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 51, NUMBER 4

DECEMBER 1999

Perspectives on Science and Christian Faith

MANUSCRIPT GUIDELINES

The pages of *Perspectives on Science and Christian Faith (PSCF)* are open to any contribution 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. All manuscripts (except Book Reviews) should be addressed to: Roman J. Miller, Editor, 4956 Singers Glen Road, Harrisonburg, VA 22802. E-mail: millerrj@rica.net
2. Authors of *Papers* and *Communications* must submit **3 copies** of their paper for review purposes (an original and two copies).
3. Regular Papers should be accompanied by an *Abstract* of not more than 100 words.
4. All manuscripts should be typed double-space on good quality 8 x 11 paper (computer copies should be printed letter-quality).
5. References and footnotes should be collected at the end. Each note must have a unique number.
6. Figures and diagrams should be clear, black and white, line ink drawings or glossy photographs *suitable for direct reproduction*. Captions should be provided separately. Graphics (electronic file preferred) that enhance the theme of the paper are desired.

REGULAR PAPERS are major treatments of a particular subject relating science and the Christian position. Such papers should be at least 10 manuscript pages in length, **but not more than 6000 words**, excluding endnotes. 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**. Accepted Communications are normally published in 6–9 months from the time of acceptance.

NEWS & VIEWS are short commentaries on current scientific discoveries or events. Lengths range **from 200 to 2000 words**. Submissions are reviewed by the editorial board and are typically published in 3–6 months from the time of acceptance.

YOUNG SCIENTIST CORNER contains varied autobiographical submissions as well as notices of special interest to science undergraduate and graduate students and young science professionals who are entering the workforce. Submissions by students are encouraged and are typically published within 6 months.

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 books available for review are available from the Book Review Editor: **Richard Ruble, 212 Western Hills Drive, 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.

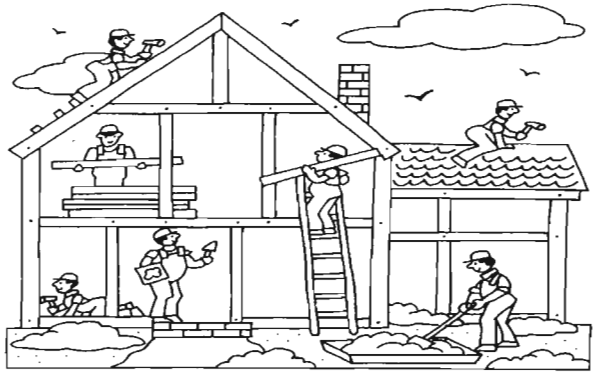
LETTERS to the Editor concerning contents of *PSCF* may be published unless marked not for publication. Any letter submitted for publication is subject to editorial review. Letters selected for publication will be published within 6 months.

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

PERSPECTIVES ON SCIENCE AND CHRISTIAN FAITH
(ISSN 0892-2675) is published quarterly for $30 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
http://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, P.O. Box 668, Ipswich, MA 01938-0668.

The View from Shepherd's Knoll...

Look Out! Construction in Progress!



A few years ago, my life was consumed by a major construction project—building our home on a Virginian hillside that we call "Shepherd's Knoll." Completing the basement foundation and walls provided a place to attach the first permanent pieces of wood that began to give shape to our modified Swiss-Chalet home. The ten months, spanning the time we first cleared trees and brush from our house site in March until the time that we moved into the house the following December, were filled with intense constructive activity. We are grateful for our house, which is functional, attractive, and "ours." I relish the southeast view from our home that catches the first rays of the morning sun rising over the top of Massanutten Mountain.

My life is in a construction mode corresponding to the writing of the Apostle Paul:

> *... each one should be careful how he builds. For no one can lay any foundation other than the one already laid, which is Jesus Christ. If any man builds on this foundation using gold, silver, costly stones, wood, hay, or straw, his work will be shown for what it is, because the Day will bring it to light* (1 Cor. 3:10b–13a [NIV]).

As a theologically conservative Mennonite in the Evangelical Anabaptist tradition, I build upon the Living Word, Jesus Christ, by embracing three foundational paragons. First of all, I am committed to the church, my "co-builders" who have voluntarily and communally entrusted themselves to the Lordship of Jesus as revealed through the Spirit and in Scripture. This local embodiment of Jesus provides direction, assistance, and discipline in constructing my personal life, my home, and my work. Secondly, the way of peace and love, as modeled by Jesus in the New Testament, is the "plumb bob" in my personal relationships, in my home and church, and even in the mission of my academic institution which seeks "to glorify God, to pursue excellence in all educational programs, and to challenge students to answer Christ's call to a life of service and peacemaking." Thirdly, discipleship means following the "blueprint" of Jesus by practically applying his teaching and example to my whole life. I read, interpret, and apply the entire canon of Scripture through the "lens" of Jesus. Choosing to follow Jesus directs me to walk a different path from our pagan culture.

In This Issue

Interested in the State of Kansas and the place of evolution in public education? Read Keith Miller's assessment of the situation in the News & Views section. Following Keith's article, David Siemens proposes that the outcomes from the action of the Kansas Board of Education may not fix a "pothole," but create a "sinkhole." Do you think his analysis is on target? Another hot topic today is the morality of using stem cells in research. Ken Roth thinks that a tempered stem cell research approach is appropriate. Darryl Maddox concludes the News & Views section by describing some tough scenarios in which science and Christian faith conflict. Darryl's answer to his question, "What do you do?" reminds us to be professional and exhibit Christian grace in these encounters.

In the Articles section, three manuscripts deal with issues related to origins. Clarence Menninga looks through the window of paleopathology and reflects on the impact that death in the fossil record has on theology. How does disease relate to God's good creation? Is physical death a normal event in creation or is it a consequence of the fall? Read Clarence's article to enlarge your perspective on this matter. Two authors, Armin Held and Peter Rüst, work at harmonizing the first two chapters of Genesis with science. Their

Thus, I believe that discipleship is more than a Christian way of thinking—it is also a Christ-like way of doing.

As the new editor of *PSCF*, I bring these construction paragons to my editing work. These paragons have defined me as a person; they will also, as I am faithful, define my editorship. I see our journal as a tool to build the kingdom of Christ among scientists who are Christians. I also see our journal as a "light on the hill" for our pagan, postmodern society. I am fortunate to follow in the footsteps of J.W. Haas, Jr., a master craftsman, who for many years has done a quality job in editing this journal. I want articles in our journal to be inclusive of science and faith issues that are important to the diversity of the membership of the American Scientific Affiliation. I hope readers will look to our journal to gain the current Christian perspectives on origins, biomedical and environmental ethics, science education, gender and sexuality issues, nature of the universe, functioning of the mind, as well as a host of other scientific issues!

In December of 1996, when we were concluding the main construction phase of our house and preparing to move into it, one obstacle remained—the final approval from the Office of the Rockingham County Building Inspection. I well remember the day when we received our occupancy permit: "You can now move into your house; the building complies with the county building code." That was a celebrative moment! In a similar vein, the Apostle Paul reminds us that a day will come when our edifice will be examined and given a final assessment by the Master Builder. In looking toward that day, I pray that my simple construction projects will reflect God's design, be helpful in building the Kingdom of Christ, and be judged as "well done." ❄

Roman J. Miller, Editor
millerrj@rica.net

anthropogenesis postulates that the description of Adam in Genesis 2 does not exclude Adam's descent from pre-existing hominids. Michael Roberts concludes this section of our journal by examining Michael Behe's understanding of design with the understanding of a nineteenth century geologist, William Buckland. The topic of Buckland's lecture, *Megatherium*, raises the question whether a Creator's design was evident in the structure of this monstrosity of a creature.

In our first Communications article, Gordon Mills assesses whether the generation of antibody diversity is a consequence of chance or design. George Blount then discusses ways in which our inventions—pendulums—give us insight into the creation of God.

In this issue we have categorized our book reviews into topical sections: Environment, Ethics, Faith & Science, Origins, and Philosophy & Theology. If your time is limited, consider scanning the reviews within the topical sections that especially interest you. Three letters to the editor conclude our journal issue.

You may have noticed the presence of cartoons! Does this mean our journal is turning into a fluffy tabloid? "No!" responds the editor. The cartoons of Sidney Harris featured in this issue and possibly in future ones are another way of seeing. While they may bring a smile, we hope they will also cause us to briefly reflect on ourselves, science, and our world.

Jocund reading, RJM

Wanted! Reviewers

The new editor of *PSCF* is enrolling a group of qualified persons who have the time and interest to review submitted manuscripts. Typically all manuscripts, published as Regular Papers or Communications, undergo peer review by two or three reviewers. The strength of a journal lies in the quality of the submitted manuscripts that are received as well as in the care and expertise of the peer reviewers. Active peer reviewers will be periodically recognized in the journal through the publication of an Honorary Reviewers List.

