sovereignty over the world during his second intense period of theological reflection. In an 1861 letter to Charles Lyell, he writes:

> The view that *each* variation has been providentially arranged seems to me to make Natural Selection entirely superfluous, and indeed take the whole case of the appearance of new species out of the range of science. ... It seems to me that variations in the domestic and wild conditions are due to unknown causes, and are without purpose, and in so far accidental; and that they become purposeful only when they are selected by man for his pleasure, or by what we call Natural Selection in the struggle for life, and under changing conditions. I do not wish to say that God did not foresee everything which would ensue; but here comes very nearly the same sort of wretched imbroglio as between free-will and preordained necessity.[45]

Paley's perfect adaptability again appears in Darwin's thinking. But more significantly, a non-teleological element is clearly developing in his understanding of evolution at this time. He is considering that biological variations "are without purpose, and in so far accidental." However, Darwin does not embrace an entirely dysteleological world view. He continues to believe in the existence of God, and he advances a sophisticated theological understanding of Divine sovereignty. The Creator's foresight ultimately reigns over the evolutionary process.[46]

Variation of Plants and Animals (1868) and *Descent of Man* (1871)

Many of the theological notions that Darwin expressed in private correspondence during the second period of intense religious reflection later became public in his more important scientific books. In the closing pages of *The Variation of Animals and Plants Under Domestication* (1868), he is still being influenced by Paleyan notions of nature, but comes to an uneasy resolution by employing his Divine foresight argument. The last sentences of this scientific work conclude:

> If we assume that *each particular* variation was from the beginning of all time preordained, then that plasticity of organization, which leads to many injurious deviations of structure, as well as the redundant power of reproduction which inevitably leads to a struggle for existence, and, as a consequence, to the natural selection or survival of the fittest, must appear to us superfluous laws of nature. On the other hand, an omnipotent and omniscient Creator ordains everything and foresees everything. Thus we are brought face to face with a difficulty as insoluble as is that of free will and predestination.[47]

Clearly, Darwin still believed in the existence of a "Creator" who was both "omnipotent" and "omniscient." However, he recognized those features in his evolutionary theory which seemed to point away from a world created by God—"injurious deviations," "redundant reproduction," "natural selection," and "survival of the fittest." Astutely, Darwin found that the mystery of Divine sovereignty mitigated the challenge of pain in nature.[48]

Unquestionably, Darwin saw the evolution of humans as neither atheistic nor dysteleological.

In *The Descent of Man* (1871), Darwin finally revealed to Victorian England that humanity was of part of his evolutionary theory. As noted previously, human evolution was an integral part of his science from the earliest notebooks in the late 1830s. Darwin hinted at it in the famed *Origin of Species* with his only remark on the subject:

> In the distant future I see open fields for far more important researches. Psychology will be based on a new foundation, that of the necessary acquirement of each mental power and capacity by gradation. Light will be thrown on the origin of man and his history.[49]

The Descent of Man offered a theory of evolutionary psychology, which included the evolution of religious belief.[50] Anticipating criticism from religious individuals, Darwin defends:

> I am aware that the conclusion arrived at in this work will be denounced by some as highly irreligious; but he who denounces them is bound to shew why it is more irreligious to explain the origin of man as a distinct species by descent from some lower form, through the laws of variation and natural selection, than to explain the birth of the individual through the laws of ordinary reproduction. The birth both of the species and of the individual are equally parts of that grand sequence of events, which our minds refuse to accept as the result of blind chance.[51]

Unquestionably, Darwin saw the evolution of humans as neither atheistic nor dysteleological. For that matter, this passage could be interpreted as an intelligent design argument. The embryological and evolutionary processes reflect a "grand" picture of nature, pointing ultimately to their Creator.

The Autobiography of Charles Darwin (1876)

Darwin's mature theological views appear in his *Autobiography* (1876) in a section entitled "Religious Belief." He deals directly with the classic arguments both for and against God's existence, and examines these in the light of evolutionary theory. Beginning with the problem of suffering, Darwin argues:

> A being so powerful and so full of knowledge as a God who could create the universe, is to our finite minds omnipotent and omniscient, and it revolts our understanding to suppose that his benevolence is not unbounded, for what advantage can there be in the suffering of millions of lower animals throughout almost endless time? This very old argument from the existence of suffering against the existence of an intelligent first cause seems to me a strong one.[52]

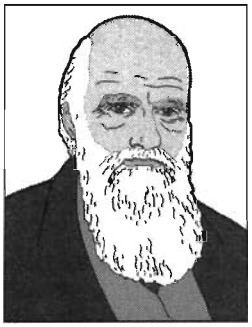
But interestingly, Darwin is quick to answer this complaint. In coming to terms with suffering, he defends:

> According to my judgment happiness decidedly prevails ... all sentient beings have been formed so as to enjoy, as a general rule, happiness ... most sentient beings [experience] an excess of happiness over misery, although many occasionally suffer much.[53]

For Darwin, this is not the beneficence-dripping cosmos of Paley, but it is a good world. In particular, life would never have evolved if creatures suffered most of the time. The bite of the *Ichneumonidae* from Darwin's second period of theological reflection seems to have lost its sting if evolution is viewed from a higher or global perspective. According to Darwin, the problem of pain is not an argument against God's existence.

The *Autobiography* then turns to two arguments for God's existence, and the centrality of intelligent design in each is evident. In the first, Darwin admits to once having what he terms a "religious sentiment." He writes:

> At the present day the most usual argument for the existence of an intelligent God is drawn from the deep inward conviction and feelings which are experienced by most persons ... Formerly I was led by feelings such as those just referred to ... [and these



Charles Darwin

The conclusion Darwin draws in "Religious Belief" from the Autobiography *is that arguments either for or against the existence of God are inconclusive.*

> led] to the firm conviction of the existence of God, and of the immortality of the soul. In my Journal I wrote that whilst standing in the midst of the grandeur of a Brazilian forest, "it is not possible to give an adequate idea of the higher feelings of wonder, admiration, and devotion which fill and elevate the mind." I well remember my conviction that there is more in man than mere breath of his body.[54]

However, Darwin writes-off these experiences as being merely psychological. He claims:

> But now the grandest scenes would not cause any such convictions and feelings to rise in my mind. It may be truly said that I am like a man who has become color-blind, and the universal belief by men of the existence of redness makes my present loss of perception of not the least value as evidence.[55]

From Darwin's perspective, "religious sentiment" is not an argument for God's existence.

In the *Autobiography*'s second argument for the existence of God, a more substantive use of the intelligent design argument is presented. Darwin writes:

> Another source of conviction in the existence of God, connected with the reason and not with the feelings, impresses me as having much more weight. This follows from the extreme difficulty or rather impossibility of conceiving this immense and wondrous universe, including man with his capacity of looking backwards and far into futurity, as a result of blind chance or necessity. When thus reflecting I feel compelled to look to a First Cause having an intelligent mind in some degree analogous to that of man; and I deserve to be called a Theist.[56]

Sensitive Darwin scholars note the present tense of the verb "feel" in the final sentence of this passage.[57] That is, in 1876, late in his life, Darwin is pressed to look for a "First Cause with a intelligent mind," and he even argues that being identified as a "Theist" is justifiable.[58]

But like the previous two arguments, Darwin has a rebuttal. He claims that though this belief in intelligent design was "strong" at the time he wrote the *Origin of Species*, it "has very gradually with many fluctuations become weaker."[59] In particular, he is deeply troubled with this line of reasoning because a "horrid doubt" arises, and he complains:

> Can the mind of man, which has, as I fully believe, been developed from a mind as low as that possessed by the lowest animal, be trusted when it draws such grand conclusions?[60]

According to Darwin, intelligent design in nature appears to be a powerful and rational argument for God's existence, but in final analysis, it is not trustworthy.

The conclusion Darwin draws in "Religious Belief" from the *Autobiography* is that arguments either for or against the existence of God are inconclusive. He then confesses: "I cannot pretend to throw light on such abstruse problems. The mystery of the beginning of all things is insoluble by us; and I for one must be content to remain an Agnostic."[61]

The Final Years (1876–1882)

Darwin's agnosticism and fluctuating theological beliefs also appear during the last years of his life. In a letter addressed to James Fordyce in 1879 regarding his beliefs, he writes:

> What my own [religious] views may be is a question of no consequence to any one but myself. But, as you asked, I may state that my judgment often fluctuates. ... In my most extreme fluctuations *I have never been an Atheist* in the sense of denying the existence of a God. I think that generally (and more and more as I grow older), but not always, that an Agnostic would be the more correct description of my state of mind.[62]

It is important to note that this letter was written only a few years before Darwin's death in 1882, and he is stating quite explicitly that he has "never been an Atheist in the sense of denying the existence of God." Therefore, Darwin throughout his professional career never did embrace an atheistic or dysteleological view of biological evolution. Moreover, it follows from this passage that if he has "never been an Atheist" and

"generally, but not always" an agnostic, then there must have been times when he was a "theist," as he had acknowledged in his *Autobiography*.

Finally, in the last year of Darwin's life, the Duke of Argyll raised with him the issue of intelligent design in nature. Writing about this conversation, he recalls:

> I said to Dr. Darwin, with reference to some of his own remarkable works on the "Fertilization of Orchids" and upon "The Earthworms," and various other observations he made of the wonderful contrivances for certain purposes in nature—I said it was impossible to look at these without seeing that they were the effect and the expression of mind. I shall never forget Mr. Darwin's answer. He looked at me very hard and said, "Well, that often comes over me with overwhelming force; but at other times," and he shook his head vaguely, adding, "it seems to go away."[63]

This is an especially fascinating passage. Only six years earlier in his *Autobiography*, Darwin claimed to have become "color-blind" to the revelatory message in nature, and that "the grandest scenes would not cause any such convictions and feelings to rise in [his] mind." Undoubtedly, the impact of "the expression of mind" in nature served as a source fueling Darwin's "not always" belief in a God.

Conclusion and Application

The historical record clearly reveals that Charles Darwin was never an atheist. Throughout his career, the father of modern evolutionary theory gave serious consideration to the religious implications of his science. For that matter, he often integrated these beliefs within his evolutionary theory as seen in his scientific notebooks, private correspondence, and professional publications. In particular, Darwin offers valuable theological insights worth consideration regarding intelligent design reflected in nature, the problem of pain, and Divine sovereignty over the world. Moreover, this brief historical review of Darwin's central religious beliefs raises some interesting questions for us today.

First, what are we to make of Darwin's many references to the experience of intelligent design in nature? Should these be written-off merely as his being socially conditioned during England's religious nineteenth century? Maybe this very common experience is only the stimulation of a set of brain cells, which evolve by chance to provide humanity aesthetic pleasure for the survival of the species. Or was Darwin responding to and affirming the reality of a nonverbal revelation that an Intelligent Mind has inscribed deeply into the fabric of nature (Ps. 19:1–4; Rom. 1:18–23)?

Second, should intelligent design in nature be real, does it necessarily undermine evolutionary theory? As noted, the notion of design was never far from Darwin's mind throughout his career, yet he gave to science an excellent outline of biological origins. Regrettably, the most vocal support for design today comes from the Intelligent Design (ID) Movement, which promotes a distinctly anti-evolutionary view of origins.[64] Could it be that so-called "ID Theory" is merely an updated version of the long-discredited design categories of William Paley? It is clear that Darwin's understanding of design was hampered and frustrated by the Paleyan interpretation. Is this also the case today with ID's purported "scientific" model of design rapidly infiltrating throughout society and evangelicalism? More incisively, is ID Theory a stumbling block, in the fullest Pauline sense (2 Cor. 6:2–3), between competent evolutionary biologists and the God who life created through a design-reflecting evolutionary process?

The time has come to let the historical record speak in order to move beyond the ill-informed myths of Charles Darwin's religious beliefs and the misunderstood theological implications of the theory of biological evolution.

Finally, what should be taught about Charles Darwin in our public schools? Tragically, a modern cultural myth has demonized the famed British naturalist along with his scientific theory. As fundamentalist Christian and leading anti-evolutionist Henry M. Morris harshly judges: "Satan himself is the originator of the concept of evolution."[65] But proselytizing atheists like Richard Dawkins are every bit as guilty in fueling Darwin's purported atheism with their often venomous and tired polemic.[66] The time has come to let the historical record speak in order to move beyond the ill-informed myths of Charles Darwin's religious beliefs and the misunderstood theological implications of the theory of biological evolution. With our children's education at stake, who can argue against such a proposal? ✦

Acknowledgments

Jennifer Shaw and Eugene Malo

Notes

[1]Richard Dawkins, *The Blind Watchmaker* (London: Penguin Books, 1991), 5–6.

[2]It is important to note the difference between the popular and academic approaches to Darwin within evangelical circles. The former conflates his theory of evolution with unbelief. The latter recognizes that a *modus vivendi* exists between evangelicalism and Darwin's science. See David N. Livingstone, *Darwin's Forgotten Defenders: The Encounter Between Evangelical Theology and Evolutionary Thought* (Grand Rapids: Eerdmans, 1987); and James R. Moore, *The Post-Darwinian Controversies. A Study of the Protestant Struggle to Come to Terms with Darwin in Great Britain and America, 1870–1900.* (Cambridge: University Press, 1979).

[3]For complete historical reviews of Darwin, see Adrian Desmond and James R. Moore, *Darwin* (New York: Warner Books, 1991); Peter Bowler, *Charles Darwin: The Man and His Influence* (Cambridge: University Press, 1990); and Michael Ruse, *The Darwinian Revolution: Science Red in Tooth and Claw,* 2d ed. (Chicago: University Press, 1999).

[4]Charles Darwin, *The Life and Letters of Charles Darwin*, ed. Francis Darwin, 3 vols. (London: John Murray, 1888), II:178. Hereafter cited as *LLD*.

[5]Charles Darwin, *The Autobiography of Charles Darwin, 1809–1882*, ed. Nora Barlow (London: Collins, 1958), 22. Hereafter cited as *ACD*.

[6]*ACD*, 25.

[7]*ACD*, 49.

[8]*ACD*, 57.

[9]The term "creationist" carries a variety of nuances and requires qualification. *Young Earth Creation* is the popular understanding of the creationist position. It rejects all the modern sciences dealing with origins and suggests that the world was created in six literal days less than 10,000 years ago and that all of geological stratification was the result of Noah's global flood. *Progressive Creation* (or Old Earth Creation) accepts the standard geological dating of the earth (4.6 billion years), but rejects biological evolution and maintains that God created life in stages over the eons of time. *Evolutionary Creation* (or Theistic Evolution) asserts that the personal God of the Bible created the universe and life through ordained and sustained evolutionary processes. *Deistic Evolution* (also Theistic Evolution) has an impersonal God begin the evolutionary process, but he never enters the universe thereafter. *Dysteleological Evolution* (or Atheistic Evolution) is the popular understanding of the evolutionist position. It rejects the existence of God and believes that the world evolved entirely by chance and irrational necessity. For an introduction to the origins debate and these categories, see my audio lecture, "Beyond the 'Evolution' vs. 'Creation' Debate," at: www.ualberta.ca/~dlamoure/beyond.html. Also see my paper on evolutionary creation at www.ualberta.ca/~dlamoure/3EvoCr.htm.

[10]Concisely stated, Paley argued that if a watch is found in a field, then it is logical to suggest the existence of a watchmaker. So too with nature. Complexity, contrivance, and design in the world point to a Creator with a purpose. See William Paley, *Natural Theology* in Robert Lynam, ed., *The Works of William Paley*, 6 vols. (Edinburgh: Baynes and Son, 1825), IV:1–12.

[11]The notion of "intelligent design" has gained much attention in recent years due to the Intelligent Design Movement. However, it is important to distinguish this modern interpretation of design from the traditional position. For intelligent design theorists like Phillip Johnson, Michael Behe, and William Dembski, design is associated with biological structures (termed "irreducibly complex" and "complex specified information") that purportedly could not evolve by natural processes. However, the traditional understanding of design focuses on the beauty, complexity, and functionality of nature, and it does not deal with the mechanisms through which these features arose. The historical view of design simply acknowledges that the world powerfully impacts everyone toward the belief that it reflects the mind of an Intelligent Being.

[12]*ACD*, 59; and Charles Darwin, *The Descent of Man and Selection in Relation to Sex*, new ed., rev. & aug. (New York: D. Appleton, 1886), 61. My italics.

[13]*ACD*, 85.

[14]*ACD*, 101.

[15]Quoted in Sandra Herbert, "The Place of Man," *Journal of the History of Biology* (1997): 233, note 50. Darwin manuscripts, vol. 42, University of Cambridge Library (Feb 1835).

[16]Charles Darwin, *Diary of the Voyage of H.M.S. Beagle*, ed. Nora Barlow, vol. 1 in *The Works of Charles Darwin*, ed. Paul H. Barrett and R. B. Freeman, 29 vols. (London: William Pickering, 1986), I:348 (18 Jan 1836).

[17]*Diary*, I:388 (24 Sep 1836).

[18]*ACD*, 85.

[19]Ibid.

[20]*ACD*, 86.

[21]Ibid.

[22]Theism refers to belief in an all-loving and all-powerful personal God. This Divine Being is personally involved in the lives of people and answers their prayers in miraculous ways. On the other hand, deism states that God is impersonal and never enters the universe, having nothing to do with humanity. It is significant to note that 40% of first-rate American scientists today are theists. See Edward J. Larson and Larry Witham, "Scientists Are Still Keeping the Faith," *Nature* 386 (3 Apr 1997): 435–6.

[23]A theological distinction needs to be made regarding Divine action. Interventionism is dramatic supernatural activity. For example, prior to Copernician astronomy, many believed that God or angels moved planets off their normal west-to-east courses, causing them to make short east-to-west loops known as "retrograde motion." Darwin refers to this type of Divine action in the next passage. Providentialism is God's subtle activity. An example would be the Creator employing natural laws to create life, both individually in the womb and collectively through evolution. This is the type of Divine activity Darwin envisioned during the years he formulated his evolutionary theory, and it was clearly included in his famed *Origin of Species*. In light of this categorical distinction, a well-known comment by Darwin can be better understood. One of the first people he revealed his evolutionary views to was J. D. Hooker. In an 1844 letter, Darwin writes: "I am almost convinced (quite contrary to the opinion I started with [i.e., progressive creation]) that species are not (it is like confessing a murder) immutable" (Darwin to Hooker [11 Jan 1844] in Francis Darwin, ed., *More Life and Letters of Charles Darwin,* 2 vols. [London: John Murray, 1888], I:40–1. Hereafter cited as *MLL*). Also found in Frederick Burkhardt and Sidney Smith, eds., *The Correspondence of Charles Darwin*, 11 vols. (Cambridge: University Press, 1987 [1985–1999]), III:2. Hereafter cited as *CCD*. Some skeptics argue that this is evidence for Darwin's atheism in that God is the murdered victim. However, an appreciation of the categories of Divine action challenges this interpretation. Darwin's intention in this letter was to confess to his slaying the interventionistic God of progressive creation, which at that time was accepted by the scientific community. As this paper will reveal, Darwin never embraced atheism. Rather, during most of his career, he believed in a deistic God who created life through a providential evolutionary process.

[24]Charles Darwin, "B Notebook (Feb 1837 to Jan 1838)," in Gavin de Beer, ed., "Darwin's Notebooks on Transmutation of Species," *Bulletin of the British Museum (Natural History)* II (1960): 101, 106. Note that excerpts from the notebooks are exactly that—rough notes that are not grammatically sound or stylistically proper. In this paper they will be presented as they appeared originally with words occasionally added in brackets [ ] to smooth a passage.

[25]Charles Darwin, "M Notebook (Jul 1838–Oct 1838)," in Howard E. Gruber, *Darwin on Man: A Psychological Study of Scientific Creativity Together with Darwin's Early and Unpublished Notebooks*, trans. and ed. Paul H. Barrett (New York: Dutton & Co., 1974), 292, #136.

[26]For the sake of brevity, I will not examine numerous theological passages that Darwin composed in the years between his early notebooks (late 1830s) and the *Origin of Species* (1859). During this

period he began with unpublished and private synopses of his theory in the "Sketch" (1842; 35 pages) and the "Essay" (1844; 213 pages). Later he started a major work, the "Big Species Book" (1856–1858), known today as *Natural Selection*, but it was abbreviated and became the *Origin of Species*. The religious beliefs expressed in these works are outlined in the notebooks and then repeated (sometimes almost verbatim) in the *Origin*. See Charles Darwin, *Foundations of the Origin of Species: Two Essays Written in 1842 and 1844*, ed. Francis Darwin (Cambridge: University Press, 1909), xxviii, 51–2, 253–5; and Charles Darwin, *Charles Darwin's Natural Selection; Being the Second Part of His Big Species Book Written from 1856 to 1858*, ed. R. C. Stauffer (London: Cambridge University Press, 1975), 224–5.

[27]See Charles R. Darwin, *On the Origin of Species. A Facsimile of the First Edition*, introduced by Ernst Mayr (Cambridge: Harvard University Press, 1964), 186, 188, 189, 413 (twice), 435, 488.

[28]*Origin of Species*, 488. In the "Big Species Book," Darwin adds to the original manuscript: "By nature, I mean the laws ordained by God to govern the universe" (*Natural Selection*, 224).

[29]The William Whewell epigraph in the *Origin of Species* depicts Darwin's rejection of interventionism: "But with regard to the material world, we can at least go so far as this—we can perceive that events are brought about not by insulated interpositions of Divine power, exerted in each particular case, but by the establishment of general laws."

[30]The term "teleology" comes from the Greek word *telos* which has a meaning of movement directed toward a goal, final outcome, or an end accomplished. See *Liddell and Scott Greek-English Lexicon* (Chicago: Follett Publishers, 1954), 697; and W. F. Arndt and F. W. Gingrich, *A Greek-English Lexicon of the New Testament and Other Early Christian Literature* (Chicago: University Press, 1979), 811.

[31]*Origin of Species*, 490.

[32]Morse Peckham, ed., *'The Origin of Species' by Charles Darwin: A Variorum Text* (Philadelphia: University of Pennsylvania, 1959), 759.

[33]Even more interesting, Darwin's modern critic Michael Behe seems to be a reincarnation of the famed evolutionist! Similar to the *Origin of Species* (1859), *Darwin's Black Box* (1996) proposes that the "irreducible structures" of the cell were put together "in one fell swoop" in a "first cell" from which all life evolved. See Michael J. Behe, *Darwin's Black Box: The Biochemical Challenge to Evolution* (New York: Free Press, 1996), 39, 227–8. Also see my response to a paper by Behe entitled "A Box or a Black Hole? A Response to Michael J. Behe," *Canadian Catholic Review* (July 1999): 67–73. This paper is also found on my web page: www.ualberta.ca/~dlamoure/3Behe.htm.

[34]Critics of this view claim that Darwin in the *Origin of Species* was simply hiding his true beliefs in order to have his book accepted. This was after all Victorian England. A letter to J. D. Hooker is often cited to defend this position. Darwin writes: "I have long regretted that I truckled to public opinion, and used the Pentateuchal term of creation, by which I really meant 'appeared' by some wholly unknown process" (Darwin to J. D. Hooker [29 Mar 1863] in *LLD*, III:18; and *CCD*, XI:278). However, if this is the case, then Darwin's regret is short-lived. In the three editions of the *Origin of Species* (1866, 1869, 1872) following this letter to Hooker, he made no effort to remove the "Pentateuchal term of creation" from his work. But more importantly, a review of Darwin's *personal* scientific notebooks, which were never intended to be public, reveal his theological views are the same as those expressed in the *Origin*. See endnote 26.

[35]See Asa Gray, *Natural Selection Not Inconsistent with Natural Theology: A Free Examination of Darwin's Treatise on the Origin of Species and of Its American Reviewers* (London: Trubner & Co, 1861).

[36]Darwin to Gray (22 May 1860) *LLD*, II:311–2; *CCD*, VIII:224. Darwin to Gray (26 Nov 1860) *LLD*, II:353–4; and *CCD*, VIII:496. My italics.

[37]*ACD*, 87.

[38]For anyone in disagreement with this statement, I appeal to no one less that the "evangelical" atheist Richard Dawkins who states:

> The complexity of living organisms is matched by the elegant efficiency of the apparent design. If anyone doesn't agree that this amount of complex design cries out for an explanation, I give up. ... Our world is dominated by feats of engineering and works of art. We are entirely accustomed to the idea that complex elegance is an indicator of premeditated, crafted design. This is probably the most powerful reason for the belief, *held by the vast majority of people that have ever lived, in some kind of supernatural deity* (*Blind Watchmaker*, xiii, xvi. My italics).

Furthermore, a 1996 Princeton University study on the beliefs of Americans reveals that 96% accept the existence of "a God or universal spirit." No author, "Religion Index Hits Ten-Year High," *Emerging Trends: Journal of the Princeton Religion Research Center* (Mar 1996): 4. Also see Darwin's affirmation of my view in quotes 56 and 63.

[39]This entrapment in Paleyan categories and the frustration it produced for Darwin is further seen in a letter to J. D. Hooker nearly ten years later. Darwin writes: "My theology is a simple muddle; I cannot look at the universe as the result of blind chance, yet I can see no evidence of beneficent design, or indeed of *design of any kind, in the details*. As for *each* variation that has ever occurred having been preordained for a special end, I can no more believe in it than that the spot on which *each* drop of rain falls has been specially ordained" (Darwin to Hooker [12 Jul 1870] *MLL*, I:321. My italics).

[40]Darwin considered this view of design in his correspondence with Asa Gray: "I am inclined to look at everything as resulting from designed laws, with the details, whether good or bad, left to the working out of what we may call chance. Not that this notion *at all* satisfies me" (*LLD*, II:311–2; *CCD*, VIII:224). Regrettably, Darwin never develops the notion, nor does he defend why it never satisfied him.

[41]Darwin to Gray (22 May 1860), *LLD*, II:311–2; *CCD*, VIII:224.

[42]Darwin to Hooker (13 Jul 1856), *MLL*, I:94; *CCD*, VI:178.

[43]For a concise review of Darwin's medical condition and possible diagnosis, see Lybi Ma, "On the Origin of Darwin's Ills," *Discover* (September 1997): 27.

[44]See James R. Moore, "Of Love and Death: Why Darwin 'Gave Up Christianity'" in his edited, *History, Humanity, and Evolution: Essays for John C. Greene* (Cambridge: University Press, 1979), 195–229; Randall Keynes, *Annie's Box: Charles Darwin, His Daughter and Human Evolution* (London: Fourth Estate 2001).

[45]Darwin to Lyell (2 Aug 1861) *MLL*, I:191–2; *CCD*, IX:226. My italics.

[46]For an excellent review of this theological approach, see Ernan McMullin, "Cosmic Purpose and the Continency of Human Evolution," *Theology Today* 55, no. 3 (1998): 389–413.

[47]Charles Darwin, *The Variation of Animals and Plants Under Domestication* (London: John Murray, 1888), II:428. My italics. Darwin seems to have eventually abandoned his Divine sovereignty argument. First evidence of this appears in a letter two years later to J. D. Hooker where he writes: "Your conclusion that all speculation about preordination is idle waste of time is the only wise one; but how difficult not to speculate!" (Darwin to Hooker [12 Jul 1870], *MLL*, I:321). Moreover, this argument does not appear in Darwin's mature theological position found in his *Autobiography* (1876).

[48]Neal Gillespie recognizes this intellection tension in Darwin's thinking. He writes: "Darwin's materialism [was] compatible in his mind with theism. ... There were in effect, two Darwins: one had caught the vision of a new method; the other still adhered to the older view that the very possibility of there being such a thing as science was necessarily linked to theism as the source of meaning and rationality in nature. ... He rejected the creationist doctrine of divine intervention or superintendence because it was philosophically incompatible with the tenets of an emerging positive science ... [but] Darwin's own approach fell short of complete positivism. Because of the theological elements in his thought, he continued to speculate ... on the possibility of life and was loath to abandon the universe to the full meaninglessness that a complete positive view of the cosmos entailed" (Neal C. Gillespie, *Charles Darwin and the Problem of Creation* [Chicago: University Press, 1979], 139, 146).

[49]*Origin*, 488.

[50]See section entitled "Belief in God–Religion" in *Descent of Man*, 93–6.
[51]*Descent of Man*, 613.
[52]*ACD*, 90.
[53]*ACD*, 88, 89–90.
[54]*ACD*, 90–1. Darwin is referring to the passage in his *Beagle Dairy*. See quote 17. Darwin's comment that this "religious sentiment" is "experienced by most persons" compliments my argument in endnote 38.
[55]*ACD*, 91. Darwin's "color-blindness" seems to be somewhat temporary or intermittent as quote 63 will reveal.
[56]*ACD*, 92–3.
[57]See Frank Burch Brown, "The Evolution of Darwin's Theism," *Journal of the History of Biology* (1986), 28. Brown argues cogently that Darwin's statement should not be understood as simply a reminiscence.
[58]The question arises as whether Darwin uses the term "theist" correctly in this passage when in fact he means "deist." In defense that he does employ the term properly is the following assertion three pages earlier in this section on "Religious Belief." Darwin states: "I did not think much about the existence of a *personal* God until a considerably later period of my life" (*ACD*, 87. My italics).
[59]*ACD*, 93.
[60]*ACD*, 93. One must ask: "Is Darwin not using a mind 'evolved from lower forms' to make this argument?" Yes, there is a problem here with self-referential incoherence.
[61]*ACD*, 94.
[62]Darwin to Fordyce (1879) *LLD*, I:304. Italics added.
[63]*LLD*, I:316.
[64]For central Intelligent Design Theory works, see Phillip E. Johnson, *Darwin on Trial* (Downer's Grove: IVP, 1991) and his *Defeating Darwinism by Opening Minds* (Downer's Grove: IVP, 1997); Michael J. Behe, *Darwin's Black Box: The Biochemical Challenge to Evolution* (New York: Free Press, 1996); and William A. Dembski, *Intelligent Design: The Bridge between Science and Theology* (Downer's Grove: IVP, 1999). For my debate with Johnson, see Phillip E. Johnson and Denis O. Lamoureux, *Darwinism Defeated? The Johnson-Lamoureux Debate on Biological Origins* (Vancouver: Regent College Press, 1999); a synopsis of my argument in this book can be see on my web page: www.ualberta.ca/dlamoure/3Johnson.htm.
[65]Henry M. Morris, *The Troubled Waters of Evolution* (San Diego: Creation Life Publishers, 1982), 75.
[66]Richard Dawkins openly admits: "I want to inspire the reader with a vision of our own existence ... I want to persuade the reader, not just that the Darwinian world-view *happens* to be true, but that it is the only know theory that *could*, in principle, solve the mystery of our existence" (*Blind Watchmaker*, xiv. Italics original). Clearly, Dawkins is promoting a secularized form of religion.

Books Received and Available for Review

Contact the book review editor if you would like to review one of these books. Please choose alternate selections. Richard Ruble, Book Review Editor, *Perspectives on Science and Christian Faith*, 212 Western Hills Drive, Siloam Springs, AR 72761. ruble@tcainternet.com

John Angus Campbell & Stephen C. Meyer, eds., *Darwinism, Design, and Public Education*, Michigan State University Press, 634 pages, 2003

George A. Erickson, *Time Traveling With Science and the Saints*, Prometheus Books, 177 pages, 2003

Hal Flemings, *Philosophical, Scientific and Theological Defense for the Notion that a God Exists*, University Press of America, 136 pages, 2003

W. R. Godfrey, *God's Pattern for Creation: A Covenantal Reading of Genesis 1*, R&R, 142 pages, 2003

Susan Haack, *Defending Science Within Reason*, Prometheus Books, 410 pages, 2003

M. Heller, *Creative Tension: Essays on Science and Religion*, Templeton, 182 pages, 2003

James Martin-Schramm & R. L. Stivers, *Christian Environmental Ethics: A Case Method Approach*, Orbis Books, 320 pages, 2003

Dorothy McDougall, *The Cosmos as the Primary Sacrament: The Horizon for an Ecological Sacramental Theology*, Peter Lang, 190 pages, 2003

T. L. Nichols, *The Sacred Cosmos: Christian Faith and the Challenge of Naturalism*, Baker Book House, 240 pages, 2003

Mark Perakh, *Unintelligent Design*, Prometheus, 460 pages, 2003

Ted Peters, *Science, Theology, and Ethics*, Ashgate, 350 pages, 2003

Ted Peters & Martinez Hewlett, *Evolution from Creation to New Creation: Conflict, Conversation and Convergence*, Abingdon Press, 215 pages, 2003

S. G. Post, *Human Nature and the Freedom of Public Religious Expression*, Notre Dame Press, 2003

S. G. Post, *Unlimited Love: Altruism, Compassion, and Service*, Templeton Foundation Press, 232 pages, 2003

Samuel Powell, *Participating in God: Creation and Trinity*, Fortress Press, 238 pages, 2003

Anne Primavesi, *Gaia's Gift: Earth, Ourselves and God After Copernicus*, Routledge, 150 pages, 2003

Jeffrey Pugh, *Entertaining the Triune Mystery: God, Science, and the Space Between*, Trinity Press International, 194 pages, 2003

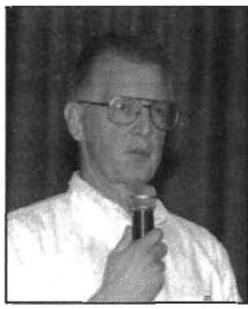
Fazale Rana & High Ross, *Origins of Life: Biblical and Evolutionary Models Face Off*, NavPress, 300 pages, 2003

R. J. Rolwing, *Digging Up Darwin in Ohio Without Holding Your Nose*, Xlibris, 220 pages, 2003

Cletus Wessels, *Jesus in the New Universe Story*, Orbis Press, 240 pages, 2003

Design: What Scientific Difference Could It Make?

Del Ratzsch



Del Ratzsch

The claims that intelligent design theories are not legitimately scientific and that such theories can carry no genuinely scientific content represent conventional anti-design wisdom. However, actual supports for such claims come to remarkably little and tend to implode under scrutiny. Furthermore, demands confronting design theories are often arbitrarily restricted to the realm of direct empirical consequences. The precise surface-level empirical upshot of design theories is, I think, still relatively minimal. But the directly empirical level does not exhaust the substance of science, and design theories may bring to science deeper cognitive richness, broader conceptual resources, and more substantive anchors than a purely (methodologically) naturalistic science can achieve.

The concept of intelligent design is frequently ruled out of the natural sciences on the grounds that if the concept is applied to nature, the only relevant designer would have to be some supernatural being ...

Intelligent design has become a focus of hot—even blistering—debate. Not all critics agree on the exact nature of the outrage it perpetrates, but high on the list of charges are (1) that the very concept of intelligent design when applied to nature itself inescapably constitutes reference to supernatural design—a reference whose illegitimacy, some apparently feel, is far beyond dispute, and (2) that even were the concept of intelligent design legitimate, in some philosophical sense, it would simply have no empirical, scientific bite.

In what follows, I wish to do three things. First, I will argue that in principle the concept of intelligent design can be legitimately applied to what we would ordinarily take to be *natural* phenomena. Second, I will explore some issues concerning the *recognition* of design. Third, I will argue that although design may not cut the swath its advocates claim for it, it does have scientifically interesting potential. Whether that potential is (or is likely to become) actual, I will not address.

I will proceed by glossing the most popular critiques of design in each of the three areas, then briefly explore resources available to design advocates in those areas.

Del Ratzsch *(Ph.D., Philosophy, University of Massachusetts) specializes in philosophy of science, with a particular interest in science/religion questions. His most recent book –* Nature, Design, and Science *– is an investigation of the philosophical and conceptual underpinnings of the concept of intelligent design in scientific contexts. Ratzsch is an avid cyclist, but is far too concerned for the aesthetic wellbeing of others to wear Spandex cycling shorts. He may be contacted by email at dratzsch@calvin.edu*

Legitimacy—The Principial Question

1. *Definition.* The concept of intelligent design is frequently ruled out of the natural sciences on the grounds that if the concept is applied to nature, the only relevant designer would have to be some supernatural being, reference to whom is scientifically forbidden. This prohibition is sometimes justified by appeal to some definition or rule of science—typically methodological naturalism (MN), which is frequently characterized as follows:

> The view that nature is the whole of reality (philosophical naturalism) may or may not be correct (science itself simply takes no position), but since science cannot deal with the supernatural, it is an essential methodological principle of science that science must proceed *as if* philosophical naturalism is correct.[1]

In practice, MN involves a provisional acceptance of a *separability* thesis—an assumption that the natural realm can be separated from the immaterial (e.g., mind, God) at some level below which it can be treated as autonomous (in a scientifically relevant sense) given suitable structural and organizational principles, or that there is some level of behavior and organization in nature below which mind and agency are not scientifically relevant. *Design*, on this view, is suspect since it represents a potential denial of separability. But separability is

a substantive thesis whose truth and essentiality to science require argument. And even were it true, determining where the relevant level(s) lies would be scientifically crucial, perhaps nontrivial, and might itself require recognition of the presence or absence of mind or agency involvement. But if science could do that, the case for barring design would be substantially undercut.

Although MN may be a valuable strategic principle, elevating it to a definitional principle generates nasty problems. Should it turn out that naturalism does *not* constitute the whole relevant story of some scientific domain, then commitment to MN will guarantee that the scientific picture generated in that domain would inescapably be either incomplete or simply mistaken. In short, if nature does not bow to our stipulations, science risks difficulty.

Furthermore, attempts to triumph definitionally are complicated by the fact that no one *has* a compelling definition of *science*, that most demarcation attempts are deep in some twilight zone, and that attempts to settle substantive issues via a priori definitional trumping do not seem consistent with the image of science even most scientists maintain.[2]

It is widely claimed that design hypotheses are unfalsifiable and consequently scientifically illegitimate. ... [T]his criticism frequently rests on the idea that design attempts are scientifically empty, being reconcilable with absolutely everything.

---

2. *Unfalsifiability.* It is widely claimed that design hypotheses are unfalsifiable and consequently scientifically illegitimate. Falsification of design hypotheses would indeed be a tricky business. Virtually any proposed empirical criterion for nondesign could be deliberately contrived by a resourceful designer. Thus, attempts to *prove* that a specific phenomenon was not designed would be virtually hopeless.[3]

More generally, this criticism frequently rests on the idea that design attempts are scientifically empty, being reconcilable with absolutely everything. This hyperflexibility charge, however, requires caution. There have been multitudinous novel empirical discoveries but relatively few theoretical revolutions, which suggests that even respectable scientific theories are flexible enough to adjust to a wide range of unanticipated phenomena. Even in cases where the alleged novel empirical phenomenon is subsequently scientifically repudiated (claims for its very existence being abandoned), during the initial period of provisional acceptance there may even be *multiple* theoretical proposals for accommodating it within a reigning theory.[4]

Could there be evidence against design adequate for scientific purposes? I see no reason why not. If we had empirical evidence that the history of human evolution really was a random "drunk walk," then although absence of design would not be *entailed*, the case for lack of design (in that specific matter) would seem to be *scientifically* defensible. That is not only adequate but perhaps as good as could be demanded.[5] In any case, unfalsifiability does not imply the absence of relevance and impact.

3. *Nonpredictiveness.* Closely intertwined with the unfalsifiability issue is a charge that intelligent design is nonpredictive. This issue, however, is not so straightforward as often thought. First, it is generally recognized that scientific theories make predictions only in conjunction with other inferential resources—boundary conditions, auxiliary hypotheses, instrumentation theories, etc. Second, different scientifically-essential principles operate at different levels in a conceptual hierarchy within science, at different degrees of removal from the empirical trenches.[6] What connection a conceptual component should have with empirical predictions is partially a function of the level upon which it operates. Further, science unavoidably rests in part upon a conceptual matrix of deep metaphysical presuppositions. Such principles must generate *some* payoff in the broader scientific picture, but that payoff is not always so simple as particular identifiable empirical predictions. Design theories *might* find their legitimacy deeply enough within the structure of science to make demands for specific empirical predictions inappropriate. Such theories might, for instance, constitute key parts of a scientific conceptual matrix whose payoff is more subtle, more contextual.[7] Thus, what does or does not count as a fatal difficulty for design theories will depend upon the exact nature and level of such theories.[8]

Although space precludes discussion here, it is worth noting that virtually every accusation in this area raised against design theories applies equally to the uniformity of nature—a principle whose scientific propriety few would care to challenge.[9] And although other principial objections to design theories in science also have been raised, I think that it can be shown that none of the objections withstand scrutiny.[10] In fact, there are considerations which suggest some degree of legitimacy for design theories. One cluster of such follows briefly.

There is no rule in science requiring either that life on earth began here or that theories concerning the origin of life on earth be restricted in that manner.

4. *Aliens.* The concept of intelligent *alien* design is certainly scientifically legitimate, and that fact has implications often not recognized. There is no rule in science requiring either that life on earth began here or that theories concerning the origin of life on earth be restricted in that manner. In fact, a number of prominent scientists (e.g., Fred Hoyle, Francis Crick) have argued that life could not have arisen naturally under prevailing early earth conditions and time constraints, and that life consequently had to have come here from elsewhere. It is at least possible in that case that life was specifically engineered for earth conditions—that life as *we* know it is an artifact of intelligent design and agency.

There is nothing inherently unscientific in that view nor in the idea that if life as we know it is a designed artifact, then it is in principle possible for us to discover that fact through empirical investigation. This line of reasoning can be extended further. It has been suggested by various physicists (e.g., Andrei Linde, Edward Harrison) that technologically advanced cultures might develop the capability of generating bubble universes. Advanced technology might even allow specification of "natural" physical parameters inside such universes—generating what could appear *inside* such a universe to be "cosmic fine tuning" or possibly even a deliberately constructed message.[11]

There seems little a priori reason for thinking that creatures developed within such a universe (perhaps as deliberately intended results of specification of the bubble's parameters) would necessarily be unable to determine the artifactual status of their universe. Prohibitions against scientific application of the concept of design either to phenomena within what we normally think of as nature, or to that "nature" itself, seem thus mistaken. So long as the cosmic artisans are natural (in some broader sense), the idea that our universe (our "nature") is intelligently designed and that empirical investigation can reveal that fact is in principle scientifically legitimate.[12]

5. *Extensions.* Two related considerations extend the implications even further. First, it is commonly observed that the *identity* of the artisan(s) should make little difference. In the movie *2001*, recognition of the monolith as designed was independent of any knowledge of the identity, character, or intentions of the designer(s) (or of the means of production). Indeed, we would have identified the monolith as designed even had its artisan been supernatural. It cannot be seriously maintained that one cannot admit within science that something is designed *unless* one knows or assumes that the designer is not supernatural. Even *if* it is illegitimate to consider the supernatural within science, obviously designed phenomena (e.g., a bulldozer) could still be legitimately recognized *as* designed even *if* their designer was in fact supernatural.

Second, sealing off science from recognition of the supernatural may not be trivial. Whether an *investigation* is scientifically legitimate is surely independent of what ultimate results the investigation generates. (Otherwise, one would not know whether to apply to NSF or NEH until *after* one's investigation were completed—a clearly intolerable situation for everyone concerned.) One possible outcome of relevant investigation would be that the universe (or life as we know it, etc.) was an artifact, and that the artisan(s) was/were technologically advanced natural beings. The *investigation* could surely be scientific, and if the identity of the artisan(s) as natural, alien, etc. were legitimately scientific, then at least according to Popperians, the latter part of that conclusion would have to be empirically falsifiable—i.e., it would have to be in principle empirically demonstrable that the artisan(s) was/were *not* technologically advanced natural beings. Were that shown, options concerning the identity of the artisan(s) would be seriously restricted. Indeed, the conclusion that the artisan(s) was/were *super*natural would be very close to entailed. (That would, of course, constitute an additional challenge to the separability thesis. One related concern will emerge later.)

I will not pursue this legitimacy issue further here.[13] But if considerations like those above do not establish the scientific in-principle permissibility of intelligent design theories, they at least suggest that the opposite conclusion is far from unchallengeable.

Recognition—The Practical Question

Such legitimacy would be of little significance were there no reliable means of detecting or recognizing design (at least sometimes) when it was manifested. What design-recognition procedures are available to us, and could any of them apply even in principle to natural phenomena?

1. *Counterflow and artifacts.* We tacitly recognize design almost non-stop in the normal course of things—in physical, conceptual, and behavioral artifacts. Design recognition is essential even in various sciences, from the social to such semi-hard sciences as anthropology, the Search for ExtraTerrestrial Intelligence (SETI), and some forensic sciences. However, the recognition process in virtually all relevant instances rests upon recognition that some aspects of the phenomenon in question exhibit *counterflow*—characteristics which nature unaided by agency does not, would not, or even could not produce. SETI, for instance, looks initially for signals of a type, pattern, or frequency not likely attributable to natural processes. Attempts to understand Stonehenge began with the trivial recognition that it was an artifact and not a product of natural processes. That is the basic pattern of familiar cases of design recognition—a preliminary recognition of counterflow and artifactuality.[14]

Our typical dependence on counterflow generates a potential difficulty with attempts to recognize design in or of *nature*, since absence of familiar counterflow and artifactuality seems to be precisely what characterizes nature *as* nature—things we find in nature are exactly what nature does, would, and can do. Could we then ever recognize design in nature?[15]

2. *Cognitive resonance.* Design recognition does not depend solely (or perhaps at all, in some cases) upon recognition of counterflow. What signals design—as opposed to just artifactuality—is that designed phenomena typically manifest some characteristic that resonates with our cognition. Even the most ordinary cases of design involve more than merely something nature would *not* do. Being deliberately agent-generated, they typically involve something that an agent, a mind, *would* do. That is the heart of the concept of design. And that characteristic in principle can be recognized independent of recognition of counterflow, and can exist independent of counterflow itself.[16]

3. *Designer psychology.* But recognition of design in nature solely on the basis of cognitive resonance seems problematic. Surely what an agent or a mind *would* do depends crucially on the type of agent/mind in question. And once outside the realm of *human* design, we apparently have no experience whatever, much less a basis for a respectable induction. What, for instance, might be the standard Alpha Centaurian psychological profile? What aims and values and concepts might such creatures have? Would *any* of those things overlap with ours? Or how would we know what a *supernatural* agent would be inclined to do, or what sorts of design an utterly infinite mind would find appealing?[17] These are, of course, question-types rooted in Hume and which flowered in Darwin.[18]

What signals design—as opposed to just artifactuality—is that designed phenomena typically manifest some characteristic that resonates with our cognition.

Those are serious, but not necessarily fatal, questions. For one thing, there might be common constraints governing any natural intelligence, or any physically-based intelligence. Indeed, SETI research tacitly employs that assumption in determining what microwave bands to pay particular attention to. For example, arguments for the so-called "waterhole" search principle involve assumptions concerning not only alien capabilities, but alien broadcast band selection strategies.

With a supernatural designer, however, such constraints might be absent. But within Judeo-Christian theology there are further potentially significant resources. First is the doctrine that humans are created in the image of God. The exact character and implications of that doctrine are disputed, but to the extent that it bears upon structures of human cognition, it may provide a basis for recognition of at least some instances of supernatural design. (In fact, science itself depends upon nature's intelligibility to us, which may in its turn depend upon structures in our cognition imaging structures in God's wisdom which he built into the creation.) Second is the traditional view that humans were created to be knowing beings. That opens the *possibility* of our having inbuilt resources allowing recognition of design, whether that design be human and alien design involving counterflow and artifactuality, or supernatural design in nature involving neither of those properties.[19]

4. *Design-recognition faculties.* Is there reason to think that we do have such capabilities? Oddly enough, Darwin

himself, in the last year of his life, testified that a conviction of design in nature "often comes over me with overwhelming force ..."[20] It was a conviction that *happened* to him—not an inference or choice or anything else of his own doing.

The contemporary biologist Francis Crick sees this intuitive tilt toward involuntary design convictions as pervasive and powerful enough to necessitate posting warnings for biologists. He cautions: "Biologists must constantly keep in mind that what they see was not designed, but rather evolved."[21]

...the traditional view that humans were created to be knowing beings ... opens the possibility of our having inbuilt resources [for] recognition of design ... whether human and alien design ... or supernatural design ...

The idea that we have an inbuilt design-recognition ability can be found in William Whewell and is mentioned in David Hume, but it is most explicitly explored in the eighteenth-century Scottish Common Sense philosopher Thomas Reid. According to Reid, our basic recognition of design (in particular, of certain properties as marks or signs *of* design) does not involve either prior experience, induction, or inference of any sort, but is ultimately involuntary and *perceptual*, roughly paralleling ordinary sensory perception. As a consequence of the constitution of our nature, certain sensory events trigger in us particular cognitive states, including not only direct recognition of and convictions concerning trees and other humans, but also recognition of and convictions concerning design.

Although I will not go into it here, I think that Reid's view is plausibly defensible.[22] He at least *seems* to be right that in our ordinary, everyday recognition and identification of human design (spoons, chairs, space shuttles) we do not engage in inference, calculate probabilities, or anything of the sort. (I suspect that we have little *clue* as to what some of the relevant probabilities even are.)[23] In fact, we sometimes appear able to directly and immediately recognize design in objects wholly beyond our previous experiences, and we presume that we would recognize as designed at least some alien artifacts whose very categories lie outside the experiences of any human being. But if something like a Reidian view is right, then recognition of design might have a legitimate claim to being observational and (at least in this respect) to being potentially as legitimate in science—and as reliable—as are other perceptual matters.[24]

Differences—The Pragmatic Question

Suppose, then, that reference to design is in principle legitimate in "natural" science, and that we could in principle recognize some occurrences in nature were such present. Would it make any real difference to science? It might initially appear that it would not. Two sets of considerations follow.

1. *Inferences to/from design.* There are two categories of design inference that require separation: (1) inference *to* design; and (2) inference *from* design. Inferences *to* design involve moving from particular empirical data to the conclusion that the phenomenon in question is a result (directly or indirectly) of deliberate design. Such inferences would require something like bridge principles stipulating that the relevant empirical characteristics indicate designedness. Establishing such connections in certain situations is unproblematic—we do so routinely every day. Unfortunately, as noted earlier, the everyday clear cases typically involve counterflow, and counterflow is precisely what is systematically missing (or at least bitterly contestable) in the cases of interest in natural science. Significantly weakening any inductive case for the crucial bridge principles are the facts that (1) the familiar cases are without exception from the artifactual category and (2) that this artifactuality plays a significant role in design attribution in those familiar cases, whereas (3) the cases of interest (design in nature) are apparently outside the artifactuality category and lack that often crucial characteristic.

Inferences *from* design involve moving from design claims (whether presuppositions or conclusions) to other empirical matters (e.g., empirical predictions). Some such inferences are in familiar cases unproblematic. Others are much less secure, given that designers can act in surprising ways. Depending upon the designer's values, motivations, capacities, conceptions, interpretations of situations, theories, etc. (all the way up to worldviews), a designer may do any number of totally unanticipatable things. Thus, although recognizing design and (after the fact) making sense of design may be nearly trivial in some cases regardless of the designer's character, values, intentions, beliefs and so forth, *predicting* the shape of design activity in the absence of

significant knowledge of those things may be virtually impossible. Thus, inferences *to* design in nature seem problematic, and even if such design is simply granted, it does not seem to lead far scientifically.

2. *Gaps, non-gaps, and existence proofs.* If we look more specifically at instances involving design, the fact/presence of design often seems to be unconnected to any scientific leverage such instances generate. That contention may be supported as follows. Specific design cases seem to come in two varieties—with and without natural causal gaps in the production of the phenomena in question.[25] Let us discuss them in turn.

If we look more specifically at instances involving design, the fact/presence of design often seems to be unconnected to any scientific leverage such instances generate.

Gaps. Suppose that the first human landing on Mars was confronted with an undeniable Martian bulldozer—a clear case of design involving a natural causal gap, since nature's capabilities unaided by agency stop well short of producing bulldozers. Discovering this bulldozer, we would infer the existence of a suitable intelligence with suitable technical capabilities. We might even be able to infer various things about the designer(s) from the bulldozer. We also might acquire substantial technical and technological knowledge from examination of the bulldozer, and might even learn some new theoretical principles as well. However, except for matters closely linked to the fact of the gap (e.g., the existence of the artisans), nearly everything we would learn would depend on the mere *existence* of the bulldozer—not on either its designedness or its artifactuality. Suppose that by some wild freak of chance, random processes had produced that exact bulldozer, down to its very molecular structure. Whatever *processes* operated in the bulldozer, whatever *principles* its functioning exhibited—all would be exactly as manifest in the chance bulldozer as in the actually designed bulldozer, and anything that was there to be learned in the one would be there to be learned in the other. Beyond issues of mere artisan existence, whether the bulldozer is *designed* seems completely irrelevant on these specific counts.[26]

Non-gaps. Gapless design cases would seem to offer even less prospect of unique scientific fruitfulness. If there are no gaps, then whatever the phenomenon, there will be a natural explanation (at the immediate level) of its existence and its characteristics. The fact that it also was designed would offer no more insight into function, principles, or mechanisms than would its mere existence. Its existence and its operation would (back arbitrarily far) seem to be wholly explicable in mechanical (at least natural) terms. There might be features about it which implied the existence *ultimately* of an intelligence that designed it indirectly, but what *scientific* impact would that have? Design would seem to be simply an add-on layer. If there are no gaps, then aside from issues of ultimate origins, the "designed" conclusion would seem to have no *empirical* implications not already implicit in the very structure, governance, and course of nature itself.

As before, any such "natural" phenomenon could constitute an existence proof, but even more than before, *designedness* would seemingly play no role. Here is an interesting recent example. An astronomer concerned with observational-field limitations of X-ray telescope lenses read an article discussing the structure of lobster eyes (more generally, macruran eyes), and recognized it as a possible solution to the problem. Some X-ray telescope technology now being developed embodies lessons learned from phenomena—lobster eyes—which the researchers apparently did not need to see as designed in order to learn the relevant lessons from it.[27] Here again, it was an existence proof—not any inference from designedness[28]—which did the work.[29]

A Deeper Look

Perhaps this dismissal is a bit too quick and simple. Recall the earlier point that how conceptual components of science function and what demands might be legitimately made of them are not all of a kind. Unnuanced demands that the payoffs of incorporating design and related concepts into science be immediate and empirically specific may reflect insufficient appreciation of some of the philosophical complexities involved. But what other sorts of payoffs might design possibly offer? Following are several suggestions.

1. *Contextual embedding.* Christian theology played a significant (perhaps pivotal) role in the birth of modern science. The doctrines of creation and of divine voluntarism figured prominently in rational justifications of essential presuppositions—uniformity of nature, intelligibility of nature, necessity of observation, reliability of human sensory and cognitive faculties, permissibility of experiment, and the like. The idea of design was crucial—things that are designed are typically intelligible, embody consistency and coherence, and generally must be empirically examined to determine what the actual structure is. Indirectly, then, design theories would tie into a deeper

Christian theology played a significant (perhaps pivotal) role in the birth of modern science. ... The idea of design was crucial – things that are designed are typically intelligible, embody consistency and coherence, and generally must be empirically examined to determine what the actual structure is.

legitimation of science's presuppositions than is otherwise available and might thus afford one a worldview which was more organically unified on its upper levels. Such unification, as a form of consilience, sometimes even has evidential force.

2. *Perspectives.* Taking nature (or subsystems) to be designed could also generate a substantively different perspective on reality. Since science cannot even in principle avoid taking some of its character and some of its conceptual resources from the larger conceptual matrix within which it is located, that *could* have significant scientific consequences. Deep principles concerning the nature of reality – including design – can affect such scientifically consequential matters as what sorts of theories might be considered legitimate, what sorts of conceptual resources are acceptable, what sorts of proposals can be considered plausible, what sorts of investigative questions are asked, what sorts of patterns in phenomena are even noticeable let alone considered genuine and revealing, what sorts of approaches are seen as legitimate and potentially fruitful, and what criteria proposed answers must meet.[30] As a broad example, think of the profound historical scientific consequences of replacing organic metaphors in science with machine metaphors.[31]

3. *Understanding.* On some views, *understanding* relevant truth is the deepest aim of science. Suppose that the fact of something being designed did not entail or predict any other empirical matters at all. That something is a product of design is nonetheless a substantive and upright bit of information about it even if knowing that it was designed did not help us understand its purpose, its history, its origin, its means of production, its producers, its operation, its incorporated principles, or much of anything else. Saying exactly why and how that is scientifically interesting is not easy. Still, any scientific investigator who managed to overlook the designedness of, say, a Martian diesel bulldozer would be inept. Surely exactly the same must be said about nature. Even were the designedness of nature to have no further *scientific* implications, the fact of that design would nonetheless be a legitimately scientifically interesting fact, and one which ought not be overlooked.[32]

4. *Existence.* Genuine design – with or without gaps – would imply the existence of a designer(s).[33] If (e.g., in a Hoyle or Crick scenario) it appears that perfectly natural aliens designed and produced life as we know it, then that would be scientifically important and could have significant further implications for research questions, aims, strategies, and permissible conceptual resources. But bare facts just concerning existence, even without such implications, are neither trivial nor scientifically irrelevant. Even if the *only* thing we learned was that such aliens (had) existed, this mere existence would have as much *scientific* propriety as the establishment of the existence of some new phylum on earth (as in the recent lobster lip case involving *Symbion pandora*), or the existence of some (any) lifeform on Mars. After all, the discoverers of *S. pandora* did not have to submit their reports to *The Journal of Philosophy*. Were it established that "normal" aliens (and not supernatural beings) had generated the bubble universe we inhabit, that absolutely would not be a matter of indifference to scientists – either qua scientists or qua human beings. And if empirically-based investigations began suggesting that the bubble-designing agent was not merely (natural) alien, it is not completely obvious why that could properly be of interest to scientists only *qua* human beings and not *qua* scientists.[34]

It will, of course, be claimed that science *could not* establish the latter. Although it should not be forgotten that some are unprepared to admit *any* limitation on science,[35] those who do stipulate naturalistic limits for science risk forcing science to miss – or worse, to deliberately ignore – what would be the biggest scientific story ever.

5. *Conceptual space.* Being open to design offers a further possible scientific benefit.[36] Design theories can allow conceptual *space* for gaps in the course of nature. There may or may not actually be such gaps (that is an empirical question, and design as such cuts neither way here), but (paralleling an earlier point) if there are gaps, then any science which denies their existence will of necessity be either incomplete (offering no relevant explanation of some aspects of the phenomenon in question) or mistaken (offering a full, gapless explanation where a gap in fact does exist). Some design theories could permit scientific recognition of gaps for what they

are, whereas blanket prior rejection of the possibility of design—and with it, the practical possibility of gaps—would deprive science of that flexibility.

Design theories can allow conceptual space for gaps in the course of nature.

That would have consequences for the alleged "self-correcting" nature of science. In cases where the truth of the matter is non-natural, even were some favored naturalistic theory discovered to be false, science would be forced by methodological naturalism to consider only naturalistic replacements—all of which would *ex hypothesi* also be mistaken. Furthermore, a doctrinaire commitment to methodological naturalism conjoined with a commitment to the position that the picture produced by science is correct and potentially complete very nearly entails *philosophical* naturalism. Of course, many religious believers explicitly deny the completeness of science, contending that wherever the supernatural is concerned science *should* fall silent. But to fall silent where it should and to speak where it should, science will need some means of identifying if, when, and where supernatural activity may be occurring (or has occurred). If science, however, can identify ifs, whens, and wheres of supernatural activity, then those cases for excluding design which rest on claims that science cannot recognize the supernatural even in principle, are thereby undercut. Unless relevant boundaries are simply stipulated arbitrarily or a priori, making a real *case* for some version of the separability thesis is going to be unavoidable for strict methodological naturalists.

6. *Reverse engineering and tenacity.* One of the major pragmatic objections to design theories is the worry that scientists (being a lazy, depraved lot) would take the easy way out in the face of scientific difficulty, would appeal to divine agency, and thus would never discover material solutions even when there were such. They would simply quit too soon.

This is a legitimate concern, and was expressed at least as early as the 1600s, in the works of both Bacon and Boyle.[37] But failure to realize when it *is* time to quit is problematic as well. Crop-circle enthusiasts who reject explanations involving human pranksters and are holding out for alien activity evidently do not know when to quit. Erstwhile inventors of perpetual-motion machines (who accuse physicists of accepting the Second Law merely as a lazy way of avoiding the hard work of inventing perpetual motion) have also fairly clearly not learned when to quit. If life on Mars ultimately originated from microbes inadvertently carried to Mars by NASA probes, far future Martian scientists trying to figure out exactly how life spontaneously originated on Mars by chemical evolution will need to learn when to quit—when to give up on that research program. And if Hoyle, Crick, and others are correct, biologists who are still trying to figure out how life emerged from nonlife under early earth conditions in the time available, have failed to learn when to quit. Openness to design would permit recognition and flexibility, *were such warranted*, concerning when to quit—when to abandon degenerating research programs.

If science were pursued within a design conceptual context, then—if the designer were God—science literally would involve, as Kepler allegedly put it, "thinking God's thoughts after him."[38] Science would in a sense be an extended attempt at reverse engineering. As some others have noted, that reverse-engineering picture is suggestive.[39] In some cases involving human artifacts, design theories are exactly what *prevent* investigators from quitting too soon. Manufacturers (of cars, computers, chips, etc.) frequently disassemble their competitors's new products, looking for innovations, problem solutions, and the like. In that investigation, puzzling features are especially thoroughly investigated precisely *because* it is assumed that the product is designed and that the puzzling feature must be doing something significant, that it is not there simply by chance, for instance. One wonders if the ever-shrinking list of human vestigial organs would have gotten as large as it once was had researchers been working from a design perspective of humans as "fearfully and wonderfully made." The tag "functionless" might have been attached a bit less blithely in that case—as might the term "junk" to "DNA."[40]

7. *Empirical ground level.* Design has not been scientifically completely barren even at ground level. Much of the data upon which Darwin built his case had been generated by investigators pursuing design conceptions. Concerning the allied concept of teleology, historian of science Timothy Lenoir recently observed:

> Teleological thinking has been steadfastly resisted by modern biology. And yet, in nearly every area of research biologists are hard pressed to find language that does not impute purposiveness to living forms.[41]

But resisted or not,

> [In early nineteenth century Germany] a very coherent body of theory based on a teleological approach was worked out, and it did provide a constant fertile source for the advance of biological science on a number of different research fronts.[42]

John Hedley Brooke cites various other examples.[43] And Harvey famously discovered circulation of the blood partly as a result of the conviction that certain structures in blood vessels were there for *some* reason. Such payoffs

If science were pursued within a design conceptual context, then – if the designer were God – science literally would involve, as Kepler allegedly put it, "thinking God's thoughts after Him."

have not been confined to biology. Fermat's (and later Maupertuis's) principle of least action (and its descendant Lagrangian and Hamiltonian formulations) seems to many straightforwardly teleological. Yet Max Planck claimed:

> Amid the more or less general laws which mark the achievements of physical science during the course of the last centuries, the principle of least action is perhaps that which ... may claim to come nearest to [the] ideal final aim of theoretical research [i.e., to "condense all natural phenomena which have been observed and are still to be observed into one simple principle ..."].[44]

Here Planck has singled out something carrying at least the distant whiff of design and intent as coming closer to the ideal of science than does any of its competitors.[45] Indeed, the whiff may not be all that distant. Elsewhere, Planck says:

> [W]hat we must regard as the greatest wonder of all, is the fact that the most adequate formulation of this law creates the impression in every unbiased mind that nature is ruled by a rational, purposive will.[46]

On the other hand, design hostility has sometimes interfered with data acceptance and theory advance. For instance, just as some resisted Big Bang theory because it looked too much like a creation, some may resist fine-tuning empirical data because conceding genuine knife-edge fine tuning threatens to stick one with deliberate supernatural planning as the only plausible explanation.[47]

Present Prospects

Does science need to explicitly acknowledge design theories at this point? I do not know the answer to that question. But it may be that science already *implicitly* does so. Science presumes a cosmos which is uniform, coherent, and intelligible, a universe in which beauty and elegance can be important markers of theoretical promise.[48] Those are arguably characteristics which any science-permitting cosmos would *have* to have, are plausible characteristics of a world a mind would plan, and are characteristics which, in the absence of a planning mind, must be either reduced to subjective human projections or left to hang implausibly in midair as "brute." That is why physicist and author Paul Davies (who is not a believer of any sort, so far as I know) recently remarked:

> Science began as an outgrowth of theology, and all scientists, whether atheists or theists ... accept an essentially theological worldview.[49]

If Davies is right – and I think he is – then why do so many scientists fail to recognize that fact? Why have *anti*-design commitments played such a prominent role, both in biology (e.g., in connection with the initial enthusiasm in some circles for Darwin) and in cosmology (in many-world theories embraced by some to circumvent fine-tuning arguments)?[50] Why are some, like Richard Dawkins, so hostile to design theories that they will assert that employing design theories is "cowardly and dishonest" – i.e., not merely a scientific failure, but a moral failure as well?[51]

I think that in some cases the answer involves deep religious matters.[52] But in other cases, it may be that the capital which science has gotten from theologically and design-shaped metaphysical principles wears the mask of the familiar, and that science (and many scientists) live off that capital without knowing its source – much as some contemporary ethics live off the capital of historical theistic ethics often without being aware of that fact. It is perhaps as Einstein once asked: "What does a fish know of the water in which it swims all its life?"

Although science operates de facto in a deep design context and is suffused with the structuring presuppositions of that context, does science need the sorts of overt empirical ground level design theories recently advocated? Indeed, *can* design theories go beyond the contextual, the perspectival, the empirically indeterminate? Again, I do not know the answer to that question. However, I see no compelling justification for either hostility or prohibitions. Current intelligent design theories do not (it seems to me) have much to show at this point. But a remark of Andrei Linde's in a different context is intriguing:

> A healthy scientific conservatism usually forces us to disregard all metaphysical subjects that seem unrelated to our search. However, in order to make sure that this conservatism is re-

> ally healthy, from time to time one should take a risk to abandon some of the standard assumptions. This may allow us either to reaffirm our previous position, or to find some possible limitation of our earlier point of view.[53] ✦

Acknowledgments

I wish to thank David Van Baak and two anonymous referees.

Notes

[1]"Methodological materialism," "methodological atheism," and "methodological naturalism" commonly are used interchangeably. Although perhaps not the first use of the term, the use in recent discussion of "methodological naturalism" probably originated with Paul DeVries. As Stephen Wykstra has pointed out, the standard characterization of methodological naturalism (MN) requires some adjustment to allow for the possibility that "nature" in a theistic universe and "Nature" in a non-theistic universe might be significantly different and that MN as a stipulation that science deal only with the natural realm thus would not necessarily be equivalent to a stipulation that science operate as if philosophical naturalism were true.

[2]Some standard conceptions of science would offer few resources to opponents of design. On anti-realist perspectives, the only plausible substantive objection would be if design concepts failed to be of practical use. That (as will emerge later) has not historically been the case.

[3]But exactly what that presumed fact would show is far from clear. Rigorous proof is, of course, not even on the scientific table—nor is rigorous falsification, for that matter. Closer to home, the parallel problem even in some cases of human design—as in deliberate attempts to conceal murder, arson, etc. by trying to make it look like a random accident or as an otherwise purely natural event—constitutes no difficulty whatever in generating scientifically legitimate design conclusions in anthropology, SETI, or even in confirming other cases as deliberate murder or arson. (That means that on a formal level, design cases would parallel what logicians call "half-yes machines.") In any case, it should not be forgotten that unfalsifiability does not imply inconsequentiality. Thoroughgoing paranoia is probably strictly unfalsifiable to its victims, but (like "bliks" in discussions of an earlier era) makes a profound difference. Similarly, uniformity of nature is probably strictly unfalsifiable, but is obviously not devoid of impact in science.

[4]For example, see the polywater case in Michael Friedlander, *At the Fringes of Science* (Boulder: Westview, 1995), 78.

[5]Of course, *establishing* that the path in question is a drunk-walk or that there is no design-relevant direction would not be trivial. In fact, it would encounter a problem frequently pinned on some design advocates—that being a dependence on "arguments from personal credulity," i.e., that we cannot identify a direction does not necessarily establish the absence of such direction. In the present case, the problem is compounded by the fact that the randomness of the walk would probably have to be established in part by reference to deep historical phylogenetic dead ends linked in specified ways to other evolutionary paths.

[6]This hierarchy climbs (roughly) from empirical data through theories (having varying degrees of theoreticity) through (among other things) axiological principles, principles concerning what concepts were or were not permissible, and on finally to metaphysical and even worldview matrices. For further discussion, see e.g., Stephen Wykstra, "The Interdependence of History and Philosophy of Science" (Ph.D. diss., Pittsburgh, 1978).

[7]Of course, there is a consequential tradeoff here. The further up the hierarchy design conceptions operate, the less rigid will be any connection between such concepts and empirical data, and the less stringent the empirical demands that can be made upon such concepts. On the other hand, the further up the hierarchy design operates, the less directly will empirical cases substantiate design principles. Thus, what a design theory might gain in immunity, it might lose in immediate empirical substance.

[8]But suppose that more specific predictive demands were appropriate. It certainly does not seem to be true that design theories are *inherently* non-predictive. If we know or believe that some subsystem S of some object is designed for some purpose or function, we can often predict some things concerning the existence and characteristics of correlated entities or other subsystems. (Or if we know anything about the tendencies of the designer, we could make even counterfactual predictions concerning how the designer would or might design in specified possible cases.) It might turn out that the specific design theories associated with contemporary design advocates make no requisite predictions, but that is simply a failure of local theory—not a principial problem. See my *Nature, Design and Science* (Albany: SUNY, 2001) for further discussion. It is also worth noting that intelligent design theories are basically *agency* theories, and that when dealing—even as scientifically as we can—with agents, our theories are quite routinely severely limited in predictive power, although often (after the fact) explanatorily quite powerful. I have made this point elsewhere, as has Bill Dembski.

[9]I have discussed this in some detail in *Nature, Design, and Science.*

[10]That is the thrust of chapter 9 of *Nature, Design, and Science.*

[11]In an interview with Rudy Rucker in *Wired* 3.07 (July 1995), Linde said:

> If I create an inflationary universe with a small density, I can prepare the universe in a particular state ... [I]f I am preparing a universe in some peculiar state, I can send [a] message encoded in the laws of physics. ... Let us imagine that someone made our universe as a message. ... To send a long message you must make a weird universe with complicated laws of physics. ... The only people who can read this message are physicists. Since we see around us a rather weird universe, does it imply that our universe was created not by God, but by a physicist-hacker? I do not entirely think of this possibility as a joke.

And John Horgan describes this speculation by Linde:

> [P]erhaps the [alien] engineer could manipulate the seed of preinflationary stuff in such a way that it would evolve into a universe with particular dimensions, physical laws, and constants of nature. In that way, the engineer could impress a message of some sort onto the very structure of the new universe. In fact, Linde suggested, our own universe might have been created by beings in another universe, and physicists such as Linde, in their fumbling attempts to unravel the laws of nature, might actually be decoding a message from our cosmic parents (John Horgan, *The End of Science* [New York: Broadway, 1996], 101).

Some ID advocates, e.g., Walter ReMine, have also argued for a "message" reading of some aspects of nature.

[12]There might, of course, be all sorts of nasty problems in pursuing such investigation (e.g., problems with design recognition), but it does not appear that those are of necessity *principial* problems.

[13]I have done so elsewhere in *Nature, Design and Science*, chap. 10.

[14]In fact, when presumed counterflow turns out to be naturally explainable, attributions of design often disappear. A nice example is the case of Jocelyn Bell Burnell's discovery of quasars, the first such source being initially (semi-humorously) informally designated "LGM-1" (Little Green Men-1), a designation which disappeared as natural mechanisms for such pulsed signals began to be proposed.

[15]Of course, if some things in nature *are* products of intelligent design, there is a broad sense in which those things *are* artifacts. (At least, without agent activity at some point in their history—perhaps primordial—they would not be as they are, or perhaps might not even be.) Thus the *formal* (although not the practical) problem would disappear. Substantial stretches of what we had previously

categorized as *natural* actually would belong in a different category. Suppose, for instance, that our cosmos was an artificially generated bubble universe. What we previously took to be natural actually would be artificial. *Counterflow*, in the relevant broader sense would have to be defined against the background of a hyperphysics or *ur*physics inhabited by the aliens involved. *Discovering* all that might be a nasty problem (to put it mildly), but the present *conceptual* problem would be removed. Of course, if nature is supernaturally created *ex nihilo*, then there is evidently no physics or *ur*physics background for some broader sense of counterflow to even be defined against. Nature would be an artifact, but not artifactual as distinct from natural.

[16]Critics of design theories, nearly without exception, in effect take design to be a theory of mere artifactuality rather than of design. Unfortunately, this is true of some design advocates as well.

[17]There are a number of complicated issues here. For instance, in prosaic cases, we sometimes recognize design through recognizing value. Many argue that value is subjective, nonscientific, socially induced, an accident of upbringing, etc. I do not think that this is true, but in any case, science itself requires application of certain values to operate at all—this is one of the major lessons of philosophy of science over the past several decades. Most scientists recognize not only epistemic values, but others, too—the values of truth, understanding, comprehension, as well as those of elegance, simplicity, consistency, and the like. Scientists committed to the legitimacy of such values—and whose science relies upon recognition and respect of such values—cannot very well reject design *merely* on the basis of its connections to value, nor upon its alleged tendency to import values into the scientific context.

[18]This cuts both ways, of course. If we cannot make defensible design judgments absent knowledge of the mind of the designer, then we cannot eliminate the possibility of design either. On the other hand, if the only evidence one has concerning a designer is through the designer's artifacts—i.e., if one only knows the designer's intentions, style, and so forth from empirical investigation of artifacts—then to the extent that design-based predictions depend upon having information concerning those intentions, style, etc., to that extent any predictive power which a design theory has will arise ultimately from the empirical data in question alone, and thus may in principle be available to empirical science *without* the mediation of any explicit design theory. Such theories might be heuristically useful, but logically, at least, they may be superfluous. In this connection, I think that it is significant that in Michael Behe's design proposal, the scientific work is done by the concept of irreducible complexity, whereas Behe's claim that irreducible complexity is a sign of *design* and the conclusion of design itself does (it seems to me, anyway) little if any scientific work at all.

[19]Herschel took the (then presumed) fact that atoms of a given type were all identical—reminiscent of the uniformity of objects mass produced by a stamping machine—as evidence of their artifactuality. Suppose that instead of mere uniformity we were to discover that every atom had a submicroscopic display (in flawless Hebrew) of a scriptural reference. And suppose that with our H. G.Wells-o-scope we established that nothing other than purely natural processes and events occurred in cosmic history back to the Big Bang. It would still be perfectly rational to identify that as designed despite the complete absence of counterflow, of any clue as to how it was done, etc.

[20]Quoted by the Duke of Argyll, "What is Science," in *Good Words* (April 1885): 236–45, p. 244.

[21]Francis Crick, *What Mad Pursuit* (New York: Basic, 1988), 138.

[22]More specifically, Reid takes the concept of *design* to apply most basically to *minds*. *Design* applies to other phenomena in, strictly speaking, only a derivative sense. I have discussed Reid's view in much fuller detail in "Perceiving Design," in Neil Manson, ed., *God and Design* (London: Routledge, 2003), 124–44.

[23]I have discussed this (as well as some objections to this line of thinking) in "Perceiving Design."

[24]In any conceptual pursuit, we ultimately have to simply depend upon some basic human intuitions. Even mathematics must rest at bottom on some apparently built-in intuitions concerning possibility and necessity and the like. And it does nothing toward escaping that fact to demand some *criteria* for such matters. Something at least similar seems to be true for sensory perception, recognition of the existence of other minds, and so forth. The demand for formal criteria for recognizing design seems to presuppose that design recognition does not have roots as deep as these other matters, and I am not sure exactly what the case for that presupposition is supposed to be. There are obvious disagreements over design, but in all these areas there are fuzzy zones and disagreements (concerning mathematical intuitions, concerning the conditions under which something may be said to be conscious and/or intelligent, etc.).

[25]We confront gaps all the time. A can of beans is something nature unaided by agency would not produce—there is a gap between nature's capabilities and the can of beans. So when confronted by the latter we fill the gap by appeal to human agency—a humans-of-the-gap explanation. Other gaps might require other gap measures. SETI, for instance, seeks phenomena which would require an aliens-of-the-gap explanation.

[26]Philip Corso, in *The Day After Roswell* (New York: Pocket, 1997), 120, claims that one military person poked his head into the (alleged) crashed Roswell craft, looked out through a port, and despite the fact that it was night found himself able to see everything outside quite clearly. This purportedly constituted crucial impetus to the idea of night vision goggles. The port was, of course, designed. But suppose that that precise sort of structure had evolved naturally and Darwinianly in a giant squid, and that someone preparing the squid head for display had looked out through the squid's eye lens just as the power failed—and had discovered herself seeing everything quite clearly. These two episodes could have had exactly the same consequences for triggering subsequent technological developments. Presence or absence of gaps in the lens production, and presence or absence of *design* would make no difference. In either case, the importance was the existence proof of a possibility. How it came into existence had no bearing upon that whatever. In some cases, discovery of a designed artifact might provide clues concerning methods of production, but in some cases it might not. For instance, Thomas Edison experimented with hundreds of different substances for light-bulb filaments. Given the wide and wild range of trials, one might almost think that he had seen a lightbulb, and via that existence proof knew—but knew *only*—that there was *some* sort of skinny thing which would work. Would anyone who really understood light bulb *theory* have tried, for instance, horsehair, as Edison did? Or settled upon bamboo splinters as the filament of choice, as Edison did? The suggestion of carbon filaments came from Edison's African-American assistant, Lewis Latimer.

[27]J. R. P. Angel, "Lobster Eyes as X-ray Telescopes," *Astrophysical Journal* 233 (1979): 364–73, M. Chown, *New Scientist* 150, no. 2025 (13 Apr 1996): 20. Space deployment of a lobster-eye telescope is apparently projected for 2009.

[28]There are numerous other cases of what is coming to be known as "biomimetics"—defined by the University of Reading Centre for Biomimetics as "the abstraction of good design from nature." See e.g., Jim Robbins, "Engineers Ask Nature for Design Advice," *New York Times* (Dec 11, 2001); and Delta Willis, "Naturally Inspired," *Natural History* 105, no. 2 (Feb. 1996): 53–5, especially p. 53. Recognition of similarity between things in nature and later human invention goes back some ways—see, e.g., J. G. Wood, *Nature's Teachings: Human Invention Anticipated by Nature* (London: Daldy, Isbister, 1877).

[29]There is a significant irony here. Some design advocates distinguish between "operation" science and "origin" science (the former involving only continuing lawlike regularities), and cite that distinction to undercut the scientific legitimacy of evolutionary theories of origins. But if that is a good distinction, then design might have no implications internal to operations science *unless* there were gaps and supernatural intervention.

[30]For further discussion of this general point, see e.g., Stephen Wykstra, "Should Worldviews Shape Science?" in Jitse van der Meer, ed., *Facets of Faith and Science* 2 (Lanham: UPA, 1996), 123–71, and Wykstra, "Religious Beliefs, Metaphysical Beliefs, and Historiography of Science," *Osiris* 16 (2001): 29–46.

[31]In fact, the idea of design has factored into not only resources and motivation for theorizing, but even into the courage to carry out such theorizing in specific directions. That could affect not only the *questions* one asked—which one might otherwise never consider—but the manner of pursuit. Along this general line, in the *Mysterium Cosmographicum,* Kepler claimed:

> [T]here were three things above all for which I sought the cause as to why it was this way and not another—the number, the dimensions, and the motions of the orbs. I have dared to carry out this search because of the beautiful correspondence of the immobile Sun, fixed stars, and the intermediate space with God the Father, the Son, and the Holy Spirit.

In similar fashion, Newton was emboldened by a doctrine of divine omnipresence to countenance something very like the otherwise proscribed concept of gravitational attraction at a distance.

[32]In light of such pervasive usefulness, orthodox anti-realism would dictate the embracing of design—albeit, of course, not as literal. Ironically, anti-realist heuristic employment of design poses some risk for design opposition, since instrumentally successful heuristics have a history of turning into realisms. For instance, Einstein's light-quantum idea was originally proposed heuristically. See e.g., Shapere, "Discussion: Doppelt Crossed," *Philosophy of Science* 55 (1988): 134–40, 138. Quarks constitute another physics example. Most scientists historically have thought that they were pursuing *truth,* and that has provided much more durable and effective motivation and inspiration than the pursuit of *as if.* And if design applies to us and our cognitive systems, we would have better grounds than otherwise available for thinking that there really is something to our typical conviction that our science aims at and sometimes captures genuine knowledge.

[33]I take "design" to mean "design," and not merely "apparent design" or "design-like" as Dawkins and some others do.

[34]There is some interesting history here. For instance, Newton, in the "General Scholium" says: "And thus much concerning God; to discourse of whom from the appearances of things, does certainly belong to Natural Philosophy," (Newton, *Principia,* Florian Cajori revision of Andrew Motte [Berkeley: California, 1962], 546). See also some of the "Questions" in the later editions of the *Optiks.*

[35]In his essay "Awesome versus Adipose," *Free Inquiry* 18, no. 2 (Spring 1998), Peter Atkins says: "Science gives us the prospect of full understanding, for it continues to show that, given time, there is no aspect of the world that is closed to its scrutiny and explanation." And that is not merely an in-principle competence. At the very end of his *The Creation* (Oxford and San Francisco: Freeman, 1981), Atkins says: "We are almost there. Complete knowledge is just within our grasp" (p. 127). It is worth noting that the view that science has no limits does not entail that religious principles are all false, but only that if they are true, science can establish them. That was, of course, the contention of natural theologians. In this connection, see Mikael Stenmark *Scientism* (Aldershot: Ashgate, 2001), 10.

[36]Of course, some benefits of this type could be achieved by employing design instrumentally, or heuristically similar to Dennett's contention that one has the best chance of beating a chess computer if one plays it *as if* it is intelligent. Even Dawkins, in attempting to describe a key feature of biological nature, resorts to counterfactual reference to an intelligent designer—see *Blind Watchmaker* (New York: Norton, 1987), 21. That may be defensible. But it is not clear why that move should be *needed* or even preferred.

[37]For instance, Boyle, in his 1688 *Disquisition* writes:

> a *Naturalist* [scientist], who would Deserve the Name, must not let the Search for Knowledge of *First Causes,* make him Neglect the Industrious Indagation of *Efficients* [emphasis his]

and Bacon in *De Dignitate et Augmentis Scientiarum* writes:

> For the handling of final causes in physics has driven away and overthrown the diligent inquiry of physical causes, and made men to stay upon these specious and shadowy causes without actively pressing the inquiry of those which are really and truly physical, to the great arrest and prejudice of science.

[38]This is widely attributed to Kepler, but I have been unable to confirm that the phrase appears in Kepler's writings.

[39]This point is made in D. Snoke, "In Favor of God-of-the-Gaps Reasoning," *PSCF* 53 (Sept. 2001): 152–8, note 2. The reverse engineering perspective may also bear upon "untestability" objections to design (closely linked to "unfalsifiability" objections). It has been argued by some that in reverse engineering one frequently does not begin with a hypothesized model, then test the model's predictions, but rather one traces mechanisms and circuits, identifies components, and otherwise tries from the object itself to figure out what the function and design is—models coming only later in the process.

[40]The point regarding "junk" DNA was made to me by one of this journal's reviewers.

[41]Lenoir, *Strategy of Life* (Chicago: University of Chicago Press, 1982), ix.

[42]Lenoir, *Strategy of Life,* 2.

[43]See his *Science and Religion* (Cambridge: Cambridge, 1991), especially chapters 1, 2, 4 and 6.

[44]This is from Planck's entry on the principle of least action in the encyclopedia *Kultur der Gegenwart* (1915), 68. This specific translation is employed by Jim Holt ("Least Action Hero," *Lingua Franca* [October 1999]: 68) and by Wolfgang Yourgrau and Stanley Mandelstam, *Variational Principles in Dynamics and Quantum Theory* 3rd ed. (Philadelphia: Saunders, 1968), 164. At least one other translator (Michael Stoeltzner) employs "probably" instead of "perhaps."

[45]Least action theories are not only predictive, but according to John Barrow and Frank Tipler, some, e.g., Euler, have argued that some problems which were practically intractable to mechanistic approaches could be solved via action principles. See Barrow and Tipler, *The Anthropic Cosmological Principle* (New York: Oxford, 1986), 150.

[46]Planck, "Religion and Natural Science," *Scientific Autobiography and Other Papers* (London: Williams and Norgate, 1950), 151–87, p. 177. The original essay was published in 1947. This passage was pointed out to me by David Van Baak.

[47]This possibility is hinted in John Leslie, *Universes* (New York: Routledge, 1989), 192. Of course, many-universe theories have been proposed as solving this "problem." I have argued that such solutions may do less than often thought—see my "Saturation, World-ensembles, and Design" [forthcoming].