Prior to receiving a paper for review, the editor typically sends the abstract of the manuscript to a potential reviewer with the request for that reviewer to examine the manuscript. If a reviewer responds affirmatively to the review request, the editor sends a copy of the manuscript to the reviewer along with a manuscript review form. Reviewers are expected to return their written reviews for a given manuscript within three weeks after receiving the materials from the editor. Reviewer comments are sent anonymously to the author of the manuscript. Based on the collective input from the reviewers, the editor makes a decision to accept or reject a paper for publication.

If you are interested in serving as a peer reviewer, please send the following to the editor: (1) name, postal and electronic address; (2) phone and fax numbers; (3) academic or professional affiliation; (4) academic and experiential qualifications; (5) a list of four-five review topics fitting your interest; (6) the maximum number of manuscripts you can review annually; and (7) citations of two articles that you have published in the last fifteen years.

Call for Papers

In an attempt to increase the diversity of submitted articles, the editor has chosen to use a thematic approach. In a few upcoming journal issues, selected manuscripts in the categories of Regular Papers and Communications will be grouped around a particular theme. The themes are broad and encompass multiple disciplines. Each theme is described with some limited examples. Stretch your creativity beyond the listed examples. Current plans are to publish about two thematic issues in 2000. The other two other issues will be used to publish the variety of articles that are typically submitted which do not necessarily relate to a common theme. **All submitted articles should deal with the interaction between science and Christian faith in a manner consistent with scientific and theological integrity.**

Proposed themes for future issues:

- **Connections.** Articles dealing with interactions between mind/body, spirit/soul/body, physics/metaphysics, spiritual/material, etc. are requested. Illuminating explanations and insights for functional attachments and interactions between unlike entities are helpful. Deadline for manuscripts: May 1, 2000.

- **Renewal.** A major focus may be the physical ecological environment including renewable resources, Christian stewardship, etc. However consider also renewal in other modalities such as living organisms and cellular systems or psychological and theological realms. Deadline for manuscripts: August 1, 2000.

- **Ethics.** How shall we live? Article foci may include such things as medicine, health, the environment, professional behavior, education, philosophical foundations, etc. Deadline for manuscripts: December 1, 2000.

- **Science Education**, **Order and Chaos**, and **Health & Healing.** Aspects of these three themes are under consideration for 2001.

Manuscript submissions relating to these specific themes are invited. All manuscripts will undergo a normal peer review process prior to publishing. Each theme has a deadline for receiving submitted manuscripts. Early submissions are appreciated.

Post-graduate, graduate, and undergraduate students are urged to submit manuscripts for the "Young Scientists' Corner." These may include biographic pieces or general informative articles relating to Christian faith and science issues in their research and academic programs.

All readers are also invited to submit articles for the "News & Views" section. These are typically opinion pieces that relate to current issues and trends in Science and Technology.

Send manuscripts to: Roman J. Miller, Editor, *Perspectives on Science and Christian Faith*, 4956 Singers Glen Road, Harrisonburg, VA 22802.

Knowledge and Loving God: Reflections on Faith and My Graduate Experience

By Johnny Lin, ASA Student Member, jlin@alumni.stanford.org
3637 Clarington Ave #204, Los Angeles CA 90034

When asked at dinner parties about my job, I reply that I am a sixth-year Ph.D. student in atmospheric sciences at UCLA, working on theoretical models to help explain tropical climate variability on time scales of a few months. "Stuff like El Nino, but quicker," I say. This is usually enough to end the conversation, unless the person I am talking to happens to be curious about tomorrow's weather. We graciously move on to other topics, with the assumption that I reasonably enjoy whatever it is that I do.

Of course, the "rest of the story" is more complicated, for the most exciting aspect of my time in graduate school has been the way God has worked to draw me closer to himself. However, in this testimony of what God has done for me, I would like to do something a little different. Instead of describing my entire spiritual journey from my conversion as a child, or even describing the spiritual lessons God has taught me while in graduate school, I would like to focus particularly on how God has used the acquisition of knowledge during my graduate studies to "grow me" spiritually. Knowledge, in and of itself, is enriching. But God has also been using knowledge to draw me deeper into worship, to help move me from certainty to faith, and to teach me to exchange control for patience. By focusing on how God has used my studies to help change me, I hope to offer at least some small encouragement that our intellectual labors may also bear spiritual fruits.

Knowledge

Some say that the purpose of a graduate education in the sciences is to learn how to learn. Primarily through hands-on experience with an advisor's coaching, a graduate student learns what questions are worth asking, what qualifies as a believable demonstration of an idea, and what level of perseverance is required en route to a publishable result. At the end, the student has learned how to work as a scientist.

While this may be true, there is more. My advisor at Stanford University, where I did my first masters degree, once told me, "When you're an undergraduate, you don't know enough to know you don't know anything. It's only once you've become a graduate student that you learn enough to know that you don't know anything." Graduate school teaches perspective, a sense of the limits of what one knows.

Sometimes this comes through humiliation, when in conversations with your advisor you repeatedly wonder, "Why didn't I remember reading that?" Or sometimes this comes through frustration, when months fly by with cells repeatedly dying, or with computer programs repeatedly going unstable. And finally, sometimes the limits of what one knows come from realizing how ad hoc and incompletely we currently understand the creation.

But more fundamentally, the graduate experience teaches perspective not through ignorance, but through knowledge. Knowledge provides the food that nourishes perspective. This is a bit paradoxical, given that we often see knowledge as the root of arrogance; indeed, it often is. Feelings of humiliation, frustration, and surprise may help control tendencies toward pridefulness. There is, however, another level in which we cannot have a healthy sense of limits without a robust base of knowledge. Recognition of the limits of what you know requires recognizing both what is inside, as well as outside, the limits.

... the graduate experience teaches perspective not through ignorance, but through knowledge.

Thus, over the last five years of graduate work, what I have most appreciated about the academic life has been the freedom to gain knowledge—not to just lap it in, but to slurp it down in large gulps. This has occurred not just in the atmospheric sciences, but also in a variety of other fields of study, including theology, poetry, business, and history. In some of these areas, like business, the learning was formalized through course work. In others, I just read books. Although the breadth of my graduate experience might be unlike the experience of others, the focus on gaining knowledge is probably not. The knowledge that I gained has yielded a harvest of perspective.

Worship

While knowledge has helped me gain perspective, it has also been used by God to help "grow me" spiritually. God has used knowledge to lead me deeper into worship. Often, we in the sciences talk about how our study of the creation gives greater testimony of the grandeur of God. "For since the creation of the world," says Paul to the church in Rome, "God's invisible qualities—his eternal power and divine nature—have been clearly seen, being understood from what has been made."[1] My mind has long accepted this idea; only recently, through the knowledge from my studies, has this hit me at the level of awe.

Johnny Lin graduated from Stanford University with a B.S. in Mechanical Engineering and a M.S. in Civil Engineering – Water Resources. After working for two years as an environmental engineer, he returned to school to pursue a Ph.D. in Atmospheric Sciences at UCLA, where he is currently a sixth year graduate student studying tropical climate variability. Having grown up in Seattle, he appreciates the sunshine in LA, but misses the presence of green plants. When he is not lamenting the lack of certainty in his world, he enjoys eating a double scoop of daiquiri ice and French vanilla ice cream from Baskin-Robbins.

God has used knowledge to lead me deeper into worship.

Earlier this year, I taught a physical science class for nonscience majors at Biola University. During the unit on astronomy, we saw the video, *Power of 10*,[2] which uses microscope imagery, satellite imagery, and animation to show the different structures in the universe ranging from the components of a carbon nucleus to galaxy clusters. In the span of a few minutes, the film moves through some forty orders of magnitude of scale. As an undergraduate, I had seen this video in my introductory physics class, and had enjoyed it. Seeing it again, my response was quite different. I was literally shaken by awe. At the end of the film, I felt drained of energy, and would have collapsed to the floor if I did not feel it unseemly. I was in awe of God and his incredible power, because I understood, with a knowledge I did not have as an undergraduate, what each of those orders of magnitude in scale meant. "Oh, the depth of the riches of the wisdom and knowledge of God!"[3] The impact of this awe continued with me for several hours after class. Through the knowledge base I had gained beforehand, God deepened and enriched my experience of his glory.