[48]For some, e.g., Dirac, beauty may be the most important such marker. For others, e.g., Weinberg, Polkinghorne, it is at least essential.

[49]P. C. W. Davies, *Are We Alone?* (New York: Basic, 1995), 138.

[50]For a nice discussion of the biology case, see Adrian Desmond's *Politics of Evolution* (Chicago: University of Chicago Press, 1989).

[51]Dawkins leveled this charge in a talk titled "Unweaving the Rainbow."

[52]In a recent interview, Crick indicated that he had gone into science because of a distaste for religion, combined with a belief that science could be employed to undercut basic supports for religious belief. See Roger Highfield, "DNA Pioneers Lash out at Religion," *London Daily Telegraph* (March 24, 2003).

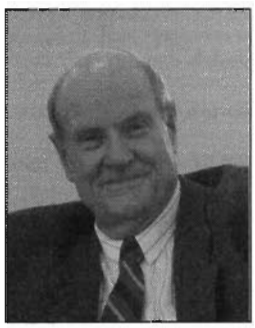
[53]"Inflation, Quantum Cosmology and the Anthropic Principle" forthcoming in *Science and Ultimate Reality: From Quantum to Cosmos* (essays in honor of John Wheeler's 90th birthday) ed. J. D. Barrow, P. C. W. Davies and C. L. Harper (Cambridge: Cambridge 2003), 24.

Article

Naturalism and Design in Biology: Is Intelligent Dialogue *Possible?*

Naturalism and Design in Biology: Is *Intelligent Dialogue* Possible?

Walter R. Thorson



Walter R. Thorson

Seen as natural theology rather than science, "intelligent design" (ID) is not incompatible with a "naturalistic" approach to biology proposed earlier (cf. notes 1, 2 below). This paper develops ideas based on this understanding, emphasizing points of mutual agreement and some unresolved differences between the two perspectives. In particular, (1) negative critiques of mechanistic biological origins theories by ID proponents have scientific merit, needing serious consideration by opponents; (2) no a priori reason exists to favor a mechanistic natural philosophy of ultimate origins over other options (such as ID); and (3) more open dialogue can be mutually constructive for each side, if philosophically polarized positions do not make it impossible. However, (4) if ID is an idea with scientific implications, proponents need to show how it affects biology as a science (i.e. in "naturalistic" terms); (5) analogy with the history of physical science suggests a primary focus on origins questions is anomalous and inappropriate for biology at present; and (6) a naturalistic program, focused not on origins per se, but on the distinctive logical organization of biosystems, is directly relevant to scientific understanding.

Since my position occupies a kind of no-man's land between the ID and traditional naturalistic camps, the option of dialogue ... is particularly attractive.

There are areas of common ground on which some proponents of "intelligent design" (ID) and theists who defend the historical policy of "naturalism" in science may carry on constructive dialogue about biology and biological origins – rather than argue diametrically opposed claims. As a scientist by background and experience, I am especially interested in promoting such dialogue because it may prove important for biology as a science. I believe "naturalism" in *science* is well justified on *theological* grounds, and have argued this in Part I of a tandem article in *PSCF*.[1] However, such a "naturalism" allows for new paradigms in biology which transcend the mechanistic and reductionist models characterizing physical science (see Part II).[2] Since my position occupies a kind of no-man's land between the ID and traditional naturalistic camps, the option of dialogue rather than warfare is particularly attractive. It is a real option, given reasonable clarification of each side's fundamental aims and assumptions. This article discusses areas of common ground based on one such dialogue described below.

It is essential to clarify what is meant by "naturalism" and "intelligent design." There are definitions of each position inherently opposed to any version of the other. If "naturalism" means insisting on the mechanistic, reductionist world-picture physical science presupposes as a paradigm for all scientific explanation, it is hard to see how it can be reconciled to *any* notion of "ID." If "ID" means proposing, as a *scientific* paradigm for biology, an artificial "intervention" by an intelligent and external agent (in an otherwise mechanistic natural order), it is incompatible with *any* kind of "naturalism" in science – including the broader options for which I argue.

In theological terms, "naturalism" means that in *science* we *deliberately refrain* from using explanatory paradigms or concepts that appeal either to divine agency itself or to any direct surrogate for such agency.[3] This policy

Walter R. Thorson *was professor of chemistry at the University of Alberta (1968–1994). A theoretical chemist, he applied quantum mechanics to small molecule dynamics and atomic collisions, and was elected a Fellow of the American Physical Society in 1987. He has a deep interest in the philosophy of science and related issues in theology, and is author of several articles on these topics in* PSCF *and elsewhere. He is an ASA Fellow, and was adjunct professor of philosophy of science at Regent College in Vancouver, BC for many years. Walter and his wife Mary now live near Sandpoint, Idaho. They have two children and four grandchildren. To contact Walter, mail correspondence to: PO Box 12, Kootenai, ID 83840 or email him: wrmethorson@myyellowstone.net*

is historically well established. It originated with the rise of modern science in the sixteenth and seventeenth centuries—specifically, in the thinking of Boyle and others about the "mechanical philosophy" as a legitimate discourse intentionally separated from theology. Naturalism in physical science has been clearly vindicated by continuing success of that enterprise. From a theological perspective, deliberate exclusion of claims about divine agency from *science* emphasizes the *limits of scientific knowledge*—and of our creaturely reason which constructs it. This article gives no further justification for "naturalism" in science, *but takes it for granted.* The question then is whether such a policy in *science* permits constructive dialogue with any understanding of "intelligent design." I suggest that it does.

In theological terms, "naturalism" means that in science *we* deliberately refrain *from using explanatory paradigms or concepts that appeal either to divine agency itself or to any direct surrogate for such agency.*

First, this theological definition allows "naturalism" much broader scientific scope. In particular, the mechanistic and reductionist paradigms proper to physical science do not exhaust its meaning. Previously I proposed a modified naturalistic paradigm appropriate to biological science.[4] I argued that biological systems differ from purely physical systems by possessing a logical organization toward *achievement of certain tasks or functions.* Scientific explanations and concepts in biology tacitly presuppose such logical organization as a *given,* whatever lip service is paid to beliefs about mechanistic explanations for it. I argued that this logical organization is *disjoint* from the mechanistic logic sufficient for explaining purely physical systems: i.e. while a "functional logic" is fully compatible with physical principles, it is not evidently derivable *from* them, either as a necessary consequence or as a result of combining physical necessity with statistically plausible initial conditions.

Such a claim is scientifically provocative, since it questions whether any purely physical model can explain biological organization. However, it is open to falsification by *scientific* demonstration(s) to the contrary. [A claim that *rules for the game of science* need changing is necessarily tentative. I do not argue that everyone should stop playing according to the older, purely mechanistic rules.] I am *formally agnostic* on the scientific question of whether a purely physical explanation for biological organization toward function might be found. This is important because there are serious research programs modeling complex dynamical systems, which aim to derive just such explanations. These efforts should not be discouraged or devalued, since in any case they will yield information relevant to the question. Meanwhile, intuitive but informed judgments on the likelihood of their success are legitimate.

Even though tacit use of functional logic plays an important role in the design and explanation of research, there is an established philosophical prejudice among scientists that the mechanistic assumptions adequate to physical science will somehow be able to explain biological organization too.[5] Such philosophical bias is plain in works (especially on the theory of evolution) by well-known professional biologists.[6] Materialism is one of many philosophical beliefs scientists might use to inform their thinking about science, but there's no clear philosophical reason for giving it *preferred* status—particularly for scientists who are theists.

Arguments for a logic of function in biology were scientific in intention. This paradigm identifies a unique feature of biological organization, which (a) universally characterizes biosystem behavior; (b) appears logically independent of (not determined by) physical principles; and (c) can be described in "naturalistic" terms of reference, as an empirical aspect of the natural world. The idea is certainly not original. Critical thinkers like Michael Polanyi ("the logic of achievement") and Walter Elsasser ("biotonic modes of behavior") earlier noticed these same unique features,[7] and had also thought about them with similar naturalistic intentions. Their ideas remain apt to current issues in biology,[8] especially molecular biology.

On the other hand, questions of *biological origins* (and questions in *natural theology* related to these) are not immediate objectives of such a "naturalistic" enterprise. Such a policy is consistent with the historical tradition in physical science—a point discussed below. Physical *origins* were not part of the initial agenda of physical science—and only *became* a part, as overall coherence of the theory eventually demanded it.

I have argued elsewhere that "intelligent design"[9] is not a legitimate scientific agenda for biology, for *two* reasons: *Explicitly,* because it is not "naturalistic" as I argue science should be; and *implicitly,* because it focuses primarily on biological origins. Since critiques of chemical evolution by intelligent design proponents tacitly adopt the same mechanistic definition of "naturalism" as the work they criticize, their *positive* arguments for ID as a *non*-naturalistic alternative appear to question the value and legitimacy of the naturalistic tradition in science. In effect,

The established habit of appealing to "evolution" as an ultimate *explanation for the biological order is no more legitimate* scientifically *than appealing to "design" – and this philosophical bias in the scientific community should be recognized for what it is.*

arguments for ID might be caricatured: *"Here ends the prospect of any naturalistic science of biology; we now resort to theological explanations as an alternative approach to that science."*

Of course, some people *do* argue for "intelligent design" in just this way. I am entirely opposed to their agenda; its goal isn't very different from that of an older "creation science"—and in the long run is hostile to genuine scientific inquiry.

However, I think some proponents of "intelligent design" have a different aim. Their positive arguments address a *different philosophical question*—and do not seek to compete with a "naturalistic" biology such as I argue for. This different question belongs to *natural theology*, rather than science—and it *is* concerned with ultimate origins. Arguments for a "naturalistic" science of biology and arguments for intelligent design in relation to ultimate origins might then have very different aims, rather than being in direct conflict. Here I discuss this possibility, looking first at areas of common ground, and then at issues needing resolution.

Constructive dialogue on this point is particularly important for Christians primarily interested in biology as science. If a materialist world view hinders creative thinking about biology, Christians active in research can help erode its influence within the scientific community by thinking with more open horizons about scientific paradigms. The established habit of appealing to "evolution" as an *ultimate* explanation for the biological order is no more legitimate *scientifically* than appealing to "design"—and this philosophical bias in the scientific community should be recognized for what it is. Instead of simply dismissing arguments made from the perspective of intelligent design as entirely antithetical to science, Christian biologists might carry on an open dialogue with at least some advocates of ID, looking for insight on *scientific* issues. Such dialogue can be very fruitful if the intelligent design argument is understood as a valid response of natural theology to a widespread metaphysical bias favoring materialism—rather than as an explicit rejection of any "naturalistic" approach to biology.

Negative Critiques of Mechanistic Origins Scenarios Are Valid Scientific Contributions.

Typically, arguments for intelligent design in biology begin with extensive negative critiques of purely mechanistic models for origins. The early book by Thaxton, Bradley and Olson[10] on the problem of "chemical evolution" (origin of the first primitive life forms) took this approach, and recent systematic treatments by Stephen C. Meyer[11] follow the same plan. (*If the mechanistic approach isn't broken, why fix it?*) Meyer's conclusion—that mechanistic origins scenarios for "chemical evolution" do not work (and probably *can't* work)—is consonant with my reasons for proposing a modified "naturalism" in biology.[12] However, I approached the issue differently, by stressing the general *epistemic* inability of purely physical descriptions to explain actual biological organization.

I take Meyer's negative critique as most representative for discussion here. [Other negative critiques by ID proponents are more oblique. For instance, Michael Behe's approach[13] exhibits the characteristic "irreducible complexity" of biosystems, illustrating their logical organization *according to function* by some beautiful examples. He concludes from inspection of such examples that biological organization cannot be understood as the result of a purely mechanistic process, but does not consider alternative "naturalistic" ways of understanding it. Instead his argument moves directly to proposing "intelligent design" as a *scientific* conclusion regarding its origins. Another example is William Dembski's largely mathematical arguments[14] based on notions of *information as analogical evidence for design.* These employ the "sieve" principle to eliminate mechanistic or random explanations for "specified complexity" (the sort of informational order seen in DNA, for example). While his discussion shows that such simple explanations cannot account for "information"[15] when it is recognized *as such*, his conclusion that *biological information has been injected from an outside source* cannot be justified by the purely formal and mathematical arguments used.]

Meyer systematically examines the scenarios for "chemical evolution," showing how mechanistic approaches lack the power to explain the origin of information needed for life even at its outset. He cites active research in the field, recording the persistent logical flaws and empirical inadequacies (sometimes recognized by the original researchers themselves) in the entire scheme of a chemical evolution based on physical necessity, chance, or a combination of the two. His balanced and critical review of the enterprise and its key failures is a valid scientific contribution, organizing a wide literature coherently with definite if negative conclusions. Meyer recognizes his conclusions are open to revision or disproof by further research. Finally, his evident competence in philosophical and logical analysis brings needed clarity to a good deal of fuzzy thinking in the original work. Those critically familiar even with the literature of physical science know how widespread such logical fuzz can be.

Such negative critique constitutes valid science. In the rush to judgment of arguments *for design* presented *subsequently* by ID proponents, secular and Christian critics seldom acknowledge this.

In philosophy and history of science, it is recognized that destructive analysis of work premised on an inadequate or mistaken scientific paradigm forms an important part of science. In *Personal Knowledge*, Michael Polanyi[16] certainly recognized destructive analysis as an important tool in science, even though he was more interested in the synthetic and tacit role played by creative imagination in forming new paradigms. Historian of science Thomas Kuhn[17] similarly identified the use of negative analytical critique as part of the process by which "normal science" gives way to a "scientific revolution." Critics of ID (especially its Christian critics) should either (a) recognize the scientific merit of negative reviews like Meyer's—or else (b) *present substantive scientific arguments refuting them.* In science, valid criticism of mistaken views may come from any rational source—and is likely to be most needed just when an inadequate paradigm is nearing collapse. Rather than simply close ranks against philosophically unpopular outsiders, astute scientists might see the appearance of sound negative arguments from them as a sign that new insight is probably needed.

Philosophical Belief Frameworks and Science: ID as Natural Theology/Philosophy

Proponents offer the intelligent design hypothesis as a positive response to negative scientific conclusions about mechanistic accounts of biological origins. Their critics claim that ID itself is not a *scientific* hypothesis—and my tandem essay agreed.[18] However, *natural theology* is also a legitimate discourse about creation and scientific knowledge, distinct from science proper. It is *not* committed to "naturalistic" presuppositions, being implicitly theological in both its content and aims. "Intelligent design" *is* a legitimate concept in natural theology. As such, it might *indirectly* influence thinking about scientific problems.

Some fruitful recent dialogue with Dr. Meyer has clarified this and related points.[19] After affirming (a) that his *negative critique* of mechanistic origins theories is valid science, I asked him how he would respond to the claim, (b) that his *positive* argument for ID (as "inference to the best explanation for the origin of biological information") is a *natural theological* response to the situation described by the negative critique. Somewhat to my surprise, Meyer readily granted this claim. However, he suggested I should in turn agree that (c) Darwinian insistence that mechanistic accounts of biological origins have an exclusive priority is *not* itself scientific, but is really an argument about ultimate origins belonging to the same *genre* as arguments for design. My tandem *PSCF* essay made essentially this same point. Meyer prefers to describe this *genre* by the term "historical sciences."[20] I prefer to use the term "natural theology" (or perhaps "natural philosophy")—and to reserve the name *science* for those enterprises which are deliberately "naturalistic" as defined above. This *semantic* difference should not obscure our essential agreement that discussion of ultimate origins questions is a discourse distinct from a legitimately "naturalistic" science.

Proponents offer the intelligent design hypothesis as a positive response to negative scientific conclusions about mechanistic accounts of biological origins. Their critics claim that ID itself is not a scientific hypothesis ...

It seems that Meyer and I both understand design, not as a working hypothesis in science proper,[21] but as a reasonable answer to a different kind of question, concerned specifically with the ultimate origins of things. We further agree that a dogmatic materialism giving exclusive priority to mechanistic scenarios for biological origins is also not scientific, but a deliberately *anti*-theological answer to the same kind of question.

Different emphases and some unresolved issues remain. Meyer argues strongly that there is a "soft," highly permeable membrane between what constitutes science proper and sets of broader philosophical beliefs that support and

We need to recognize that a variety of philosophical contexts may sustain and inform science – and that there is no real justification for the priority currently given by both secular culture and the established public community of science to a materialist, reductionist world view.

inform scientific thinking. He is also more optimistic than I am that thinking with the specific presupposition of ID can stimulate scientific insights. While I agree with him that traffic can and does occur across this membrane, I tend much more to stress the importance of its *intentionally and carefully limited* permeability – and to be more critical as a scientist, asking what ID as currently formulated can contribute to a "naturalistic" biological science.

Meyer agrees that some kind of modified "naturalism" in biology might be justified on terms such as I have argued previously[22] – aiming to describe created things in their own internal terms of reference, and making no claims about divine agency. Such a project is not necessarily in conflict with his concerns about ultimate origins issues, especially as it has no immediate or strict agenda regarding origins.

This is a somewhat different understanding of what ID means than many of its critics assume. In particular, Meyer clearly argues that "intelligent design" is primarily concerned with a question about the ultimate origins of created things, and not the inductive, descriptive and "law-like" explanations of natural phenomena that concern science proper. (He also claims that ideas like ID could influence scientific thinking constructively, and certainly there are no rules against that.) It is not clear that all proponents of ID would agree with this view of its aims.

In any case, an important point emerges from this discussion: We need to recognize that a variety of philosophical contexts may sustain and inform science – and that there is no real justification for the priority currently given by both secular culture and the established public community of science to a materialist, reductionist world view. It is no more "scientific" than its philosophical competitors (e.g., various forms of pantheism or theism, including the kinds of theism in which "intelligent design" is a key idea). The mere fact that physical science can't address questions outside its own very limited paradigm says nothing about either the legitimacy or the validity of broader world views – or the scientific paradigms they might sponsor. Nor are there established formal canons of philosophical principle or method, a priori to scientific enterprise itself, which can establish such priority or preference.[23]

Constructive *Scientific* Dialogue Is Blocked by Strongly Polarized *Philosophical* Positions.

Extreme positions on "naturalism" and "intelligent design" *are* mutually incompatible. Polarizing argument around the claims of either leads to conflict rather than scientific insight. Historically, the ID position has emerged as a reaction to an extremely limited understanding of what naturalism means (i.e. materialism, mechanism, reductionism). Oddly, many ID proponents and most of their naturalistic opponents *share* this understanding as their only point of agreement – and then seek *philosophical* arguments to justify oppositely polarized positions.

ID proponents who believe that a naturalistic science can only be mechanistic and reductionist (i.e. like physical science) will tend to insist on a philosophical remake of science that rejects any form of naturalism, rather than seeking alternatives more consistent with the scientifically fruitful past as I advocate here. This view is very clear both in the writing of Phillip Johnson,[24] who has played a seminal role in the ID movement, as well as in works by well-known ID proponents (e.g., William Dembski[25] and to a lesser extent Michael Behe[26]).

In its strongest form, such rejection asserts that biological information (what Ernst Mayr calls "the genetic program")[27] has been generated by an intelligent agent's "intervention" in an otherwise mechanistic (and lifeless) physical order. Both Johnson and Dembski's arguments suggest this view, and certainly much popular writing and talk about ID takes this position explicitly.[28]

Debate between Howard Van Till and proponents of ID bears primarily on this conception of ID.[29] In his arguments for a "Robust Formational Economy Principle" (RFEP),[30] Van Till *appears* to be arguing also that the physical order necessarily contains the seeds of the biological order within itself – not only as scientifically plausible, *but as entailed in a sound theology of creation.* However, the issue is more complex because Van Till really argues *against* the "interventionist" view just described.

First, Van Till, like myself, is committed to "naturalism" in science: that is, (a) we *do not* believe that divine agency (whether described as "intervention" or "directly controlling the creation process") can be *identified as such* by mundane scientific inquiry[31]; and (b) we *do* believe that legitimate explanatory paradigms in science should deliberately avoid appeals to divine agency or surrogates for it. If "intelligent design" really means claiming we can detect "divine intervention" (or some unspecified external agency as a surrogate for it), in an otherwise perfect but lifeless physical order, *or* as the proximate cause of further innovation in an existing but more primitive biological order, I agree with Van Till in rejecting such ideas as both scientifically *and* theologically inappropriate. But perhaps there are ways of looking at the problem that recognize the essentially *innovative* aspect of biological creation without abandoning a legitimate naturalism.

There is no basis for completely rejecting the design argument if it is seen as natural theology *– or for the gratuitous hostility toward* scientific *arguments by its proponents, which is sometimes shown by theists who think a purely mechanistic theory is still a plausible hypothesis.*

For example, the "fully gifted" creation Van Till argues for might only be *scientifically intelligible* as a hierarchy of logically distinct levels or *orders of being and meaning;* in fact, that idea has a rich and legitimate historical and theological tradition behind it. Insofar as I relate the creation account of Genesis 1 to these issues, it seems to me that Genesis describes God as introducing *just such radical novelty in the orders of being* on the successive days of creation. *Since the entire narrative presents God as the only purposive agent,* we could hardly call such innovation an "interference" or "intervention."

Second, I am not sure Van Till really intends to exclude the possibility of logically distinct levels of meaning – or at least his *argument* doesn't exclude it.[32] The "RFEP" rightly argues *against* the notion of a *scientifically detectable divine intervention or agency.* It is true that Van Till's emphasis on the adequacy of *physical structures and forms* might suggest he further argues *for* the adequacy of a reductionist, mechanist approach to biology – and his ID opponents seem to understand him and the "RFEP" in this way. No one in this debate argues that the physical order is *incompatible* with biological organization; but some of us *do* argue that physics probably cannot provide concepts adequate to *understanding* that organization. In other words, the real problem is not metaphysical or theological, but *epistemological* – and, eventually, *scientific.* Fruitful dialogue will be possible to the extent that each side finds common ground for it. Intelligent design advocates gain nothing by rejecting a suitably grounded "naturalism" *unless their agenda insists on the "interventionist" thesis as a scientific claim.* Each side is entitled to pursue the question on the terms it sees fit; but then it surely goes without saying that *each side must respect the other's arguments and deal with them on their scientific merits.*

Conversely, theists who believe that "naturalism" *is* exhaustively defined by the mechanistic presuppositions of physical science – and hence that biology *will* prove to be derivable logically as some complex result of physics – make dialogue with *any* version of ID impossible if they claim this belief has independent philosophical or theological foundations. There is no basis for completely rejecting the design argument if it is seen as *natural theology,* or for the gratuitous hostility toward legitimate *scientific* critiques of purely mechanistic theories of evolution, which is sometimes shown by theists who still think such mechanistic ideas adequate.[33] Questions relevant to biology – and particularly to the status and meaning of "evolution" as an idea in biology – need to be discussed as problems in science, not as issues entailing irreconcilable world views. Because science is our creaturely response to a contingent creation, theological justification for its presuppositions (e.g., "naturalism") needs no appeal to metaphysical arguments. Although scientific inquiry is probably inherently committed to a realist epistemology of some kind, disjoint levels of discourse in our logical understanding of creation are not incompatible with that commitment; we need to read the "book of nature," form appropriate ideas in response, and not be unduly obsessed with the demand for a unified theory of everything – at least to begin with.

Finally, while science may influence our metaphysical views (and physics obviously has done so), there is no *epistemological* ground for making the traffic into a closed loop: i.e., no particular metaphysical view should have determining power in forming epistemic judgments about scientific paradigms. Our metaphysical views are notoriously subject to change as scientific knowledge changes. (Hence, for example, it may be interesting, but is not essential, to discuss unspecifiable elements in a scientific account of the world which provide opportunity for both creaturely and divine agency from the viewpoint of metaphysics or natural theology.[34] Of course, all such philosophical

Thinking within a new paradigmatic framework may eventually suggest better ways to frame questions about evolutionary processes – not to deny that they occur.

questions are as open to dispute and various resolutions, as the scientific questions on which they may bear.)

A "Logic of Function" Paradigm in Biology Is Compatible with Biological Evolution.

As suggested previously,[35] an embodied logic of function in biosystems is quite consistent with the scientific hypothesis of biological evolution, at least in a "weak" sense:

1. Major evolutionary change and a general increase in diversity of life-forms over geologic times (macro-evolution of species) clearly *has* occurred. The fossil record provides definite evidence for this—even if it does not unequivocally support a gradualist model.

2. Biological descent from a common biological ancestor or ancestors is a fruitful and powerful working hypothesis in which both natural selection and genetic mutation play significant roles. The claim that mutations occur entirely at random has *not* been proved.

The hypothesis of biological evolution in this "weak" sense has clear scientific merit, especially as an organizing scheme for understanding diversity, classification and complexity of living things. (This remains the case, in spite of the well-known difficulties of its justification on the basis either of sufficient mechanisms or paleontological evidence—which have led some critical commentators to observe that in practice the theory is not really open to falsification.)

A useful "naturalistic" paradigm should not tear down what has already proved constructive to understanding. The functional logic paradigm is essentially neutral in this respect. Thinking within a new paradigmatic framework may eventually suggest better ways to frame questions about evolutionary processes—*not to deny that they occur.*

Openness toward evolution is also important for another reason: If we are now only at the beginning of a true *bio*logical science (as the proposal of a biological organization based on function implies), the situation posed for the future is highly unspecified—just as it was for physical science at its beginning. Let's examine this point further.

The History of Physical Science Offers a Constructive Analogy for the Present Situation.

In its weak form, the hypothesis of evolution has played and continues to play an important constructive role in biology. However, many major concerns of biology (especially its modern developments in molecular biology, biochemistry, immunology and genetics) pose specific logical questions to which "evolution" so far offers no particular scientific answer. Prominence given to "evolution" as a *mechanistic* key to all explanation in biology seems premature in this context. If "ID" is offered as a *different* key for the same task, its anomalous and inappropriate character for that purpose is even more obvious to most scientists. I believe an analogy with the history of physical science offers helpful insight here.

In arguing for the "mechanical philosophy" in the seventeenth century, Robert Boyle certainly had explicitly theological beliefs about origins, presupposing divine purpose, agency and design in creation. However, he understood that the mechanical philosophy is a useful limited discourse for which those concepts are neither necessary nor particularly constructive. Physical origins were not part of the initial agenda of physical science—and only became a part later, when overall coherence of the theory demanded it.

Imagine we were living (say) in the eighteenth century, at a time when the initial successes of Newtonian mechanics were clearly established in relation to such problems as planetary motions under gravity, and its relevance to problems of terrestrial mechanics was beginning to be recognized. While we might well believe such a "naturalistic" science could tackle applications of physical theory to specific aspects of the world, many of us would still have considered an argument for design as "inference to the best explanation" for the *origins* of the physical order—and both Boyle and Newton *did* think about creation in just this way. Although some took the success of a mechanistic science to be evidence for an atheistic world view, or for assuming that the universe and its matter/energy were eternal and *without any origin*, many scientists then and through much of the history of physics continued to believe in *design* as *sound natu-*

ral theology, the best explanation for the *ultimate origin* of the physical order. Attempts to construct and develop cosmological theories, starting from early ideas such as Laplace's nebular hypothesis (*circa* 1800) and still later, more elaborate synthetic hypotheses about stellar and galactic origins and evolution, were understood as legitimate and potentially fruitful enterprises. Nevertheless for most scientists these ideas had very limited relevance to the philosophical question of ultimate beginnings.

What we have learned about the world from a naturalistic physical science has in the end reinforced the rather different kind of understanding of its meaning and origins to which "the inference to design" had pointed long before ...

In the meantime, development of a naturalistic physical science continued, effectively including more and more aspects of the physical universe and facing up to the odd but curiously solvable problems such systematic exploration posed. By the mid-twentieth century it began to emerge (to everyone's surprise) that the "problem of origins" might have a *naturalistic* solution. Eventually, that solution, worked out more coherently, entailed not only a picture of our universe at the largest physical scale, but its intimate, necessary connection to specific field-theoretic models of fundamental particles and their physical interaction, separate lines of thought and evidence being tightly linked in the standard cosmological model or "big bang" scenario.[36]

While we should surely exercise caution in arguing a direct correspondence between the picture of origins given by the naturalistic standard cosmological model and biblical accounts of God's creation "in the beginning," striking similarities cannot be ignored, and have deeply influenced some scientists active in cosmology. More important, there is a kind of *complementarity* between the naturalistic picture of origins, and "the inference to design as the best explanation" for ultimate origins of our universe. What we have learned about the world from a naturalistic physical science has in the end *reinforced* the rather different kind of understanding of its meaning and origins to which "the inference to design" had pointed long before[37] – not finally discredited it.

This surprising outcome was certainly not guaranteed by the process of scientific inquiry or its terms of reference. Beliefs about origins neither served as the fundamental framework determining new concepts in physics – nor did they suggest problems for such concepts to explain. (For example, the cascade of important discoveries which began with construction of classical electromagnetic theory in the second half of the nineteenth century, and moved toward both quantum theory and general relativity, was almost always set in context of scientific world views in which it did not matter very much whether the material universe had always existed or in what fashion it began – even though some visionaries recognized that evidence to that question might perhaps be entailed in future scientific discovery.)

A modified "naturalistic" paradigm for biology proposes we learn to think in its terms of reference about various existing forms and behavior in biological systems – *without having any immediate or explicit agenda regarding ultimate origins.* This does not mean that the set of questions posed by the thesis of biological evolution is irrelevant to biology, but that answers proposed to them should not rigorously control our methodology and concepts from the outset. If a more definite set of questions and problems bearing on biological change and biological origins eventually emerges from such inquiry, a more convincing "naturalistic" theory of biological origins might instead reshape the meaning of "evolution." If the history of physics offers a relevant analogy, *origins* arguments and concerns should not have a rigorously determining role in thinking about biology now. As Francis Bacon pointed out long ago, arrogant confidence in our rational powers hinders humility in reading the book of nature.

Conversely, if "intelligent design" also offers distinctive *scientific* implications for biology, then it is very important for its proponents to show how it sponsors new paradigms constructive for further understanding and development of a biological theory of things *as they now are* – not purely as an answer to origins questions now inaccessible to science. I prefer to think of ID as a complementary *natural theology,* not as science – and therefore as quite compatible with an appropriate "naturalism" in biology. But the issues certainly need continuing dialogue – once we can agree on common grounds for it. ✦

Notes

[1]W. R. Thorson, "Legitimacy and Scope of 'Naturalism' in Science: Part I. Theological Basis for a 'Naturalistic' Science," *Perspectives on Science and Christian Faith* [this Journal: hereafter abbreviated as *PSCF*] 54 (March 2002): 2–11.

[2]W. R. Thorson, "Legitimacy and Scope of 'Naturalism' in Science: Part II. Scope for New Scientific Paradigms," *PSCF* 54 (March 2002): 12–21.

[3]Of course, the concept of "a direct surrogate for divine agency" is not sharply defined. From a theological point of view, many useful scientific concepts are *indirect* or *attenuated* surrogates for divinely

given order or divine agency: for example, as was pointed out by a nineteenth century theologian, the useful notion of "laws of nature" is just such a surrogate concept, since the order to which we refer in using this term is a *given* reality, not derivable from more elementary assumptions; "laws of nature" are really "customs of God." In general, a *direct* surrogate for divine agency would be any idea or explanatory concept which (a) likewise appeals to a given, not further explained reality, but *also* (b) deliberately draws attention to natural theological inferences or implications. In spite of disclaimers by some proponents of "intelligent design," I maintain that, as currently used, the idea *is* a direct surrogate for divine agency—and that *inference to a natural theological conclusion is the primary intention of those who argue positively for it.* [But I also argue that such ideas or inferences are legitimate, reasonable *and* justified in the non-naturalistic context of *natural theology*.]

[4]Thorson, "Legitimacy and Scope of 'Naturalism' in Science: Part II."

[5]This assumption is clearly implied in a "strong" version of the hypothesis of evolution (which may be called "extreme Darwinism"). A metaphysical world view restricted to the physical world as the only ontological reality ultimately lies behind strong assertions that *random mutation plus natural selection* (usually linked to some form of *gradualism*) must be able to account for the present variety and complexity of biological forms.

[6]Richard Dawkins' books (*The Blind Watchmaker, The Selfish Gene, Climbing Mount Improbable*) clearly exhibit this bias; Dawkins is not a professional biologist, but a faithful spokesman for the extreme Darwinist position. But see works by professionals, such as: G. Gaylord Simpson, *The Meaning of Evolution* (Reprinted; New Haven, CT: Yale University Press, 1990); Jacques Monod, *Chance and Necessity: Essay on the Natural Philosophy of Biology* (New York: Random House Publishers, 1972); Melvin Calvin, *Chemical Evolution* (Oxford, UK: Oxford University Press, 1969); Ernst Mayr, *What Evolution Is* (New York: Basic Books, 2002); ——, *Evolution and the Diversity of Life* (Cambridge, MA: Harvard University Press, 1976); R. C. Lewontin, *Genetic Basis of Evolutionary Change* (New York: Columbia University Press, 1974); ——, *Biology as Ideology: The Doctrine of DNA*, 3rd ed. (New York: Perennial-Harper-Collins, 1993); Stephen J. Gould, *The Structure of Evolutionary Theory* (Reprinted; Cambridge, MA: Harvard University Press, 2002); T. Dobzhansky, *Evolutionary Biology* (New York: Plenum Press, 1976); ——, *Genetics and the Origin of Species*, S. J. Gould, ed. (Reprinted; New York: Columbia University Press, 1982). Whatever merits these works have, their authors all presuppose a priori that a mechanistic, reductionist science provides an adequate basis for explaining biological origins and development. This long set of citations is necessary if tedious evidence to my point; some respondents to my March 2002 *PSCF* essays suggested my criticisms of "extreme Darwinism" failed to distinguish science from mere *scientism*. Proponents of "intelligent design" who have advanced serious negative criticisms of reductionist scenarios for chemical and biological evolution can bear ample witness to the power of such prejudice in stifling worthwhile discussion and instead responding with a *hermeneutic of suspicion* toward their critiques.

[7]See, e.g., Michael Polanyi, *Personal Knowledge: Toward a Post-Critical Philosophy* (London, UK: Routledge and Kegan Paul, 1958), Part IV, chap. 11, sections 1-3; and Walter M. Elsasser, *The Chief Abstractions of Biology* (Amsterdam, Netherlands: North Holland Publishing Co., 1975).

[8]In his most recent book about evolution and biology (*This is Biology: the Science of the Living World* [Cambridge, MA: Harvard University Press, 1997]), Ernst Mayr argues for an understanding of biology which he calls "organicism." According to Mayr, "organicism" accepts the *operational* fact of a logic in biology distinct from physics and not obviously reducible to it (Mayr's favorite expression for this logic is "the instructions from the genetic program"); on the other hand, it appeals to the extraordinarily fuzzy idea of "emergence" as a reason to claim that the existence of this higher logic somehow has a purely *mechanistic* explanation. Mayr's argument is profoundly flawed at this point. Like a good positivist, he strictly denies the possibility that objectively real principles are embodied in this operational logic—and calls both Polanyi and Elsasser "vitalists" because they accepted such an objective reality; and he very carefully avoids facing up to the fact that this logic is universally concerned with *function* or *achievement* (concepts which must remain meaningless for a strictly mechanistic science). But "the genetic program" is patently organized toward such limited *goals*; hence, a kind of creaturely *telos* is indeed manifest in living organisms—and has scientific importance. (I stressed in "Legitimacy and Scope of 'Naturalism' in Science: Part II" that the descriptive language and assumptions of research in modern biology tacitly presuppose logical organization in terms of function as a given and indispensable fact). "Organicism" attempts to avoid these hidden implications in current scientific work while justifying the covert use of such logical reasoning. I can see no epistemological basis for this position, even though it rationalizes the exploration of the same functional logic I argue for as a paradigm.

[9]Cf. my essays, "Legitimacy and Scope of 'Naturalism' in Science: Part I" and "Part II"; further see Responses to these essays and my Replies to Respondents, *PSCF* 54 (March 2002): 22-46.

[10]Charles B. Thaxton, Walter L. Bradley and Roger L. Olsen, *The Mystery of Life's Origin: Reassessing Current Theories* (New York: Philosophical Library, Inc., 1984). While details of some arguments offered by these authors on ideas of "chemical evolution" current at the time have since been validly criticized, the overall negative critique they offered still has some scientific merit.

[11]Stephen C. Meyer, "DNA by Design: An Inference to the Best Explanation for the Origin of Biological Information," *Rhetoric and Public Affairs* 1, no. 4 (1998): 519-55; Stephen C. Meyer, "Evidence for Design in Physics and Biology: From the Origin of the Universe to the Origin of Life," in *Science and Evidence for Design in the Universe* (San Francisco: Ignatius Press, 2000), 53-112. See also ——, "DNA and Other Designs," *First Things*, no. 102 (April 2000): 30-8. I stress that in all these citations *Meyer has given a substantial and scientifically valid negative critique of "chemical evolution" theories.* Meyer's *positive* arguments for design in either physics or biology in these articles are not directly pertinent to their citation here.

[12]Thorson, "Legitimacy and Scope of 'Naturalism' in Science: Part II."

[13]Michael J. Behe, *Darwin's Black Box: The Biochemical Challenge to Evolution* (New York: The Free Press, 1996). Although Behe's book uses scientific instances to support an argument in natural theology (for "intelligent design"), the instances of biological organization he describes in detail clearly illustrate the fact that the organizing logic needed to explain them is concerned with *function* rather than mechanism as such. "Irreducible complexity" *is* a scientifically meaningful concept because it describes a system which is logically unitary or simple with respect to a performed function, but unintelligibly complex when viewed only in terms of its mechanistic components. As Behe regularly points out both in his book and in replies to critics, the claim that a system is "irreducibly complex" is open to empirical falsification (particularly in the case of the "molecular machines"). Not one of Behe's critics has undertaken that challenge directly. The long argument of Kenneth R. Miller for "evolution" [see "Legitimacy and Scope of 'Naturalism' in Science: Part II," p. 21, note 15; and note 33 below] does not invalidate "irreducible complexity" as a scientific idea, but only *Behe's use of that idea* to argue for inference of design as a divine *intervention* in nature.

[14]William A. Dembski, *Intelligent Design* (Downers Grove, IL: InterVarsity Press, 1999). In commenting on Dembski's arguments in relation to *negative critiques* of mechanistic scenarios for generating information, I have ignored Dembski's claims about a *positive* agenda for "intelligent design" as a *scientific idea*. In my view, these positive claims have never been demonstrated. So far, Dembski's idea of "intelligent design" seems opposed not only to naturalism as currently understood in physics, but also to any modified "naturalism" in science—even on the theological terms I propose.

[15]I pointed out in "Legitimacy and Scope of 'Naturalism' in Science: Part II" that "information" is in the eye of the beholder, shown for example by the *weather* as an "information-rich" but still merely mechanical system. Mathematical assessments of the amount of

information in a system do not therefore demonstrate that its organization has a positive scientific *meaning* not credibly explained by a null hypothesis. They do have some merit in negatively eliminating trivial mechanistic or statistical explanations, such as the two extreme cases of determinate order or randomness which Dembski discusses in his book.

[16]M. Polanyi, *Personal Knowledge: Toward a Post-Critical Philosophy*, Parts I–III; especially Part I, chap. 4 and Part III, chap. 8.

[17]Thomas S. Kuhn, *The Structure of Scientific Revolutions*, 2d ed. (Chicago, IL: University of Chicago Press, 1970). Cf. esp. chaps. VI–IX.

[18]Thorson, "Legitimacy and Scope of 'Naturalism' in Science: Part I" and "Part II."

[19]Meyer and I were joint lecturers and discussion participants (together with Loren Wilkinson and Rikk Watts of Regent College) in a one-week seminar course on "Perspectives on Creation, Evolution and Design," held June 10–14, 2002, at Regent College in Vancouver, BC, Canada. No formal written proceedings have been published or authorized by Regent College in connection with the course, and informal reports such as the dialogue described here must be considered private communications. I have tried here to represent accurately the points of mutual agreement or consensus between us, though of course they are presented here in relation to my own concerns.

[20]Meyer says he classifies both Darwinism and design as theories within the *historical sciences* "because it is the job of such sciences to reconstruct the causes of past events." Since theories in the historical sciences often have broad philosophical or theological implications, he concedes that science-based design arguments can be considered a kind of natural theology. However, he would prefer to classify them as works of historical science—based on the methodological similarity they share with Darwinist and other forms of evolutionary argument.

[21]What I here call "science proper," Meyer calls "nomological or inductive sciences," and he uses the term "historical sciences" for what I have here called "natural theology" (see also note 20 above). These semantic differences do indicate some potential divergence in our respective views.

[22]Thorson, "Legitimacy and Scope of 'Naturalism' in Science: Part I" and "Part II."

[23]See, for example, arguments of Del Ratzsch, "Design: What *Scientific* Difference Does it Make?" [an unpublished essay, presented in a lecture by Ratzsch (Dept. of Philosophy, Calvin College) at Whitworth College, Spokane, WA (April 2002); Ratzsch has kindly provided me the text of his paper]; see also Stephen C. Meyer, "The Scientific Status of Intelligent Design: The Methodological Equivalence of Naturalistic and Non-Naturalistic Origins Theories," in *Science and Evidence for Design in the Universe*. While I disagree at some points with Meyer's arguments, his claim that scientific methodology has no *formal principles* which rule out design a priori is valid.

[24]See citations to Phillip Johnson's works in my essay, "Legitimacy and Scope of 'Naturalism' in Science: Part I," p. 10, notes 1, 9; and in Donald Yerxa's historical account, "Phillip Johnson and the Origins of the Intelligent Design Movement," *PSCF* 54 (March 2002): 47–52.

[25]Michael J. Behe, *Darwin's Black Box: The Biochemical Challenge to Evolution*.

[26]William A. Dembski, *Intelligent Design*.

[27]See note 8 above.

[28]The irony in such an "interventionist" paradigm for ID, taken to its extreme, is that it seems to presuppose the adequacy of a purely mechanistic physical order to sustain the ability of the injected information to meet the challenges facing biological existence—a new kind of Deism, perhaps? Of course such a paradigm is made to order to argue for the essential fixity of biological species, rather than for any form of macro-evolution.