Faith

I grew up in a conservative, moderately fundamentalist church. I feel privileged to have experienced the leadership of pastoral staff persons who were, and still are, devoted followers of Christ. But, as is characteristic of a more fundamentalist culture, I do not remember much discussion of the role of uncertainty and mystery in faith. This suited me just fine, since I have always had an allergic reaction to uncertainty. I want to be sure. Throughout my early undergraduate days, this showed itself in a desire to master logical demonstrations of God's existence to form a lock-tight case for faith. On the positive side, this desire for certainty pushes me to be more conscientious in my work. On the negative side, sometimes it makes me quite inflexible.

Curiously, God has used knowledge as an antidote for my need for certainty.

God has been helping me break my addiction to certainty by drawing me instead to rest deeper in faith. On one level, the two do not contradict. We have trust in our Savior because we are confident he has risen from the dead. Yet, on another level, certainty poisons faith. Certainty demands that an infinite God fit into categories a finite human being can grasp and understand. Certainty saps the ability of the heart to say, "not my will, but yours." To marry trust, one must first be a widow of certainty.

Curiously, God has used knowledge as an antidote for my need for certainty. As the years have passed, one of the recurring themes in my studies is a vision of the world as incredibly complex. Everywhere I look, I see many levels of activity, each differing in complexity, each not fully explained by their constituent parts. In my field of research, I find that the atmosphere is both inherently chaotic and unpredictable as well as embedded with modes of regularity. There are no simple systems, only a tangle of causes and effects that leads me to regard almost every solution as provisional. I see no easy answers. For some, the response to a world of seemingly contradictory answers is relativism. Is not postmodernism, on one level, an attempt to make sense out of chaos by abandoning any requirement for order? In myself, however, God has somehow used the knowledge of uncertainty to draw me to trust him more. I see chaos and order in-

tertwined, and my appreciation of the mystery of God grows. I struggle to find the right solution for a problem, and the intractability of the situation somehow points me to trust God, not just in a fatalistic manner, but to trust him for good. On one level, I find it hard to explain how God uses this uncertainty to draw me to faith. Yet, at the core of my being, it has the ring of truth to it. For it would seem strange if the purpose of God's existence, or that of creation, was to be merely understood.

Patience

Patience is often associated with inactivity. This is a tragic mistake. Donald McNeill, Douglas Morrison, and Henri Nouwen explain: "True patience is the opposite of a passive waiting ... Patience means to enter actively into the thick of life and to fully bear the suffering within and around us."[4] Why? Because, "patience requires us to go beyond the choice between fleeing or fighting ... patience is a willingness to be influenced even when this requires giving up control and entering into unknown territory."[4] At its heart, patience is deeply connected with surrendering one's authority, the insistence for circumstances to conform to one's will.

At its heart, patience is deeply connected with surrendering one's authority, the insistence for circumstances to conform to one's will.

Patience of this variety has been somewhat of a rare commodity for me. Even more than one who desires certainty, I am the type of person who desires control. Not so much control of others (although I have had more than my share of problems with that), as much as control of myself. I want all my thoughts and actions to have a reason and purpose, preordained and guided by myself. Why do I feel a certain way? Should I feel that way? How should I react? All this results in a lifestyle of order and analysis, but severely limits spontaneity and joy.

The story of God's work in weaning me from my need to control is a fairly recent one; much of my progress has occurred in the last year or so. It is a complicated story, involving personal traumas, heartache, sorrow, and the crushing of hope. As the details are not that pertinent to the question of how God has used my graduate studies to grow my faith, I leave them for another time.

Knowledge was the personal trainer that built up the strength I needed when I was suddenly thrust into a race.

However, what is pertinent is that the knowledge gained during my graduate studies has drawn me to desire a controlling lifestyle less and to move to engaging life more. Knowledge created conditions making me receptive for God's use of the personal trauma that came to me. Knowledge was the personal trainer that built up the strength I needed when I was suddenly thrust into a race. What happened was this: somehow, through all the reading and learning over the past five years, a space in my heart was slowly and imperceptibly being banged out. By this, I do not mean that I was becoming more compassionate. Rather, I mean that the capacity of my heart to hold "more" was increased. This resulted directly from the uncertainty I have previously mentioned, generated by the growth of knowledge. To properly hold the uncertainty, I had to expand the dimensions of my heart; my heart had to become more accepting. But as a side effect, I found I had more heart available for God to stretch and fill up with himself when the personal problems began about a year ago. I had more heart to enable me to ask God for help to fully enter into the joy and the pain I was feeling. I had more heart to ask him to

In learning how to love God with my mind, it turns out that God has also been using my mind to show his love to me.

grow in me a heart of flesh, not of stone. Thus, paradoxically it was "book learning," usually associated with dry intellectualism that helped make this "heart surgery" possible during my time of trouble.

My advisor thinks I can probably finish up by June of next year, so it looks like my days as a graduate student are numbered (knock on wood)! As I reflect on these last five years, and the way God has used my graduate studies to draw me closer to him, I am heartened by how much God sees the boundaries between the various "parts" (heart, mind, etc.) that make up "me" as porous and violate. Instead of compartmentalizing, God appears to use each and every part of my being to work together to "grow me" spiritually. Thus, the knowledge gained through my studies, far from being valuable only for its usefulness in getting me a job, instead has been interconnected with the very core of my person as I grow in worship, faith, and patience. In learning how to love God with my mind, it turns out that God has also been using my mind to show his love to me. ❄

Notes

[1] Romans 1:20 (NIV).
[2] Charles and Ray Eames, *Powers of Ten* (Santa Monica, CA: Pyramid Film and Video, 1978).
[3] Romans 11:33 (NIV).
[4] Donald P. McNeill, Douglas A. Morrison, and Henri J.M. Nouwen, *Compassion: A Reflection of the Christian Life* (New York: Image Books, 1982), 93.

Books Received and Available for Review

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

C. S. Carnell, *Bright Shadow of Reality: Spiritual Longing in C. S. Lewis*, Eerdmans, 1999
David Clark, *Dialogical Apologetics: A Person-Centered Approach to Christian Defense*, Baker, 1999
Eugene d'Aquili & Andrew B. Newberg, *The Mystical Mind: Probing the Biology of Religious Experience*, Fortress Press, 1999
Ken Gnanakan, *God's World: A Theology of the Environment*, SPCK, 1999
R. S. Gottlieb, *A Spirituality of Resistance: Finding A Peaceful Heart and Protecting the Earth*, Crossroad, 1999
John Hitchcock, *Healing Our Worldview: The Unity of Science and Spirituality*, Chrysalis Books, 1999
Ruth & Elijah Hubbard, *Exploding the Gene Myth: How Genetic Information Is Produced and Manipulated*, Beacon Press, 1999
Max Jammer, *Einstein and Religion*, Princeton Univ. Press, 1999
Michael Molnar, *The Star of Bethlehem: The Legacy of the Magi*, Rutgers Univ. Press, 1999
John Oswalt, *Where Are You God? Malachi's Perspective on Injustice and Suffering*, Evangel, 1999
Ted Peters, ed., *Science and Theology: The New Consonance*, Westview, 1998
Richard Petersen, *New Insights to Antiquity: A Drawing Aside of the Veil*, Engwald, 1998
Paul Rabinow, *French DNA: Trouble in Purgatory*, Chicago Univ. Press, 1999
Ronald J. Sider, *Just Generosity: A New Vision for Overcoming Poverty in America*, Baker, 1999
Tom Sine, *Mustard Seed versus McWorld: Reinventing Life and Faith for the Future*, Baker Book House,1999
Brian Swimme, *The Hidden Heart of the Cosmos: Humanity and the New Story*, Orbis, 1996
Ray Tallis, *The Explicit Animal: A Defence of Human Consciousness*, St. Martin's Press, 1999
Arne Wyller, *The Creating Consciousness: Science As The Language Of God*, MacMurray and Beck, 1999

News & Views

The Controversy over the Kansas Science Standards

by Keith B. Miller, ASA Fellow, kbmill@ksu.ksu.edu
Department of Geology, Kansas State University, Manhattan, KS 66506

First, some words about how the current situation developed. As part of an effort to develop clearer, more effective guidelines for public school curricula in Kansas, the State Board of Education appointed a 27-member committee of K–12 science teachers, science educators, and scientists to develop a science standards document. Over a thirteen-month period, it went through several drafts and several rounds of public comment. During this process, there was considerable opposition by certain Christian groups who sought the elimination of evolution from the curriculum. In the end, the resulting document was really quite well written and stressed both the nature and methodologies of science as well as several unifying theories and concepts (including evolutionary theory) that cut across disciplines.