[29]See Mark Discher, "Van Till and Intelligent Design," *PSCF* 54 (December 2002): 220–9; Howard J. Van Till, "Is the Creation a 'Right Stuff' Universe?" *PSCF* 54 (December 2002): 230–9; and Discher's reply, "Is Howard Van Till's Response to 'Van Till and Intelligent Design' the 'Right Stuff'?" *PSCF* 54 (December 2002): 240–8. The real issue between scientists like Van Till and myself, and many proponents of "ID," is their refusal to take seriously the strong theological grounds for "naturalism" in science—and the resulting confusion about what may have legitimate scientific meaning. Discher criticizes philosophical inconsistencies in Van Till's formal position, but avoids this essential issue. Discher is correct in asserting that whatever decidable questions ID may raise about biology must be settled empirically, i.e. the resolvable problems *are* scientific. However, his arguments are *misleading* by failing to make any distinction between ID as *natural theology*, and the (completely unsubstantiated) claim that ID is a *scientific hypothesis* with specific scientific consequences. Discher's "ID scientists" ready to realize this claim so far do not exist.

[30]For a good summary of what Van Till means by the "RFEP," see Van Till's citations to his own essays on that and related subjects in his recent *PSCF* response, "Is the Creation a 'Right Stuff' Universe?" p. 239, note 22. Continuing debate between Van Till and especially William Dembski on the version of ID Dembski argues for is also relevant to this discussion.

[31]In this connection, see my essay "Fingerprinting *GOD?* Divine Agency and 'Intelligent Design,'" in *CRUX* XXXVI, no. 2 (June 2000): 2–9. I argue in particular that divine agency is not knowable *as such* by *mundane rational inquiry*, which all scientific inquiry necessarily is—because of its universal accessibility to all human beings without their repentance.

[32]Private correspondence with Van Till confirms that he does *not* wish to exclude from science the possibility of logically disjoint but naturalistic accounts of biological organization like those I have proposed. Van Till's understanding of the "RFEP" therefore would concede that a purely mechanistic account of biology may *not* be scientifically adequate—and a corresponding need for philosophically richer terms of reference for a "naturalistic" biological science. Some critics have misunderstood Van Till's arguments about the RFEP on just this point.

[33]Debates between Kenneth R. Miller and various proponents of ID often seem to reflect such gratuitous rejection of any possible validity in ID (even as natural theology), and a corresponding unwillingness to consider the valid science contained in negative critiques of mechanistic evolutionary theories offered by Behe, Meyer and some others. See Kenneth R. Miller, *Finding Darwin's God: A Scientist's Search for Common Ground between God and Evolution* (New York: Harper Collins Publishers, 1999); more particularly, see ongoing debate between Miller and others about the notion of "irreducible complexity" in relation to both design, and to evolution as process [much of this debate has appeared in public lectures (unpublished) and commentary is available on the Internet]. Miller seems to think that the good evidence for "evolution" as developmental process in a rather weak sense also invalidates any critique of *purely mechanistic theories* of that process. *But this is an ellipsis in reasoning.* If (as I suggest might be the case) the historical process of "evolution" is also the history of a heuristic development of a functional logic in and by living things, following crucial events not fully determined by *physical* causality, then "evolution" in the weak sense (which Miller's arguments support) is the very process by which "irreducible complexity" has emerged. Nothing in Miller's arguments shows that "irreducible complexity" itself is a scientifically meaningless or invalid concept. On the contrary, such complexity shows the relevance of the functional logic paradigm to biology.

Willem Drees' response to my *PSCF* essay ["Can We Reclaim One of the 'Stolen Words'? *PSCF* 54 (March 2002): 24–5] seems to link my claim that a purely mechanistic explanation of biological organization is unlikely (and that a logic of function needs to be considered instead as a naturalistic but *non-physicalist* paradigm for biology), with a refusal on my part to "accept evolutionary biology as scientifically adequate." I show that no such refusal is entailed on p. 32 (under A "Logic of Function" Paradigm). The considerable scientific evidence in support of the hypothesis of evolution in the "weak" sense does *not* also suffice to show that

purely physicalist explanations will eventually provide an adequate *scientific* understanding of biological organization (unless one believes a priori that the terms of reference for physical science exhaust the meaning of "scientific"). Since Drees has often defended the philosophical idea that the physical world is the only *ontological* reality, he has some a priori commitment to the view that a mechanistic theory of evolution must necessarily be adequate, too. I happen to think the matter is at least an open question scientifically, but that does not mean I am "seeking support for faith in marginal if not even mistaken science," as Drees incorrectly asserts.

[34]In recent books on science/theology dialogue and particularly in relation to the question of divine agency, John C. Polkinghorne and others have argued that there must be "open places" in the physical specifiability of the world which "permit" a kind of divine agency distinct from that manifest in physical causality. While I do not intend any particular critique of such ideas, they present entertaining speculations in natural theology and/or metaphysics. From a natural theology perspective, the notion of a functional logic embodied in biological systems *is* compatible with at least some perspectives implicit in Polkinghorne's view of "creation as kenosis." It implies a kind of *telos* is resident in creation itself, entailing its own legitimate freedom—not just a *telos* imposed on it by divine fiat. See: John C. Polkinghorne, "God in Relation to Nature," in *The 1998 Witherspoon Lecture* (Princeton, NJ: The Center of Theological Inquiry, 1998); cf. also J. C. Polkinghorne, ed., *The Work of Love: Creation as Kenosis* (Grand Rapids, MI: Wm. B. Eerdmans Publishing Co., 2001), esp. the essay by Polkinghorne; and a few related comments by other contributors to that work.

[35]Thorson, "Legitimacy and Scope of 'Naturalism' in Science: Part II."

[36]See Joseph Silk, *The Big Bang*, rev./updated ed. (New York: W. H. Freeman & Co., 1989). For a closer account of the relation to fundamental particle physics, see also Steven Weinberg, *The First Three Minutes: A modern view of the Origin of the Universe*, 2d ed. (New York: Basic Books, 1993); and Frank E. Close, *The Cosmic Onion: Quarks and the Nature of the Universe* (Reprinted 1984, 1985, 1986 with minor additions; New York: American Institute of Physics, 1983).

[37]See Owen Gingerich, "Is the Cosmos All There Is?" in *Reflections* 5 (Spring 2002): 2-23.

Upcoming ASA Conferences

July 23–26, 2004:
Location: Trinity Western University, Langley, British Columbia Canada
Topic: "Neuroscience and the Image of God"
Program Co-Chairs: Judith Toronchuk, CSCA; Kenneth Dormer, ASA; and Hugh Reynolds, CiS
Local Arrangements Chair: David Clements

Aug. 5–8, 2005:
Location: Messiah College, Grantham, PA
Theme: "Alternative Energy Resources, Conservation and the Environment"
Program Chair: Kenell Touryan
Local Arrangements Co-Chairs: Ted Davis and Jerry Hess

July 28–31, 2006:
Location: Calvin College, Grand Rapids, MI
Theme: "Science, Technology and Ethics"
Program Chair: Hessel Bouma III
Local Arrangements Co-Chairs: Loren & Deborah Haarsma

A Call for Works in the Arts!

We are seeking original, previously unpublished submissions which may be in the form of poetry, musical score, drawings, cartoons, photography, short prose or meditative thoughts. Ideally the work in art depicts the relationship between science and Christian faith.

Guidelines for submissions:

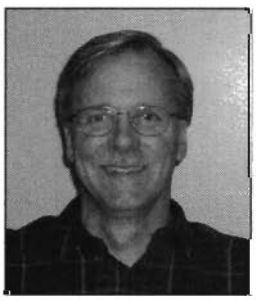
- All submissions must have a title and be less than 300 words.
- Photographs and artwork must be black-and-white or grayscale. No color accepted.
- Three copies of each submission must be on single sheets of plain white paper.
- One copy must be in digital file form (Word document for text, JPG or TIFF for artwork) sent on a PC-formatted floppy disk or as an e-mail attachment.
- Submissions will be peer-reviewed prior to publication.
- Send submission with a cover letter indicating that the submission is intended for the "Art Eyes Science" section to:

Roman J. Miller, Editor
4956 Singers Glen Road
Harrisonburg, VA 22802

millerrj@rica.net
540-432-4412

Embryonic Stem Cells and a Reformed Christian World View

Robert A. Boomsma



Robert A. Boomsma

Stem cells promise to treat diseases in ways not before possible. However, the use of human embryonic stem (hES) cells raises important issues that must be dealt with before development of clinical therapies proceeds too far. Key themes from a Reformed Christian perspective are used to frame the issues surrounding hES cells in order to address the central question: Can we obediently develop hES cell technology in order to heal the broken world? These themes include creation-fall-redemption, stewardship, human worth, the kingdom of God and social justice. It may be possible to view hES cell technology as something that promotes redemptive/stewardship roles as long as steps are taken to promote justice for the embryo and society.

It is important that Christians confront the question of hES cell use so that the response to this technology can be proactive instead of reactive.

Since human embryonic stem (hES) cells were first isolated in 1998,[1] controversy has surrounded their use. Scientists desire to study these cells in order to develop their potential use in clinical and research settings while many others have argued that use of hES cells should be discontinued immediately. A variety of positions have developed.[2] At one end of the spectrum, it is argued that embryos have no moral status and so research with hES cells should proceed without restriction. At the other end, it has been suggested that all use of hES cells should stop since it requires the destruction of human embryos which is essentially the killing of humans. Intermediate positions have argued for the regulated use of hES cells under certain conditions.[3] A consensus has not been reached within the Christian community or the public at large. It is important that Christians confront the question of hES cell use so that the response to this technology can be proactive instead of reactive.

Robert A. Boomsma *is professor and chair of biology at Trinity Christian College in Palos Heights, IL. After receiving his B.A. from Trinity, he earned his Ph.D. in anatomy from the University of Illinois, Medical Center in 1981. Bob's research has centered on the physiology of the female reproductive tract and early development. He is currently on sabbatical studying adult stem cells in the rat. Bob is married, has two children and enjoys playing the guitar, singing and skiing.*

A person's world view will determine how they will respond to the issue of hES cells. World view is "the comprehensive framework of one's basic beliefs about things,"[4] a "set of presuppositions ... which we hold ... about the basic makeup of our world."[5] A person's world view is the way in which one looks at the world and understands one's place in it.[6] This perspective on the animate and inanimate world guides a person's thoughts as he or she makes decisions. In order to make good decisions and act in a morally consistent way on controversial issues, one must understand one's world view. Christians base their world views on biblical revelation and a common faith commitment, a basic Christian theism that separates them from non-Christian world views.[7] As John Calvin asserts, the Bible provides us with the "spectacles" through which we can understand God and his creation.[8] However, many types of Christian world views have developed due to the roles that life experience and the historical development of faith communities play in world view formation.[9]

This paper will utilize a Christian world view from the Reformed tradition in assessing stem cell use. Its focus is to develop a Reformed Christian perspective on hES cell use that will address this central question: Can we obediently develop hES cell technol-

ogy in order to heal the broken world? To answer this question, the science behind hES cells will be summarized and then important aspects of a Reformed Christian world view will be used to frame the issues surrounding hES cells. Since there are many facets from which to view the question of hES cells, the result of this discussion will be complex instead of a single, simple resolution to the question raised.

Stem Cells

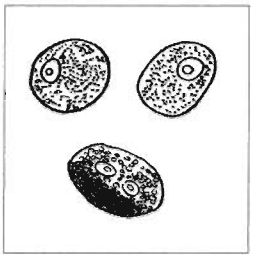
Stem cells are "cells with the capacity for unlimited or prolonged self-renewal that can produce at least one type of highly differentiated descendant."[10] These are relatively undifferentiated (unspecialized) cells that have the capability to become various types of more differentiated cells. The two properties of differentiation and self-renewal allow stem cells to be cultured in a relatively undifferentiated state until they are directed to develop into more specialized cells. Depending on their origin, stem cells could theoretically develop into any of the approximately two hundred types of specialized cells in the body if the appropriate signals were known and applied.

There is great excitement over the potential uses of stem cells.[11] From a basic science perspective, stem cells could be used to understand important processes that control the differentiation of cells during development. They could also be used to identify chemicals that cause developmental abnormalities and to test the safety of potential new drugs. However, the most excitement arises over their potential to cure various types of diseases either by replacing damaged cells or enhancing the survival and function of existing cells. Stem cells have the potential to provide therapeutic benefits for coronary heart disease (approximately 12.9 million cases in the US), type I diabetes (0.8–1.7 million cases), spinal cord injuries (200,000 cases), Parkinson's disease (1.5 million cases), Alzheimer's disease (4 million cases) and others.[12] Considering the number of individuals affected by these diseases in the United States alone, there is tremendous potential for relieving considerable suffering.

Stem cells can be derived from either embryonic or adult tissue. Embryonic stem (ES) cells typically originate from blastocyst stage embryos that are formed approximately six days after fertilization in the human. These blastocysts may be formed from "left over" frozen embryos after in vitro fertilization from infertility procedures but sometimes from embryos specifically created for research purposes.[13] Blastocyst embryos have two basic cell types: the inner cell mass which develops into various cells of the body and the trophoblast which develops into placental tissue. The inner cell mass is isolated and the cells cultured as ES cells.[14] Although ES cells have the potential to develop into any of the types found in the body, they are considered pluripotent instead of totipotent (able to form any embryonic cell or able to form a complete individual) since they are unable to form the supporting tissues of the placenta and would therefore not implant if placed into the uterus.[15] Pluripotent stem cells also have been isolated from testis/ovary precursor tissue from 5–9 week terminated pregnancies and are sometimes referred to as human embryonic gonadal (hEG) cells to distinguish their source.[16] There is also the potential to create embryos using somatic cell nuclear transfer (cloning) techniques. Although this has reportedly occurred, significant obstacles remain before primate nuclear transfer for stem cell production can be attained.[17] The benefit of using cloning techniques would be that a given individual could be the source of his or her own stem cells, circumventing tissue rejection problems that may or may not occur when cells from another individual are used.[18] Other potential methods under study to avoid rejection that do not involve cloning include the use of parthenogenetically activated eggs[19] and ES cells genetically engineered to express the Class I major histocompatability antigens of the transplant recipient.[20] The creation of numerous stem cell lines would also enhance the possibility of using a cell that would not be immunologically rejected.

Depending on their origin, stem cells could theoretically develop into any of the approximately two hundred types of specialized cells in the body if the appropriate signals were known and applied.

Much of the work with ES cells since the 1980s has been with mouse embryos. Researchers have been able to induce cultured mouse ES cells to differentiate into at least nineteen different cell types including nerve, muscle and bone cells.[21] Some success has been attained in using ES cells to treat animal models of human disease such as diabetes, liver disease and Parkinson's disease.[22] Also, mouse ES cell-derived cardiac muscle cells were functional when implanted into mice, and ES cells were used to treat rat models of a human myelin disease and Parkinson's disease.[23] Work with human ES cells has not progressed as far as in animals since they have only recently been derived and limits have been placed on federal funding. Currently, researchers are attempting to control the differentiation of these cells. For example, liver-like cells and insulin producing cells have been derived from hES cells.[24] Clearly,



The Reformed Christian world view is a holistic one that has as a fundamental principle God's sovereignty over all of his creation in the natural and moral realms.

many more studies are required with animal and human stem cells before successful treatment of human disease can occur. However, the promise of ES cells seems to be bearing fruit, particularly in the arena of animal experimentation.

The other basic type of stem cell is the adult stem cell. It appears that most, if not all, organs in the body contain some type of stem cell that can be used to renew lost cell types. Sites of stem cell populations include the bone marrow, epidermis, brain, liver, and adipose tissue.[25] It is hypothesized that adult stem cells have a more limited potential to develop into various cell types, and so they are characterized as being multipotent instead of pluripotent.[26] However, recent reports suggest that some adult stem cells have a broader multilineage potential than previously thought,[27] although others have called this conclusion into question.[28] For example, hematopoietic stem cells may be able to form three types of brain cells, skeletal and cardiac muscle cells, and liver cells in addition to blood cells.[29] Animal studies suggest that bone marrow stem cells may be useful in the treatment of myocardial infarction, diabetes, and liver disease.[30]

Less controversy surrounds the use of adult stem cells since the origin of these cells is from an adult who can give consent. It is the use of hES and hEG cells that has generated significant controversy due to the source of the cells. A blastocyst embryo must be destroyed in order to isolate the inner cell mass for hES cells. Testis/ovary precursors use tissue from terminated pregnancies. Many equate these two sources with the killing of human persons. Using cloning techniques to produce blastocyst embryos raises a host of additional ethical issues. Because of the significant moral issues raised, there are those who would advocate only the development of adult stem cells[31] while others argue that both adult and embryonic stem cells be pursued in order to maximize the potential of stem cell use.[32] Although using adult stem cells may be a simple way to relieve an ethical quandary, it does not directly address the issues surrounding hES cell use. If hES cells are more useful than adult cells and if their use can be justified, it would seem prudent to pursue this technology. Thus, the focus of this paper is on the use of hES cells.

Embryonic Stem Cells and A Reformed Christian World View

The Reformed Christian world view is a holistic one that has as a fundamental principle God's sovereignty over all of his creation in the natural and moral realms.[33] All life is subject to the rule of God. A Reformed Christian world view is not dualistic, separating the secular from the sacred, but is an integral perspective that says nothing falls outside of God's purview.[34] It has been characterized by Niebuhr in "conversionist" terms as "Christ the transformer of culture,"[35] and emphasizes personal piety and evangelism along with social and cultural issues.[36] What follows is an analysis of hES cell technology using the following important themes from a Reformed Christian world view: creation-fall-redemption, stewardship, human worth, God's kingdom and social justice. These themes are not mutually exclusive but serve to highlight important aspects of the world view relevant to hES cell technology.

Creation-Fall-Redemption and Stewardship

The principles of creation, fall, and redemption form an overarching framework for a Reformed Christian world view.[37] God created the universe and by his providence he continues to preserve, govern, and care for it.[38] Although characterized as very good, it was not completely finished in the sense that nothing was meant to change after the beginning. Creation continues to unfold according to God's plan; development is expected and desired with humans given a role to play in that process.[39] Therefore, human activities are important for the furtherance of God's plan for this world. The idea of playing God is often used in a very negative sense, that humans are somehow overstepping their bounds and moving into realms that only God should go. However, in a sense humans are called to play God, to be his agents in developing the creation[40] as long as this is done according to his will and plan, playing God "as God plays God."[41] Technological development is an important part of human cultural activity and developing hES technology could be seen as part of God's creative plan.

The fall into sin caused our entire nature to be corrupted[42] and has affected the direction that all of reality is taking,[43] not just humans. Redemption is for all of creation[44] "to reconcile to himself *all* things."[45] Salvation is a restoration of the creation—not a retreat to the original created state, but a removal of the effects of sin at its present level of development. Redemption through Christ places humans in covenant with God and all of creation, accompanied by certain rights and responsibilities.[46] Christians have a role to play in this restorative process, to work as Christ's agents in this world by using their Spirit-driven actions to help redeem the brokenness. Certainly disease was not part of God's original plan, and so alleviating disease is a high calling as Christians work with Christ to redeem the world. Using hES cells to cure previously intractable diseases would provide a significant step toward redeeming the brokenness of creation.

Certainly disease was not part of God's original plan, and so alleviating disease is a high calling as Christians work with Christ to redeem the world. Using hES cells to cure previously intractable diseases would provide a significant step toward redeeming the brokenness of creation.

The creation-fall-redemption theme is intimately tied to the pre-fall call of stewardship, often understood as the cultural mandate.[47] Although stewardship was mandated prior to the fall, this is also a covenantal responsibility in response to Christ's redemptive act.[48] Reichenbach and Anderson describe this stewardship principle as a threefold mandate: to fill, to subdue or rule over, and to care.[49] Since filling the earth is a qualitative change for the better in addition to a quantitative increase in numbers, this mandate calls us to work with God in the development of his creation including cultural possibilities.[50] Subduing or ruling over the earth must be done according to God's plan in a caring manner as caretakers of the creation for God. Technology in general,[51] and hES cells in particular, can be seen as one way to fulfill the stewardship responsibility of developing, caring for, and helping redeem the creation.

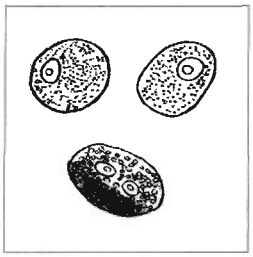
A word of caution regarding technology should be noted here. Many would regard technologies as neutral and that the use of the technology will determine whether the activity is good or bad. However, as cogently argued by Monsma and colleagues,[52] technologies are not neutral. Value decisions are made in terms of what technologies will be developed and use of a technology in turn affects what activities will and will not occur. The development of hES cell technology is occurring as part of a commitment to high-tech, expensive, rescue medicine and siphons resources from other approaches to health care.[53] Christians should not fall prey to technicism, an approach that sees technology as the solution to all human problems.[54] It may be that hES cells is an appropriate technology. But one must be wary and not blinded by its apparent promise to the point of neglecting other approaches and becoming over-reliant on technological solutions.

Finally, it could be argued that hES cell technology is part of the brokenness of creation and thus would itself need redemption. To some, redemption would mean avoiding hES cells altogether and focusing only on adult stem cells. However, as will be discussed below, redemption also could mean using human embryos for furthering stewardship in such a way that promotes justice.

Human Worth

Much of the discussion about hES cells centers on this question: What is the worth of the human embryo? This is an important question since embryos must necessarily be destroyed in the derivation of hES cells. This question must be answered adequately in order to decide whether to pursue this technology. The fundamental worth of all humans, the sanctity of life, is an important theme in all theistic world views.[55] This dignity is grounded in the creation of humans in the image of God and their redemption by Christ's work on the cross. As participants in God's covenant, humans are placed in moral community with others and so must treat people with reverence and respect—as ends in themselves and not as means to an end.[56] However, there is significant disagreement on how human embryos fit in. Are embryos human persons from the point of fertilization or is there some other way to look at embryos that would allow their being treated differently from fully developed humans? Intimately tied to this are questions regarding the meaning of being a human person and the image of God.

One approach to determine the status of a human embryo is to identify a developmental stage before which the developing human is not a person and after which full status as a human person is present. Stages that have been used include fertilization (conception), implantation into the uterus (beginning about day 7), early formation of the spinal cord/brain (about day 14), presence of basic body organs including heartbeat (about 4 weeks), brain activity (about 6 weeks), quickening (17–20 weeks), viability (about



One approach to determine the status of a human embryo is to identify a developmental stage before which the developing human is not a person and after which full status as a human person is present. ... It is hard to justify choosing any one [stage] as the decisive moment at which personhood is attained.

24 weeks) and birth.[57] It is hard to justify choosing any one of these stages as the decisive moment at which personhood is attained. Arguments have been presented elsewhere,[58] and it is beyond the scope of this paper to repeat them. However, special mention will be made regarding conception.

Conception is a common stage chosen by many evangelical Christians for personhood to begin.[59] However, fertilization itself is a process that begins when a spermatozoon meets the egg and is complete when cell division begins, a process that takes approximately 30 hours. At which point during that process is essential humanness present? Peterson believes that the genetic uniqueness which occurs due to fertilization is the strongest argument in favor of conception as the critical stage.[60] This would argue for amphimixis, or the union of the egg and sperm nuclei during fertilization, as the point at which full status is attained. Hui suggests that the presence of a unique genetic constitution, the ontological continuity between the zygote and adult, and the self development of the embryo due to its genetic constitution supports this view.[61]

Using the biological event of amphimixis to define personhood places too much emphasis on an individual's genetic composition. A human person is more than his or her genetic code. Early zygotic divisions are under the influence of maternal information, a concept acknowledged by Hui but minimized by the unsubstantiated assertion that the embryo controls their use.[62] The environment, both before and after birth, plays a major role in the development of a person. In addition, up until approximately 14 days the early embryo is able to divide into two, resulting in identical twins. This leads to confusion regarding the genetic uniqueness of the individual if the conception view of personhood is held since it is not clear which of the two new embryos (and thus persons) is ontologically continuous with the first. Others have made the following analogy: *If* a clone were created from an adult cell, it would be clear that a person existed before this "twinning" event; therefore, a person exists before the twinning of embryos.[63] However, it is very clear in the cloning case which of the two individuals is continuously present before and after while it is not clear at all in the embryo's case. The fact that twins are genetically identical, yet clearly different persons argues against the genetic view. The emphasis on the embryo's ability to self-develop due to its genetic composition[64] diminishes the importance of the variety of factors involved as *God* "knit [us] together in [our] mother's womb."[65]

Part of the argument in favor of fertilization as the critical point is that once fertilized, the zygote has the potential to fully develop into a human person.[66] Certainly after the sperm enters the egg there is potential to develop, but so is there potential in each individual sperm and egg, particularly after they approach each other. Although there are no guarantees, the zygote is more likely to develop fully and can thus be considered to have more potential. Since the embryo's potential is dependent on its successful interaction with the mother, even more potential is present after implantation. Importantly, having potential is not the same as being.[67]

Potential has significance when discussing isolated stem cells as well. Human ES cells are considered pluripotent and adult stem cells multipotent, not totipotent. However, these distinctions are not clear-cut.[68] Some would suggest that if hES cells were totipotent, then each cell would be considered a human person since it has the potential to develop into a complete human,[69] an argument that also holds if adult stem cells were able to become totipotent.[70] As Peters argues, it is not out of the range of possibility that adult stem cells could become totipotent. Although speculative, eventually any cell in the body might be coaxed into being a totipotent stem cell leading to the conclusion that every cell in the body is a potential human.[71] Will every cell in the body then have status as a potential human? Clearly, the very understanding about what it means to be a person is being challenged.

Biblical texts have been used to support the contention that personhood occurs at fertilization.[72] However, careful analysis of these passages suggests that none of them clearly denotes a stage at which personhood is attained.[73] Psalm 139:13-16 and Job 31:15 point to God's knowledge and creative activity prior to birth. Jeremiah 1:5 emphasizes God's relationship with Jeremiah prior to conception. None of the other passages

frequently cited (Job 3:3, Isaiah 49:1, Psalm 51:5, Luke 1:41–44) say anything concrete about when personhood is attained while Exodus 21:22–25 and Numbers 5:11–31 could be interpreted to suggest that personhood is not immediately present at fertilization. The Bible does emphasize, however, God's knowledge about each person prior to birth, his care for people, and the intimate role he played in forming humans.

One important way to address the issue of human worth and when personhood occurs is to analyze what makes humans unique and when during the life cycle this uniqueness is found. Many have identified various important characteristics that seem to separate humans from other animals. These characteristics include imagination, rationality, communication, ability to feel pain, self-conception, self-control, playfulness, curiosity and others.[74] Focusing on these characteristics is problematic since it is difficult to exclude these characteristics from animals. Current research is showing that animals may have some or all of these to a limited degree.[75] Also, using characteristics to define humanity results in a devaluing of those with various types of disabilities.

Christians emphasize the idea that humans are created in the image of God. The problem then comes in defining what is meant by the image of God and when it is present. Old Testament scholars view the "image of God as the royal function or office of human beings as God's representatives and agents in the world, given authorized power to share in God's rule over the earth's resources and creatures."[76] The image of God is not those characteristics that humans have that animals don't but is a transformation of physical characteristics for stewardship responsibilities.[77] It is difficult to pinpoint exactly what the characteristics of the image of God are. Bouma and colleagues emphasize the importance of reflective choice-making that allows humans to perform their stewardly responsibilities in relationship with God, the creation, other people, and the individual.[78] Peterson suggests that the image requires capacity, task, and relationship: the capacity (such as reason) to carry out the stewardship task in relationship to God.[79] We image God by using the stewardship authority given to us and by living in loving communion with others.[80] Although the image is imperfect due to a fallen relationship with God, it is still maintained in a distorted manner.[81] This discussion still begs the question of when the image is seen in humans, leaving the discussion where it was before with no direct biblical guidance. However, it is difficult to claim that the 6-day embryo has the same type of capacity, task, and relationship inherent in the image of God as a newborn does.

The gradualist theory, sometimes called the potentiality principle, is an approach to the problem of when personhood is attained that takes into account the continuum of change that occurs during human development.[82] Using the term "gradualist" distinguishes between the ideas of "potential persons" espoused here versus "persons with potential" inherent in views that emphasize critical stages like conception.[83] The gradualist view states that human life at all stages is created by God and deserves respect, and that embryos are potential humans that realize their full potential as they gradually develop into a fetus and then a child. A general rule of protection for embryos and fetuses is emphasized due to their potential to become imagers of God.[84] No clear point during development where a fertilized egg's potential is changed to a person with the full image of God can be delineated. Extreme care and respect is due embryos because of their potential to fully develop into imagers of God, but they can be treated differently since they have not completely become persons. As development proceeds, increasing care and respect is due because of the increasing development of personhood. The gradualist theory allows the embryo to be held in high regard but takes into account the observation that an embryo is different from a fetus and a newborn, with different capacity, task and relationship inherent in the image of God.

The gradualist view states that human life at all stages is created by God and deserves respect, and that embryos are potential humans that realize their full potential as they gradually develop into a fetus and then a child.

This developmental approach is used in various situations. Parents are seen as caretakers of children, and rights and responsibilities are given in increasing proportion as they develop. Many would argue that aborting a fetus to save a mother's life is justifiable. This is a decision of relative worth, the fetus with potential and the mother actualized. Others would argue that abortion is wrong except in the case of rape or incest. It would be difficult to justify this decision if the developing embryo were fully human. The gradualist theory allows issues to be sorted that are not clear-cut. It provides a way to emphasize the importance of developing humans while allowing valid judgments to be made in difficult situations. In terms of hES cells, it may allow the technology to be seen as something that promotes stewardship and redemption, so long as the embryo is treated with appropriate respect.

Alleviating human pain and suffering is part of the redemptive and stewardship roles God has given to humans. ... Viewing embryos from a developmental perspective, as having worth due to their potential to fully develop as image bearers but yet different from full persons, allows us to consider destroying embryos to create stem cells.

God's Kingdom and Social Justice

Christ established his kingdom at the time of his first coming, but it will be fully instituted at His second coming.[85] Reformed Christians place an important emphasis on the present reign of Christ in the world[86] which leads to "a very practical concern for an involvement in the world."[87] The kingdom of God claims all of creation, not just parts of it.[88] As forcefully stated by Kuyper, "there is not a square inch in the whole domain of our human existence over which Christ, who is Sovereign over *all*, does not cry: 'Mine!'"[89] The implications of this kingdom perspective are that all areas of life demand the activities of Christians in furthering the work of the kingdom[90] and that Christians should be concerned about the conditions of society and justice.

Social justice can be defined as the application of God's desires in the world in our relationships with each other. Justice for the poor and oppressed is a central theme of the Old and New Testaments, and believers are called to care for them.[92] God's kingdom is concerned about justice/righteousness, and since justice is relational it is social by definition.[93] Christians are to seek both the common and individual good.[94] Reformed Christians have been a major driving force for liberty and freedom, and this drive has at its origin the concept of the sovereignty of God.[95]

Alleviating human pain and suffering is part of the redemptive and stewardship roles God has given to humans. Since hES cells have the potential to cure a variety of intractable diseases for a large number of people, the development of this technology would appear to be worth pursuing. Viewing embryos from a developmental perspective, as having worth due to their potential to fully develop as image bearers but yet different from full persons, allows us to consider destroying embryos to create stem cells. However, the issue of justice must be considered as hES cell technology is assessed.

One needs to determine whether justice is done for embryos by using them for hES cells. There is both a desire to fulfill the redemptive/stewardship role and a desire to hold the embryo as a potential image bearer in high regard. Since the present is a "not yet" state[96]—a fallen world where Christ's redemptive work is in the process of permeating all of creation—there is a tension between what one would do in a perfect world and what needs to be done in a fallen one. Moral decisions are often made by weighing options without precise formulas[97] and the Reformed Christian world view allows for grappling with situations on the edge.[98] Multiple examples of this type of tension can be found. Although divorce is considered contrary to God's plan, it is accepted at times. Killing humans is wrong, yet many believe the death penalty is justified and just war theory allows it. Abortion might be considered acceptable by some under certain situations.[99] Human ES cells places two principles at odds: the worth afforded embryos throughout their development versus the desire to alleviate human disease and suffering. In ethical terms, this may be a conflict of prima facie duties.[100] There is the desire to protect human embryos, but the redemptive/stewardship goal of healing coupled with the gradualist theory for embryos may tip the balance in favor of using embryos for hES cells.

Even if we sanction using embryos for hES cell development, the concept of justice still demands that we treat them with respect because of their status as potential image bearers. Respect should be given practical meaning or we should discard the term altogether.[101] Lebacqz argues that respect includes not treating embryos cavalierly, minimizing harm wherever possible, determining the necessity of using each individual embryo and the way the embryo is spoken about and handled.[102]

Respect can be taken further, however, if the concept of purpose is included. Purpose has been used to consider abortions in certain, but not all, situations.[103] As argued earlier, hES cell use may be justified if the purpose is to promote redemption/stewardship responsibilities. This would suggest that using embryos to cure disease or for research to that end would promote respect while using embryos for egotistical or capitalistic purposes or for research that has no intention to promote health would not. The purpose for which the embryos were initially created may also be important. It is common practice to create extra, unused embryos during clinical in vitro fertilization procedures that will be frozen and eventu-

ally discarded. Since the original purpose for creating these embryos was good and since they will be discarded anyway, their use to "save" someone from illness would promote respect for the embryo.[104] Some would argue that creating extra embryos in these situations is wrong and that only as many embryos as are going to be used or donated to "adoptive" parents should be created.[105] While it would be preferable to utilize all embryos created, the gradualist perspective promoted here does not require it. In addition, creating extra embryos minimizes medical harm and cost for the parents. Loss of embryos prior to implantation is a normal occurrence and the purpose for their creation is appropriate. Creating embryos for the sole purpose of research or hES cell development promotes the view that embryos are simply commodities[106] and may lead to reducing the value placed on humans at all stages. Creating embryos using somatic cell nuclear transfer (cloning) techniques raises unique issues that are beyond the scope of this paper. Thus, it is possible to respect an embryo in practical ways and still allow for its use. Respect as defined here is not a set of clearly defined procedures but a system of attitudes, born of a world view, which guide individual actions.

Although purpose can be an important component of maintaining respect for the embryo, it must be remembered that intentions are not always simple or pure. Research often has multiple goals, and the original goal of a research project may change as data are gathered. The creation of excess embryos during infertility treatment may itself be a coercive process born of the pressures of society on women to conceive and of clinics to increase their success rates.[107] A separation of the decision to create extra embryos and using them for research is not always clearly demarcated. An infertile couple may have knowledge of the possibility to use the extra embryos for research and therefore will not be bothered if "extras" are made. In addition, the same people doing the infertility treatment may also be involved in the research. Finally, no matter how diligent one is, motives are under the influence of sin. Even the best of intentions are colored by egotistical desires. This is not an argument against promoting respect for embryos by using the idea of purpose. It is a warning to be led by the Spirit through constant prayer while making decisions regarding embryos, making sure that one's motives fit with God's purposes of redemption and stewardship.

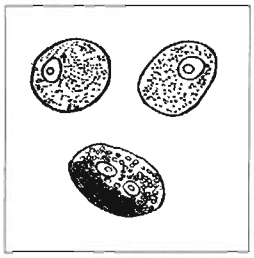
Health care technology in general, and hES cell technology in particular, raises broader societal issues in addition to those that relate to individual embryos. Already mentioned is our society's dependence on high-tech rescue medicine with the concurrent shifting of funds away from other types of health care initiatives such as prevention or minimum health care for all citizens.[108] Also, since stem cell therapy will be expensive, issues regarding access are raised since those in poverty tend to have poor health but will not be able to afford the cures.[109] Stem cell research can be seen as a luxury to those who do not have access to basic heath care.[110] Scarce research funds are being directed toward a therapy that will benefit the few who can afford it.[111] Christians should be concerned about the unequal distribution of wealth, the real everyday needs of everyone and how these resources are allocated.[112]

Government regulation limiting the creation and use of hES cells for medical purposes only is necessary in all sectors in order to maintain the respect due the human embryo ...

Justice must be pursued individually and collectively. Each individual should seek justice for all with whom they come into contact. However, society as a whole depends on the government to ensure that justice is done for the marginalized. This is an important role mandated by God where the State is to balance the need for individual personal liberties with appropriate regulations to ensure that all are treated with justice.[113] Currently in the United States, federally funded research on hES cells is regulated and limited to a few existing stem cell lines while the private sector is completely unregulated.[114] Individual companies, such as Geron, may set up their own advisory boards but it is not a requirement.[115] This situation does not allow for adequate governmental oversight of hES cell research. Government regulation limiting the creation and use of hES cells for medical purposes only is necessary in all sectors in order to maintain the respect due the human embryo as discussed above. In addition, a national approach to health care is needed to promote the concept of distributive justice and provide fairness of access.[116] In order to use hES cells appropriately, it is imperative that the government adequately promote justice for individual embryos and all members of society.

Conclusion

Can we obediently develop hES cell technology in order to heal the broken world? A world view perspective allows all facets of this central question to be addressed. The key Reformed Christian world view themes of creation-fall-redemption, stewardship, human worth, the kingdom of God and social justice provide a way to frame the issues in order to understand them more clearly and to address the



Embryo use for clinical therapy development is appropriate. This should be done prayerfully to be sure that our motives are pure and each embryo used serves an important purpose in order to justly promote the redemptive/ stewardship task of alleviating human disease.

central question. As one looks at this question from a world view perspective, it becomes apparent that the answers are not black and white, and that there is much room for disagreement. Discussing the issue in this way allows Christians to understand each other, identify areas of common ground, and work together toward fulfilling their God-given tasks.

Technologies are developed in response to God's desire that humans work with him as he develops and redeems his creation and in response to his call to stewardship. Since disease is not part of God's original plan, hES technology can be seen as something that promotes redemption and stewardship of the creation. The gradualist theory holds that human embryos have worth due to their potential to develop fully into humans, but since potential is not the same as being they can be treated differently than fully developed humans. This allows for the use of embryos under circumstances that promote justice toward those embryos. Justice demands respect and respect demands appropriate purpose. Therefore, the best argument can be made for using preimplantation "spare" embryos from infertility procedures for hES cells in the area of clinical therapy development. The government must play a key regulatory role in making certain that justice is being done by regulating the creation and use of embryos and providing its citizens fair access to the technology.

Should hES cell technology be pursued? Moral decisions such as these require us to weigh the options and proceed with care. The discussion presented here suggests that embryo use for clinical therapy development is appropriate. This should be done prayerfully to be sure that our motives are pure and *each* embryo used serves an important purpose in order to justly promote the redemptive/stewardship task of alleviating human disease. ✧

Notes

Research for this paper was supported by a grant from the Trinity Christian College Alumni Association.

[1]J. A. Thomson, J. Itskovitz-Eldor, S. S. Shapiro, M. A. Waknitz, J. J. Swiergiel, V. S. Marchall, and J. M. Jones, "Embryonic Stem Cell Lines Derived from Human Blastocysts," *Science* 282 (1998): 1145–7; J. J. Shamblott, J. Axelman, S. Wang, E. M. Bugg, J. W. Littlefield, P. J. Donovan, P. D. Blumenthal, G. R. Huggins, and J. D. Gearhart, "Derivation of Pluripotent Stem Cells from Cultured Human Primordial Germ Cells," *Proceedings of the National Academy of Sciences USA* 95, no. 23 (1998): 13726–31.

[2]G. Outka, "The ethics of stem cell research," Paper presented to the President's Council on Bioethics, April, 2002. www.bioethics.gov/background/outkapaper.html (last accessed December 2003). Revised version in *Kennedy Institute Ethics Journal* 12, no. 2 (2002): 175–213.

[3]A. R. Chapman, M. S. Frankel, and M. S. Garfinkel, "Stem Cell Research and Applications Monitoring the Frontiers of Biomedical Research," *American Association for the Advancement of Science and the Institute for Civil Society*. www.aaas.org/spp/dspp/sfrl/projects/stem/report.pdf (1999): 10–1 (last accessed December 2003).

[4]A. M. Wolters, *Creation Regained: Biblical Basics for a Reformational Worldview* (Grand Rapids, MI: Wm. B. Eerdmans, 1985), 2.

[5]J. W. Sire, *The Universe Next Door: A Basic Worldview Catalog*, 3rd ed. (Downers Grove, IN: InterVarsity Press, 1997), 16.

[6]J. H. Olthuis, "On Worldviews," *Christian Scholars Review* 14, no. 2 (1985): 153–64.

[7]Sire, *The Universe Next Door*, 23–38.

[8]J. T. McNeill, ed., *Calvin's Institutes of the Christian Religion, Book 1* (Philadelphia: Westminster Press, 1960), 70.

[9]Olthuis, "On Worldviews," 153–64.

[10]F. M. Watt and B. L. M. Hogan, "Out of Eden: Stem Cells and Their Niches," *Science* 287 (2000): 1427–30.

[11]National Institutes of Health, "Stem Cells Basics," http://stemcells.nih.gov/infoCenter/stemCellBasics.asp (last accessed December 2003); T. B. Okarma, "Human Embryonic Stem Cells: A Primer on the Technology and Its Medical Applications," in *The Human Embryonic Stem Cell Debate: Science, Ethics and Public Policy*, ed. S. Holland, K. Lebacqz, and L. Zoloth (Cambridge: MIT Press, 2001), 3–13; D. A. Kerr, J. Llado, M. J. Shamblott, N. J. Maragakis, D. N. Irani, T. O. Crawford, C. Krishnan, S. Dike, J. D. Gearhart, and J. D. Rothstein, "Human Embryonic Germ Cell Derivatives Facilitate Motor Recovery of Rats with Diffuse Motor Neuron Injury," *Journal of Neuroscience* 23 (2003): 5131–40.

[12]American Heart Association, *Heart Disease and Stroke Statistics – 2003 Update* (Dallas: American Heart Association, 2002), 5; Center for Disease Control, Diabetes Public Health Resource, *National Diabetes Fact Sheet*, www.cdc.gov/diabetes/pubs/estimates.htm (last accessed December 2003); American Diabetic Association, www.diabetes.org/main/info/facts/facts_natl.jsp (last accessed December 2003); National Spinal Cord Injury Statistical Center, *Spinal Cord Injury: Facts and Figures at a Glance, May 2001*, www.spinalcord.uab.edu (last accessed December 2003); National Parkinson Foundation, Inc., *What the Patient Should Know*, www.parkinson.org/pdedu.htm (last accessed December 2003); Alzheimer's Association, *Statistics About Alzheimer's Disease*, www.alz.org/aboutad/statistics.htm (last accessed December 2003).

[13]D. Josefson, "Embryos Created for Stem Cell Research," *British Medical Journal* 323, no. 7305 (2001): 127.

[14]J. S. Odorico, D. S. Kaufman, and J. A. Thomson, "Multilineage Differentiation from Human Embryonic Stem Cell Lines," *Stem Cells* 19 (2001): 193–204.

[15]National Institutes of Health, "Stem Cells Basics."

[16]J. J. Shamblott, et al., "Derivation of Pluripotent Stem Cells," 13726–31; J. A. Thomson, "Human Embryonic Stem Cells," in *The Human Embryonic Stem Cell Debate*, p. 18.

[17]J. B. Cibelli, A. A. Kiessling, K. Cunniff, C. Richards, R. P. Lanza, and M. D. West, "Somatic Cell Nuclear Transfer in Humans: Pronuclear and Early Embryonic Development," *e-biomed: The Journal of Regenerative Medicine* 2 (2001): 25–31; C. Simerly, T. Dominko, C. Navara, C. Payne, S. Capuano, G. Gosman, K.-Y. Chong, D. Takahashi, C. Chace, D. Compton, L. Hewitson, and G. Schatten, "Molecular Correlates of Primate Nuclear Transfer Failures," *Science* 300 (2003): 297.

[18]J. S. Odorico, D. S. Kaufman, and J. A. Thomson, "Multilineage Differentiation from Human Embryonic Stem Cell Lines," *Stem Cells* 19 (2001): 193–204.

[19]J. B. Cibelli, K. A. Grant, K. B. Chapman, K. Cunniff, T. Worst, H. Green, S. J. Walker, P. Gutin, L. Vilner, V. Tabar, T. Dominko, J. Kane, P. J. Wettstein, R. P. Lanza, L. Studer, K. E. Vrana, and M. D. West, "Parthenogenetic Stem Cells in Nonhuman Primates," *Science* 295 (2002): 819.

[20]Department of Health and Human Services, *Stem Cells: Scientific Progress and Future Directions* (June 2001): 17. Available at http://stemcells.nih.gov/stemcell/pdfs/fullrptstem.pdf (last accessed December 2003).

[21]Ibid., p. 8.

[22]N. Lumelsky, O. Blondel, P. Laeng, I. Velasco, R. Ravin, and R. McKay, "Differentiation of Embryonic Stem Cells to Insulin-Secreting Structures Similar to Pancreatic Islets," *Science* 292 (2001): 1389–94; H. Yamamoto, G. Quinn, A. Asari, H. Yamanokuchi, T. Teratani, M. Terada, and T. Ochiya, "Differentiation of Embryonic Stem Cells into Hepatocyes: Biological Functions and Therapeutic Application," *Hepatology* 37, no. 5 (2003): 983–93; J.-H. Kim, J. M. Auerbach, J. A. Rodriguez-Gomez, I. Velasco, D. Gavin, N. Lumelsky, S.-H. Lee, J. Nguten, R. Sanchez-Pernaute, K. Bankiewicz, and R. McKay, "Dopamine Neurons Derived from Embryonic Stem Cells Function in an Animal Model of Parkinson's Disease," *Nature* 418 (2002): 50–6.

[23]K. Johkura, L. Cui, A. Suzuki, R. Teng, A. Kamiyoshi, S. Okamura, S. Kubota, X. Zhao, K. Asanuma, Y. Okouchi, N. Ogiwara, Y. Tagawa, and K. Sasaki, "Survival and Function of Mouse Embryonic Stem Cell-Derived Cariomyocytes in Ectopic Transplants," *Cardiovascular Research* 58, no. 2 (2003): 435–43; O. Brustle, K. N. Jones, R. D. Learish, K. Karram, K. Choudhary, O. D. Wiestler, I. D. Duncan, and R. D. G. McKay, "Embryonic Stem Cell-Derived Glial Precursors: A Source of Myelinating Transplants," *Science* 285 (1999): 754–6; L. M. Bjorklund, R. Sanchez-Pernaute, S. Chung, T. Andersson, I. Y. C. Chen, K. S. P. McNaught, A.-L. Brownell, B. G. Jenkins, C. Wahlestedt, K.-S. Kim, and O. Isacson, "Embryonic Stem Cells Develop into Functional Dopaminergic Neurons After Transplantation in a Parkinson Rat Model," *PNAS* 99, no. 4 (2002): 2344–9.

[24]L. Rambhatla, C. P. Chiu, P. Kundu, Y. Peng, and M. K. Carpenter, "Generation of Hepatocyte-like Cells from Human Embryonic Stem Cells," *Cell Transplantation* 12, no. 1 (2003): 1–11; S. Assady, G. Maor, M. Amit, J. Itskovitz-Eldor, K. L. Skorecki, and M. Tzukerman, "Insulin Production by Human Embryonic Stem Cells," *Diabetes* 50, no. 9 (2001): 1691–7.

[25]Watt, " Out of Eden," 1427–30.

[26]National Institutes of Health, "Stem Cells Basics."

[27]M. F. Pittenger, A. M. Mackay, S. C. Beck, R. K. Jaiswal, R. Douglas, J. D. Mosca, M. A. Moorman, D. W. Simonetti, S. Craig, and D. R. Marchak, "Multilineage Potential of Adult Human Mesenchymal Stem Cells," *Science* 284 (1999): 143–7; Y. Jiang, B. N. Jahagirdar, R. L. Reinhardt, R. E. Schwartz, C. D. Kenne, X. R. Ortiz-Gonzalez, M. Reyes, T. Lenvik, T. Lund, M. Blackstad, J. Du, S., Aldrich, A. Lisberg, W. C. Low, D. A. Largaespada, and C. M. Verfaillie, "Pluripotency of Mesenchymal Stem Cells Derived from Adult Marrow," *Nature* 418 (2002): 41–9.

[28]Q.-L. Ying, J. Nichols, E. P. Evans, and A. G. Smith, "Changing potency by spontaneous fusion," *Nature* 416 (2002): 545–8; N. Terada, T. Hamazaki, M. Oka, M. Hokl, D. M. Mastalerz, Y. Nakano, E. M. Meyer, L. Morel, B. E. Petersen, and E. W. Scott, "Bone Marrow Cells Adopt the Phenotype of Other Cells by Spontaneous Cell Fusion," *Nature* 416 (2002): 542–5.

[29]National Institutes of Health, "Stem Cells Basics."

[30]D. Orlic, J. Kajstura, S. Chimenti, I. Jakonluk, S. M. Anderson, B. Li, J. Pickel, R. McKay, B. Nadal-Ginard, D. M. Bodine, A. Lerl, and P. Anversa, "Bone Marrow Cells Regenerate Infracted Myocardium," *Nature* 410 (2001): 701–5; BD. Orlic, J. Kajstura, S. Chimenti, D. M. Bodine, A. Leri, and P. Anversa, "Bone Marrow Stem Cells Regenerate Infracted Myocardium," *Pediatric Transplantation* 7, no. 3, Suppl (2003): 86–8; A. Ianus, G. G. Holz, N. D. Theise, and M. A. Hussain, "In Vivo Derivation of Glucose-Competent Pancreatic Endocrine Cells from Bone Marrow Without Evidence of Cell Fusion," *Journal of Clinical Investigation* 111, no. 6 (2003): 843–50; G. Vassilopoulos, P.-R. Wang, and D. W. Russel, "Transplanted Bone Marrow Regenerates Liver by Cell Fusion," *Nature* 422 (2003): 901–4; X. Wang, H. Willenbring, Y. Akkari, Y. Torimaru, M. Foster, M. Al-Dhalimy, E. Lagasse, M. Finegold, S. Olson, and M. Grompe, "Cell Fusion is the Principal Source of Bone-Marrow-Derived Hepatocytes," *Nature* 422 (2003): 897–901.

[31]Christian Medical Association, "Stem Cell Research: Executive Summary," www.cmdahome. org (go to issues and then stem cells) 2001 (last accessed December 2003); Center for Bioethics and Human Dignity, "On Human Embryos and Stem Cell Research: An Appeal for Legally and Ethically Responsible Science and Public Policy," www.cbhd.org/resources/stemcells/position_statement.htm, 1999 (last accessed December 2003).

[32]Chapman, et al., "Stem Cell Research and Applications," p. 3.

[33]H. H. Meeter, *The Basic Ideas of Calvinism*, 6th ed. (Grand Rapids, MI: Baker Book House, 1990), 15–23.

[34]Wolters, *Creation Regained*, pp. 10–1.

[35]H. R. Niebuhr, *Christ and Culture* (New York: Harper and Row, 1951), 45, 190.

[36]J. Hesslink, *On Being Reformed: Distinctive Characteristics and Common Misunderstandings*, 2d ed. (Grand Rapids, MI: Reformed Church Press [Eerdmans], 1988), 64.

[37]Wolters, *Creation Regained*, p. 11; C. Plantinga, Jr., *Engaging God's World: A Christian Vision of Faith, Learning, and Living* (Grand Rapids, MI: Wm. B. Eerdmans, 2002), chaps. 2–4.

[38]H. Bouma, III, D. Diekema, E. Langerak, T. Rottman, and A. Verhey, *Christian Faith, Health, and Medical Practice* (Grand Rapids, MI: Wm. B. Eerdmans, 1989), 8–9.

[39]Wolters, *Creation Regained*, pp. 35–41.

[40]J. C. Peterson, *Genetic Turning Points: The Ethics of Human Genetic Intervention* (Grand Rapids, MI: Wm. B. Eerdmans, 2001), 80–9.

[41]A. D. Verhey, "Playing God," in *Genetic Ethics: Do the Ends Justify the Genes?* ed, J. F. Kilner, R. D. Pentz, and F. E. Young (Grand Rapids, MI: Wm. B. Eerdmans, 1997), 72.

[42]Plantinga, *Engaging God's World*, p. 54.

[43]Wolters, *Creation Regained*, p. 44.

[44]Ibid., p. 57; Plantinga, *Engaging God's World*, pp. 95–6.

[45]Col. 1:20, NIV; italics added.

[46]Bouma III, et al., *Christian Faith, Health, and Medical Practice*, p. 84.

[47]Monsma, et al., *Responsible Technology: A Christian Perspective*, p. 38.

[48]Bouma III, et al., *Christian Faith, Health, and Medical Practice*, pp. 83–94.

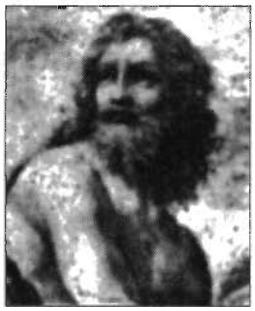
[49]B. R. Reichenbach and V. E. Anderson, *On Behalf of God: A Christian Ethic for Biology*, (Grand Rapids, MI: Wm. B. Eerdmans, 1995), 49–56.

[50]Plantinga, Jr., *Engaging God's World*, p. 33; Reichenbach and Anderson, *On Behalf of God: A Christian Ethic for Biology*. pp. 49–51.

[51]Monsma, et al., *Responsible Technology: A Christian Perspective*, pp. 55–7.

[52]Ibid., pp. 24–36.

[53]T. A. Shannon, "Human embryonic stem cell therapy," *Theological Studies* 62, no. 4 (2001): 811-24.
[54]Monsma, et al., *Responsible Technology: A Christian Perspective*, pp. 49-51.
[55]Sire, *The Universe Next Door*, p. 27-30.
[56]Bouma III, et al., *Christian Faith, Health, and Medical Practice*, pp. 84-7, 90-1; K. L. Vaux, *Health and Medicine in the Reformed Tradition* (New York: Crossroad, 1984), 43-6.
[57]Peterson, *Genetic Turning Points*, pp. 116-27; S. B. Rae, *Brave New Families: Biblical Ethics and Reproductive Technologies* (Grand Rapids, MI: Baker Books, 1996), 95-9.
[58]Peterson, *Genetic Turning Points*, pp. 116-27; Rae, *Brave New Families*, pp. 95-104; Reichenbach and Anderson, *On Behalf of God*, pp. 165-6; D. G. Jones, *Brave New People: Ethical Issues at the Commencement of Life* (Grand Rapids, MI: Wm. B. Eerdmans, 1985), 155-64.
[59]Rae, *Brave New Families*, p. 108; P. Lachine, "The Biotech Temptation," *Christianity Today* 43, no. 8 (1999): 26-7; Christian Medical Association, "Stem Cell Research: Executive Summary"; and Center for Bioethics and Human Dignity, "On Human Embryos."
[60]Peterson, *Genetic Turning Points*, p. 127.
[61]E. C. Hui, *At the Beginning of Life: Dilemmas in Theological Bioethics* (Downers Grove, IN: InterVarsity Press, 2002), 58-61.
[62]Ibid., pp. 63-5.
[63]D. M. Sullivan, "The Conception View of Personhood: A Review," *Ethics and Medicine* 19, no. 1 (2003): 11-34.
[64]Hui, *At the Beginning of Life*, p. 60.
[65]Psalm 139:13, NIV.
[66]Peterson, *Genetic Turning Points*, pp. 130-4.
[67]Bouma III, et al., *Christian Faith, Health, and Medical Practice*, pp. 45-8.
[68]T. Peters, "Embryonic Stem Cells and the Theology of Dignity," in *The Human Embryonic Stem Cell Debate*, pp. 127-39.
[69]Christian Medical Association, "Stem Cell Research: Executive Summary."
[70]Hui, *At the Beginning of Life*, p. 254.
[71]Peters, "Embryonic Stem Cells and the Theology of Dignity," pp. 127-39.
[72]Rae, *Brave New Families*, pp. 104-8.
[73]Bouma III, et al., *Christian Faith, Health, and Medical Practice*, pp. 36-7; Peterson, *Genetic Turning Points*, pp. 113-6; Sullivan, "The Conception View of Personhood," pp. 11-34.
[74]Bouma III, et al., *Christian Faith, Health, and Medical Practice*, pp. 28, 35-6; Rae, *Brave New Families*, pp. 100-4.
[75]Bouma III, et al., *Christian Faith, Health, and Medical Practice*, p. 29.
[76]J. R. Middleton, "The Liberating Image? Interpreting the *Imago Dei* in Context," *Christian Scholars Review* 24, no. 1 (1994): 8-25, p. 12.
[77]Bouma III, et al., *Christian Faith, Health, and Medical Practice*, pp. 29-34.
[78]Ibid., p. 32.
[79]Peterson, *Genetic Turning Points*, pp. 69-70.
[80]Plantinga, Jr. *Engaging God's World*, pp. 30-4.
[81]Bouma III, et al., *Christian Faith, Health, and Medical Practice*, pp. 33-4; Peterson, *Genetic Turning Points*, p. 69.
[82]Bouma III, et al., *Christian Faith, Health, and Medical Practice*, pp. 45-8; Reichenback and Anderson, *On Behalf of God*, pp. 112-7; Jones, *Brave New People*, pp. 156-7; R. N. Wennberg, *Life in the Balance: Exploring the Abortion Controversy* (Grand Rapids, MI: Wm. B. Eerdmans, 1985), 112-23.
[83]Hui, *At the Beginning of Life*, pp. 322-8.
[84]Bouma III, et al., *Christian Faith, Health, and Medical Practice*, p. 208; Jones, *Brave New People*, pp. 161-4.
[85]H. Ridderbos, *The Coming of the Kindgdom* (Philadelphia: Presbyterian and Reformed Publishing Company, 1962), 61; J. Hesslink, *On Being Reformed: Distinctive Characteristics and Common Misunderstandings*, 2d ed. (Grand Rapids, MI: Reformed Church Press [Eerdmans], 1988), 65.
[86]I. C. Rottenberg, *The Promise and the Presence: Toward a Theology of the Kingdom of God* (Grand Rapids, MI: Wm. B. Eerdmans, 1980), 48-9.
[87]Hesslink, *On Being Reformed*, p. 65.
[88]Wolters, *Creation Regained*, p. 64.
[89]J. D. Bratt, *Abraham Kuyper: A Centennial Reader* (Grand Rapids, MI: Wm. B. Eerdmans, 1988), 488.
[90]Wolters, *Creation Regained*, p. 67.
[91]Rottenberg, *The Promise and the Presence*, pp. 83, 93.
[92]H. A. Snyder, *A Kingdom Manifesto* (Downers Grove, IL: Inter Varsity Press, 1985), 51-4; P. Toon, *God's Kingdom for Today* (Westchester: Cornerstone Books, 1980), 106,108; Meeter, *The Basic Ideas of Calvinism*, pp. 189-90.
[93]Snyder, *A Kingdom Manifesto*, pp. 54-6.
[94]Bouma III, et al., *Christian Faith, Health, and Medical Practice*, 91-3.
[95]A. Kuyper, *Lectures on Calvinism.* (Grand Rapids, MI: Wm. B. Eerdmans, 1953), 78-9.
[96]Bouma III, et al., *Christian Faith, Health, and Medical Practice*, pp. 16-26.
[97]Wennberg, *Life in the Balance*, pp. 122-3.
[98]Vaux, *Health and Medicine in the Reformed Tradition*, pp. 96-100.
[99]Bouma III, et al., *Christian Faith, Health, and Medical Practice*, pp. 226-33; K. L. Vaux, *Health and Medicine in the Reformed Tradition*, pp. 99-100; Wennberg, *Life in the Balance: Exploring the Abortion Controversy*, pp. 169-73; Hui, *At the Beginning of Life*, pp. 349-52.
[100]K. Lebacqz, "On the Elusive Nature of Respect," in *The Human Embryonic Stem Cell Debate*, p. 159.
[101]G. Meilaender, "Some Protestant Reflections," in *The Human Embryonic Stem Cell Debate: Science, Ethics and Public Policy*, p. 146.
[102]Lebacqz, "On the Elusive Nature of Respect," pp. 158-60.
[103]Bouma III, et al., *Christian Faith, Health, and Medical Practice* pp. 226-33; Vaux, *Health and Medicine in the Reformed Tradition*, pp. 99-100.
[104]Outka, "The Ethics of Stem Cell Research," pp. 175-213.
[105]Rae, *Brave New Families*, pp. 130-40.
[106]Christian Century, "Embryos and Us," *Christian Century* 118, no. 22 (2001): 5-6; Shannon, "Human Embryonic Stem Cell Therapy," pp. 811-24.
[107]C. B. Cohen, "Leaps and Boundaries: Expanding Oversight of Human Stem Cell Research," in *The Human Embryonic Stem Cell Debate*, pp. 212-4.
[108]T. A. Shannon, "From the Micro to the Macro," in *The Human Embryonic Stem Cell Debate*, pp. 180-3.
[109]L. Zoloth, "Jordan's Banks: A View from the First Years of Human Embryonic Stem Cell Research," in *The Human Embryonic Stem Cell Debate*, pp. 237-8.
[110]S. Holland, "Beyond the Embryo: A Feminist Appraisal of the Embryonic Stem Cell Debate," in *The Human Embryonic Stem Cell Debate*, pp. 83-5.
[111]Shannon, "Human Embryonic Stem Cell Therapy," pp. 811-24.
[112]Rottenberg, *The Promise and the Presence*, pp. 98-9; Verhey, "Playing God," p. 70.
[113]Meeter, *The Basic Ideas of Calvinism*, p. 102; R. S. Wallace *Calvin, Geneva, and the Reformation* (Grand Rapids, MI: Baker Book House, 1988), 116.
[114]N. Gibbs and M. Duffy, "The Stem Cell Decision," *Time* (August 20, 2001): 14-6; J. Kluger and M. D. Lemonick, "And What About the Science?" *Time* (August 20, 2001): 20-1.
[115]Zoloth, "Jordan's Banks: A View From the First Years of Human Embryonic Stem Cell Research," pp. 225-8.
[116]Bouma III, et al., *Christian Faith, Health, and Medical Practice*, pp.162-4; M. R. McClean, "Stem Cells: Shaping the Future in Public Policy" in *The Human Embryonic Stem Cell Debate*, 197-207.



Establishing Adam: Recent Evidences for a Late-Date Adam (AMH@100,000 BP)

David L. Wilcox

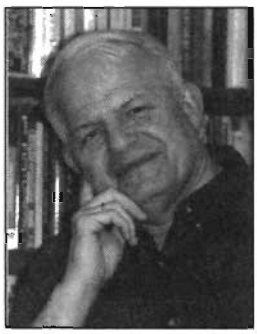
The appearance of modern humans continues to be a major controversy in paleoanthropology. The issues include genetic, anatomical, and cultural matters. For the Christian, there are also important theological issues, leading to various estimations of the timing of "Eden" ranging from two million years ago to six thousand years ago.[1] Several interesting papers related to this issue were published last year. This communication notes several of these and suggests a biological mechanism possibly involved in the process by which God created humanity.

The controversy centers on the idea that the modern human skeletal form first appeared around 100,000 to 160,000 years ago in northeast Africa. Does this represent a unique cusp of history, or is it just a standard spot on the long path from ape to human? (Or, since human and chimpanzee share at least 95% of their genes—from proto-chimp to professor.)[2] The primary evidence is genetic.

Genetic trees depend on mutation and drift, processes that are highly sensitive to the effective population size (Ne). It is instructive to compare the Ne's of modern hominoids. Estimates for the long term (Pleistocene) effective population size of *Homo sapiens* are in the range of eight to ten thousand individuals.[3] In contrast, high gene diversity in the five extant ape species indicates they all have Ne's that are four to nine times greater.[4] Apparently the common ancestor of humans and chimps also had a larger Ne.[5] In fact, gene diversity within the two chimp species (*Pan*) is almost as great as the genetic distance between them.[6] Since the two chimp species diverged around 1.8 million years ago, populations with Ne's of around 40,000/80,000 (like the chimps) retain one to two million years of mutational (gene sequence) diversity.[7]

One and one-half million years ago saw *Homo erectus* (or *ergaster*) scattered from Kenya, to Dmanisi in Georgia, and on to Indonesia.[8] Thus, genus *Homo* has been spread over a much wider area than genus *Pan* for the last two million years. Subdivided populations have much larger Ne's, retaining far more genetic diversity.[9] Also, the human species (and its Ne) obviously is currently much larger than that of any ape species. If we were descended from all of those ancient scattered populations of archaic hominids, we should have retained most of their ancient genetic diversity—and added all of the new mutations of the last two million years. Thus we should be far more genetically diverse than genus *Pan*, not less.

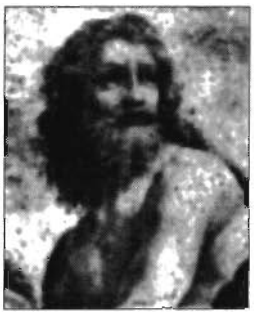
Is it possible that humans are unusual, demographically speaking? Did we move around so much that we "pruned" our worldwide genetic tree to the point that our Ne looks much smaller than it really is? Recent reports of relic African tribes (the Hadzabe, the Sandawe, and the !Kung) indicate otherwise.[10] These ancient tribes have almost as much genetic diversity in one valley as the rest of the entire human race, i.e., they have retained most of the diversity generated since the time of their founding. So, ancient isolated human populations can and do maintain high levels of genetic diversity.



David Wilcox

The controversy [of the appearance of modern humans] centers on the idea that the modern human skeletal form first appeared around 100,000 to 160,000 years ago in northeast Africa.

David Wilcox *is professor of biology at Eastern University, where he has taught since 1976. David was stimulated by a conference on Christian graduate work to study evolutionary mechanisms, leading to a Ph.D. in population genetics from Penn State. He has contributed through several publications on theoretical aspects of Christianity and evolution. David is a fellow of the ASA and served on the Executive Council, 1993–1997. He can be reached at: dwilcox@eastern.edu*



Communication

Establishing Adam: Recent Evidences for a Late-Date Adam (AMH@100,000 BP)

All primate species but us have two chromosomes that are homologous to the two arms of our second chromosome. Human chromosome two clearly was created by fusing two ancestral sub-metacentric chromosomes. ... That fusion chromosome, at first existing in only a single organism, has become the established human karyotype.

The relatively low overall human genetic diversity must mean that we grew numerous recently (and relatively rapidly) from some single small population (termed "founder effect").[11]

Having a smaller Ne than *Pan* is particularly remarkable, since apparently the chimp species also went through a sharp reduction in numbers—an AIDS epidemic about two million years ago.[12] The human lineage therefore must have experienced an even sharper reduction in population size than that caused by an uncontrolled AIDS epidemic.

The timing of this bottleneck is indicated by many studies (for example, the recent FOXP2 study) that suggest such genetic diversities stem from 100,000 to 200,000 years ago.[13] But is such an event biologically reasonable? There is indeed a smoking gun, clear evidence pointing to a necessary bottleneck. All primate species but us have two chromosomes that are homologous to the two arms of our second chromosome. Human chromosome two clearly was created by fusing two ancestral sub-metacentric chromosomes.[14] The fusion happened between the telomeres of the short arms (each about 30 map units in length), producing a fusion chromosome with two centromeres 60 map units apart. Relic telomeric and centromeric sequences still exist in the corresponding sites of the human chromosome. That fusion chromosome, at first existing in only a single organism, has become the established human karyotype.

Hominids with the fusion chromosome would have had a profound reduction in fertility due to the formation of abnormal karyotypes during meosis (caused by nondisjunction and chromosome breakage). When one of the centromeres became deactivated, fertility would have improved, but would still have been below normal in "cross-breeds." Nondisjunction would reduce gamete production, and crossovers with the short arm of an ancestral-type chromosome could reactivate the relic centromere. Only about one third of the gametes formed by such "cross-breeds" would produce viable offspring.

In a large population, natural selection would quickly get rid of such a fusion chromosome. It could only replace the original karyotype in a small isolated population where genetic drift instead might weed out the ancestral form within a very few generations. When a new karyotype becomes established in such an isolated population, it will have full fertility, but only as long as breeding stays within the group. Any mating that takes place with individuals having the ancestral karyotype (in this case, all other living hominids on the planet) would have sharply reduced fertility. This must have happened to the human lineage. (This is not the only evidence, of course. Such an abrupt bottleneck might also be implicated by the excess of 313 SNP's that seem to be derived sequences in the human [different than the chimp sequence], and yet show no signal of positive selection.)[15]

In most mammals, this strong fertility barrier will drive the quick establishment of pre-reproductive isolating mechanisms—i.e., recognizable identification signals such as changes in physical appearance and behavior. Apply this process to hominids.[16] A recent report identifies two unique and non-overlapping features of the modern skull vis à vis the archaic skull—facial retraction and neurocranial globularity.[17] ("Modern" includes the early modern skulls of Skhul and Qafzeh in Israel). Add in the modern pointed chin. All three change the shape of the face, the primary recognition site for primate communication. Facial change would not be driven by brain evolution—the archaic hominids of the period already had large brains—nor was it a product of a lifestyle. Analyses of growth in Neanderthal neonates indicate that such unique differences in skulls were apparent from birth.[18] The biological explanation for facial change is species recognition. Think of the striking differences between the faces of many monkey species.

Where would this happen? Biologically speaking, most new species seem to form as isolated populations on the edge of a "parental" species (peripatric speciation). Such an isolate would be necessary to allow fixation of the fusion chromosome and the various genetic shifts involved in the making of modern humans. As an alternative model, Eller has suggested a large widespread subdivided population, with continuous extinction and recolonization, thus keeping the effective population size small.[19] However, though such a "winner-takes-all"

evolutionary lottery might reduce population size by catastrophes, or by attacks on neighboring populations, it simply would have the effect of isolating a single population. The usual model seems more reasonable.

Biologically speaking, most new species seem to form as isolated populations on the edge of a "parental" species ... Such an isolate would be necessary to allow fixation of the fusion chromosome and the various genetic shifts involved in the making of modern humans.

Where was the location of the "parental" population? The oldest evidence of modern humans points to Ethiopia. A modern specimen found at the Omo River is dated at 130,000 years ago, and three modern skulls dated at 160,000 years ago have been found in the Middle Awash area.[20] However, since peripatric speciation requires significant isolation, the middle of the African savannah seems unlikely. A peripheral isolate plausibly could have been established somewhere on the Arabian peninsula, on the northeastern border of the African savannah—perhaps even in the fertile valley which existed where the Persian Gulf presently flows. The incipient human species could easily return to northeast Africa, spinning off bands of ancient wanderers, working their way down the endless savannas of East Africa to leave their bones at the Klaises River mouth in South Africa.[21]

Species also are distinguished from each other by behavior. No species has ever had as much behavioral flexibility as the human, of course. But when and why did that flexibility begin? Perhaps this too reflects the need to generate species recognition signals. Humans can obtain a change in appearance a lot faster by applying ocher than through changes in melanin density! And early moderns used it.[22] (So do late moderns, but our palette has grown.)

The argument has frequently been made that archaic hominids showed behaviors that indicate they were fully human. For instance, the presence of ancient tools on the island of Flores is taken to mean they built boats.[23] But, a recent report of an Indian "tool factory" of one million years ago indicates those stone tools were simply made, used, and tossed away—hardly a modern pattern of thoughtful provision.[24] Since the channels of the Sunda shelf at Glacial maximum would have been at most only a few miles wide, it seems more likely that the transportation was rafts of flood vegetation—or even swimming. That is a far cry from the ninety kilometers of open ocean to be crossed to reach the Sahel shelf of greater Australia.

Were Neanderthals fully human? Certainly they had brains as big as modern people, but we do not know exactly how they used them. Did they behave in ways we would recognize, or are we only seeing them in a foggy mirror? Are we really looking for ourselves rather than at their reality? The difficulty of human preconceptions in evaluating ambiguous evidence is illustrated in a recent paper on Neanderthal adaptations for cold climate.[25] The authors propose as possible adaptations—brown adipose, heat shock proteins, growth factors, altered calcium metabolism, and typical physiological shifts, though they think subcutaneous fat (blubber) too difficult and too expensive to maintain. However, it does not seem to occur to them that a primate with a 500,000-year history of glacial adaptation would be likely to have the energetically cheap adaptation to cold of the Japanese macaque—a built in fur coat. In any other mammal lineage, it would be a foregone conclusion. The obvious conclusion should be that modern arctic zone humans have bare skins only because they arrived in the Arctic already able to borrow coats from the reindeer.

Of course, hairy or not, this is not to say that the Neanderthals were necessarily without wisdom and beauty. In theory, they could have been our cultural equals.[26] Perhaps they were the first choral singers and superb birch bark artists. But they left no indisputable signs that they had such capacities. It is true that they sometimes cared for their disabled and possibly buried some of their dead. But elephants seem to mourn their dead. And caring for the disabled is typical behavior for pack predators such as wolves. In fact, evidence of healed disabling wounds is used to argue for such pack behavior in saber-tooth cats and tyrannosaurs.

However, it is the genetic evidence that is compelling. Four Neanderthal mtDNA sequences cluster neatly together at a common distance from modern human sequences, corresponding to a common root of 500,000 years ago.[27] Cro-Magnon mtDNA groups with modern Europeans, not Neanderthals.[28] There have been some critiques,[29] but so far the results still seem convincing. Further, ongoing evaluation of what seemed to be a hybrid child (Spain) points away from that conclusion.[30] Skeletal evidence of jaw structure indicates that Neanderthals were a specialized species which is not ancestral to ours.[31] And even if it were demonstrated that Neanderthal genomes group with those of modern humans, it would not change the genetic comparison with the various ape species.[32] Humans are still genetic paupers.

Communication

Establishing Adam: Recent Evidences for a Late-Date Adam (AMH@100,000 BP)

... the FOXP2 gene, a transcription factor involved with the face and jaw movements necessary for speech ... shows ... two [sequence changes] between chimp and humans ...The probability is 95% that divergence in this gene within the human species took place in under 120,000 years.

Not that ancient DNA has all of the answers. The complexities and pitfalls of such analyses are illustrated by a report that the human nuclear genome has more than one thousand sequences (including later duplications) homologous to sections of mtDNA.[33] This report is particularly significant, because the uniquely distant mtDNA sequence reportedly extracted from a Lake Mungo skeleton in Australia is close to some of these insertions.[34] This suggests that it is likely to be a bit of modern nuclear DNA picked out for the PCR by mtDNA primers rather than a sign of ancient admixture.[35]

Can genetic studies shed light on what happened as we became human? How significant is the 95% sequence similarity between human and chimp genomes? A broad survey of gene expression in various human tissues (for transcriptomes and protein expression patterns) shows pronounced changes in the gene expression pattern only in the brain.[36] We can conclude that these are not new genes, but new patterns of expression, new genetic blueprints made from the old clay. And too, there is evidence that endogenous retroviruses may be implicated in sudden genomic reorganizations in the human lineage producing "punctuation" events, such as the appearance of modern traits.[37]

Certain specific genes, however, do seem to have been modified. For instance, the membrane protein sialic acid is not made in humans, a deactivation event due to an ALU shift thought to have occurred around two million years ago.[38] Genes such as apoE are turned on—or modified significantly.[39] The most interesting is the FOXP2 gene, a transcription factor involved with the face and jaw movements necessary for speech. This highly conserved gene shows three sequence changes between mouse and humans. Two of these changes are between chimp and humans, only one change is between mouse and chimp. The FOXP2 gene shows a selective sweep—the value of Tajima's D statistic for FOXP2 has the most significant value of any human gene (save one). The probability is 95% that divergence in this gene within the human species took place in under 120,000 years. Further, the differences between the human and all other forms of the gene are functional differences—the human protein is phosphorylated.[40] Such changes alter the activities of entire genetic networks. So speech too probably began with a bang—or perhaps with a click. (Click languages are still spoken by the most ancient tribes—the Hadzabe and !Kung.)[41]

If genetic and skeletal evidences point to a common era, how about culture in that era? The early (100,000 years ago) modern forms at Skhul and Qafzeh caves on Mount Carmel apparently used artifacts which were much like those of the Neanderthals who used the neighboring Tabun cave. However, there is some new evidence about them. The hand bones of early moderns have articular surfaces indicating that their owners were engaged in modern manipulative behaviors.[42] This conclusion is reinforced by several reports from central Africa indicating the use of ocher and the manufacture of incised stones, beads, micro-liths (compound tools) and carved bone harpoons dating to 90,000 years ago.[43] This evidence is consistent with the appearance of folks who thought like us at around 150,000 years. Around those early dates we see modern morphology, glimmers of complex thought, genetic roots, etc. Shall we place Adam there? That is probably a theological decision rather than a scientific one.

It is true that the culture implied in the Genesis narrative (Gen 4: 2–4, 19–22) did not exist 160,000 years ago. It, in fact, did not exist anywhere until about 11,000 years ago.[44] Further, in much of the world (Australia, for instance) culture has never reached that level. Even where it did arrive, it was preceded by vast stretches of time in which the hunting and gathering ancestors of the farmers used only wood, bone, and stone. Does Genesis describe Adam's culture, or the author's understanding of culture?

Does proposing a mechanism of creation imply that Nature rather than God created us? Only if God is an absentee landlord. Would he use such methods? If he governs nature (as in Psalm 104), obviously he uses nature every day. Unless God made Adam with the appearance of very specific "pseudo-ancestors," hominid descent was involved in his creation. This leaves the theological problem, of course. Is Adam unique? Do we have souls? Surely God's governing of nature does not preclude his placing a soul within a creature that he had

prepared for it by using natural forces. At some point was Adam the only human?[45] The mechanism of human origins is not "business as usual" in the New Species shop. There is evidence of a sharp bottleneck. All humans must be descended from that hominid with the chromosomal (#2) fusion. But there are still difficulties in fitting Adam to all of the data. At this point, it does not look possible to make the immunological evidence fit a single human pair. We have too many alleles in the HLA immune system.[46] Rather, it looks like we all descended from a small contemporary group of that hominid's "clan." Could Adam have been placed in the garden to sin or swim as a representative of his "clan"? Perhaps.

Since all truth is one and all truth is God's truth, all the puzzle pieces can fit together. Somehow. I have done my best. Dump the box for yourself, but don't lose any of the pieces! ✦

Notes

[1]J. A. McIntyre, "The Historical Adam," *Perspectives on Science and Christian Faith* 54, no. 3 (Sept. 2002): 150–7; and G. R. Morton, "Language at the Dawn of Humanity," *Perspectives on Science and Christian Faith* 54, no. 3 (Sept. 2002): 193–4.

[2]R. J. Britten, "Divergence Between Samples of Chimpanzee and Human DNA Sequences Is 5%, Counting Indels," *Proceedings of the National Academy of Sciences USA* 99, no. 21 (Oct 15, 2002): 13633–5; and E. Eller, "Population Extinction and Recolonization in Human Demographic History," *Mathematical Bioscience* 177–8 (May–Jun 2002): 1–10.

[3]F. C. Chen, E. J. Vallender, H. Wang, C. S. Tzeng and W. H. Li, "Genomic Divergence Between Human and Chimpanzee Estimated from Large-Scale Alignments of Genomic Sequences," *Journal of Heredity* 92, no. 6 (Nov–Dec 2001): 481–9; and E. Zietkiewicz, V. Yotova, M. Jarnik, M. Korab-Laskowska, K. K. Kidd, D. Modiano, R. Scozzari, M. Stoneking, S. Tishkoff, M. Batzer and D. Labuda, "Genetic Structure of the Ancestral Population of Modern Humans," *Journal of Molecular Evolution* 47, no. 2 (Aug 1998): 146–55.

[4]I. Ebersberger, D. Metzler, C. Schwarz and S. Paabo, "Genomewide Comparison of DNA Sequences Between Humans and Chimpanzees," *American Journal of Human Genetics* 70, no. 6 (Jun 2002): 1490–7; P. Gagneux, C. Wills, U. Gerloff, D. Tautz, P. A. Morin, C. Boesch, B. Fruth, G. Hohmann, O. A. Ryder and S. Woodruff, "Mitochondrial Sequences Show Diverse Evolutionary Histories of African Hominoids," *Proceedings of the National Academy of Sciences USA* 96, no. 9 (Apr 27 1999): 5077–82; and A. C. Stone, R. C. Griffiths, S. L. Zegura and M. F. Hammer, "High Levels of Y-chromosome Nucleotide Diversity in the Genus *Pan*," *Proceedings of the National Academy of Sciences USA* 99, no. 1 (Jan 8 2002): 43–8.

[5]M. I. Jensen-Seaman, A. S. Deinard and K. K. Kidd, "Modern African Ape Populations As Genetic and Demographic Models of the Last Common Ancestor of Humans, Chimpanzees, and Gorillas," *Journal of Heredity* 92, no. 6 (Nov–Dec 2001): 475–80; and E. Zietkiewicz, et al., "Genetic Structure of the Ancestral Population of Modern Humans."

[6]A. C. Stone, et al., "High Levels of Y-Chromosome Nucleotide Diversity in the Genus *Pan*."

[7]N. G. de Groot, N. Otting, G. G. Doxiadis, S. S. Balla-Jhagjhoorsingh, J. L. Heeney, J. J. van Rood, P. Gagneux and R. E. Bontrop, "Evidence for an Ancient Selective Sweep in the MHC Class I Gene Repertoire of Chimpanzees," *Proceedings of the National Academy of Sciences USA* 99, no. 18 (Sep 3 2002): 11748–53; and A. C. Stone, et al., "High Levels of Y-Chromosome Nucleotide Diversity in the Genus *Pan*."

[8]A. Vekua, D. Lordkipanidze, G. P. Rightmire, J. Agusti, R. Ferring, G. Maisuradze, A. Mouskhelishvili, M. Nioradze, M. P. De Leon, M. Tappen, M. Tvalchrelidze and C. Zollikofer, "A New Skull of Early Homo from Dmanisi, Georgia," *Science* 297, no. 5578 (Jul 5 2002): 85–9.

[9]V. Laporte and B. Charlesworth, "Effective Population Size and Population Subdivision in Demographically Structured Populations," *Genetics* 162, no. 1 (Sep 2002): 501–19.

[10]M. K. Gonder, H. Mortensen, J. B. Hirbo, J. Mountain and S. A. Tishkoff, "Demographic History of Khoisan Speakers of Tanzania Inferred from mtDNA Control Region Sequences," The American Society of Human Genetics (2002); www.ashg.org/genetics/ashg/ashg02search.html; and A. Knight, P. A. Underhill, H. M. Mortensen, L. A. Zhivotovsky, A. A. Lin, B. M. Henn, D. Louis, M. Ruhlen and J. L. Mountain, "African Y Chromosome and mtDNA Divergence Provides Insight into the History of Click Languages," *Current Biology* 13, no. 8 (Apr 15 2003): 705.

[11]E. Zietkiewicz, et al., "Genetic Structure of the Ancestral Population of Modern Humans."

[12]de Groot, et al., "Evidence for an Ancient Selective Sweep in the MHC Class I Gene Repertoire of Chimpanzees."

[13]W. Enard, M. Przeworski, S. E. Fisher, C. S. Lai, V. Wiebe, T. Kitano, A. P. Monaco and S. Paabo, "Molecular Evolution of FOXP2, A Gene Involved in Speech and Language," *Nature* 418, no. 6900 (2002 Aug 22): 869–72; and B. Sykes, *The Seven Daughters of Eve* (New York: W.W. Norton Co, 2001).

[14]G. Finlay, "*Homo divinus:* The Ape that Bears God's Image," *Science and Christian Belief* 15, no. 1 (2003): 17–40; J. W. Ido, A. Baldini, R. A. Wells, D. C. Ward and S. T. Reeders, "FRA2B Is Distinct from Inverted Telomere Repeat Arrays at 2q13," *Genomics* 12, no. 4 (1992 Apr): 833–5; and J. W. Ido, A. Baldini, D. C. Ward, S. T. Reeders and R. A. Wells, "Origin of Human Chromosome 2: An Ancestral Telomere-Telomere Fusion," *Proceedings of the National Academy of Sciences USA* 88, no. 20 (1991 Oct 15): 9051–5.

[15]J. A. Schneider, A. E. Anastasio, Y. Morozov, T. S. Kalbfleisch, C. D. Brain, J. L. Vanden-Eng, M. S. Pungliya, R. Jiang, C. Xu, R. S. Judson and J. C. Stephens, "Non-neutral Evolution Revealed by Comparison of Gene-Based DNA Sequence Diversity in Humans and Chimpanzees," The American Society of Human Genetics (2002): www.ashg.org/genetics/ashg/ashg02search.html

[16]C. J. Jolly, "A Proper Study for Mankind: Analogies from the Papionin Monkeys and Their Implications for Human Evolution," *American Journal of Physical Anthropology* Suppl 33 (2001): 177–204.

[17]D. E. Lieberman, B. M. McBratney and G. Krovitz "The Evolution and Development of Cranial Form in *Homo sapiens*," *Proceedings of the National Academy of Sciences USA* 99, no. 3 (2002 Feb 5):1134–9.