This standards document was before the State Board of Education for three months awaiting approval. However, one state board member put forward an alternative proposal that had completely bypassed any process of review or public comment. It was largely ghostwritten by members of a local creation science organization. This document eliminated any mention of evolution and also removed reference to any unifying scientific theories. It rather put the focus on "technological science," and dismissed "theoretical science" as unproved speculation with little practical application. Fully half the members of the State Board of Education (an elected body under no other political, educational, or legislative body) favored this proposal over the document developed by the education committee, resulting in an immediate deadlock.

In the last turn of events, three members of the Board rewrote the standards to produce a "compromise" document. While not including the more objectionable parts of the alternate proposal, it still eliminated the theory of evolution as a model for understanding the history and diversity of life. Furthermore, it does not mention cosmology (Big Bang) or the Age of the Earth. It also includes errors of fact and misrepresentations of scientific methodology and content. This version passed the Board on August 12, 1999 by a 6 to 4 vote. The original standards document written and unanimously endorsed by the appointed committee was not even brought to a vote. This decision was made in opposition to the recommendations of virtually every scientific and educational body in the state. The Governor of Kansas and all of the presidents of the regents' institutions (state universities) appealed to the Board to reject the alternate document. The academic and educational communities are very irritated by the current situation.

The new science standards do not require or mandate teachers to teach anything. They certainly do not mandate the inclusion of creationism. What they do is establish the content of statewide assessment tests, and thus serve as recommendations for which topics and principles should be emphasized at each grade level from K–12. Teachers and local school boards are free to establish their own curricula. However, the exclusion of evolutionary theory as an explanatory framework for the history of life and as a unifying concept in the biological sciences, the exclusion of theories of the origin of the universe (Big Bang model of cosmology), and the removal of references to a very ancient Earth history from the standards have significant implications. These omissions are critical, and remove the core unifying concepts from the sciences of biology, geology, and astronomy. Since they will not be subject to state assessment tests, these concepts are much less likely to be taught in districts where there is vocal opposition. By throwing the issue to "local control," the state board leaves teachers much more vulnerable to complaints by parents or administrators eager to avoid controversy. Furthermore, the decision is already having an impact on textbook publishers. Since the decision, one publisher has removed an introductory chapter on the geologic history of Kansas from a history textbook for fear that it would limit sales.

Aside from the impact on public education, the decision of the Board reflects several widely held misconceptions about the nature of both science and religious faith. Those seeking the elimination of evolution see current scientific and theological descriptions as being mutually exclusive and contradictory. The warfare view of science (particularly

evolutionary biology and geology) and faith is assumed. But this view has been soundly refuted by a multitude of historical studies. For example, several of the founders of modern geology were committed Christians. Young Earth views were virtually absent among Christian apologists until well into this century. The primary proponent of Darwin's ideas in North America was Asa Gray, who was a committed evangelical Christian. Furthermore, several contributors to the "Fundamentals" (a series of volumes from which the name "fundamentalist" derives) accepted some form of evolution. Many scientists presently teaching at the leading evangelical Christian colleges accept evolution as a powerful and well-supported theory of biological origins. My point here is that there is no necessary, inherent conflict between an ancient evolving Earth and a high view of the authority of Scripture.

Another major misconception is that science is simply the accumulation of observational fact, and theories are merely unsubstantiated guesses. This "facts only" view of science misses the core of what the scientific enterprise really is. In my opinion, nothing could be more deadly to teaching science than to divorce it from the unifying theories which give meaning to observations. They make the world comprehensible. They also generate the testable hypotheses (expectations) that drive further exploration and discovery. When science is taught as only factual observation (something the standards passed by the Board would encourage), then disagreements among scientists and changing scientific views are seen as weaknesses and failings of scientific knowledge. However, the exact opposite is the case. It is the dynamic, changing, self-correcting nature of science that is its very strength. The less science is seen as a body of established knowledge, the more inherently interesting and exciting it becomes. ❄

The "compromise" standards that were passed can be viewed at <http://www.ksbe.state.ks.us/cgi-bin/science_stds> and the committee-developed standards (that included evolution as a unifying theory of the biological sciences) can be viewed at <http://www.kabt.org>. The original "creationist" alternate standards can be viewed at <http://www.geocities.com:80/CapitolHill/Parliament/6215/index.html>.

The Kansas Board of Education Action: Potholes into Sinkholes

by David F. Siemens, Jr., ASA Fellow,
dfsiemensjr@juno.com
Mesa, AZ

Since the version of the Science Education Standards passed August 12, 1999, by the Kansas Board of Education was crudely revised by striking out items from the fifth-draft version produced by more than two dozen teachers, consultants, and professors, it requires revision. Its final version was not available in the middle of September at the time of this writing. Consequently, the results may differ slightly from those discussed. But the apparent ramifications are broader than generally realized.

The first and most obvious effect will be to exclude mention of evolution and evidence for an old universe from the statewide achievement tests scheduled for 2001. Since the content of high school courses sometimes springs from teaching to the tests, excluding mention of evolution in the tests may remove it from the classroom. A teacher who tries to introduce the excluded topics is open to any parents' challenge, "Why are you teaching what my child does not need to know to graduate?"

What other effects will it have on students? Unless the national tests produce a special edition for Kansas, those who take the SAT for example, will be penalized for their ignorance of evolutionary and cosmological theories unless they have done outside reading on the subjects, which is what the Board intended to exclude. There is also the question of how admissions officers might view a test tailored to a limited area. In either case, it is not likely to benefit the majority of students. This appears to be grounds for a successful lawsuit.

In addition, the specified topics are only a small part of the total problem for those who espouse young-earth creationism. For example, the students not only need to be protected from radioactive dating, which has been deleted, but also from the area of physics on which the dating is based, including fusion and fission devices and the stellar reactors. It was reading the journal articles on radioactive dating which first convinced me that recent creationism is false.

Sheltering the students from plate tectonics requires eliminating reference to satellite positioning, which is now accurate enough to measure, for example, the movement of the Indian plate into the Eurasian plate and the ongoing elevation of the Himalayas. This orogeny demonstrates that plate tectonics supports an old earth. Also, all mention of the large meteor craters, like those in Yucatan and Canada, must be excluded, for a calculation of their minimum effect precludes their happening in the post-diluvian period.

Reference to the Hubble telescope is included in the draft that was passed by the Board. Unfortunately for those who hold the universe to be no more than a few tens of thousands of years old, many of the Hubble telescope observations refer to objects hundreds of millions and billions of light years away. Even our neighboring Andromeda Galaxy, visible to the naked eye, is about two million light years distant. So, unless Kansans are restricted to naked eye astronomy, some of the students are likely to raise questions about years. Of course, a return to the Ptolemaic system, with all the fixed stars equidistant, could prevent the questions that otherwise must arise. The alternative, a God who misleads, is worse.

Also included in the passed version is the statement that past and present earth processes are similar, along with references to erosion and the deposition of the eroded material. Either at least one of these statements must be eliminated or students have to be sheltered from ever hearing about varves and similar layered deposits.

Any of these items which come to the attention of inquiring students will lead them to ask why they are being excluded from the facts. The effect will tend more toward doubt of the protected view than toward confidence in creationism. Of course, proscribing something always seems to make it more attractive to adolescents. Hence, this action by the Board may prove to be one of the more counter-productive attempts by supporters of young earth theories. It seems probable that including the deleted material with the express provision that the student should understand it and that "'understanding' does not mandate 'belief,'"[2] is more desirable. ❄

Notes

[1]The documents may be found at www.kabt.org.
[2] Kansas Science Education Standards, fifth draft, p. 53.

Stem Cell Research: Potential Life-Saver or Just "Playing God?"

by Kenneth E. Roth, Assistant Professor of Biology, Eastern Mennonite University, Harrisonburg, VA

Recent advances in the isolation and culture of human pluripotent stem cells have opened the doors to avenues of research not previously investigated. The possibilities afforded by these advances may be met by both excited enthusiasm on the one hand, and a degree of fear and hesitation on the other. While the medical applications are potentially great, one must also remain aware of the equally great potential for abuse.

Stem cells are defined as cells that are both self-renewing and also able to give rise to other more specialized types of cells. Totipotent stem cells are those that can differentiate into all the different cell types of the mature organism. For example, a human fertilized ovum has the ability to form an entire human being (it has total potency). While viable human offspring have resulted from the implantation of such a fertilized ovum into the uterus of a suitable woman, the technology does not presently exist that would enable us to create a human being without her. However, the possibility of developing that technology raises obvious ethical issues that will likely one day need to be addressed. This discussion will focus on a different type of stem cell, the pluripotent stem cell, which can give rise to many types of cells in the organism, but not all types.