[18]B. Maureille, "Anthropology: A Lost Neanderthal Neonate Found," *Nature* 419, no. 6902 (2002 Sep 5): 33–4; M. S. Ponce de Leon and C. P. Zollikofer, "Neanderthal Cranial Ontogeny and Its Implications for Late Hominid Diversity," *Nature* 412, no. 6846 (2001 Aug 2): 534–8; and R. Rogers-Ackermann and G. E. Krovitz, "Common Patterns of Facial Ontogeny in the Hominid Lineage," *Anatomical Record* 269, no. 3 (2002 Jun 15): 142–7.

[19]E. Eller, "Population Extinction and Recolonization in Human Demographic History," *Mathematical Bioscience* 177–178 (2002 May–Jun): 1–10.

[20]J. D. Clark, Y. Beyene, G. WoldeGabriel, W. K. Hart, P. R. Renne, H. Gilbert, A. Defleur, G. Suwa, S. Katoh, K. R. Ludwig, J. R. Boisserie, B. Asfaw, and T. D. White, "Stratigraphic, Chronological and Behavioural Contexts of Pleistocene *Homo sapiens* from Middle Awash, Ethiopia," *Nature* 423 (2003 June 12): 747–52; and T. D. White, B. Asfaw, D. DeGusta, H. Gilbert, G. D. Richards , G. Suwa, and F. C. Howell, "Pleistocene *Homo sapiens* from Middle Awash, Ethiopia," *Nature* 423 (2003 June 12): 742–7.

[21]C. S. Henshilwood, F. d'Errico, R. Yates, Z. Jacobs, C. Tribolo, G. A. Duller, N. Mercier, J. C. Sealy, H. Valladas, I. Watts and A. G. Wintle, "Emergence of Modern Human Behavior: Middle Stone Age Engravings from South Africa." *Science* 295, no. 5558 (2002 Feb 15): 1278–80; and C. S. Henshilwood, F. d'Errico, C. W. Marean, R. G. Milo and R. Yates, "An early Bone Tool Industry from the

Middle Stone Age at Blombos Cave, South Africa: Implications for the Origins of Modern Human Behaviour, Symbolism and Language," *Journal of Human Evolution* 41, no. 6 (2001 Dec): 631–78.

[22]Henshilwood, et al., "Emergence of Modern Human Behavior."

[23]Morton, "Language at the Dawn of Humanity."

[24]H. Briggs, "Human Ancestors 'Dogy at DIY,'" Report, British Association Science Festival, Leichester, *BBC NEWS* (2002 Sept 12).

[25]A. T. Steegmann Jr., F. J. Cerny and T. W. Holliday, "Neanderthal Cold Adaptation: Physiological and Energetic Factors," *American Journal of Human Biology* 14, no. 5 (2002 Sep–Oct): 566–83.

[26]Morton, "Language at the Dawn of Humanity"; M. A. Schillaci and J. W. Froehlich, "Nonhuman Primate Hybridization and the Taxonomic Status of Neanderthals," *American Journal of Physical Anthropology* 115, no. 2 (2001 Jun): 157–66; and R. W. Schmitz, D. Serre, G. Bonani, S. Feine, F. Hillgruber, H. Krainitzki, S. Paabo and F. H. Smith, "The Neanderthal Type Site Revisited: Interdisciplinary Investigations of Skeletal Remains from the Neander Valley, Germany." *Proceedings of the National Academy of Sciences USA* 99, no. 20 (2002 Oct 1): 13342–7.

[27]Ponce de Leon and Zollikofer, "Neanderthal Cranial Ontogeny and Its Implications for Late Hominid Diversity."

[28]D. Caramelli, C. Lalueza-Fox, C. Vernesi, M. Lari, A. Casoli, F. Mallegni, B. Chiarelli, I. Dupanloup, J. Bertranpetit, G. Barbujani, and G. Bertorelle, "Evidence for a Genetic Discontinuity Between Neanderthals and 24,000-year-old Anatomically Modern Europeans," *Proceedings of the National Academy of Sciences USA* 100, no. 11 (2003 May 27): 6593–7.

[29]G. Gutierrez, D. Sanchez and A. Marin, "A Re-analysis of the Ancient Mitochondrial DNA Sequences Recovered from Neanderthal Bones," *Molecular and Biological Evolution* 19, no. 8 (2002 Aug): 1359–66.

[30]J. Arsuaga, V. Villaverde, R. Quam, A. Gracia, C. Lorenzo, I. Martinez and J. Carretero, "The Gravettian Occipital Bone from the Site of Malladetes (Barx, Valencia, Spain)," *Journal of Human Evolution* 43, no. 3 (2002 Sep): 381.

[31]Ponce de Leon and Zollikofer, "Neanderthal Cranial Ontogeny and Its Implications for Late Hominid Diversity"; Y. Rak, A. Ginzburg and E. Geffen, "Does Homo Neanderthalensis Play a Role in Modern Human Ancestry? The Mandibular Evidence," *American Journal of Physical Anthropology* 119, no. 3 (2002 Nov): 199–204; and Rogers-Ackermann and Krovitz, "Common Patterns of Facial Ontogeny in the Hominid Lineage."

[32]Jolly, "A Proper Study for Mankind."

[33]Y. Tourmen, O. Baris, P. Dessen, C. Jacques, Y. Malthiery and P. Reynier, "Structure and Chromosomal Distribution of Human Mitochondrial Pseudogenes," *Genomics* 80, no. 1 (2002 Jul): 71–7.

[34]G. J. Adcock, E. S. Dennis, S. Easteal, G. A. Huttley, L. S. Jermiin, W. J. Peacock, and A. Thorne, "Mitochondrial DNA Sequences in Ancient Australians: Implications for Modern Human Origins," *Proceedings of the National Academy of Sciences USA* 98, no. 2 (2001 Jan 16): 537–42.

[35]A. Cooper, A. Rambaut, V. Macaulay, E. Willerslev, A. J. Hansen and C. Stringer, "Human Origins and Ancient Human DNA," *Science* 292, no. 5522 (2001 Jun 1): 1655–6.

[36]W. Enard, P. Khaitovich, J. Klose, S. Zollner, F. Heissig, P. Giavalisco, K. Nieselt-Struwe, E. Muchmore, A. Varki, R. Ravid, G. M. Doxiadis, R. E. Bontrop and S. Paabo, "Intra- and Interspecific Variation in Primate Gene Expression Patterns," *Science* 296, no. 5566 (2002 Apr 12): 340–3.

[37]I. Ovchinnikov, A. Rubin and G. D. Swergold, "Tracing the Lines of Human Evolution," *Proceedings of the National Academy of Sciences USA* 99, no. 16 (2002 Aug 6): 10522–7.

[38]H. H. Chou, T. Hayakawa, S. Diaz, M. Krings, E. Indriati, M. Leakey, S. Paabo, Y. Satta, N. Takahata and A. Varki, "Inactivation of CMP-N-acetylneuraminic Acid Hydroxylase Occurred Prior to Brain Expansion During Human Evolution," *Proceedings of the National Academy of Sciences USA* 99, no. 18 (2002 Sep 3): 11736–41.

[39]H. S. Kaplan and A. J. Robson, "The Emergence of Humans: The Coevolution of Intelligence and Longevity with Intergenerational Transfers," *Proceedings of the National Academy of Sciences USA* 99, no. 15 (2002 Jul 23): 10221–6.

[40]M. Balter, "Language Evolution: 'Speech Gene' Tied to Modern Humans," *Science* 297, no. 5584 (2002 Aug 16): 1105; H. A. Bruce and R. L. Margolis, "FOXP2: Novel Exons, Splice Variants, and CAG Repeat Length Stability," *Human Genetics* 111, no. 2 (2002 Aug: 136–44; W. Enard, M. Przeworski, S. E. Fisher, C. S. Lai, V. Wiebe, T. Kitano, A. P. Monaco and S. Paabo, "Molecular Evolution of FOXP2, A Gene Involved in Speech and Language," *Nature* 418, no. 6900 (2002 Aug 22): 869–72; and C. S. Lai, S. E. Fisher, J. A. Hurst, F. Vargha-Khadem and A. P. Monaco, "A Forkhead-Domain Gene Is Mutated in a Severe Speech and Language Disorder," *Nature* 413, no. 6855 (2001 Oct 4): 519–23.

[41]A. Knight, P. A. Underhill, H. M. Mortensen, L. A. Zhivotovsky, A. A. Lin, B. M. Henn, D. Louis, M. Ruhlen and J. L. Mountain, "African Y Chromosome and mtDNA Divergence Provides Insight into the History of Click Languages," *Current Biology* 13, no. 8 (2003 Apr 15): 705.

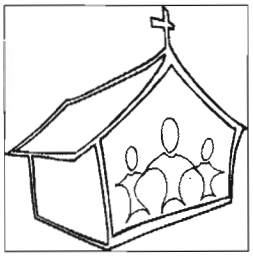
[42]W. A. Niewoehner, "Behavioral Inferences from the Skhul/Qafzeh Early Modern Human Hand Remains," *Proceedings of the National Academy of Sciences USA* 98, no. 6 (2001 Mar 13): 2979–84.

[43]Henshilwood, et al., "Emergence of Modern Human Behavior"; and Henshilwood, et al., "An Early Bone Tool Industry from the Middle Stone Age at Blombos Cave, South Africa."

[44]J. Diamond and P. Bellwood, "Farmers and Their Languages: The First Expansions," *Science* 300 (2003 Apr 25): 597–603.

[45]J. A. McIntyre, "The Historical Adam."

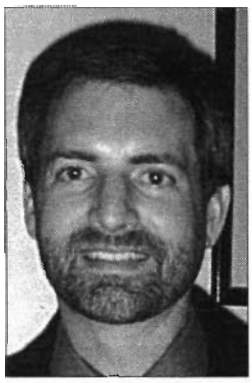
[46]de Groot, et al., "Evidence for an Ancient Selective Sweep in the MHC Class I Gene Repertoire of Chimpanzees."



Complexity Theory as Model and Metaphor for the Church

David A. Wollert

No doubt, most churchgoing Christians have at one time or another, while sitting in a pew on Sunday morning, posited the question "Why am I here?" They are not asking this question in the grandiose sense of "What is the meaning of life?" Rather, they are pondering "Why am I here at Walnut Street Church this morning, interacting with fellow Christians, singing hymns, reading Scripture, and breaking bread? What is the purpose of the church? And how does Walnut Street Church fit into the broader context of God's Kingdom?" In an attempt to address such questions, it might be profitable to consider an equally vexing problem in science. It is a problem that is beginning to be solved (to the extent that it can be solved), and it may provide some useful metaphors, if not outright models, for understanding our roles as individuals in the church, both the church local (i.e., Walnut Street) and the Church universal (i.e., God's Kingdom).



David A. Wollert

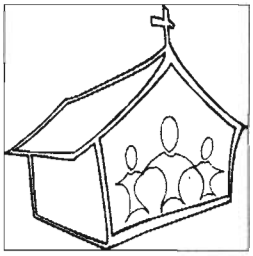
Science has always had a difficult time accounting for consciousness. Just what is consciousness? Is it a physical phenomenon? Is it metaphysical? Traditional scientific orthodoxy claims that reality is fundamentally physical. Whatever consciousness is, it must somehow or other be reducible to patterns of electrical and chemical signals inside the brain. But how then do we account for the introspected first-person awareness of conscious experience? David Chalmers has termed this paradox the "Hard Problem" of consciousness, in contrast to the "Soft Problem" of mapping out the neural interactions that correlate to conscious mental events.[1]

Yet even the "soft problem" of consciousness appears to have defied the reductionistic tools that have traditionally served science so well. Reductionism, of course, is the notion that a large-scale structure or phenomenon can be understood by breaking it down into its component parts, studying the parts, and then using knowledge of the parts to reconstruct and explain the whole. It is a method of explanation that has proven enormously successful over the centuries. Indeed, reductionism has brought us some of our greatest scientific triumphs.

And so, scientists have sought to explain consciousness by studying the component parts of the brain—the nerve cells and the biomolecules that comprise them—and then seeking linear cause-and-effect relationships that can be built up piecemeal to form thoughts, memories, emotions, and consciousness. Although considerable progress has been made in the understanding of neural networks, a systematic description of consciousness simply has not been forthcoming. A new tool in science is beginning to provide additional insight into the problem. The tool is called complexity theory, and it seeks to understand complex systems holistically, in terms of both their parts *and* their wholes.[2]

A new tool in science [called complexity theory] is beginning to provide additional insight into the problem [of explaining consciousness].

David Wollert *teaches biology at Northeast State Community College in Blountville, TN. He began his scientific career as a senior research assistant with the Health Sciences Research Division of Oak Ridge National Laboratory. A strong interest in teaching led him to accept faculty positions at Black Hawk College and Northeast State. David is an active member of Grandview Christian Church in Johnson City, TN, and enjoys speaking about topics in science and religion at local colleges and churches. Correspondence can be sent to him by email: dawollert@NortheastState.edu*



Communication

Complexity Theory as Model and Metaphor for the Church

Complexity theory is a set of mathematical tools for addressing the dynamic behavior that results when rich interactions within a system allow it to self-organize.

Complexity Theory

Complexity theory is a set of mathematical tools for addressing the dynamic behavior that results when rich interactions within a system allow it to self-organize. Self-organization refers to a wide range of processes in both living and nonliving systems. The systems are characterized by simple "rules" that direct localized interactions between the subunits of the system. Despite the simplicity of the rules and the short range of their immediate effects, the system gives rise to the spontaneous emergence of pattern, order, and structure on a global, system-wide scale.[3] Of particular interest are self-organizing systems operating away from equilibrium. Complex systems of this type often generate hierarchies of emergent system-maintained properties that cannot be predicted from studying the parts alone.

As a simple example of a complex, self-organizing system, consider the formation of Bénard cells in water. Imagine a thin layer of liquid water between two parallel plates as shown in Figure 1A. If the liquid and the two plates are at the same temperature and the liquid is motionless, then the system is in equilibrium. Suppose now the bottom plate is heated slowly so as to induce a thermal gradient. The heat will pass from the bottom plate to the liquid, where it will then be transferred upward through the liquid by the process of thermal conduction. In thermal conduction, there is no bulk motion of the liquid. Rather, thermal motion of the individual molecules causes the transfer of heat from the warmer layers to adjacent cooler layers.

However, as the temperature of the bottom layer is increased, a critical temperature is reached where the liquid overcomes its viscosity (the internal friction which opposes movement) and begins to undergo bulk motion. A bifurcation occurs in the system as the highly variable motions of the individual molecules suddenly become organized into coherent flow patterns that dissipate heat more effectively than simple thermal conduction. At the critical temperature, convection (transport of heat by mass movement) in self-organized spatial structures becomes the dominant process and a new behavior emerges (see Figure 1B).

If the temperature gradient is increased further, the convective rolls undergo a further bifurcation to produce hexagonal Bénard cells of the type shown in Figure 1C. This leads to periodicity in the spatial variation of temperature within the system, as opposed to the simple gradient generated by conduction alone. If the temperature of the lower plate continues to be increased, other periodic modes appear, grow in amplitude, and contribute to the motion (i.e., convective rolls within convective rolls). The result is a series of bifurcations yielding increasingly complex patterns of flow and spatial variations in temperature.

Eventually the system crosses another threshold. Turbulence sets in and the motion of the water molecules becomes chaotic. Turbulence, however, is not a stochastically random process. Chaos theory tells us that turbulence reflects a system exhibiting nonlinear properties that are deterministic, but not predictable.[4] The nonlinear equations

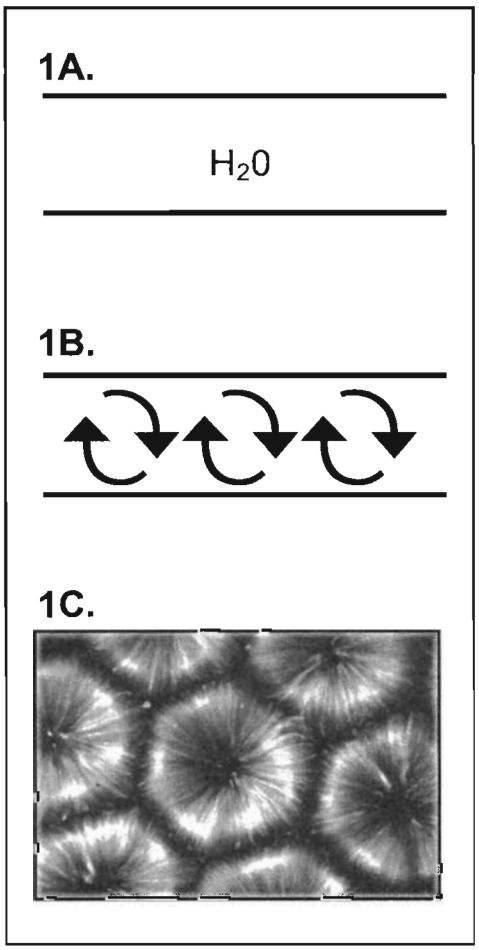


Figure 1. Formation of Bénard Cells

describing the system follow an ordered trajectory that bounds the system while never actually repeating itself. Such trajectories are called "strange attractors" and their discovery has lead to the now common saying that "there is order in chaos." The famous Lorenz Attractor, one of the first strange attractors discovered, is shown in Figure 2.

An important aspect of the system described above is that once the first critical point is crossed and self-organization occurs, causation operates in two directions. Convective flow is an emergent property of the dynamic water molecules and is, therefore, partially explainable in terms of the molecules themselves. But, the self-organized flow patterns in turn influence the behavior of the molecules that initially gave rise to the patterns. Thus, the system is not fully explainable in terms of its parts. Higher-level equations are also needed.

In Search of Self-Organization

At first glance, the process of Bénard cell formation may appear to be a scientific curiosity relegated to the specific conditions allowable in a laboratory experiment. But self-organized patterns of convective flow are quite common in the natural world and manifest themselves on many hierarchial levels. Self-organizing flow patterns of air can produce the configurations of sand dunes observed in the desert, can bring about localized weather conditions, and even can direct the Earth's climate (see Figure 3).

Many complex chaotic systems appear to be self-organizing. For example, a living cell is composed of a rich and complex matrix of chemical cycles which self-organize in such a way as to regulate the overall activity of the cell. Indeed, several biologists have suggested that the total ongoing product of this matrix of activity is no less than the cell itself.[5] Thus, the principle activity of a living cell, when all its complex metabolic activities are summed up, is the continuing creation of itself. This process has been termed *autopoiesis*, or self-creation.[6] Autopoiesis manifests itself at many hierarchial levels—cells, organisms, and ecosystems. A variety of other complex systems exhibit autopoiesis, such as the international economy[7] and even human societies. All of these systems, in addition to being self-creating, are capable of evolving over time.[8]

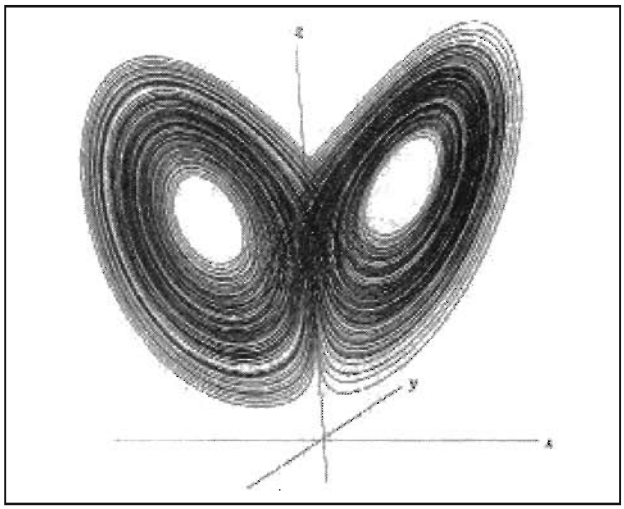


Figure 2. The Lorenz Attractor

A Model for Consciousness?

The fact that nonlinear and chaotic systems can give rise to order and new complexity at higher levels in the system has led many scientists to suggest that similar models might provide an understanding for the emergence of consciousness itself. Some even have come to view consciousness as an emergent, self-organizing phenomenon—an autopoietic, quasi-physical phenomenon emerging from the complex interactions of component parts.[9] Such a system would also evolve over time as external stimuli continually influence the system and become integrated within it.

Again, the interesting thing about this type of emergent phenomenon is that causation operates in two directions. The dynamic interactions of the parts, in this case the nerve cells, influence the properties of the emergent consciousness, but consciousness in turn influences the interactions of the component parts. As a result, the system exhibits nonlinear properties that are deterministic, but not fully predictable.[10] It is for this reason that the reductionistic approach has failed to explain consciousness. Reductionism only accounts for information flow from the bottom up. In reductionism the interconnections between components are lost, and with them all of those higher-level constructs that make our world so interesting—constructs that cannot be collected, observed under a microscope, and stored in museums.

Another notable feature of complex systems is that the interactions between component parts need not, indeed must not, be *complicated*. Social insects, such as termites and army ants, display wonderful examples of emergent

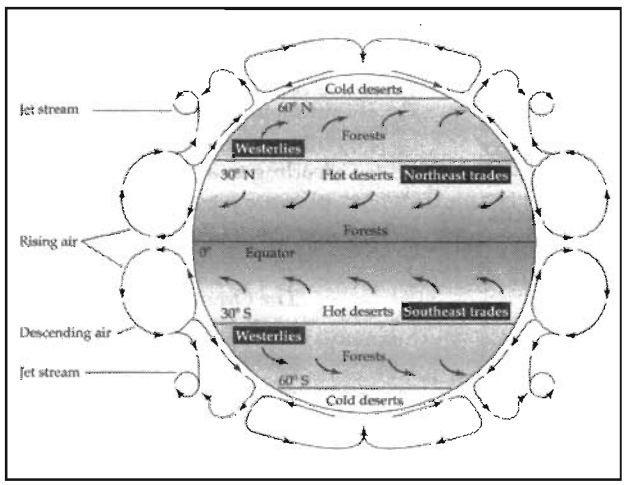
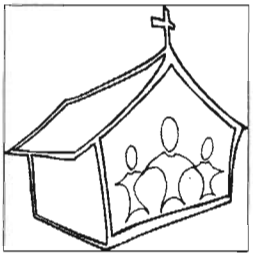


Figure 3. Global Patterns of Airflow Contributing to the Earth's Climate



Communication

Complexity Theory as Model and Metaphor for the Church

If the metaphor is valid, then "the church" simultaneously represents both an eschatological community (we are to live as an end-times people) and an ontological community (God's Kingdom on earth is in a state of becoming in which we play an active role).

behavior. But while colonies of social insects behave in complex ways, the capacities of individuals are relatively limited. Army ants engage themselves in one of a few basic behaviors, switching from one type of activity to another in response to local concentrations of pheromones laid down by individual members of the colony.[11] Individuals do not gather, store, and process information by themselves. Instead, they interact with each other in such a way that information is manipulated by the collective. Similarly, the rules governing communication between nerve cells are quite simplistic, with each nerve cell limited to only a few basic responses to incoming stimuli from neighboring cells. Complexity emerges from the vast *array* of neurons involved in co-dependent localized interactions.

A Metaphor for the Church?

So what, if anything, does complexity theory have to do with the church? Whether as model or metaphor, it seems that God's earthly Kingdom could be viewed as an emergent self-organizing phenomenon—a large-scale phenomenon of love, compassion, peace, and forgiveness emerging from the interactions of Christians following a few simple rules. Viewed in this way, we, through our interactions with others, are to a large extent responsible for making God's Kingdom manifest here on earth. But our participation implies that the Kingdom itself will in turn influence us—our behavior and our lives. Causation flows in both directions.

Complexity theory may provide a scientific framework for the ideas of Jesuit priest and scientist Pierre Teilhard de Chardin. He argued that as people come closer together in their activities and communications, their interactions take on an internal dynamic leading to a new and higher level of being, a planetary consciousness, which he termed the *Omega Point*.[12] According to psychologist Allan Combs:

> The Omega Point unifies and "centralizes" the activities of its constituent minds in a fashion not unlike that in which the activity of the individual human mind draws together and centralizes the activities of the nerve cells of the brain. This process occurs, however, not through loss of individuality, but through a mutual enfolding of the most personal inwardness of each individual.[13]

Teilhard de Chardin identified this most personal inwardness with the experience of love. He wrote: "Love alone is capable of uniting living beings in such a way as to complete and fulfill them, for it alone takes them and joins them by what is deepest in themselves."[14] For Teilhard de Chardin, the highest expression of love is selfless love, which he understood through the Christian faith.

Combs reminds us that "the Omega Point is not something that might possibly come into existence in some ideal future. It is taking form during this very moment of evolutionary time, and its deep personal and mystical dimensions tend to draw us toward it as an organizing principle already felt as a presence in the world."[15] If the metaphor is valid, then "the church" simultaneously represents both an eschatological community (we are to live as an end-times people) and an ontological community (God's Kingdom on earth is in a state of becoming in which we play an active role).

Unlike passive components, such as water molecules, human beings presumably can direct their own interactions. Thus the connectivity of "the church" itself is a dynamic process and not a static map. How we interact with one another becomes one of the major defining features in an emergent systems view of the church. If we isolate ourselves, then the church will tend toward a static or fixed attractor; if we interact with everything around us, then the church will tend to become chaotic and overextended to the point of failure. Maintaining an optimum autopoietic state requires an adaptive form of connectivity, sufficiently self-contained to maintain stability and individuality, yet sufficiently responsive to the world to benefit from the synergy of working together. In the jargon of complexity theory, the church must exist at "the edge of chaos."

Making It Happen

The apostle Paul clearly promoted a complex systems approach to the Church. In his first epistle to the Corinthians, Paul writes: "The body is a unit, though it is made up of many parts; and though all its parts are

many, they form one body. So it is with Christ. ... If one part suffers, every part suffers with it; if one part is honored, every part rejoices with it. ... Now you are the body of Christ, and each one of you is a part of it."[16]

Perhaps no better example of Christ's teachings manifesting themselves in an emergent self-organizing way can be found than in the formation of the Church itself as described in the book of Acts.

The final question, then, is by what simple rules should we, the component parts of the Church, operate? The answer is deceptively simple and was provided by Christ in his explication of the greatest commandment: "Love the Lord your God with all your heart, with all your soul, and with all your mind, and love your neighbor as yourself."[17] Perhaps no better example of Christ's teachings manifesting themselves in an emergent self-organizing way can be found than in the formation of the Church itself as described in the book of Acts. The following account is taken from Howard Vos' *Exploring Church History*. Bearing in mind the discussion of Bénard cells, note the phase transitions that precede two critical points in the story, specifically following the gathering in the upper room and Peter's preaching of Christ.

> The Passover season was ended. The crowds that had gathered for the occasion dispersed, and Jerusalem returned to normal. Some were puzzled, however, by the unusual circumstances surrounding the crucifixion of a certain Jesus of Nazareth, who appeared to be revolutionist—for he had talked about setting up a kingdom of His own. A rumor had spread concerning His resurrection from the dead, but certainly that was impossible, they thought. Had not the soldiers who guarded his tomb reported the theft of His body by His followers? That was sufficient explanation for most. Another Galilean rabble-rouser had come to a grisly end.
>
> One hundred twenty of His followers who had gathered in an upper room in Jerusalem knew otherwise. Having seen and talked with the risen Lord, they awaited at His command the coming of the Holy Spirit. On the day of Pentecost (fifty days after the crucifixion and ten days after the ascension), they were rewarded. A sound as of a rushing wind filled the house. On each of the group lighted what appeared to be a tongue of flame. Immediately they were filled with the Sprit and began to speak in other tongues.
>
> Rapidly word of this phenomenon spread among Jews gathered for the feast of Pentecost, and a crowd came running to investigate. Upon arrival each heard the message of truth in his own language. Some marveled. Others accused the disciples of being intoxicated. But that was a foolish assertion; drunkenness would only produce gibberish, not intelligible conversation in another language. Besides, it was early in the day—too early for such a large group to be drunk.
>
> At that point Peter, who had been the leader of Jesus' disciples, arose and addressed the throng. He argued that this remarkable phenomenon was a result of the Holy Spirit's ministry among them. Then he preached Christ: His death, resurrection, and ascension and the present necessity of receiving Him by faith as Savior and being baptized in His name. The Holy Spirit so wrought that three thousand believed on that memorable day.
>
> Thus the church was born. And wonderful was the experience of believers during succeeding days. They held to the true doctrine, were faithful in prayer, partook frequently of the Lord's Supper, enjoyed each other's fellowship, were in one accord, and lived joyous lives. Those who met them were strangely moved and awed; many believed daily. Soon the number of believers swelled to about five thousand.[18] ✦

Notes

[1]D. J. Chalmers, "Facing Up to the Problem of Consciousness," *Journal of Consciousness Studies* 2 (1995): 200–20.

[2]For an overview of complexity theory see: Richard Solè and Brian Goodwin, *Signs of Life: How Complexity Pervades Biology* (New York: Basic Books, 2000); Roger Lewin, *Complexity: Life at the Edge of Chaos* (New York: Macmillan Publishing Company, 1992); and Stuart Kauffman, *At Home in the Universe* (New York: Oxford University Press, 1995).

[3]S. Camazine, "Patterns in Nature," *Natural History* (2003): 34–41.

[4]James Gleick, *Chaos: The Making of a New Science* (New York: Penguin Books, 1987), 121–53.

[5]H. R. Maturana, F. J. Varela, and R. Uribe, "Autopoiesis: The Organization of Living Systems, Its Characterization and Model," *Biosystems* 5 (1974): 187–96.

[6]Ibid.

[7]P. Anderson, K. Arrow, and B. Arthur, eds., *The Economy as an Evolving Complex System* (Reading, MA: Addison-Wesley, 1987).

[8]Solè and Goodwin, *Signs of Life: How Complexity Pervades Biology.*

[9]Allan Combs, *The Radiance of Being: Complexity, Chaos, and the Evolution of Consciousness* (St. Paul, MN: Paragon House, 1995).

[10]Ben Goertzel, *Chaotic Logic* (New York: Plenum, 1994).

[11]Solè and Goodwin, *Signs of Life: How Complexity Pervades Biology,* 147–78.

[12]Pierre Teilhard de Chardin, *The Phenomenon of Man* (New York: Harper, 1959).

[13]Combs, *The Radiance of Being,* 87.

[14]Teilhard de Chardin, *The Phenomenon of Man.*

[15]Combs, *The Radiance of Being,* 87.

[16]1 Cor. 12:12, 26–27 (NIV)

[17]Matt. 22:37, 39 (NIV).

[18]Howard Vos, *Exploring Church History* (Nashville: Thomas Nelson Publishers, 1994), 3. Used by permission of Thomas Nelson, Inc.

Donors in 2003

We wish to publicly thank the following people and foundations for their contributions to ASA in 2003.

Paul A. Adams
Jerry D. Albert
Moorad Alexanian
Edward B. Allen
Jacqeline L. Allen
Daniel Andersen
Philip E. Anderson
Robert D. Anderson
Stanley E. Anderson
V. Elving Anderson
Anonymous
Jonathan P. Arm
J Richard Arndt
Harold G. Ashcraft
Robert H. Baldwin
Chester W. Bart II
Gwen D. Bart
Monroe H. Bartel
John L. Bartlett
George L. Bate
William E. Bauer
J Philip Bays
Richard S. Beal, Jr.
Ronald W. Beery
Stephen Bell
Joshua N. Bembenek
George D. Bennett
Sarah Berel-Harrop
Judson J. Bergan
Daniel J. Berger
Lynn L. Billman
Reid D. Bird
Charles R. Boardman III
Gerald P. Bodey
Robert L. Bohon
Hessel Bouma III
Neal O. Brace
Raymond H. Brand
Bruce E. Breeding
Gordon E. Brown
Jerry L. Bruemmer
Timothy Brush
Adel D. Budagher
Wilbur L. Bullock
John W. Burgeson
James O. Buswell III
Russell R. Camp
William W. Camp
Joel W. Cannon
Richard E. Carlson
Richard F. Carlson
Robert A. Carlstrom
Richard A. Carpenter
Ben M. Carter
Lisa Ann Cawyer
Gulbank D. Chakerian
Stanley G. Chamberlain
John D. Chan
Dorothy F. Chappell
Karen L. Cianci
Bruce J. Clark
Gerry W. Clarkson
Bryan L. Cleaveland
Stephen E. Cloutier
E. Howard Coker
R. David Cole
Francis S. Collins
Richard H. Comfort
Robert J. Conrad
Robert A. Conradi
Lyn S. Cook
John A. Cramer
Edward B. Crowell, Jr.
Kyle M. Cudworth
Thomas F. Cummings
Pradeep M. Dass
Lloyd J. Davis
Dwight T. Davy
Benjamin B. Dayton
John S. de Grassie
Herman De Haas
Anne D. Deckard
Donald E. DeGraaf
Franklin P. DeHaan
Robert F. DeHaan
Randall J. DeJong
James L. Dennison
Charles P. Downey
C. Ashton Drew
William C. Duke, Jr.
Robert K. Duncan
Keenan E. Dungey
Gordon J. Ebert
Alfred C. Eckert, Jr.
Lester C. Eddington
Vernon J. Ehlers
Georgia C. Eizenga
David A. Ellis
Stewart E. Ensign
Mark C. Eppley
Heinrich E. Erbes
Peter D. Esser
Karl V. Evans
Robert S. Evatt
Robert C. Fay
Fidelity Investments
Charitable Gift Fund
George H. Fielding
Robert B. Fischer
David E. Fisher
Frank J. Fishman
Marilyne S. Flora
John & Julie Forrestal
Eileen Foulks
William S. Foulks, Jr.
Loyd D. Frashier
John E. Fredrickson
Robert E. French
Preston N. Garrison
Harry H. Gibson, Jr.
Owen Gingerich
Earl W. Godfrey
Paul R. Godfrey
Marilyn R. Graves
Paul E. Greaves
Roger D. Griffioen
Robert B. Griffiths
David E. Grove
Donald H. Grove, Sr.
Robert G. Grubb
James K. Gruetzner
Harry H. Guetter
Patrick E. Guire
John W. Haas, Jr.
Beth A. Habecker
Susan E. Halbert
Kathleen A. Hardy
Gary R. Harpel
Franklin H. Harris
Michelle L. Harris
George W. Harrison
Jonathan A. Harton
Allan H. Harvey
John D. Haynes
Douglas A. Hayworth
Walter R. Hearn
E. Clark Heath
Donald A. Hedlund
Ann B. Hein
Richard A. Hendry
Carl F. H. Henry
Robert L. Herrmann
Jerrad J. Hertzler
Gerald D. Hess
Fred S. Hickernell
Fred J. Hickernell
John M. Hill
Eldon T. Hitchcock
Ronald V. Hodges
J. Todd Hoeksema
Michael Hogye
Jay L. Hollman
James D. Hooper
Joseph R. Hoover
Bruce J. Hrivnak
Joseph B. Huber
Edward R. Huff
Ann H. Hunt
Peter D. Hyde
Randy & Marta Isaac
Foundation
David H. Ives
Marsha D. Jakobi
Fred Jappe
Carey Johnson
Douglas E. Johnson
Michael R. Johnson
Walter C. Johnson
Walter Johnson Charitable
Lead Annuity Trust
Charles C. Kankelborg
O. Carroll Karkalits
Joseph T. Keiser
Victor S. Kennedy
Roger H. Kennett
William J. Kinnaman
Jeffrey L. Kirkbride
Glenn I. Kirkland
Robert A. Kistler
Dwight H. Klaassen
Kristina P. Knutson
Donald H. Kobe
Thomas O. Kraner
Albion J. Kromminga
John L. Kulander
David C. Lahti
Richard A. Lane
Brian J. Larson
Ronald G. Larson
Winston M. Laughlin
David A. Leep
Paul A. Lepse
Thomas Lesh
Catherine Lewis
Kathleen E. Lewis
L. Gaunce Lewis, Jr.
Gordon R. Lewthwaite
Robert Ligtenberg
Kenneth A. Lincoln
Richard L. Lindroth
D. Wayne Linn
David C. Look
Justin L. Lorieau
Harry J. Lubansky
Harry Lubansky, Sr.
Carl Lynch III
Howard W. Lyon
Rob Roy MacGregor
David B. MacKay
Thomas E. Madre
Vernon P. Magnuson
James F. Mahaffy
David C. Mahan
Thomas J. Manetsch
Myron A. Mann
Djikolngar Maouyo
John H. Marshall, Jr.
David F. Marten
Kenneth A. Martin
Jennie E. Master
Paul B. Mauer
Richard J. Mawhorter, Jr.
Donald E. McDowell
Donald A. McLachlan
Jerrold L. McNatt
Paul M. Means
Howard R. Meyer, Jr.
Kenneth N. Mickleson
E. Scott Middleton
Sara J. Miles
Keith B. Miller
Robert L. Miller
Ruth D. Miller
Gordon C. Mills
Jim G. Mitroka
David O. Moberg
Stanley W. Moore
J. Terence Morrison
Roy T. Mould
Amy B. Mueller
Donald W. Munro
Murdock Charitable Trust

George L. Murphy
Lytton J. Musselman
Steven R. Musterman
David & Carol Myers Foundation
Robert C. Newman
David Newquist
Davis B. Nichols
Sidney Niemeyer
Joan P. Nienhuis
Donald V. Noren
Nancy E. Norris
Wesley L. Nyborg
Philip M. Ogden
Lawrence R. Olsen
Kenneth C. Olson
Clifton J. Orlebeke
John M. Osepchuk
Daniel H. Osmond
Yoshihiko Otani
Paul Palmberg
Charles D. Park
Walter Partenheimer
John T. Penniston
Alan W. Pense
Lyle B. Peter
Arthur F. Peterson
Walter L. Pfleger
Perry G. Phillips
Bernadette Pistone
James Brian Pitts
J. David Price
Martin L. Price
Clarence E. Prince, Jr.
Stephen D. Prince
Ralph B. Puchalski
Dean A. Ranger
Kermit O. Ratzlaff
Martha Regier
Stephen L. Reinbold
Carl L. Resler
Curtis N. Rhodes, Jr.
Richard R. Rickard
Jonathan C. Rienstra-Kiracofe
Scott A. Riley
Donald G. Ring
Glenn E. Roark
W. Bryce Roberson
Eliot C. Roberts
Frank H. Roberts
Roland B. Roberts
David A. Rogers
Virginia C. Roundy
Peter Ruest
Craig F. Rusbult
William L. Ryder
W. Thomas Schipper
Robert C. Schneider
Linda S. Schwab
Debra A. Schwinn
Randal A. Seburg
Paul H. Seely
David G. Seiler
Frederick D. Shannon
Timothy J. Shaw
Makoto Shimada
David F. Siemens, Jr.
Frederick J. Sigworth
James W. Sire
Albert J. Smith
Timothy Jay Smith
Thomas S. Smith III
Joseph L. Spradley
Charles H. Stagg
Glenn L. Stahl
Walter L. Starkey
Ralph A. Stone
Stratford Foundation
Kevin T. Stroom
Donald H. Strum
Robert E. Sundell
Melvin J. Swanson
Dale Swartzendruber
Jack C. Swearengen
Susan B. Swint
Liskin Swint-Kruse
Sho Takagaki
Richard C. Taylor
William L. Taylor
David C. Teigland
John Templeton Foundation
C Richard Terman
Brian C. Thomas
Gary W. Thorburn
Patricia C. Thorburn
Walter R. Thorson
Thomas F. Torrance
Kenell J. Touryan
Margaret G. Towne
Thaddeus J. Trenn
Frederick D. Trexler
Donald A. Van Beek, Jr.
Kenneth J. Van Dellen
Peter J. van der Burgt
Howard J. Van Till
John Van Zytveld
Gordon J. VanWylen
William H. Venable
John G. Verkade
Dick F. Vesperman
Peter J. Vibert
Gladys L. Vieira
Roger J. Voskuyl
Timothy P. Wallace
Frank Walmsley
Ray D. Walton, Jr.
Baldwin M. Way
Bryan D. Webb
Charles L. Webber, Jr.
Chester V. Wells
Wesley J. Wentworth, Jr.
Robert J. Werking
Earle West
Norman G. Wheeler
Andrew Whipple
Elden C. Whipple
Michael G. White
James G. Widmer
Reuben B. Widmer
John L. Wiester
Alan J. Williams
Leland H. Williams
David L. Willis
Jennifer J. Wiseman
Mark T. Witwer
W. Raymond Womack
Kevin J. Woods
Richard T. Wright
Ingrid J. Wysong
Edwin M. Yamauchi
David Yee
L. William Yoder
Chuk-lam Yuen
Robert G. Ziegler
J. Raymond Zimmer ✦

Reviewers in 2003

Moorad Alexanian
Jonathan P. Arm
Paul Arveson
Michael Behe
Stephen Bell
Jud Bergan
Jerry Bergman
Hugo Boschmann
Hessel Bouma III
Richard Bowman
Raymond H. Brand
John W. Burgeson
Russ L. Bush
James O. Buswell
Owen D. Byer
Richard Carlson
David A. Cater
Dennis W. Cheek
Tar Timothy Chen
Karen M. Cianci
Jack Collins
Harry Cook
John J. Davis
Christian Early
L. Alan Eby
David E. Elliott
Gary Emberger
Dick Fischer
Stephen Gatlin
P. David Glanzer
Brian T Greuel
Roger D. Griffioen
Stan Grove
J. W. Haas, Jr.
William Hawk
Douglas Hayworth
Walter R. Hearn
David C. Hess
David Ives
Frank James
D. Gareth Jones
Chris Kaiser
Roger H. Kennett
David Lahti
Cameron Lee
Verne Leininger
Gordon R. Lewthwaite
Johnny Lin
Russell Maatman
David Mackay
James Mahaffy
H. Newton Malony
Joseph W. Mast
John A. McIntyre
A. Clair Mellinger
Clarence Menninga
Sandra Merryman
Sara Jane Miles
Keith B. Miller
David Moberg
John W. Montgomery
Glenn Morton
Stephen O. Moshier
George L. Murphy
Robert C. Newman
Evelina Orteza y Miranda
Kristen Page
Arthur Peterson
Douglas L. Phinney
Pattle P. Pun
Del Ratzsch
Charles E. Reece
Richard Rempel
Stanley Rice
Jim Ruark
Peter Ruest
Timothy Shaw
David F. Siemens, Jr.
Deirdre Smeltzer
Joseph Spradley
Mark Strand
William Struthers
Jack Swearengen
Walter R. Thorson
Judith Toronchuk
Thaddeus J Trenn
David Unander
Peter J. Vibert
Earle West
William Wharton
David Wilcox
Richard Wright
Edwin M. Yamauchi
James E. Yoder
Jim Yoder
Perry Yoder
Davis A. Young
J. Raymond Zimmer
Uko Zylstra ✦

Book Reviews

FAITH & SCIENCE

ENCYCLOPEDIA OF SCIENCE AND RELIGION (2 vol.) by Wentzel Van Huyssteen, ed. New York: Macmillan Librayr Reference, 2003. xxxviii + 1049 pages, index, bibliography. Hardcover; $331.25. ISBN: 0028657047.