Human pluripotent stem cell lines have been derived from cells taken from the inner cell mass of human embryos at the blastocyst stage and from fetal tissue obtained from terminated pregnancies. The continued use of either of these sources will certainly lead to some level of disapproval from the public, and will undoubtedly require substantial justification and documentation on the part of the investigator (informed consent, etc.). Another option for deriving pluripotent stem cells is the use of somatic cell nuclear transfer (SCNT). In this procedure, which is still being developed, the nucleus is removed from a normal animal egg cell, and what remains is fused with a somatic cell from the same animal. The resulting fused cell is believed to be totipotent and can soon form a blastocyst. Pluripotent stem cells can then be isolated from the inner cell mass.

The uses of pluripotent stem cell research are potentially valuable. Stem cells can help us gain a better understanding of human development. The "signals" that cause a stem cell to differentiate along a given lineage are largely unknown. Identifying microenvironmental factors that dictate these decisions may prove helpful in developing therapies for medical conditions such as cancer and birth defects that are due to abnormal cell differentiation and cell division.

Stem cell research will allow the preliminary stages of drug testing to be conducted in tissue culture flasks, rather than in laboratory animals or humans. Using pluripotent stem cells in these tests will not replace testing at the organismal level, but it can be used to screen candidate drugs so that only those deemed the safest would be used in animal or human testing.

After the necessary decision-making signals are discovered, a more exciting consequence of stem cell research is that many different types of cells and tissues can be grown in the laboratory. The laboratory cultures may be used to restore tissue that has been damaged due to injury or disease. The applications are wide-ranging. One possibility is transplanting cultured heart muscle cells to restore cardiac function in patients with chronic heart disease or following myocardial infarction. This type of transplant has already been done successfully in mice. Other possibilities include treatment of spinal cord injuries, stroke, diabetes, Alzheimer's disease, burns, arthritis, and many others.

I believe that the positive outcomes of stem cell research are very promising and should be pursued. Yet, this research must be tempered by an awareness of the potential for its abuse. For example, one might envision the engineering of taller and stronger athletes by the implantation of additional pituitary gland somatotrophes and muscle cells, for example. With minimal strain on the imagination, a long list of such abusive applications easily comes to mind. For this reason, research in this area should be carefully monitored and regulated to ensure that it is both ethical and scientifically valid. ❄

ASA's E-mail Address
asa@asa3.org

What Do You Do?

by Darryl W. Maddox, ASA Member, dpmaddox@arn.net
Instructor in Geology and Physics,
Amarillo College, Amarillo, TX

Consider these situations:

- You are walking down the science building hall when you glance at the bulletin board by the geology lab, and notice a sign that says: "Learn the *truth* about Creation Science and the facts about the evolution *myth*." You attend the advertised meetings. For five nights you listen to a retired highway patrolman tell how easy it is to prove that those geologists are wrong. He claims that all one needs to do is just listen to the tapes and read the books. Everything is there in black and white—and free to boot! What do you do?

- It is a Thursday afternoon when your wife shows you an eye-catching advertisement for a church-sponsored lecture series featuring "Dr. Jones." You go, and for two nights you listen to a dentist describe the same thing it took the highway patrolman five nights to describe. However, for good measure, "Dr. Jones" throws in some comments about how the methodology she learned while doing her graduate research proved radiometric dating cannot be right because there is no way to test the model before the tests are run. What do you do?

- You are sitting in your faculty office when a student comes in looking a bit unsure and says, "Would you mind reading this and telling me what you think?" Scanning the book, you see that it is written by a Ph.D. computer scientist. One chapter describes tulips in the stomachs of the woolly mammoths found in Alaska. Another chapter includes some nice quips about circular reasoning in using fossils to date rocks and rocks to date fossils. What do you do?

- You are at a choir cookout when you hear one of the choir members say, "I wish I could afford to send my kids to a private school, because I don't want anyone teaching them that evolution nonsense." He knows you are a geologist; he just assumes you agree with him because you go to the same church. What do you do?

- You are at a Bible class social when the teacher says, "Well, it's easy to prove Noah's flood. Just go over to Sandia Peak and look at all the sea

shells in the rocks on top of the mountain." She never stopped to think that what she had just said did not make perfectly good sense. After all, she was only repeating what she had heard a Ph.D., who claimed to know about geology, say on a videotape. What do you do?

Since I started teaching geology at a community college four years ago, situations like these have caused me to do some real hard thinking about my role as a scientist, an educator, a church member, and a friend. How should we, as scientists, Christians, friends, and members of our community (sometimes on the payroll of our community) react when we encounter such situations?

Obviously, making and receiving corrections is part of the daily world of the scientist and teacher. Most corrections are made within a common paradigm and carry no inherent challenge to either our professional standing or to our credibility as a Christian. Rarely do they endanger our friendships. However, when someone espousing a different paradigm makes the errors, the matter of making the correction carries an extra weight. We should ask ourselves: Are we behaving professionally? Are we behaving in a Christian manner? Are we questioning the speaker's professional competence or integrity? Are we casting dispersions on the Christian character of the speaker or book author? Are we acting within the proper function of our position within the church body, the community, or the college faculty?

Answers to these questions may be far more important with those who doubt the traditional earth and life history paradigms than the factual or logical matters themselves. I also believe how we conduct ourselves may be far more influential to the rest of our community than our knowledge. I believe such encounters will significantly influence the future of both science and religious education in America for some decades. It is up to us to make that influence a positive one.

I am not upset by the situations that I listed in the opening. As odd as it may seem to you, and it certainly seems odd to most of the people with whom I teach and work, I actually enjoy the free exchange of ideas and encourage others to jump into the fracas! I see these encounters as opportunities to show people that scientists, and particularly earth scientists, are not necessarily the cold-hearted, ruthless atheists that some think we are. These circumstances are wonderful opportunities to teach people about geology, earth history, the power of logic in analyzing controversial issues, and various views on interpreting the Bible.

In the past two decades, an increasing number of well-trained physical and life scientists have expressed views contrary to the traditionally-accepted paradigms of earth history. Also, a general trend toward more public involvement in the discussion of scientific matters has developed. This has led some to believe that all views are equally justified. Relevant material is increasingly available to the nonspecialist but it is matched by a large quantity of erroneous material available through the internet and privately-published sources.

The combination of a rise in public involvement, an increase in the background diversity of the participants, and the abundance of misinformation has created a set of conditions which affect our decision about whether it is appropriate to respond, and if so, what kind of response to make. These conditions include the following:

1. Variation in the academic and experiential qualifications of the debaters is more extreme than in most other areas of conversation. Consequently, some debaters do not know enough to understand your correction should you offer it.

2. Persons in public speaking have an emotional interest in what they are presenting, even though they may lack the appropriate education and experience to really understand their topic. They may think that because they have read a few books or heard a few talks they are fully qualified to discuss their topic. This combination of emotional involvement and belief in their qualification can cause an attitudinal problem that bars successful communication.

3. In an effort to make the issues simple enough for lay people to understand within the time available for the presentation, writers and speakers on both sides have simplified data and arguments to the point that they are more easily misunderstood than understood.

The result is that there is no simple way to respond to a statement containing a logical or factual error. To be most effective, our response needs to be tailored to the person making the statement and to the circumstance in which the statement is made. If we decide to respond, we should have an objective, and we should respond in a manner that is likely to achieve that objective. Sometimes I decide it is just

better not to respond. But, when I choose to respond, my objectives are generally to:

1. Make the speaker aware of my belief that an erroneous statement has been made or that logical fallacies have been committed and give them an appropriate reference that supports my logic and understanding of the facts.

2. Assure them that I am not challenging their professional competence, ethics, Christian faith, or whatever else they may value and think that I am challenging.

3. Let them know I am interested in any information they may have which is contrary to what I have said.

4. Ask for references that support their information if these were not provided in handouts or by some other means.

5. Try to establish a correspondence with them to exchange information and views.

To accomplish these goals, I have found it best to make the person aware of my concerns in a private conversation after the talk or presentation. With a smile on my face, I sincerely try to compliment them on some aspect of their talk or presentation that I really did think was good. Never, never do I criticize or question their religious beliefs. If I have any credibility, it is as a geologist, not as a theologian.

Here are some examples of factual and logical errors I have encountered and how I have tried to correct them:

1. *The complete geologic column cannot be found anyplace on earth,* and/or variants of this, such as *the geologic column exists only the minds of geologists.* I refer them to the *Impact* article, in which Steve Austin listed this idea as one of the ten misconceptions about the stratigraphic column, and to the *CRSQ* article by John Woodmorrape, in which he showed that about four percent of the earth's surface was underlain by the complete column.

2. *Using fossils to determine the age of rocks when the age of the rocks are used to determine the age of the fossils is circular reasoning.* I point out that the sequence of the rocks was worked out first based on the law of superposition. Then, using the concept of faunal succession, geologists developed the concept of index fossils. At the time (before Darwin published), geologists did not have the entire column in one place from which to work. However, since we have now seen its existence in several places, the order is proven correct.

3. *Radiometric dating can only be done on igneous rocks.* I provide references to books showing the use of ash falls or igneous intrusions to establish boundary dates and to the article in the July 1999 issue of *Science* about using the mineral xenotime.

4. *There is no way to check for the validity of the assumptions inherent in radiometric dating.* I refer them to the FAQ at http://www.talkorigins.org/ and to freshman geology textbooks.

5. *The concept of uniformitarianism means all geologic processes are slow.* I point out that this is a "straw man" argument because that is not what uniformitarianism means. I illustrate the lack of plausibility of such an interpretation by talking about volcanoes, hurricanes, and spring floods.

6. *Radiometric ages are not "absolute" as presented by traditional geology.* I indicate that this is an error of equivocation that hinges on the meaning of the word "absolute." I show them a freshman text that explains how we use the word "absolute."

7. *The age of the Mississippi delta proves the earth is young.* I explain that this is an error where the premise is irrelevant to the conclusion. The age of a delta no more sets the maximum age for the underlying crust than the age of a house sets a maximum age for the dirt upon which it rests.

The best benefit of trying to correct such errors is that I have become acquainted with many people of different backgrounds and beliefs. Our conversations have given me many new references to scientific papers and internet web pages. I have grown both in my appreciation for beliefs others hold about Christianity and in my own views of the data and interpretations of historical geology. ❄

Disease and Dying in the Fossil Record: Implications for Christian Theology

Clarence Menninga*
menn@calvin.edu

Calvin College
Grand Rapids, MI 49546

A traditional view among Christians has been that death of all sorts is a consequence of Adam's disobedience and fall into sin. Beginning about two hundred years ago, the study of rocks led many Christians to accept the conviction that the Earth is vastly older than six thousand years, and the study of fossils found in the rocks brought Christians to face the question of death among plant and animal organisms prior to the existence of humans. While death before the Fall is still a hurdle for some Christians, many of us have come to accept this scientific conclusion as being compatible with a proper understanding of Scripture. A topic which has not been the subject of much discussion among us, however, is the matter of disease and trauma in fossil organisms, including pre-Adamic hominids. This study, called "paleopathology," demonstrates the presence of disease and trauma in many fossil plants and animals prior to the existence of humans on Earth, and faces Christians with the question of the relationship of disease to God's good creation. A brief description of some of the evidence for disease and trauma in fossil organisms serves as the impetus for discussion of the teaching of Scripture with regard to disease, trauma, and dying.

Much evidence has been collected from the study of God's world which supports the conclusion that the Earth and its fossils are vastly older than the several thousand years that were espoused by Bishop Usscher and are still being proposed by a significant number of Christians. This paper is written in the context of a conviction that the history of the Earth and its living organisms has extended over billions of years. There is abundant evidence in the fossil record justifying the conclusion that dying has been an integral part of the existence of living organisms on Earth. The very existence of a fossil older than human existence on Earth demonstrates the occurrence of death among living organisms prior to human disobedience and sinfulness. While death of living organisms prior to human sin is an unacceptable conclusion for some Christians, many of us are convinced that such a conclusion is amply testified to by the evidence, and that this conclusion is compatible with historic Christian faith.

There is also a preserved record of disease and trauma in fossils spanning much of the history of living organisms on Earth. Evidence of pathological conditions are found in a wide range of organisms, including plants, insects, dinosaurs, mammals other than hominids, hominids other than modern humans (*Homo sapiens sapiens*), as well as in modern humans of ancient times. These observations raise questions for Christians that have not been discussed much in our theology, i.e., questions about the origins of disease and the relationships between disease and the fall of humans into disobedience and sin. The fossil evidence argues against the common perception that disease and trauma are the consequence of human sinfulness. This paper is written in the hope of instigating and furthering the discussion by Christians about the relationships among disease, human sinfulness, and redemption in Christ.

*ASA Member

Observational Evidence

In addition to the testimony to death and dying that is presented by the existence of a fossil record, there is a large amount of evidence for disease and trauma in living organisms spanning much of the history of life on Earth. A few examples of such evidence in plants, insects, dinosaurs, mammals other than hominids, and in hominids are presented in the figures accompanying this paper. (Figures are reprinted with permission.)

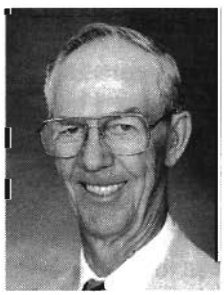
Figure 1 shows galls on fossil oak leaves which are approximately fifteen million years old. Figure 2 shows a termite preserved in amber along with the fungus infection which had invaded its body prior to its death and preservation. Figure 3 shows the preserved parts of the forelimb of a Tyrannosaur, which lived approximately seventy million years ago, with damage to its humerus resulting from injury sustained during its lifetime and healed prior to its death and preservation. Figure 4 shows a diseased rib from a woolly mammoth, along with graphical data on disease in Pleistocene elephants in Britain. (Glacial and interglacial periods are identified by European nomenclature. The Cromerian interglacial period began approximately 1.5 million years ago, and the decline of the Devensian glaciation took place approximately fifteen to eleven thousand years ago.) Figure 5 shows three different views and an x-ray view of the right humerus of a Neanderthal individual whose skeleton was excavated from Shanidar Cave (modern Iraq). This individual lived approximately seventy thousand years ago. The humerus displays atrophy from paralysis (or possibly hypotrophy from a birth defect). The bone had been broken in at least two places, and had healed during the individual's lifetime. The arm had been severed just above the elbow, either by some accident or by amputation, and healing had occurred before the individual died. Figure 6 shows the diseased right ankle and foot bones of the same Neanderthal individual whose arm is shown in Figure 5.

Other examples of pathological conditions found in fossil organisms have been published in the scientific literature. The *Smithsonian* printed a summary of a paper presented at a University of Texas symposium in Nov 1989 in which evidence was presented for "broken limbs, dislocated hips, severe back injuries, and chronic arthritis" in many of the study's two thousand saber-toothed tigers from the La Brea tar pits of California.[1] A discussion of feeding behavior in carnivorous dinosaurs in *The Dinosauria* reports: "Carnosaur skeletons exhibit signs of more frequent injury than those of herbivorous dinosaurs. Broken ribs are found in *Tyrannosaurus rex*, fractured humeri in *Albertosaurus libratus* [see Fig. 3], and fractured humeri and radii in *Allosaurus fragilis*; all had healed. These suggest that struggles with prey did take place ..."[2] An article in the Nov 1991 issue of *Discover* magazine is entitled "Dinosaur Doctors" and subtitled "Tracing Modern Disease to the Ancient Reptiles." The article reports finding evidence of rheumatoid arthritis in dinosaur skeletons, as well as in pre-Columbian native American skeletons and in modern humans.[3] The connection between ancient dinosaur disease and modern human afflictions is only suggestive, but the existence of disease in various ancient organisms is beyond dispute. So disease and trauma, along with earthquakes and tornadoes, are somehow a part of God's good creation, in existence long before the Fall of humankind into sin and disobedience.

Theological Discussion

But how is the history of disease, trauma, and dying in living organisms to be taken into account in our Christian theological perspective? Are disease and dying a normal aspect of our creatureliness as humans (in our state as *sinless* creatures) as it is for plants and other animals?

If we accept the antiquity of the Earth and its fossils, as many or most Christians do, the dying of plant and animal organisms is a normal part of the



Clarence Menninga is Professor of Geology, Emeritus at Calvin College in Grand Rapids, Michigan. He completed his undergraduate study at Calvin College, earned the M.A.T. at Western Michigan University, and the Ph.D. (Chemistry) at Purdue University. He joined the faculty of Calvin College in 1967, and pioneered the establishment of the geology program at Calvin. He is co-author (with Howard Van Till and Davis A. Young) of the book Science Held Hostage, *and has published numerous articles on the relationship of science and Christian faith in denominational and Christian school journals.*

processes taking place in God's creation. While many preachers and other Christian leaders have accepted the conclusion that dying occurred among plants and animals long before humans existed on Earth, they have not generally spoken or written about disease and trauma as experiences which are a normal part of our human existence. Many Christian sermons, especially at funerals, attribute disease and physical suffering in this world to the consequences, if not the curse, of human sinfulness. But, if the evidence cited earlier is valid, it must be the case that disease, too, is a normal component of God's good creation.