The last two decades have witnessed a remarkable increase of academic and popular interest in science-religion themes. There has emerged a growing sentiment that these fields of discourse have much to say to each other. While various threads of Christian theological agendas remain the central driving force, increasing interest is being generated by Islam, Hinduism, Judaism and others in what has become a multidisciplinary landscape. Cosmology, evolutionary biology, micro-physics, the neurosciences, ecology, biotechnology and ethical concerns provide formidable challenges for those who would include the sciences in their world view.

Newcomers to the field and veterans alike can benefit from the *Encyclopedia of Science and Religion*. It seeks "to be accessible to a wide readership from high school students to independent researchers and academics" (vii). The over 400 entries range in length from several thousand words on major topics to hundred-word definitions of terms. A diverse set of indices, an annotated bibliography, a well-integrated system of cross-references, and a synoptic outline provide easy entry into these volumes. The synoptic outline (viii) offers "an organized map" of the entire field.

For those curious about the field, the Introduction (ix-xii) and "Christianity, History of Science and Religion" (Edward B. Davis, pp. 123-7) provide a helpful start. As a chemist, I appreciated David Knight's piece on chemistry (pp.103-6). Other essays that caught my interest included "Scriptural Interpretation" (Kurt Richardson, pp. 786-90), "Origins of Science" (Peter Harrison, pp. 779-82), "Behavioral Genetics" (V. Elving Anderson and Audry R. Chapman, pp. 58-9), "Science and Religion, History of Field" (John Hedley Brooke, pp. 748-55), "Classical Physics" (Howard Van Till, pp. 664-7), "Anthropology" (Paul K. Wason, pp. 20-4), "History of Science and Religion in China" (Hing Kau Young, pp. 114-8) and "Cosmology, Religious and Philosophical Aspects" (Norriss Hetherington, pp. 177-83).

Paul Allen's analysis of current apologetic trends offers a sample of the riches found in these volumes. Late twentieth-century apologetic literature with a scientific accent and doctrinal focus is represented in the writings of the scientist-theologians Stanley Jaki, Alister McGrath, Arthur Peacocke, John Polkinghhorne, Robert John Russell, and Thomas Torrance. A less precise theological reconstruction of apologetics exists. It transposes Christian doctrine philosophically through a capacious theoretical commitment. This method is present in the writings of scientists such as Pierre Teilhard de Chardin and Alfred North Whitehead, contemporary philosophers Nancey Murphy, Joseph Bracken, and Holmes Rolston III, as well as theologians Wolfhart Pannenberg and John Haught (p. 26).

The two hundred plus contributors provide a diversity of knowledge and viewpoints that makes these volumes an invaluable reference. A second edition of the *Encyclopedia of Science and Religion* should include additional material on the *culture* of science and religion. While academic centers and scholarly associations engaged in the field are mentioned at various points, there is no concentrated effort to identify their goals and support communities or their successes and failures. An analysis of the effects of the growing conversation on science and religion on the faith of individuals and the communities they represent would be helpful.

The *Encyclopedia of Science and Religion* belongs in institutional libraries and the personal collections of the more affluent.

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

SCIENCE AND RELIGION: A Historical Introduction by G. B. Ferngren, ed. Baltimore, MD: The Johns Hopkins University Press, 2002. 401 pages. Paperback; $19.95. ISBN: 0801870380.

This book is a selection of essays reproduced from the comprehensive *History of Science and Religion in the Western Tradition: An Encyclopedia* edited by Gary Ferngren. Professor of history at Oregon State and author of numerous articles on science and religion, Ferngren has selected thirty articles focusing on the major sites of interaction within the West to craft an outstanding introductory text. The result is a detailed and scholarly book that is accessible for a scientifically inclined audience.

The interaction of science and religion is as complex as the intricacies of any intense human endeavor. Unfortunately the general perception is that science and religion have always existed in tension despite significant evidence to the contrary. Dispelling the conflict thesis of science and religion is a theme that runs deeply through most of the essays, particularly the first two that survey the interactions in centuries past and the tools historians use to dissect the most accurate historical picture.

The essays are grouped into seven sections roughly following the development of science from the premodern period to the present. Each essay is arranged in short sections, the first being a very helpful overview and orientation of the key issues under discussion. The result is a series of articles that generally provide an excellent précis of topics. Dembski's short essay on "The Design Argument" (pp. 335-44) is a particularly fine example. Overall the essays are well-balanced presentations that acknowledge a broad spectrum of contributions giving the reader insight into the important issues while avoiding a monolithic presentation of the interaction between science and religion.

"If the study of the intersection of religion and science demonstrates anything, it is the enduring vitality and influence of some of the most basic traditions of the Western world—religious, philosophical, and scientific—which

still retain their ability to shape ideas and inform our culture in the twenty-first century" (p. xiv). Ferngren is to be commended for conveying the vitality and influence of science and religion through this series of excellent contributions from leading authors in the field.

The book has potential as an introductory textbook with many of the self-contained essays being ideal for out of class assignments. ASA readers will find this a valuable book for the classroom and an essential resource for libraries that do not have the larger volume.

Reviewed by Fraser F. Fleming, Associate Professor of Chemistry, Duquesne University, Pittsburgh, PA 15282.

MINDING GOD: Theology and the Cognitive Sciences by Gregory R. Peterson. Minneapolis: Fortress Press, 2003. 252 pages. Paperback; $19.00. ISBN: 0800634985.

The premise of the book is the conviction that "serious consideration of the cognitive sciences stands to affect nearly every facet of Christian theological thinking" (p. 12). *Minding God* is a book-length argument for the validity of this claim.

The author begins with a description of the field of cognitive science with an indication of the shift from using the computer as the model of the mind to the emphasis of the importance of the brain (chap. 2). In chap. 3, he presents the many views on the elusive problem of consciousness. The problem is important because "consciousness has in many ways taken the place of the soul" (p. 70). The best approach for a nonspecialist is "a prudent agnosticism about the ultimate nature of consciousness" (p. 71).

Notwithstanding this warning, the author is confident that it is justified to interpret Genesis 2 as conveying the view that consciousness does not "descend from above but emerge(s) naturally as the result of biological development" (p. 71). Next, the author investigates the problem of freedom (chap. 4). We are bound and free in our personal life because the mind depends on the brain (p. 97), but "cognitive science cannot speak about the true freedom" (p. 98) discussed by theologians in the context of validity of the doctrine of predestination.

In chap. 5, Peterson presents some experiments on brain activity associated with religious experiences ("neureotheology"). The author is correct to conclude that "to show that a brain state correlates with a certain kind of experience is not to show that such an experience is false" (p. 114).

Chapter 6 describes some research on presumed intelligence and self-awareness of animals. The author conveniently states that the burden of proof is on those who deny consciousness of animals (p. 128), yet he agrees that proving consciousness in animals is "exceedingly difficult," and the ascription of these traits to instinct alone is "difficult to disprove" (p. 136). Peterson describes some AI research, although he is not yet ready, along with several other authors, to ascribe intelligence to machines. This type of research leads Peterson away from the belief that we were created in the image of God to the understanding that all of creation reflects the basic character and nature of God (p. 147). The problem is that this seemingly more ecumenical approach simply dilutes the importance of the problem of the image of God.

Chapter 7 discusses sociobiological research on altruism and warns against genetic determinism in the case of morality but concludes with the statement that "we are who we are because of our biological heritage" (p. 177). The explanation of the original sin in terms of the fall of the first couple the author finds, to be sure, naive; a non-naive view is to see this sin as "a dynamic that emerges out of our evolutionary history" (p. 178), which sounds very modern and science-conscious but explains nothing.

In the penultimate chapter, the author gives a critique of the argument from design and then, somewhat incongruously, he turns to the problem of the nature of God. He is correct to stress that disanalogies between man and God are more important than analogies and cognitive science is "a kind of *via negativa*" in investigating the nature of God (p. 201).

Finally, Peterson argues against treating humans as the apex of creation, pointing to the vastness of the universe (chap. 9). Also, after justifiably criticizing the vision of immortality offered by computer science (through downloading the soul, so to say), he concludes that the matter of eschatology cannot be solved by cognitive science because the latter "cannot tell us of existence in alternative realities." Nicely phrased in the last sentence of the book, the matter is resolved by putting "faith in not merely a God of minds, but a God who minds" (p. 221).

Although Peterson competently presents the many facets of cognitive sciences, he really does not make a convincing argument that they seriously affect theological thinking. The big issues of theology are hardly affected by the developments of cognitive science. Of course, theologians should be familiar with these developments, but any revolutionary change in theology proper should not be expected as the result of this familiarization.

Reviewed by Adam Drozdek, Duquesne University, Pittsburgh, PA 15282.

THE SYMPHONY OF CREATION: Science and Faith in Harmony by Steven E. Stoller. Phoenix, AR: ACW Press, 2002. 235 pages, index, notes. Paperback; $14.95. ISBN: 1892525925.

Stoller is a physician who has practiced medicine in the field of eye surgery for twenty-five years. He is an ASA member who also has earned a degree in theology. Prior to his premedical studies, he was a music composition major and he has continued to use his musical training in a variety of capacities. The primary metaphor of this book, which is suggested in the title, is that the universe is an unfolding symphony of creation, whose Composer and Conductor is God. Stoller introduces this metaphor by stating that nature is like music in that "just as music needs both the science of sound and the spirituality of art, so nature needs both science and faith for its full comprehension only when science joins with spirituality do we appreciate the purpose and true grandeur of the universe."

Stoller's primary motivation for writing relates to his own personal struggle as an undergraduate science stu-

dent in trying to reconcile the science he was learning with the claims of his Christian faith. The purpose of this book is to show that scientific findings are not only compatible with Christian faith, but that they actually bolster its claims by pointing to the necessity and grandeur of God. Scientific evidence for the necessity of God is provided in chapter three under the headings of cause (the cosmological argument), contingency (the anthropic principle), complexity (the argument from design), and the comprehensibility of the universe. While Stoller admits that none of these four factors proves God's existence, "together they support the probability of a power and purpose behind the universe."

In the other seven chapters of the book, Stoller surveys a number of issues that are typically addressed in books that seek to harmonize the findings of contemporary science with Christian faith. The evidence for an ancient universe that has been shaped by the process of evolution is presented in chapter two. This evidence is harmonized with the biblical understanding of creation through a brief summary of the "framework" interpretation of Genesis One. In chapters five and six, the evolution of the human body from nonhuman ancestors is discussed. Stoller attempts to harmonize the scientific account of human evolution with a Christian perspective by suggesting that "around 50,000 years ago, God gave spirits to two or more individual *Homo sapiens*. This caused their souls to be fully born, completing their creation in the image of God" (p. 159).

The question of how God works in the universe is answered in chapter four. Stoller rejects both deism and interventionism, arguing instead for a biblical theism which understands God to be an ever present Conductor who sustains and directs the universe by his Spirit. As Conductor of the symphony of creation, God balances the two principles of "freedom for orchestral members and faithfulness to the divine score" in a delicate and mysterious manner. After engaging the problem of evil and suffering in chapter seven, Stoller concludes the book by exalting God's greatness, revealed through the power, precision, profusion, and provision inherent in creation.

Stoller states in the introduction that his purpose in writing is to provide a general overview of a variety of issues that pertain to the interface between contemporary science and Christian belief. He succeeds admirably by covering a number of perplexing issues in a manner that is accessible to a general Christian audience. Notes are provided for those who would like to explore specific topics in more depth, although a bibliography of recommended readings could also have been included. Discussion questions specific to each chapter are provided at the back of the book. While the book is not overly technical, it is academic enough for use in introductory courses on the relationship between science and Christian faith at the college level. It could also be used in a variety of other educational settings. While young-earth creationists and those who reject any consideration of evolution may not like the book, anyone who is open to the possibility of God creating through the process of evolution will find this introductory survey helpful.

Reviewed by J. David Holland, Associate Professor of Life Science, Nyack College, One South Boulevard, Nyack, NY 10960.

HAS SCIENCE FOUND GOD? by Victor J. Stenger. Amherst, NY: Prometheus Books, 2003. 373 pages, index. Hardcover; $21.00. ISBN: 1591020182.

Stenger is emeritus professor of physics and astronomy at the University of Hawaii and adjunct professor of philosophy at the University of Colorado. He has written other books on topics relating to science, religion, and mysticism including: *Timeless Reality, The Unconscious Quantum, Physics and Psychology*, and *Not by Design*. He has given many high profile talks on the topics of science and religion and has faced such notable debate opponents as William Lane Craig.

Has science found God? No, says Stenger. In twelve chapters and three appendices, Stenger reviews the physical evidence for the support or proof for God or of gods or spirits. Topics include young-earth creationism as professed by Henry Morris, intelligent design of Dembski, more progressive creationism of Hugh Ross and Gerald L. Schroeder, and a category labeled "premise keepers" which includes Ian Barbour and John Polkinghorne. The book has many black-and-white illustrations, notes at the end of each chapter, and an index.

Stenger maintains an agnostic position on the existence of a god. He takes a strong negative position on whether contemporary scientific methods and theories can give evidence for a god or any supernatural or mystical phenomena. He makes short work of dismissing the scientific claims of the young-earth creationists and thinks contemporary intelligent design proponents are mistaken thinkers. Stenger spends some time dealing with the statistical arguments of Dembski's intelligent design.

Though Stenger does not make argument with the cosmology of Ross and Schroeder, he does reject the "fine tuning argument by use of the anthropic principle." He argues that the form of life is dependent on the nature of the universe; therefore, it is not surprising that we have the form of life that we do. Stenger states that it has not been proved that other forms of life cannot exist under a universe governed by different physical parameters.

With respect to the pro-evolutionary, theistic "premise keepers," Stenger takes issue with the philosophical, therefore unscientific, interpretations of scientific evidence for the existence of God. Also, Stenger states that this group has assimilated so much science into their philosophy that there is little left of traditional Christianity.

Stenger also discusses medical studies on the effects of prayer, psychics, out-of-body experiences, near death experiences, and Bible codes. He states that the studies are inconclusive or misleading. He discusses statistical errors, systematic errors, and biases associated with popularly referenced studies.

Stenger takes a very thoughtful and thorough approach to the topic of scientific evidence for God and other supernatural and mystical experiences. He draws upon his own Christian heritage of Roman Catholicism, and he is well acquainted with the doctrines and apologetics involved. His experience in physics allows for a well-informed and thorough treatment of the science. To Stenger's credit, the weakness in the book is also self-identified. He acknowledges that the issue of God's existence is philosophical.

Continued on p. 66

Continued from p. 64

Since Stenger's goal is to address the science associated with support for the existence of God, he spends little time on the issues of philosophy.

This book gives an excellent overview of the physical science based arguments for the existence of God. It summarizes the major scientific arguments for the existence of God and the weaknesses of these arguments. Though the book would not be read for spiritual edification, it is a book that should be read by theistic scientists and theists interested in the sciences to help develop their own apologetics.

Reviewed by Gary De Boer, Associate Professor of Chemistry, LeTourneau University, Longview, TX 75607-7001.

HISTORY OF SCIENCE

DOUBTS ABOUT DARWIN: A History of Intelligent Design by Thomas Woodward. Grand Rapids, MI: Brazos/Baker Books, 2003. 303 pages, index. Hardcover; $19.95. ISBN: 0801064430.

The debate over the Intelligent Design movement (ID)—well documented in *Perspectives on Science and Christian Faith*—has generated a significant amount of literature since its inception around the early 1990s. However, I was surprised to hear of a *history* of this movement, since it was only about a decade old and because there were already several general introductions to ID. Nevertheless, *Doubts About Darwin* gives a unique approach focusing on the rhetorical factors involved. It should not disappoint anyone interested in learning more about the personalities and rhetorical strategies of the ID movement and its critics. (Although Woodward spends more time on ID's naturalistic critiques than on its Christian detractors, who support theistic evolution). While Woodward is favorable toward ID, he is neither partisan nor propagandistic.

Doubts About Darwin is a revision of the author's doctoral dissertation in the field of rhetoric, specifically the nascent discipline known as the rhetoric of science (which incorporates the philosophy and history of science and appropriates much from Thomas Kuhn). Unlike some dissertations-cum-books, *Doubts* makes the transition gracefully. It is not a warmed over thesis, but a well-written, amply documented, and genuinely insightful study of a significant movement challenging the dominance of Darwinism. By approaching ID from a rhetorical angle, Woodward captures both the straight arguments for and against ID as well as the considerations of timing, approach, use of terms, dreams, and models of presentation. This makes for an intellectual drama where an underdog takes on a giant. One learns about rhetorical theory in the process, but that conceptual machinery is neither cumbersome nor overwhelming to the non-specialist.

Phillip Johnson emerges as the rhetorical genius of ID (he wrote the forward to the book) who developed a specific strategy against Darwinism rather than coming with the essential evidence against it. After reading Richard Dawkin's pro-evolution *The Blind Watchmaker* and Michael Denton's *Evolution: A Theory in Crisis* in the late 1980s, Johnson became convinced for scientific reasons that Darwinism was evidentially challenged. Darwinism was supported more by the *a priori* commitment to philosophical materialism than by any hard evidence. This exposure of philosophical materialism as the real engine of Darwinism, along with the basic evidential criticisms leveled by Denton, gave Johnson the intellectual traction he needed to start a revolution.

Johnson was not the first to stake a scientific claim against Darwinism. Besides Denton's critique, the Bradley, Thaxton, Olsen volume, *The Mystery of Life's Origin* (a critique of abiogenesis), was published in 1984. These stirred the waters, but a rising tide of dissent was yet to form. Moreover, Johnson was not a scientist but a law professor, and found himself in an awkward position to lead a revolt. Nevertheless, Johnson, along with others, crafted a strategy and cast a vision. The strategy required a distancing from "creation science," because of its association with biblical literalism and its pariah status among most scientists. The ID movement would be "metaphysically minimalist" (my term) in its approach, focusing on the scientific evidence and where it led. It would not address specifics of Christian theology, but argue that certain evidences of nature pointed toward a designer and that chance and necessity were not sufficient to explain the living world. It would cast a broad net and employ the arguments of non-evangelicals (Michael Behe) and even non-Christians (David Berlinsky). The plan was "the wedge strategy"—to drive a wedge between the findings of empirical science and philosophical materialism. In so doing, it had to challenge certain assumptions about the nature and philosophy of science, specifically its metaphysical or methodological naturalism. Johnson would be the leading edge in pointing out evidential and logical weaknesses in Darwinian theory; philosophers, such as Stephen Meyer, would draft more sophisticated arguments; and scientists, such as William Dembski and Behe, would develop ID into a full-orbed research program. Woodward also observes that Johnson's temperament has been crucial for the ID movement. He is both genial in demeanor and rigorous in argumentation, making friends with the Darwinists he debates whenever possible. In addition, he has been tireless in taking the message to the universities and elsewhere.

This timely and informative book would make a fitting textbook in classes addressing the history and philosophy of science as well as Christian apologetics. It would also make an apt case study for courses in rhetoric.

Reviewed by Douglas Groothuis, Professor of Philosophy, Denver Seminary, Denver, CO 80210.

GALILEO'S MISTAKE: A New Look at the Epic Confrontation between Galileo and the Church by Wade Rowland. New York: Arcade Publishing, 2003. Hardcover; $25.95; ISBN: 1559706848. Paperback; $14.95; ISBN: 1559707224.

Just when we thought that the Galileo affair could be put on the shelf, Rowland has utilized a stylistic flair that makes the book difficult to put down. Two aspects of the book are worthy of comment. First, the survey of what could be dry historical chronology is interspersed with a contemporary *trialogue* among the author, a former stu-

dent "Berkowitz," and a diminutive nun "Sister Celeste" over the hermeneutics of science and religion. Second, the account of the issues leading up to Galileo's appearance before the Inquisition are coupled with the saga of the controversy over where he would ultimately be buried.

The trialogue takes place in modern Italy. Rowland makes the surroundings in which Galileo lived come alive for the reader. It is remarkable that so many of the avenues and buildings of the sixteenth century still exist.

Further, the trialogue reflects a method perfected by Galileo himself—the interaction among supposed real persons who represent differing theoretical positions. In the *Dialogue on the Two Chief World Systems*, Galileo has figures representing the Copernican and Ptolemaic systems interacting with one another as in a drama. Unfortunately, when Galileo represents Ptolemy's approach in a figure named *Simplicus*, readers quickly see his bias. Rowland fares a bit better. His and Sister Celeste's caution against Berkowitz's scientism is well reasoned and convincing.

Protestants and northern Europeans claimed that the church suppressed progress and oppressed a loyal, faithful scientist to the point where he recanted. However, Rowland offers a more complex, penetrating analysis of the issues themselves. He suggests that the negative judgment of the church was less dependent on Galileo's *Dialogue* book than on his famous *Letter to the Grand Duchess Christina*. Here Galileo proposed that the Scriptures should be interpreted allegorically, not literally—an opinion considered by the church to be an inappropriate intrusion by a layperson into theological reasoning. He also suggested that the physical evidence (human observation both with and without scientific manipulanda) should take precedence in determining what is truly "real." Rowland portrays Galileo as a Pythagorean who believed that reality could be explained mathematically. To reduce the meaning of reality to measurements of mass and force sabotaged the church's understanding of meaning and purpose—an idea just as heretical as the thought that the earth moved around the sun.

The church was not as "anti-scientific" as it has been made out to be by historians. It held two opinions. First, scientists could conjecture as much as they liked so long as they utilized their conclusions as in-house language that assisted the scientists in their calculations. Second, the church held that *demonstrations* were not proof. The church felt that Galileo never proved that the earth moved, he only "demonstrated" that it made better mathematical sense to conclude that it did. The church was unwilling to acquiesce to Galileo's contention that nature and Scripture were equal revelations of God—a viewpoint that later was to be common parlance among such thinkers as Sir Isaac Newton.

Of course, the subtlety of these arguments is lost in the brutal concreteness of Galileo's confession before the Inquisition. Here he overtly confesses his error in asserting that the earth moved around the sun. Rowland addresses adroitly the question of whether Galileo changed his mind. He denies that Galileo whispered "but it still moves" under his breath. Instead he asserts that Galileo finally understood the difference between demonstration and proof. There was no threat of physical punishment looming over him. He had a friend in both Cardinal Bellarmine, who directed the affair, and in Pope Urban VIII, who reluctantly ordered it. The house arrest he enjoyed was relatively painless and people from all over Europe were given free access to visit him. He recanted on the basis of seeing the error of his hermeneutics.

All in all, this book was a wonderful read! It led me back to previous accounts in *Galileo's Daughter*, *Issues in Science and Religion*, and *God and Nature*.

Rowland is to be complemented in the way he convinces the reader that the issues are perennial, not just historical. I recommend it to all who are convinced that some issues are perennial, not simply historical.

Reviewed by H. Newton Malony, Senior Professor, School of Psychology, Fuller Theological Seminary, Pasadena, CA 91101.

THE CALVINIST COPERNICANS: The Reception of the New Astronomy in the Dutch Republic, 1575–1750 by Rienk Vermij. Amsterdam, The Netherlands: Royal Netherlands Academy of Arts & Sciences, 2003. X + 433 pages, bibliography, index. Hardcover; $49.00. ISBN: 9069843404.

David Livingston has impressed his readers with the importance of geography in assessing the response to a new scientific concept. The newly formed Dutch Republic, small enough to (presumably) be encompassed by one investigator yet a region with vigorous intellectual discussion, strong scientific tradition, and freedom of speech, offered such a venue.

Vermij argues the central role of the universities yet finds that the independent intellectuals—refugees, preachers, court mathematicians, builders of waterworks, millers, and physicians—invariably were the first to debate new scientific ideas. Ultimately academic institutions would pick what they liked from among the ideas in the marketplace for insertion into the curriculum.

The secular Dutch State did not exercise theological influence on the universities. However, many scholars were influenced by the desire to bring nature in line with Scripture, and the Dutch churches had much to say about the place of the earth in the cosmos.

Part I. "A World of Order" considers the initial Dutch response to Copernican ideas. The newly founded University of Leiden (1575) emphasized humanistic learning (philology, rhetoric, history, and mathematics) over theology and philosophy (logic, physics, etc.). Humanism searched the ancient texts for the lost classical wisdom with the purpose of having them re-established, thus muting the need for further investigation of nature. Astronomy was valued as offering evidence of God's hand in creation.

Leiden humanists valued Copernicus for citing Pythagoreans and Philolas and largely using Ptolemy's data in building his heliocentric views. They praised his argument for the revolution of Venus and Mercury around the sun. However, the heliocentricity of the other planets and the motion of the earth were seen as insufficiently proven. Initially, his mathematical astronomy was of little interest. Later the mood changed with a loss of respect for classical education and the rise of mathematics as an independent discipline able to assert itself against tradition and philosophy.

Part II. "The Challenge to Philosophy" deals with the important role of Galileo's telescopic discoveries. By 1610 his work was well known. However, the generally poor quality of the Dutch instruments delayed wide local use of the instruments until 1630. The trial of the famous astronomer and open condemnation of the Roman churches brought more attention to the new cosmology. He was offered asylum but turned down the offer because of his advanced age and poor health.

Dutch scholars rooted in the old mathematical astronomy of the universities were slow to adopt a full-blown Copernicanism. As a result, the most daring attempts to break out of the box were made by independent thinkers who expanded on Galileo's ideas in relating them to newly reported observations. Others sought to fit the new discoveries into the old picture of heavenly spheres and celestial influence.

Part III is titled "The Universe of Law." The1640s saw the role of mathematics diminished as the philosophy of Rene' Descartes moved cosmography to the realm of the natural philosophers. Copernicanism become a world system based not on a mathematical theory of the heavens but on the application of general physical principles to the phenomena of the solar system. Descartes' ideas were prominently featured in the curriculum replacing not only the old scholasticism and Aristotelianism, but also the humanistic-philological approach, which had dominated scholarship. By the late 1640s theological resistance to the Cartesian world view led him to move to Sweden. Protestant theologians returned to Aristotelian philosophy shaped into a neo-scholastic mold for the purpose of warding off attacks of unbelievers. Some held that the "Holy Scriptures" had no place in discussions of the system of the world. Others vigorously argued against a Copernican-Cartesian system. Most sought a cautious middle. Even though Descartes failed to carry the universities, his more zealous followers and students spread his ideas to the alumni and the general public.

Part IV. "Biblical Authority and Christian Freedom" discusses Protestant resistance to heliocentrism that was based on biblical texts and a concern for the recognition of God's place in nature. The various expressions of Protestantism developed creeds and confessions legitimized by an *inspired* Scripture. By 1656 Copernicanism became the center of a debate over biblical interpretation that virtually split the Dutch Reformed Church.

Part V is titled "God Back in Nature: Copernicanism in the 18th Century." Newton's *Principia* (1687) opened a new view of the world. The Dutch only recognized the importance of his work after publication of the second edition in 1711. Willem Gravesand and Petrus van Musschenbrock led a generation that generally adopted Newton's theories as a basis of departure for the study of physics and the vindication of Copernicus. The new physics was "put forward as an alternative to Cartesianism with the express intent of bringing science in accordance with religious feelings" (p. 349).

Vermij aptly describes the confused ways that the acceptance of heliocentrism played out in the early Dutch State. Rigid specialization, professionalization, and an explosion of knowledge today separate the scientist from those who seek to include science into twenty-first century world views. Our struggle finds much in common with the Dutch experience.

This fascinating work may be obtained free in PDF format at http://www.knaw.nl/cfdata/publicaties/detail.cfm?boeken__ordernr=991129

Reviewed by J. W. Haas, Jr., Gordon College, Wenham, MA 01984.

Origins & Cosmology

PERFECT PLANET, CLEVER SPECIES: How Unique Are We? by William C. Burger. Amherst, NY: Prometheus Books, 2003. 345 pages. Hardcover; $29.00. ISBN: 1591020166.

Burger is curator emeritus in the Department of Botany at the Field Museum of Natural History in Chicago. He shows that it was only a series of amazing accidents that led to the evolution of life, humans, and science. However, this does not lead him to a belief in the supernatural, because that would be outside the realm of science. Most of the book is a restatement of existing material, but it is presented in an interesting and informative way that is accessible to the educated layperson.

The first part of the book talks about the critical parameters that must be satisfied by our sun, solar system, and planet in order for life to evolve. These parameters include such factors as the location of the earth's orbit in the solar system, the location of the solar system in the galaxy, the relative abundance of various chemical elements, and the gravity of earth. This material is similar to Ward and Brownlee's *Rare Earth*.

The next part of the book speculates about the origin of life and intelligence. Interestingly, the author considers life's origin to be almost inevitable, given the "just right" conditions for its beginning on earth. The author also discusses the evolution of human intelligence. He presents a long and somewhat convincing argument that intergroup warfare among various tribes of prehistoric humans is responsible for the rise of intelligence.

Burger next discusses the rise of science, attributing it to the Judeo-Christian world view and several other "accidents," including the fortuitous mastery of agriculture and metalworking. Human intelligence leveled off about 100,000 years ago, but humans have mastered science only in the last few hundred years, so the rise of science in an intelligent species is far from inevitable. Just as astronomical conditions have to be "just right" in order for life to evolve and survive, cultural conditions have to "just right" in order for intelligent beings to master science.

The author admits that "intelligent design" may be responsible for the existence of life and intelligence, but dismisses this speculation with the claim that such investigations are outside the realm of science. The book makes for an interesting read as it covers a wide variety of disciplines, from astronomy to biology to anthropology. It is well documented with over four hundred notes and references, but the conclusions are often speculative.

Reviewed by Dan Simon, Associate Professor of Electrical Engineering, Cleveland State University, Cleveland, OH 44115.

CREATION: From Nothing Until Now by W. B. Drees. New York: Routledge, 2002. 115 pages, index. Paperback; $15.95. ISBN: 0415256534.

At first glance, I was afraid that *Creation: From Nothing Until Now* was going to be another of the efforts that I think of as attempts to mythologize evolution. The poem "A Creation Story" that begins the book, and the pastiche-like adaptation of biblical phrases, prepared me for the worst. Upon thorough reading, though, there is much more here: a lucidly presented academically disciplined exposition, such as we might expect from one who holds the chair in philosophy of religion and ethics in the Department of Theology and Ethics at Leiden University, and serves as president of the European Society for the Study of Science and Theology. Each short chapter explores important issues about some aspect of the origin and evolution of things, setting forth what needs to be engaged whether one is developing a new sort of natural theology, as Drees seems to be doing ("a quest for faith in the context of the natural history of our universe"), or whether one is starting to explore the epic of evolution from a particular set of faith convictions.

Drees' approach to theology as fluid and open-ended may be discomforting to some conservative Christians. Yet it is good to be reminded that we engage in theology not just to develop a compendium of answers, but as a stimulus to asking questions. For example, the chapter on "Mystery" is very helpful in drawing distinctions between questions arising from gaps in the scientific knowledge, and questions that occur at the limits of doing science. And the chapter on "Purpose" explores the sense in which the evolutionary process is both purposeless and purposive; or as Francisco Ayala might put it, how chance and necessity can give rise to a natural teleology.

The questions posed here are consistent throughout with Drees' expressed opinion that "we need to think more modestly about Jesus." The basic Christian story for Drees is the parable of the good Samaritan. His use of the story is focal in his exposition of our calling to creative and responsible service. Yet I am not sure he ever engages the fact that Jesus did not answer the question "Who is my neighbor?" but rather advocated and upheld neighborly behavior in all circumstances. Nevertheless, the core story for most Christians is not a story Jesus told, but the story of his incarnation, passion, death and resurrection.

Without the incarnation, it is easier to downplay the significance of humankind. In fact, Drees uses the word "significant" in several places to speak of the relative unimportance of humanity when one's world view is informed by evolution. But is the significance of humanity diminished by evolution for the Christian? Not, I think, in the sense that we understand human praise of the Creator to be a sign of the longing for reunion and shalom of all creation, and in the sense that we consider God's embodiment in Christ to be the first fruit of that reunion. For Christians, the mystery of God lives in the tension between the humility and the cosmic significance of Jesus Christ.

It may be in that last chapter, "From Now On" that Drees is most in touch with what for me is a fundamental aspect of Christianity—an openness to the future. In discussing the value of "stewardship" in how we humans influence the world around us, Drees reminds us that both in Scripture and liturgy, past and future, memory and hope are intertwined. "Stewardship" may put undue emphasis on preserving, conserving, and looking backward, while ignoring the new thing that God is doing in our midst and the promise of the reign of God.

For those who are looking for an evolution-based apologetic for evangelical or conservative Christianity, this is not the book. For those who are seeking to integrate understandings of evolution and the God revealed in Jesus Christ, there is help here in asking the questions and pursuing a critical examination of facile answers.

Reviewed by Josephine Borgeson, Faith Network Project Coordinator, National Center for Science Education, Oakland, CA 94609.

FAITH, FORM AND TIME: What the Bible Teaches and Science Confirms About Creation and the Age of the Universe by Kurt P. Wise. Nashville, TN: Broadman and Holman, 2002. 288 pages. Paperback; $14.99. ISBN: 0805424628.

Wise is qualified to speak on this topic, having a Ph.D. in paleontology from Harvard. His thesis was supervised by Stephen J. Gould. The author espouses young-earth creation in six, twenty-four-hour days. He uses a scientific approach to interpret all of the data needed to explain the findings of paleontology that will conform to a young-earth interpretation of the Bible. The book is divided into five parts as follows: 1. God's Word on the Subject; 2. The Dating Game; 3. Creation Week; 4. From the Garden to the Grave; and 5. From Noah to the New Earth.

The author states emphatically that there is nothing new in this book. He claims that he deserves credit only for synthesizing the works of others. He uses an original format for this presentation. The first step to justifying a "young earth" creation is to assume the creation days in Genesis One all are six earth-rotation days. The second step to determine the creation date is to work through the biblical chronology of the genealogies of Genesis 5, 7, and 8. The process is repeated to get from Noah to Abraham since we know approximately when Abraham was born. All of this leads the author to conclude that the earth and the physical universe are only 6,000 years old. William H. Green in 1890 published an article in *Bibliotheca Sacra* that convinced biblical scholars that the genealogies in Genesis are not father-son relations in all cases. Wise is either unaware of this work or chose not to discuss it. Wise does not devote much space to consideration of the position of Bible-believing Christians in science who adhere to the old-age universe. He is sure his position is a minority one, but thinks the young-earth creation view will gain adherents in the future.

Wise avoids polemics in his presentation. He asserts that Noah's flood was universal over planet earth. Many ASA members assert that Noah's flood was local. They agree with Albertus Pieters, an Old Testament scholar, who comments that Gen. 7:19 which refers to the flood waters covering all the high mountains under the entire heavens means that the observers in Noah's area could see no mountains that were not covered. The verse has no reference to the Rocky Mountains or the Himalayas.

Wise is a talented writer, and given his assumptions, makes a strong case. The weakness of the book is that he does not devote enough space to the views of scientists who believe in an old universe. I would recommend this book to anyone who wants an excellent treatment on young-earth creationism.

Reviewed by O. C. Karkalits, McNeese State University, Lake Charles, LA 70605.

DARWIN'S PROOF: The Triumph of Religion over Science by Cornelius G. Hunter. Grand Rapids, MI: Brazos Press, 2003. 168 pages. Hardcover; $17.99. ISBN: 1587430568.

Two decades ago Ronald Burwell wrote in *JASA:*

> ... if recent philosophy of science has taught us anything it has shown us that science does not exist in a vacuum. It is culture bound, it is theory bound, it is paradigm bound, and it is intrinsically united to a world view.[1]

Hunter's first forays into the Christianity/evolution field, *Darwin's God: Evolution and the Problem of Evil* (2001),[2] and the current volume surely follow Burwell's dictum. Hunter's major point is that "negative theology of the day" (the notion that God could not have created a cruel and imperfect world) led Darwin to a deistic world view colored by nineteenth century natural theology rather than the traditional Christian view of creation.

Darwin's Proof follows the same line: "Evolution is considered to be a fact because Darwinists believe they have disproven the alternative: divine creation ... [and] ... the paltry evidence is converted into unbeatable arguments when a particular religious filter is applied" (p. 80). Hunter's case is rooted in the failure of evolution to explain biological complexity and in the inadequacy of the evidence offered. Evolution fails on the grounds of self contradiction. Its claim as a naturalistic explanation is contradicted by the religion that provides its roots. Finally, for the Christian, it fails on the theological level. His solution for biological research—the intelligent design framework (ID)—claims to "make scientific predictions and provides a framework upon which to formulate subhypotheses and pursue further scientific investigation."

Chapters 2 and 3 detail the inability of mainstream evolution to explain the origin and role of DNA in the complex-interrelated mechanisms of nature. Hunter argues that Darwin, recognizing the thinness of his evidence, shifted the burden of proof from showing that evolution *could* create complexity to requiring a skeptic to prove that evolution *could not* produce a particular structure. Chapters 4 and 5 offer Hunter's take on the deficiencies of such evolutionary evidences provided by fossil remains, comparative anatomy, vestigal organs, molecular comparisons found in molecular clocks, protein sequences and genomic similarities. He accepts "small-scale" evolution but balks at any extrapolation to "large-scale" changes. Speculations about the origin of life are found wanting. He states: "The fact that evolutionists would make such a claim says more about their judgement than the state of scientific research" (p. 63).

Chapter 6 offers historical evidence that Darwin and his successors (Le Comte, Gould, Zimmer) use various forms of a non-Christian religious premise to conclude that a naturalistic model for the diversity of life is mandated. Chapter 7 considers the pre-Darwin paths of deism and natural theology and the roles of Joseph Butler, William Paley, David Hume and the Bridgewater Treatises in influencing the Victorian consciousness. For Hunter: "The theological argument against evolution is that its theological assertions fail St. Anselm's test" (p. 96).

Chapter 8 offers a biblical view of God, humanity, and the created order concluding with the good news of salvation. Chapter 9 takes into account humanity's misunderstanding of God's purposes in an appeal to the reader to be a "good student of God's Word." This includes recognizing that God did not make a world "optimal in a material sense"and the effects of the Fall. He asks: "Was it serendipity that creation just happened to be full of analogies to spiritual truths that are given in scripture?" (p. 114).

Chapters 10 and 11 deal with intelligent design theory (ID). The usual criticisms of ID are seen as stemming from the paradigm of perfection that Darwin and his successors advocated—leading to the distancing of God from creation and leaving science free to go about its business. Secularism in public life is a corollary result. The design perspective is seen as offering new research areas and predictions in biology presumably not appealing within the evolutionary paradigm. He suggests that design topology offers such an opportunity. Here the observed large differences in amino acid sequences capable of making the same protein are seen as necessary areas of investigation while evolutionists ignore the question assuming that the results are a function of random change. Hunter sees this ID strategy as extending the search for function to the cellular level. ID explains the marsupial-placental convergence in mammals "naturally" rather than resorting to evolutionary "just-so-stories."

This book will infuriate or delight readers depending where they stand on evolution. Unfortunately the author's "in your face" style, use of the "killer" quote, overly repetitive arguments, lack of theological nuance, thinness of evidence for Darwin's metaphysical views (which often changed) and unwillingness to seriously engage the thought of Christians who think otherwise, may turn off readers from considering the issues raised.

Notes

[1]Ronald J. Burwell, *JASA* 31 (December 1979): 199.
[2]Review *JASA* 54 (September 2002): 200.

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

PHILOSOPHY & THEOLOGY

GOD'S BOOK OF WORKS: The Nature and Theology of Nature by R. J. Berry. London, England: T&T Clark, 2003. 286 pages, index. Paperback; $29.95. ISBN: 0567089150.

In 1885, Lord Adam Gifford endowed a lecture series for "Promoting, Advancing, Teaching, and Diffusing the Study

of Natural Theology in the widest sense of the term." In 1997–1998, Berry presented a series of Gifford Lectures which served as the basis for this work. His ambitious aims are to examine religious faith(s) in the light of science, test whether science offers an accurate description of the human condition, investigate the relevance of religion today and develop an ethic for behavior "in a crowded and ill-treated world." The author sees himself as an evolutionary biologist and, while a geneticist by profession, has been involved with ecological aspects of biology since the early '70s.

Berry does an excellent job in the first three chapters of setting the current debate in its historical context by tracing the history of natural theology and the impact that Darwin's theory had on it. He believes that by the mid-1800s "the compatibility of evolution and Christian doctrine was gradually acknowledged 'among more educated Christians.'" Berry believes Lord Gifford would see the current attempt of fundamentalists to promote "scientific creationism" as an attempt to return to the pre-1543 era where "myth and pseudo-authority" ruled instead of "observation, test and considered learning."

In his discussion of the "Theology of DNA," Berry discusses the nature of "human-ness" and the responsibility that being in the image of God conveys on us. At this point Berry does very little to explain how and when this "image of God" became imposed on our ancestors and at what point the biblical Adam came to be. Later, in chapter eleven, Berry returns to this topic stating "a tentative hypothesis" that Adam was created in the body of a farmer around 10,000 years ago. He distinguishes, therefore, between *Homo sapiens* and *Homo divinus* in an attempt to rectify the apparent discrepancies between the Darwinian view of human origins and the biblical idea of a literal Adam.

In chapter five, Berry analyzes "Green Religion" examining a wide variety of religions and philosophies. His analysis of the strengths and weaknesses of these views is both accurate and fair, but he ultimately concludes that they are insufficient in their views of nature. He follows this with an analysis of "Green Science" examining the field of environmental science rather harshly, believing that the science of ecology does not offer much support for many of the assumptions of those in the environmental movement. However, he does believe that "the place where green religion meets green science is the test-bed of natural theology" and makes a strong case for the need to concentrate on the processes that create the patterns rather than the patterns themselves.

In "Running Out of World," Berry examines both the historical and current state of the planet, again taking more of a historical approach, and does pretty much the same in chapter eight where he examines the politics involved in dealing with nature. Chapter nine discusses the idea of stewardship as a biblical way for Christians to approach their dealings with God's creation. It is here, perhaps, that the author's familiarity with British aspects of the topic is most evident although it is present throughout the work.