It has also been commonly supposed by many Christians that the dying of humans is the consequence of human sinfulness, and a result of God's curse pronounced in Genesis 3. While many preachers and other Christian leaders have accepted the idea that death occurs among plants and other animals as a normal part of God's good creation, many sermons, especially at funerals, refer to the dying of humans as "not the way it was supposed to be."

... physical death is a normal and expected aspect of life on Earth, and ... the dying which follows sinfulness is a spiritual dying ...

What is the teaching of Scripture? Are there some alternative perspectives which are consistent with good exegesis of Scripture? Yes, there are. In Genesis 2, in his instructions to humans in the garden, God said: "When you eat of it [the tree of the knowledge of good and evil] you will surely die" (vs. 17, *New International Version*. The *King James Version* translates it: "in the day that thou eatest thereof, thou shalt surely die"). But Adam did not experience physical dying until many years later. It is clear that physical dying, for Adam, was not the immediate consequence of his disobedience. We must conclude that the Scripture has another meaning. I suggest that the death which God threatened is the separation from God which sin inevitably brings, and which is sometimes called "spiritual death." Physical dying of humans, however, like physical dying of other creatures, is a normal aspect of God's good creation.

This perspective, i.e., that physical death is a normal and expected aspect of life on Earth, and that the dying which follows sinfulness is a spiritual dying, is also consistent with New Testament teaching. This is especially apparent in Jesus' conversation with Martha upon the physical dying of Lazarus (John 11: 21–27). Jesus' words, "I am the resurrection and the life. He who believes in me will live, even though he dies; and whoever lives and believes in me will never die" (John 11:25, 26), obviously do not promise that believers will never experience physical dying, because many have experienced physical death during the centuries since Jesus lived on Earth. So the deliverance which Jesus promises is the deliverance from the spiritual separation and estrangement which were the consequences of sin. Jesus promises complete deliverance from the guilt and curse resulting from our sinfulness, but belief in Jesus does not release us from physical dying. Thus we conclude that human dying, also, is a part of God's good creation.

The Heidelberg Catechism (an ancient catechism) also teaches this interpretation of Scripture. On the physical dying of humans, it asks the question, "Since Christ has died for us, why do we still have to die?" and gives the answer, "Our death does not pay the debt of our sins. Rather, it puts an end to our sinning and is our entrance into eternal life" (Q. & A. 42).

Allow a pure conjecture, please. If humans had not sinned, but had maintained perfect obedience and fellowship with the Creator, we would still not be immortal. We would have to undergo some sort of transformation to make the transition from life on Earth to life in God's presence, a transformation that the Apostle Paul refers to as a process or event in which "the perishable must clothe itself with the imperishable, and the mortal with immortality" (1 Cor. 15:53). Our present-day experience of physical dying may indeed be blemished with some of the fear which often accompanies our feelings of guilt, but might physical dying, shorn of that fear, be the process or event by which we are transformed from mortal existence to immortality? Then God's statement as he banished Adam and Eve from the garden, "dust you are and to dust you will return" (Gen. 3:19b) is a description of our human creatureliness, and not a pronouncement of a curse resulting from human disobedience.

There are some Christians who consider it unthinkable that death of any sort occurred before humans fell into sin. In "Back to Genesis," Henry Morris wrote:

> At the conclusion of God's six days of creating and making all things, He placed it all under man's dominion and then pronounced it all to be 'very good' (Gen. 1:26, 28, 31). There was, therefore, nothing bad

> in that created world, no hunger, no struggle for existence, no suffering, and certainly no death of animal or human life anywhere in God's perfect creation ... no carnivorous activity at that time, ...[4]

The testimony of the evidence presented here, in the context of the conviction that the history of Earth and its living organisms spans billions of years, is in sharp disagreement with the perspective expressed by Morris.

Christians should study and consider the evidence for the antiquity of the Earth and its fossils, think and talk about the evidence for the existence of disease in living organisms before humankind fell into sin, and discuss the possible place for incorporating the conclusions from that evidence into our Christian perspective. But in our discussion of death and dying and disease in the history of living organisms, we should sympathetically recognize the wide range of views held by fellow Christians. We hope and pray that the discussion will be carried out in the spirit of mutual Christian love and charity. ❄

Notes

[1] Robert McC. Adams, "Smithsonian Horizons," *Smithsonian* (Feb. 1990): 12.
[2] R. E. Molnar and James O. Farlow, "Carnosaurian Paleobiology," in *The Dinosauria,* Weishampel, et al., eds. (Berkeley: University of California Press, 1990), 223.
[3] Karen Wright, "Dinosaur Doctors: Tracing Modern Disease to the Ancient Reptiles,"*Discover* (Nov. 1991): 46–51.
[4] H. Morris, "Back to Genesis," insert in *Acts and Facts* (April 1998).

Oak Leaf Galls
Middle Miocene

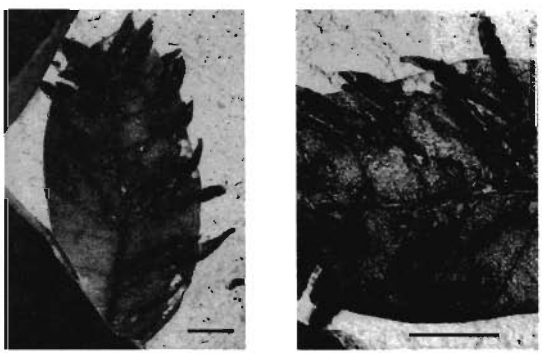


Fig. 1. Entire leaf infected with approximately twenty galls, caused by galling wasps. Scale bars are 5 mm. From the Miocene Gillam Springs Flora, Nevada, USA. *Journal of Paleontology* 70:6 (1996): 1080–4.

Termite with Fungus Infection
Oligocene/Miocene Amber

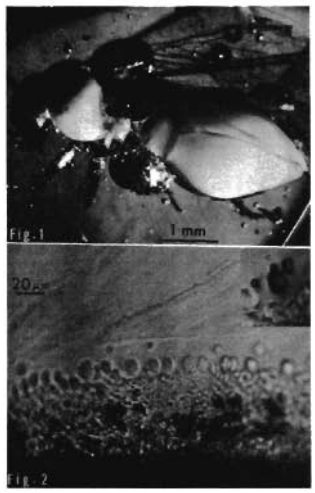


Fig. 2. (1) Termite showing white mycelial growth covering abdomen and thorax. (2) Enlarged view of mycelium. Specimen approximately twenty-five million years old. *Mycologia* 74:2 (Mar–Apr 1982): 332–4.

Tyrannosaurid Forelimb
Humerus Damaged During Life

Fig. 3. Forelimb of *Daspletosaurus torosus,* distal end of humerus pathologic due to damage during life. Specimen from National Museum of Canada, found in the Oldman Formation, late Cretaceous of Alberta, Canada."Tyrannosaurs from the Late Cretaceous of Western Canada," *Publications in Paleontology,* No. 1 (1970), National Museum of Natural Sciences, Ottawa.

Disease in Pleistocene Elephants

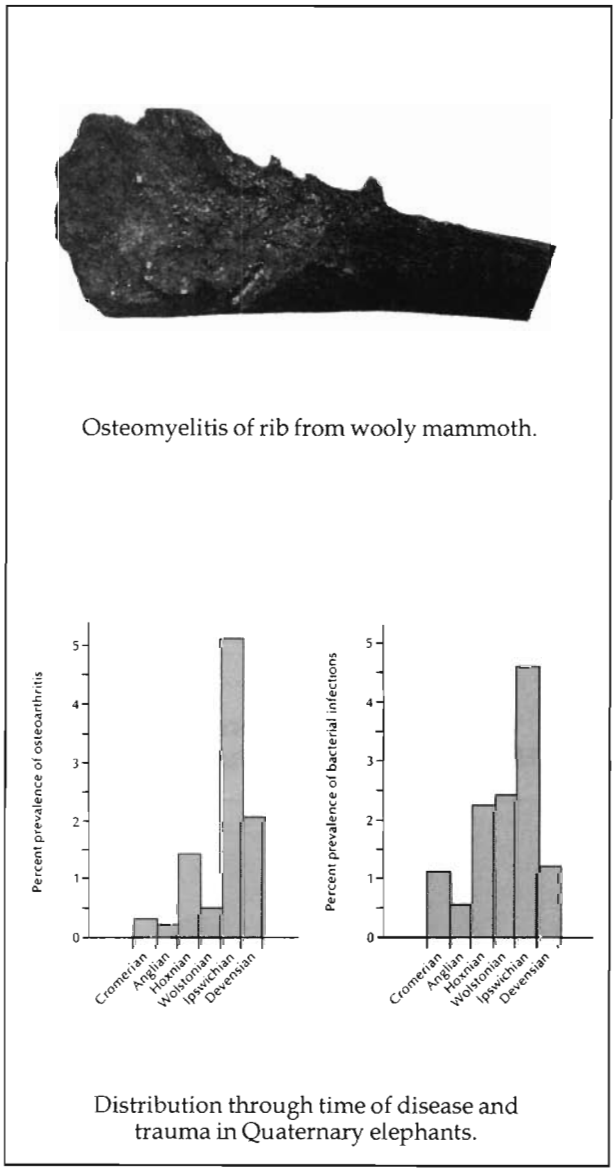


Fig. 4. "Palaeopathology of Pleistocene proboscideans in Britain," *Modern Geology* 11 (1987): 295–309.