There is much to recommend in this book with its excellent historical examination of the various aspects of the subject and its numerous quotes from other authorities. It is a wide-ranging work covering many issues important to arriving at a truly biblical view of nature and, with scriptural, subject, and name indices, it will make an excellent reference book. However, the author's strong belief in the process of evolution as the means by which God created the world frequently seems at odds with his conclusions regarding how and why nature, including *Homo divinus*, can teach us anything about God, which is the basic premise of the text. Nowhere is this more evident then in the chapter on "Awe and Wilderness" where he does an excellent job of showing how writers, from the Psalmist to modern environmentalists, speak of nature with true awe. However, he never truly answers his own question of where this sense of awe comes from. Ultimately, his attempt to mesh his view of modern science with his own view of Scripture and natural theology, in my mind, fails.

Reviewed by Scott S. Kinnes, Professor of Biology, Azusa Pacific University, Azusa, CA 91723.

POWER FAILURE: Christianity in the Culture of Technology by Albert Borgmann. Grand Rapids, MI: Brazos Press, 2003. 144 pages, index. Paperback; $14.99. ISBN: 1587430584.

Borgmann, a philosopher at the University of Montana, has written a unique book. His argument is that our culture is so influenced by technology that we are losing our former habits of communal celebration. However, he is not a Luddite. "We should neither try to demolish technology nor run away from it. We can restrain it and must redeem it" (p. 8). Nor is Borgmann the kind of philosopher that only other philosophers can understand.

In the first three chapters (part 1), Borgmann describes the current culture. He tells us more than we might have wanted to know about Cool Whip™ in the first chapter, "The Invisibility of Contemporary Culture." You read that right. Cool Whip™, that artificial substitute for whipped cream, is an example of how modern technological society has substituted the bland and artificial for the real. Borgmann challenges us to see the equivalent of Cool Whip™ in other products and aspects of our society. He describes our society as having a "device paradigm."

The third chapter, "Communities of Celebration," exceeds the combined length of the first two and the Introduction. Celebration, a central theme of the book, has become less of a communal event due to a technologically oriented culture. Commercialization, via television, has made celebration more remote. Although Borgmann does not mention the Super Bowl, there is probably no better example. He argues that without real celebrations where real participants do things when they are physically together, humanity is cheapened.

The second part is about the place of Christianity. Chapter four, "Contingency and Grace," is one of the reasons why a review of this book is relevant. Borgmann understands atheists Richard Dawkins, Daniel Dennett, and Stephen Weinberg well enough, and shows that they recognize contingency in the universe. He sees a connection between contingency and grace. People experience different kinds of grace which eventually determines the

"chances" in their lives. Living in a technology society, which claims to have answers to so many human needs, puts people at risk of not seeing, or even looking for, God's grace.

Borgmann also writes about how the device paradigm, contemporary technological culture, is marginalizing genuinely valuable and important parts of culture. For example, reading books is much less common. Finally, he calls us to genuine, face-to-face celebration, as Christians and as inhabitants of culture. Such celebration takes real work and real communication, but it produces a more Christian and humane society. This is a philosophy book that does not try to win an argument. It is philosophy in the sense of examining what it means to be human and what actions this meaning should promote.

Reviewed by Martin LaBar, Professor of Science, Southern Wesleyan University, Central, SC 29630.

RELIGION AND CHRISTIAN FAITH

THE RESURRECTION OF THE SON OF GOD by N. T. Wright. Minneapolis: Fortress Press, 2003. 817 pages. Paperback; $39.00. ISBN: 080062681.

This is the third volume in a series by Wright entitled "Christian Origins and the Question of God." Wright, a much published author, is Bishop of Durham in England and SPCK Research Fellow. He has taught New Testament studies at Oxford, Cambridge, and McGill Universities.

Wright acknowledges that the book is long but observes that it could have been twice the length if he "had explored all the interesting-looking secondary roads that lead off this particular highway." His main point is that the resurrection of the body was denied by pagans but affirmed by many Jews and reaffirmed and redefined by early Christians. (Dan. 12:2-3 is the clearest Old Testament passage on a physical resurrection. Isaiah offers the earliest Old Testament reference to bodily life the other side of death.)

In the ancient classical world, physical resurrection was deemed impossible in reality and denied in myth. Pagans believed lots of things could happen to dead people but physical resurrection was not one of them. Wright believes that in the Hellenistic world, Homer functioned as its Old Testament and Plato as its New Testament. Neither affirmed belief in a physical resurrection. Why? Because the human body, with its infirmities and pains, was looked upon as a torture chamber, a prison, an unsuitable house for the soul. Death was to be welcomed because it liberated the soul from the body.

The ancient view of bodily resurrection explains why the Athenian philosophers stopped Paul when he preached the physical resurrection of Jesus. Wright summarized the view the Greeks held about a dead body: "... nobody in their right mind would want it or something like it back again." While the people of the ancient world believed in life after death, none believed in a physical resurrection.

Wright challenges what he perceives as the dominant paradigm for understanding Jesus' resurrection, namely, that the earliest Christians believed Jesus' resurrection was a spiritual but not physical one; that the gospel resurrection accounts are late inventions; and that Jewish resurrection belief was fuzzy. When early Christians spoke of Jesus being raised from the dead, they proclaimed something that was unique to Jesus. Christian belief in Jesus' deity did not require belief in his resurrection: "Divinization did not require resurrection; it regularly happened without it. It involved the soul, not the body."

Reading this book was somewhat of a challenge because of its unique (British) punctuation, long sentences, and the use of pronouns and antecedents. The deciphering of the footnotes' format requires special attention. However, the footnotes are well worth examining and contain some of Wright's wittiest quips. Wright pulls no punches when commenting on the words of other scholars with whom he disagrees. Wright leaves no doubt that he is firmly in the camp of those who revere the resurrection of Christ accounts as accurate.

Readers may profit from reading this book in a number of ways: they will learn from original sources what ancient documents, biblical and nonbiblical, say about bodily resurrection; they will explore how resurrection is used in a metaphorical and literal sense in both Bible Testaments; they will see the centrality of the resurrection in Paul's writings; and they will have their Christian faith and biblical understanding expanded. It informed my mind and stimulated my faith, and I highly recommend it.

Reviewed by Richard Ruble, John Brown University, Siloam Springs, AR 72761.

ONE TRUE GOD: Historical Consequences of Monotheism by Rodney Stark. Princeton and Oxford: Princeton University Press, 2001. 319 pages. Hardcover; $24.95. ISBN: 069108923X.

The emergence of monotheistic worship in some unknown place more than three thousand years ago is, according to Stark, perhaps the aspect of human history that has had the single largest impact. Monotheism brings people together and, in its varying forms, drives them apart. Since all monotheisms are inherently intolerant, monotheism is of great interest sociologically.

Judaism is an ethnically based version, but Christianity with its universal appeal became the dominant religion of the Roman Empire. Islam moved beyond its origins to appeal to all races as well. In both these latter cases, the broad appeal was largely to the elite of society, rather than to the masses, according to Stark. Monotheism leads to mission: knowing the truth leads to wanting to spread it. Stark describes the history of monotheistic expansion and contrasts it with the patterns for other religions.

According to Stark, religious differences have been behind some of the most brutal conflicts in history. If there is only one possible view on any issue—that derived from the orthodox understanding of the revelation of the one true God—then intolerance can easily be justified. The book contains a description of conflicts between the various monotheistic faiths. Yet despite conflict, monotheistic faiths survive over long periods of time. And, in spite of

the historical pattern of conflict, peaceful coexistence is possible, but in the presence of religious pluralism so that there is no single dominant view that can exert force to protect its privileged position.

Stark claims that a scientific approach cannot prove or disprove the existence or nonexistence of gods, so the only scientific view is agnosticism. His sociological and historical analyses, though, are nonetheless stimulating and informative for those who do believe in the one true God.

Reviewed by David T. Barnard, University of Regina, Regina, Canada.

SOCIAL SCIENCE

THE IMAGINED WORLD MADE REAL: Towards a Natural Science of Culture by Henry Plotkin. New Brunswick, NJ: Rutgers University Press, 2002. 301 pages, index. Paperback; $22.00. ISBN: 081353268X.

The stated target audience is professionals and educated laypersons. The author, by and large, communicates science in layperson's terms, even when the subject matter is complex. Chapters are largely autonomous. Sections within chapters rarely exceed ten pages and the reader is frequently reminded of the relevance of the current detailed discussion to the bigger picture. The subject matter is complex and at times reading becomes tedious as too much space is devoted to tangential material. Some sentences (one with 66 words) require reading more than once. This book has seven wide-ranging chapters. Each chapter concludes with a short list of suggested readings.

Ultimately, evolutionary theory is seen as the bridge between the social sciences and biology. We are repeatedly informed: "There simply is no other possibility." Evolution which normally stores information as "gene frequencies in gene pools, evolved a kind of proxy information-gatherer in the brains of some animals. This is why intelligence is an adaptation."

Human culture might be an "extraordinary manifestation of human intelligence," but it is reduced to "imagination made real." Culture rests totally on psychological foundations with no nonmaterial causes. That there may be a discontinuity—an *imago dei*—separating humans and animals is never entertained. The details of culture are irrelevant. Even universal testimony to the reality of the supernatural world and human spirituality are dismissed without discussion. "To repeat, culture is awesomely complex. But it must be—it simply must be—within the scope of understanding of the natural sciences."

Within my own field of linguistics, I was disappointed to see Plotkin muddying the waters by using the term "protolanguage" to refer to the superficial similarity between ape and infant-human language. Given (and Plotkin accepts the linguistic evidence) that there is no relationship between animal communication and human language, it is scientifically irresponsible to use a technical-sounding term that equates the end point of one system with the starting point of the other.

Plotkin is a modern conquistador leading his followers to the ultimate El Dorado. He envisages a futuristic unified science in which culture will be reduced via an incredibly complex labyrinth of relationships between the social sciences, psychology, neuroscience and biology to explanatory causal mechanisms expressed in terms of chemistry and physics. His commitment is to a science that maintains that "life, including mental and cultural life, is no more than chemistry and physics."

The reader's arduous journey through this uncharted jungle is lightened by glimpses of familiar flora and fauna. Our guide is well informed and early days are filled with a plethora of interesting details of exotic species. However, as doubts grow about the existence of the fabled city, and of the adequacy of Plotkin's evolutionary compass to lead us in the right direction, one begins to panic at the prospect of endless tedious days of wandering, lost in the jungle.

The greatest weakness of the book is Plotkin's failure to mention other approaches at the macro level (though at other levels he readily accepts current debate) and for this reason the book fails to allow students to form their own opinions on the most crucial issue of all. No argument is stronger than its unstated presupposition. His assumption is that design by a Creator is not worth considering by "true" scientists. Hence, despite the author's erudition, the book may not be blazing a trail through Amazonia after all, but wandering around a boggy swamp.

Plotkin, professor of psychobiology at University College in London, has previously authored *Darwin Machines and the Nature of Knowledge* and *Evolution in Mind.*

Reviewed by Bryan Ezard, 8 Johnston Street, Goolwa, 5214, Australia.

THE NATURE AND LIMITS OF HUMAN UNDERSTANDING: The 2001 Gifford Lectures at the University of Glasgow by Anthony J. Sanford, ed. New York: T & T Clark, 2003. 259 pages. Hardcover; $85.00. ISBN: 0567089460. Paperback; $29.95. ISBN: 0567089479.

The editor claims this book is the first to "examine the nature of human understanding from the perspective of psychology (linguistics), biology (neural sciences), philosophy (metaphysics) and theology." The book's five contributors all have training and experience as professors.

The book is divided into five parts, each with two chapters. Part I by Phil Johnson-Laird focuses on human limitations in understanding natural language. The basic thesis is that "human understanding depends on the construction of mental models from perception, from imagination, and from the comprehension of language. The limits on human understanding arise from limits in these processes and from limits in 'working memory'— those components of the brain that enable individuals to hold in mind information whilst they think about it." Laird discusses two barriers to human understanding: (1) our limited ability to detect inconsistencies; and (2) our limited comprehension of the concept of cause.

In Part II, George Lakoff develops the theory of the embodied metaphorical mind based on new discoveries in neuroscience. His approach is reductionist in which he argues that "any concept at all must be neurally embod-

ied" because humans think with their physical brains. If the body shapes thought, then the idea of a soul is untenable, mathematics cannot be objectively true, God is not transcendent, etc. However, when it comes to human consciousness, Lakoff admits that there can be "no complete neural computational theory of consciousness."

In Part III, Michael Ruse examines the implication of evolutionary theory for the nature and limits of understanding. He explicitly addresses the question of how Darwinism may offer a basis for our understanding of ethics and ethical behavior. However, he concedes that the Darwinian position may have gaps. For example, the Darwinian cannot throw much light on some of the ultimate metaphysical questions, "specially those about ontology." (In fact, in a separate article published in *Science* 299 [2 March 2003], Ruse admits that Evolution could very well be a "secular religion.")

It is in Parts IV and V that we finally come to a positive discourse that supports the holistic, nonreductionistic view of human understanding, as one encounters in the Christian world view. Lynne Baker, in Part IV discusses how *scientism* underlies reductionism and neither our first-person knowledge (knowledge that a knower would express in a first-person sentence) nor our third-person understanding (knowledge that does not require that a knower have first-person perspective) can be reductionist.

Finally, Brian Hebblethwaite in Part V presents the importance of metaphysics and theology in human understanding and discusses their respective limits. He defines theology as metaphysics plus revelation, and argues cogently that metaphysical and theological knowledge enriches our conceptions by dealing with phenomena where science appears mute (such as art, beauty, morality, the good, etc.). After surveying a number of metaphysical and theological systems, Hebblethwaite concludes that Christianity makes "better sense of everything" in human understanding when placed side-by-side with all other world views, including the knotty problem of theodicy.

Overall, the lecture series presents a reasonable balance between the empirical-reductionist views of human understanding (e.g., Lakoff) and the philosophical-theological perspectives by Baker and Hebblethwaite, with Ruse taking an intermediate, *fence-riding* position.

The ASA reader interested in the rapidly evolving field of cognitive science, especially as it pertains to the neural-computational models, will find these lectures challenging, informative, and very thought provoking.

Reviewed by Kenell J. Touryan, Chief Technology Analyst at the National Renewable Energy Laboratory, Golden, CO 80401. ✦

Letters

The Flood

I am responding to Carol Hill's invitation (*PSCF* letters, September 2003) to comment on her suggestion that people conceived of "the world" more narrowly in Genesis 6–9 (the Flood) than in Genesis 10 (the Table of Nations). My comment is that, whatever the merits of this suggestion, it does not support her thesis that the flood described in Genesis is the one that took place in Mesopotamia in *ca.* 2900 BC. The people who lived in Mesopotamia at this time (the Sumerians) knew that the world extended beyond this region. Trade routes by the third millennium stretched all over the Middle East (see, for example, J. D. Hawkins, ed., *Trade in the Ancient Near East* [London: British School of Archaeology in Iraq, 1977]).

A possible solution is to take *ha'arets* in Genesis 6–9 to mean "the land." However, when the word has this sense elsewhere in Genesis, the name of the land is usually given ("the land of X"). Genesis does not refer to Mesopotamia ("the land of *Shin'ar*") until after the Flood (10:10, 11:2).

I discuss the difficult problem of identifying Noah's flood in my book, *Big Bang, Small Voice: Reconciling Genesis and Modern Science* (Latheronwheel, Caithness, Scotland: Whittles, 1999). I can supply copies of this on request.

P. G. Nelson
25 Duesbery Street
Hull, HU5 3QE
England
P.G.Nelson@hull.ac.uk

On the Structure of Genesis

The December 2003 issue of *PSCF* had several excellent articles that I deeply appreciated. Especially noteworthy were Carol Hill's article "Making Sense of the Numbers in Genesis" (pp. 239–51) and Dick Fischer's "Young-Earth Creationism: A Literal Mistake" (pp. 222–31). I want to make a few comments that are pertinent to both articles.

Among my books that I highly prize in my library is P. J. Wiseman's *Ancient Records and the Structure of Genesis*.[1] Unfortunately, this book is out of print but it contains some timely information that I want to share. Wiseman (1888–1948), though not a trained researcher himself, spent time in the Middle East in the 1920s and early 1930s and took interest in the archeological work of Sir Leonard Wooley and Professor S. H. Langdon. In short, this is what he relates in his book.

From the thousands of clay tablets found in Mesopotamia, their form was: (1) a title, (2) the body of the text, and (3) ending in a colophon that generally contained the name of the owner or scribe and some attempt at dating.

In Genesis, the colophon is indicated by the recurring phrase, "These are the generations (*toledah*) of" ... the Hebrew phrase meaning "history, or family histories, or genealogies."

Some of the conclusions on Genesis were: (1) it was originally written on stone or clay tablets in the ancient script of the time; (2) it was written by the patriarchs who were intimately concerned with the events related, and whose names are clearly stated; (3) Moses was the compiler, possible translator, and editor of the book, as we now have it; and (4) Moses plainly directs attention to the source of his information.

It becomes obvious (the assigning of chapters to the Bible in the thirteenth century) that Genesis was mis-

labeled chapter-wise because it was thought that the "*toledah*" colophon was designated to appear before the body or text of the assigned chapter. The ancient Mesopotamian tablets show the opposite. The colophon statement (the Hebrew "*toledah*") points backward to a narrative, not forward. The "*toledah*" therefore ends a section or chapter. Of particular interest is Genesis 1 where that chapter should actually end with Gen. 2:4, "these are the generations of the heavens and the earth ..." Now, Fischer's argument for an old earth becomes even more effective. Fischer makes the point that Gen. 2:4 supports an old-earth view because the plural (*toledah*) generations—meaning long periods of time—fit into one (*yom*) day. The same patriarch or scribe, who wrote the inspired words of Genesis 1, also wrote the "*toledah*" of Gen. 2:4 to end his account. The patriarch or scribe who wrote Genesis 2 started his account with Gen. 2:5.

Text ending statements ("*toledah*" —these are the generations) occur in Genesis:

2:4	... of the heavens and the earth
5:1	... of Adam
6:9	... of Noah
10:1	... of the sons of Noah
11:10	... of Shem
11:27	... of Terah
25:12	... of Ishmael
25:19	... of Issac
36:1	... of Essau
36:9	... of Essau
37:2	... of Jacob

It is my hope that Wiseman's *Ancient Records and the Structure of Genesis* would again be published, if not by Thomas Nelson Publishers, then by another publisher who would buy the publishing rights.

Notes

[1]P. J. Wiseman, *Ancient Records and the Structure of Genesis* (Nashville, TN: Thomas Nelson Publishers, 1985).

Henry F. Blank
ASA Subscriber
1645 Via Ventana
San Lorenzo, CA 94580
nblank@worldnet.att.net

Numbers in Genesis

I appreciated the article by Carol A. Hill in the December issue (*PSCF* 55, no. 4 [2003]: 239–51).

Another scriptural reason follows for doubting that the numbers in Genesis can be used for bookkeeping, like that Bishop James Ussher tried to do (*The Annals of the World*, 1658). Genesis 46:26 indicates that 66 people went into Egypt and lists them. However, Gen. 46:7 describes daughters and granddaughters, plural, when there is only one daughter and one granddaughter listed. Even if these plurals hadn't been used, it seems extremely unlikely that all of Jacob's descendants, save these two, were male. Not only that, no wives are mentioned by name at all, even though verse 5 and common sense tell us that wives were included among those who went into Egypt. So 66 is not the real number, although the Bible says that it is. How can this be? Surely those who wrote down Scripture knew full well that 66 is less than 66 plus wives, daughters, and granddaughters. More important, God, the inspirer of Scripture, knew it, too. The conclusion I come to, which is the same as Hill's, is that God had other purposes than the arithmetic when these numbers were given, and, furthermore, that the arithmetic is not important.

Keep up the good work. "For the Lord God is a sun and shield, the Lord bestows favor and honor; no good thing does he withhold from those whose walk is blameless" Psalm 84:11 (NIV).

Martin LaBar
ASA Member
Southern Wesleyan University
907 Wesleyan Drive
Box 1020
Central, SC 29630
864-644-5270
mlabar@swu.edu

Concordism's Illusion That It Is Upholding the Historicity of Genesis 1–11

In *PSCF* Letters (June 2003: 138), I said that neither creation science's global flood nor concordism's local flood could solve the problem of the conflict between the biblical account of the flood and the findings of modern science. Since then Carol Hill (*PSCF* 55 [Sept. 2003]: 209), John McIntyre, and Thomas Godfrey (*PSCF* 55 [Dec. 2003]: 276–8) have written resisting my answer to the problem, namely that God accommodated his theological revelation in Genesis 1–11 to the now antiquated science/ history of the times.[1] They say they believe the history in Genesis 1–11 is accurate history that agrees with the historical/scientific facts.

This belief, though a popular assumption, is not provable from Scripture.[2] There is no biblical reason why God could not or would not accommodate his revelation of theology to the science/history of the times, and all the more so if he has delegated the discovery of science/history to humankind.[3] Indeed, Jesus showed that he believed Scripture is sometimes accommodated to ingrained cultural concepts which are not merely scientifically defective, but which are morally defective (Matt. 19:8/Mark 10:5). Divine inspiration does not exclude divine accommodation.

In addition, the writers of history in the Bible regularly imply or say that they are relying upon merely human sources and never claim to have received their history *qua* history from God by revelation. Consequently, the accuracy of the historical books in Scripture is contingent upon the quality of the sources employed. That is why the history in Genesis 1–11, which gives evidence of resting in part upon earlier Mesopotamian stories and motifs, can be considered of rather poor historical worth, while chapters 12–50 regarding the patriarchs can be esteemed more highly because they apparently rest upon traditions passed down by the patriarchs themselves. The resurrection of Christ can be esteemed yet even more highly because it rests upon eyewitness accounts from that very generation.

With regard to the historicity of Genesis 1–11, we can learn something from creation science. It also claims to believe that the history in Genesis 1–11 is accurate history that agrees with the historical/scientific facts. Most readers of this journal are well aware that the way creation science squares the biblical account with the historical/scientific facts is by rejecting the overwhelming consensus of the best-trained scientists in the relevant sciences and substituting in its place private interpretations of the scientific data. In addition it finds evidence in Scripture for items which Old Testament scholars do not find there, like multiple volcanoes exploding at the time of the flood.

Is concordism any different? Despite the honesty of the concordists with regard to the relevant sciences, concordism squares the biblical account with the historical/scientific facts primarily by rejecting the overwhelming consensus of the best-trained Old Testament scholars and substituting in its place private interpretations of the biblical data. With regard to pre-Adamites, it finds evidence for them in Scripture in places where Old Testament scholars do not find them.

As for a local flood, which has become a standard staple of concordism, the overwhelming consensus of Old Testament biblical scholars is that the Bible is saying that the Flood was anthropologically universal and that during the Flood the entire earth was virtually returned to its pre-creation state described in Gen. 1:2.

One need not take my word for it. Go to a good theological library and find twenty commentaries on Genesis by qualified Old Testament scholars. Carefully read the sections supposedly supporting pre-Adamites and the section on the flood. You will be lucky to find even two Old Testament scholars who think Scripture is speaking of pre-Adamites or a local flood. Concordism is not resting upon any firmer a foundation than is creation science. It simply prefers a private interpretation of the Bible to a private interpretation of science.

Despite its sincerity, effort, and hopeful thinking, concordism's Day-age, pre-Adamites, local flood, and local language at the Tower of Babel are rejections of the historical accuracy of Genesis 1–11. Concordism replaces the history offered in Genesis 1–11 with a different history based on private interpretations which are determined not by the context of Scripture, but by the findings of modern science.

This does not mean that creation science gets off scot-free with reference to its interpretation of Scripture. For one thing, as Dick Fischer pointed out in his paper (*PSCF* 55 [Dec. 2003]: 222–31), the "fountains of the great Deep" (Gen. 7:11) are fresh water terrestrial fountains; and it is they along with rain that supplied the water for the flood.[4] The ocean, which is not fresh water, cannot be employed as a means of flooding the globe (or half the globe à la Godfrey/Aardsma) without doing the same thing that concordists are doing: replacing the history in Genesis 1–11 with a private interpretation.

Calvin's doctrine of accommodation, which I believe should be followed in principle, has a great advantage over creation science and concordism in that it allows both the Bible and the scientific data to freely say what they say. Concordism and creation science with their private interpretations have replaced the reality of Scripture and science with an illusion.

Notes

[1]It would be just as misleading to say Genesis 1–11 is either "fiction" or "myth" as to say that the early geology books which explain the results of the Missoula floods as being due to glaciers were either fiction or myth. Genesis 1–11, like those early geology books, is the outmoded history/science of those times.

[2]The fact that New Testament writers accept Genesis 1–11 as historical only proves that modern history/science was not revealed to them any more than to the Old Testament writers.

[3]My book, *Inerrant Wisdom*, develops this thesis.

[4]Cf. Gerhard F. Hasel, "The Fountains of the Great Deep," *Origins* 1, no. 2 (1974): 67–72.

Paul H. Seely
ASA Member
1544 S.E. 34th Avenue
Portland, OR 97214
Phseely@aol.com

Do Ice Cores Disprove Aardsma's Flood Theory?

In a recent *PSCF* article, Paul Seely pointed to recent Greenland ice core data as "ultimate proof that Noah's Flood was not global," concluding "that on any possible scenario ... the 110,000 regular annual layers of fresh-water ice in the GISP2 ice core falsify the theory of a global Flood in the time of Noah."[1] The scope of this claim clearly extends to Aardsma's flood theory, which was introduced in my letter in the same issue that carried Seely's article.[2] The clear, well-written case may have persuaded many *PSCF* readers to rule out even this promising theory immediately, so my purpose here is to argue that no such hasty rejection is warranted.

Seely's case is indeed impressive. What may actually prove fatal to any theory that leaves no ice sheet on Greenland at the conclusion of the flood is his positive evidence for far too many years of history in the one resting there now. Nevertheless, Michael Oard, Larry Vardiman, and other proponents may yet discover new ways to defend such a theory. Time will tell.

But what about other global flood theories, like Aardsma's, where the ice sheet forms before the flood yet is not destroyed by it? Seely devoted only two paragraphs to refuting these,[3] arguing that the flood must have affected both top and bottom sides of the ice sheet if it floated, or else at least its top side. He wrote: "Gen 7:19–8:4 virtually demands that it was covered by the ocean," but even if it never was submerged, certain evidence he believes should be found is missing. Seely therefore extended his "ultimate proof" claim to cover even Aardsma's flood theory using an entirely different line of reasoning, where positive evidence from the ice core data has little or nothing to do with his case against it.

Although he concluded that a pre-flood ice sheet should have been flooded, since Gen 7:19 says "all the high mountains under the entire heavens were covered," Seely also discussed the "rather unbiblical scenario" where it was not under water. He reasoned that "the extraordinary amounts of precipitation at the time of the Flood (Gen. 7:4, 12) would cause the ice core to have either an extra-large melt layer from rain as well as ice pipes, lenses, glands, and such in the snow above or an extra-large annual layer of snow sometime in the past, probably in the last 8,000

years, but it does not." In these scenarios, Seely preferred an interpretation where the narrator speaks entirely from God's omniscient perspective. Aardsma favors one where "Genesis 7 and 8 record Noah's accurate but finite observations of the Flood."[4] We can agree that Seely's interpretation deserves consideration, but the issue remains unsettled, with Aardsma's idea still quite viable.

Apparently, Seely entertained only one explanation for a total lack of the distinctive ice core features that global flood theories allegedly predict if the ice sheet was not submerged, namely, the theories must all be wrong. However, other reasonable alternatives do come to mind. Maybe the features were seen but not recognized as noteworthy, so they were never reported. Even if they really are missing, this does not necessarily endanger the theories. The best cores may have missed, perhaps by inches, the features sought at the depth of interest. Can we be sure it rained even in Greenland? As for "an extra-large annual layer of snow," can we know how much snow should have accumulated at the exact position of the ice cores, and how much the wind may have blown away? Certainly not, so a given core might not show anything unusual at its flood layer.

Aardsma believes the Greenland ice sheet should have floated "at least 6,600 feet above its bed,"[5] so it is important to consider three other reasons Seely gave for ruling out this scenario: (1) "it probably would have floated away," but even if it did not, (2) "ocean currents would have kept it from coming back down exactly in its former place," and (3) "the sloping parts of the ice sheet would have produced a unique 'marine' ice that is found under ice shelves but ... is not under the Greenland ice sheet." As for the first two points, if Seely even considered the coastal mountain ranges, his brief comments do not explain why he concluded that the ice sheet should have cleared them, or why they would not have guided it back to its old bed. On his last point, how careful was his search for marine ice? How can he know the old shelf areas did not flow out to sea in glaciers and form icebergs long ago? A mere failure to find a feature hardly guarantees it never existed.

If the ice cap floated, ocean water should have melted some of its underside. If it did not float, then the date for the bottom of the GISP2 ice core should be when central Greenland was most recently free of ice. Unfortunately, dating the bottom layer is problematic, but one study Seely cited "yielded an estimated age for the ice at the silty ice boundary of 'at least 250,000 BP.'"[6] Is this also the date for the most recent climate warm enough to melt all the ice? A plot of land ice and temperature on earth over the past 800,000 years shows the warmest, most ice-free time at about 123,000 BP.[7] If Greenland kept its ice then, because older ice has been found there, can we speculate that ice disappeared most recently during some earlier, still warmer period off the chart? It would follow that layers spanning over 500,000 years might have melted off the bottom of the ice sheet during the flood at the GISP2 project site. Loss of the bottom layers would leave us no way to date the event. This cursory analysis is admittedly far from conclusive, but Aardsma claims an ice core taken at Camp Century as "clear" evidence that the Greenland ice sheet has floated.[8]

What Aardsma really wanted was a nearby ice sheet with datable remnants of pre-flood ice left frozen to its bed throughout the flood. He claimed he found this at Devon Island and discussed seven lines of evidence that his theory has been confirmed, with a "best date" of 3429 BC for the boundary between pre-flood and post-flood ice, and 80% of the older ice melted away.[9]

Since Aardsma believes the date of creation is 5176 ± 26 BC,[10] one can still say that ice core evidence invalidates at least this date, but this separate issue, which Aardsma has also addressed, is really too big to cover here.[11] Hopefully, while the debate is still on the historicity of the flood, neither side will prematurely dismiss any theory as promising as Aardsma's without ample and reasonable justification. In the end, the truth will prevail.

Notes

[1]Paul H. Seely, "The GISP2 Ice Core: Ultimate Proof that Noah's Flood Was Not Global," *PSCF* 55.4 (2003): 253. The term *global flood* does not necessarily refer to one that covered every square inch of the globe. It can also refer to one that stretched around the globe or covered most dry land on the globe, not just a single watershed. Note 32 is the only indication in the article that Seely knew about the particular theory defended here.

[2]Thomas J. Godfrey, "On the Hills of Concordism and Creation Science," *PSCF* 55.4 (2003): 278.

[3]Paul H. Seely, "The GISP2 Ice Core," p. 253. Unless otherwise noted, all other Seely quotes also come from the same first two paragraphs on p. 253.

[4]Gerald E. Aardsma, "Chronology of Noah's Flood," *The Biblical Chronologist* 3.1 (1997): 6.

[5]Gerald E. Aardsma, "The Depth of Noah's Flood," *The Biblical Chronologist* 3.3 (1997): 8-9. See his article, "Noah's Flood at Devon Island," *The Biblical Chronologist* 3.4 (1997): 4–6, for his explanation of the math and physics behind the probability that a given thickness of ice will break away from its bed and float.

[6]Paul H. Seely, "The GISP2 Ice Core," p. 254.

[7]Richard B. Alley, *The Two-Mile Time Machine: Ice Cores, Abrupt Climate Change, and Our Future* (Princeton: Princeton University Press, 2000), 94. See James Zachos, et al., "Trends, Rhythms, and Aberrations in Global Climate 65 Ma to Present," in *Science*, 292.5517 (April 27, 2001): 689, for a similar plot that goes back four million years. Both plots are based on isotope measurements for shells taken from sediment cores. Here the validity of these climate plots is presupposed without challenge or endorsement.

[8]Gerald E. Aardsma, "Noah's Flood at Devon Island," pp. 14–5. Aardsma did not discuss the GISP2 data, but he cited Susan Herron and Chester C. Langway, Jr., "The Debris-laden Ice at the Bottom of the Greenland Ice Sheet," in *Journal of Glaciology*, 23.89 (1979): 194.

[9]Gerald E. Aardsma, "Noah's Flood at Devon Island," pp. 6–14. Aardsma's calculation for the boundary date is on page 9, and his date for the Flood based on biblical data is 3520 ± 21 BC.

[10]Gerald E. Aardsma, "Toward Unification of Pre-Flood Chronology," *The Biblical Chronologist* 4.4 (1998): 4.

[11]Aardsma wrote a series of five articles on this, beginning with the article cited in note 10. It culminated in "A Unification of Pre-Flood Chronology," *The Biblical Chronologist* 5.2 (1999): 1–18, where he finally proposed his solution, which does not depend on the validity of his flood theory.

Thomas James Godfrey
707 Burruss Drive
Blacksburg, VA 24060
godfrey@verizon.net

Art Eyes Science
Beginning, etc.

Beginning, etc.

Harry Lee Poe

I.
In the beginning was the double negative
cause there weren't nothin'.
God brooded over the confusion and thought,
"If there weren't somethin'
there ought to at least be nothin'."
But there weren't.
And God said,
"Let's put a little light on the subject."
And he did.
And the light cleared things up.
So everything that was cleared up
God called something.
And everything that weren't
God called nothing.
And when God settled on the difference
between something and nothing
He called it good.
But people call it science
because they don't like values.

II.
And God noticed the problem with something:
It wasn't very well organized.
It wasn't much better organized than nothin'.
Atoms and quarks and charms
zipped all over the place.
Something was acting like nothing
cause nothing had no use for anything
and neither did something.
Oxygen atoms had no use for one another
and certainly no use for hydrogen atoms.
And God said,
"Settle down and behave."
And they settled down
into solids and liquids and gases.
And when everything started behaving
God called it the Heavens,
because that's what it was.
But people call it the Universe
because it sounds more scientific.

Harry Lee Poe
Union University
Jackson, TN 38305
hpoe@uu.edu

Harry Lee Poe *serves as Charles Colson Professor of Faith and Culture at Union University. He has written or contributed to over twenty-five books, including* Science and Faith *and* Designer Universe *with Jimmy H. Davis. Poe also serves as president of the Edgar Allan Poe Museum of Richmond, Virginia, and as program director for the C. S. Lewis Summer Institute in Oxford and Cambridge.*

The Ultimate Wonder

Esther F. Siemens

When I consider all the world around,

I wonder how it all began to be,

How time could intercept eternity,

And thrust us into this reality.

The heart can only ask—How can this be?

Yet with the question comes an inward peace,

Although the mind continues asking how.

Though scientific knowledge may increase,

The wonder of it all will never cease.

We live and move in God's eternal now.

Esther F. Siemens
2703 E. Kenwood St.
Mesa, AZ 85213-2384
480-834-9188
efsiemens@juno.com

Esther Siemens, *a retired literature teacher, is now associated with the Grand Canyon Institute for Advanced Studies. For her, poetry has always been a way to set words to music. She is the mother of two children and grandmother of three. Esther lives with her husband in Mesa, Arizona.*

ASA Application/Subscription Form

(Subscribers complete only items 1, 2 & 8)

American Scientific Affiliation, PO Box 668, Ipswich, MA 01938-0668

1. Name (please print): _____ Date: _____

2. Home Address: _____

_____ Zip: _____

Office Address: _____

_____ Zip: _____

Home phone: _____ Office phone: _____

FAX: _____ E-mail: _____

I prefer my ASA mailings sent to: ❑ home ❑ office

I give permission to publish my home phone number in the membership directory: ❑ yes ❑ no

3. Sex: ❑ male ❑ female 4. If married, spouse's name: _____

5. Academic Preparation:

Institution	Degree	Major	Year

Field of Study (broad): _____ Concentration (2-word limit): _____

Briefly describe your present or expected vocation: _____

_____

_____

6. How did you learn about the ASA? _____

I am interested in the goals of the American Scientific Affiliation. Upon the basis of the data herewith submitted and my signature affixed to the ASA Statement below, please process my application for membership.

Statement of Faith

I hereby subscribe to the Doctrinal Statement as required by the Constitution:

1. We accept the divine inspiration, trustworthiness and authority of the Bible in matters of faith and conduct.
2. We confess the Triune God affirmed in the Nicene and Apostles' creeds which we accept as brief, faithful statements of Christian doctrine based upon Scripture.
3. We believe that in creating and preserving the universe God has endowed it with contingent order and intelligibility, the basis of scientific investigation.
4. We recognize our responsibility, as stewards of God's creation, to use science and technology for the good of humanity and the whole world.

Signature: _____ Date: _____

(required for Full Member, Associate Member, Student Member, Student Associate status)

7. If you are an active overseas missionary, please give the name and address of your mission board or organization to qualify for complimentary membership.

Mission Board: _____

Street: _____

City: _____ State: _____ Zip: _____

8. I have enclosed in U.S. funds (Please check one):

_____ $60, Full Member _____ $60, Associate Member _____ $60, Friend of the ASA

_____ $20, Student Member _____ $20, Student Associate _____ $10, Spouse

_____ $35, Subscriber

MasterCard or VISA: ☐☐☐☐-☐☐☐☐-☐☐☐☐-☐☐☐☐

Expiration Date: _____ Signature: _____

Name as it appears on your credit card: _____

(Please print)

Please mail to: American Scientific Affiliation, PO Box 668, Ipswich, MA 01938-0668

What Is the American Scientific Affiliation?

The American Scientific Affiliation (ASA) is fellowship of men and women in science an related disciplines, who share a commo fidelity to the Word of God and a commitmer to integrity in the practice of science. Founde in 1941, the ASA has grown significantly sinc then. The ASA's stated purposes are: "t investigate any area relating Christian fait and science" and "to make known the result of such investigations for comment and crit cism by the Christian community and by th scientific community."

How Do I Join The ASA?

Anyone interested in the objectives of th Affiliation may have a part in the ASA.

Full membership is open to all persons wit at least a bachelor's degree in science wh can give assent to our statement of faitl Science is interpreted broadly to includ anthropology, archeology, economics, engi neering, history, mathematics, medicine political science, psychology, and sociolog as well as the generally recognized scienc disciplines. Philosophers and theologians wh are interested in science are very welcome Full members have voting privileges and cai hold office.

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

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

Spouses may qualify for a reduced rate **Full-time overseas missionaries** are enti tled to a complimentary membership.

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

Subscriptions to *Perspectives on Science & Christian Faith (PSCF),* are available a $35/year (individuals), $55/year (institutions) and $20/year (students).

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

Phone: (978) 356-5656
FAX: (978) 356-4375
E-mail: asa@asa3.org
Web site: www.asa3.org

American Scientific Affiliation

Founded in 1941 out of a concern for the relationship between science and Christian faith, the American Scientific Affiliation is an association of men and women who have made a personal commitment of themselves and their lives to Jesus Christ as Lord and Savior, and who have made a personal commitment of themselves and their lives to a scientific description of the world. The purpose of the Affiliation is to explore any and every area relating Christian faith and science. *Perspectives on Science and Christian Faith* is one of the means by which the results of such exploration are made known for the benefit and criticism of the Christian community and of the scientific community.

Canadian Scientific & Christian Affiliation

A closely affiliated organization, the Canadian Scientific and Christian Affiliation, was formed in 1973 with a distinctively Canadian orientation. The CSCA and the ASA share publications (*Perspectives on Science and Christian Faith* and the *ASA/CSCA Newsletter*). The CSCA subscribes to the same statement of faith as the ASA, and has the same general structure; however, it has its own governing body with a separate annual meeting in Canada. Contact CSCA by writing to: Canadian Scientific and Christian Affiliation, PO Box 40086, 75 King St. S., Waterloo, ON N2J 4V1 or visit their web site at: www.csca.ca.

On the Web

Some **ARTICLES** published in *PSCF* are posted on our web site <www.asa3.org> under Topic Collections. Topics include:

About Science
Apologetics
Astronomy-Cosmology
Bible & Science
College Teaching & Research
Creation-Evolution
Dialogues
Education
Environment
Essay Reviews
Ethics
Historical Studies
Mathematics
Origin of Life
Philosophy
Physical Science
Psychology-Neuroscience
Science & Technology Ministry
World View
Youth Page

BOOK REVIEWS published in *PSCF* from 1990 are posted on our web site <www.asa3.org>.

For issues related to our **web site**, contact:
Web master Terry Gray: grayt@lamar.colostate.edu
Web editor Jack Haas Jr: haas.john@comcast.net

Indices to Back Issues

INDICES to back issues of the *Journal of the American Scientific Affiliation (JASA)* later named *Perspectives on Science and Christian Faith (PSCF)* are published as follows:

Vol. 1–15 (1949–1963), *JASA* 15 (1963): 126–32
Vol. 16–19 (1964–1967), *JASA* 19 (1967): 126–28
Vol. 20–22 (1968–1970), *JASA* 22 (1970): 157–60
Vol. 23–25 (1971–1973), *JASA* 25 (1973): 173–76
Vol. 26–28 (1974–1976), *JASA* 28 (1976): 189–92
Vol. 29–32 (1977–1980), *JASA* 32 (1980): 250–55
Vol. 33–35 (1981–1983), *JASA* 35 (1983): 252–55
Vol. 36–38 (1984–1986), *JASA* 38 (1986): 284–88
Vol. 39–41 (1987–1989), *PSCF* 42 (1990): 65–72
Vol. 42–44 (1990–1992), *PSCF* 44 (1992): 282–88
Vol. 45–47 (1993–1995), *PSCF* 47 (1995): 290–96
Vol. 48–50 (1996–1998), *PSCF* 50 (1998): 305–12
Vol. 51–53 (1999–2001), *PSCF* 54 (2002): 71–78

A keyword-based on-line **subject index** is available on the ASA web site at: www.asa3.org

Articles appearing in *Perspectives on Science and Christian Faith* are abstracted and indexed in the *Christian Periodical Index; Religion Index One: Periodicals; Religious & Theological Abstracts*, and *Guide to Social Science and Religion in Periodical Literature*. Book Reviews are indexed in *Index to Book Reviews in Religion*. Present and past issues of *PSCF* are available in microfilm form at a nominal cost. For information write: University Microfilm Inc., 300 North Zeeb Rd., Ann Arbor, MI 48106.