Neanderthal Hominid from Shanidar Cave (Iraq)

Fig. 5. (d) Anterior, lateral, and dorsal views and (e) x-ray of atrophied right humerus, with healed breaks, and severed and (healed during life)above the elbow. Scale in centimeters. *The Shanidar Neanderthals* (New York: Academic Press, 1983), 402.

Neanderthal Hominid from Shanidar Cave (Iraq)

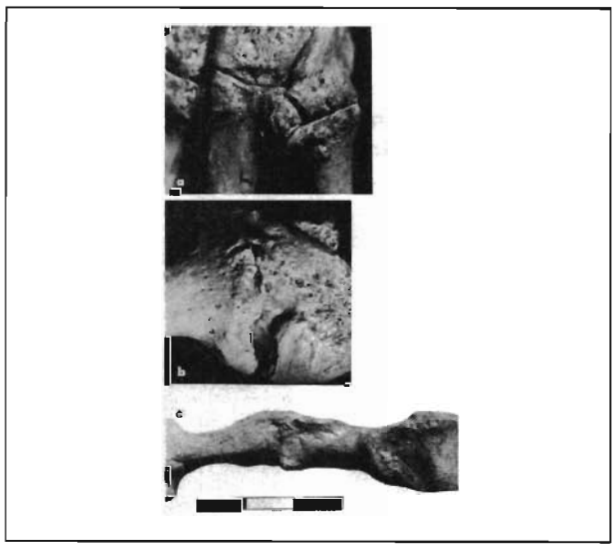


Fig. 6. (a, b) Diseased right ankle and foot bones; (c) healed fracture is metatarsal; same individual as Fig. 5. Scale in centimeters. *The Shanidar Neanderthals* (New York: Academic Press, 1983), 406.

Genesis Reconsidered

Armin Held

Am Raun 3
A-6460 Imst
Austria

Peter Rüst*[1]
e-mail: pruest@dplanet.ch

CH-3148 Lanzenhäusern
Switzerland

The Bible and creation have been called the two books of revelation. The trend to disparage attempts at harmonization is mistaken, resulting from inadequate care in interpretation. Their primary aims are different, but interpretational crosschecks are meaningful. Taking Genesis 1–2 to reveal different modes of God's creating, and to constitute a continuous narrative, rather than two "creation stories," resolves some otherwise unsolved problems.

The biblical texts were written by fallible humans, who were dependent on their own culture, with their language, limited knowledge, and imperfect understanding. This does not, however, automatically imply errors in their writings. The Bible claims to be inspired by God. He designed it for all cultures, but letting it be contaminated with gross errors would compromise it. Since the Creator is its ultimate author, interpreting a biblical text merely within the framework of ancient Near Eastern culture is inadequate. A biblical writer was guided to select, from his own vocabulary, words and phrases compatible with reality, even while perhaps holding some erroneous belief. But a myth masquerading as prophetic narrative revealing God's creation would be inconsistent with God's character of truth.[2] The Bible is not equivalent to any other book. It might contain information beyond the ken of its writers.

The "two books of God" provide complementary and concordant approaches to an indivisible reality. We may not always succeed in "reading" them without contradiction, as neither theologians nor scientists are infallible. But with sufficient care, we may approximate the facts. We start with the original data, i.e., the Hebrew text. Dictionaries and concordances clarify central concepts of Genesis, which are merged into an interpretation of the context as a unity.[3] Conflicts with scientific evidence must send theologians and scientists back to their studies, until a consensus is reached.[4]

*ASA Fellow

The Meaning of Creation

Creation and development

A frequent misunderstanding, not supported by the text, consists of seeing God's work in Genesis 1 as primarily miraculous. The Hebrew verb *bara* (to create)[5] designates exclusively divine creation of novelty. Three such creations are mentioned: the universe (1:1), animals (1:21), and humans (1:27), originating the physical, sentient, and spiritual realms. Between these events, developmental processes constituted the major part of what happened. Here, *asah* (to make, also used of humans) is typically found, implying the further "preparation" or "development" of preexisting entities.[6] God saw that "all that he prepared" [*asah*] was "very good," and finished "his work which he prepared."[7]

A second misunderstanding expects God's creating to have yielded the end product immediately. This reflects neither the meaning of *bara* nor the context. A good idea of its significance is conveyed by the fact that each individual is said to be created

[*bara*].[8] Yet, upon conception this being is in no way finished; the seminal beginning is followed by a long development to the adult. There is no contradiction between having parents and being created by God. Genesis 1 makes it clear that after the origin of the universe "in the beginning," the creation was not finished, but had to pass through quite a development before achieving the desired state.

A third misunderstanding is the assumption that every creative act was detached from and independent of existing circumstances. Creative acts subsequent to the "beginning" had to occur into developmental processes already underway. This certainly was the case for the creation [*bara*] of the people of Israel, and other historical events called creations.[9] Each of them starts a development, but is itself logically and chronologically embedded in the course of history.

Creation in Development

A fourth misunderstanding opposes "supernatural" creation by God, which is not subject to scientific investigation, to "natural" events supposedly happening all by themselves and, in principle, explainable by science. All of creation is not only permanently held in existence by God, but also the object of his continuous activity. Whatever happens is either done by him, or, with acts of personal creatures, permitted by him. From the way he normally acts in the visible world,[10] we formulate our natural laws. Thus, all we call "natural" has a "supernatural" foundation in the invisible world. Occasionally, as part of his special revelation, God performs special acts distinguished by their exceptionality. These "signs" attract attention precisely because his usual work consists of repeatable events, on which we may depend—so much so that their regularity is mistaken for necessity.

Furthermore, much of what happens in our "natural" world requires intelligent input to succeed. It begins with the "Anthropic Cosmological Principle," continues with the origin of life, and extends to much of what happened in the further history of life. Biology is brimful of structures of irreducible complexity, whose attribution to chance would be unreasonable.[11] The great mystery is not "natural selection of the fittest," but their origin. Atheists have a surprisingly huge faith in the gaps of our knowledge. God's invisible qualities can be recognized by pondering his handiwork.[12]

God has innumerable options of guiding natural events. They may be called "hidden options," because science is in principle unable to trace them.[13] Invoking chance just glosses over our ignorance. There is ample leeway in the known limits of scientific knowability. Quantum-indeterminate events or other contingencies, like the occurrence of a particular value out of a Gaussian distribution, pervade all natural processes. Atomic events can grow to global scopes, whenever nonlinearity is involved. One mutation may change the biosphere. Some of God's creating [*bara*], such as the composition of a genome at conception, and much of his developmental work [*asah*], such as originating life and many life functions, may involve such "hidden options."

Therefore, in addition to his normal activity in all of what happens, four types of creative acts of God can be distinguished: (1) the creation of new dimensions, as seen in the three uses of *bara* in Genesis 1; (2) the creation of individual "souls" and individual "spirits"; (3) the creation of novel, sometimes transastronomically improbable configurations during evolution; and (4) the performance of signs.

Creation versus Evolution?

Is creation or evolution true? Both are true; the Bible links them inseparably. At the end of the "creation story," the entire process is summarized: "These are the generations of the heavens and the earth in their being created."[14] The noun *toledoth* (generations) derives from the verb *holid* (to beget) and is a "technical term" for lines of descent and family trees.[15] Apparently, Genesis 1 is a register of descent, a genealogy, a phylogeny, containing

Armin Held was born in 1961 in Garmisch, Germany. Married since 1981, he and his wife have four children (ages 11, 9, 7, and 3). Shortly after beginning medical school in 1980, he accepted Jesus and transferred to the Theological Faculty at Munich University, studying Hebrew and Greek. Armin spent several years concentrating on specialized studies, particularly creation and evolution, based on the original languages. He cooperated in and headed a ministry among marginal groups, with street evangelism, tearoom, and supervised community (Teen Challenge) for several years. While recovering from cancer (1992), he worked in a "normal" occupation as an employee in a guest house. Since 1998, Armin has been a preacher in Tirol, Austria.

words like seed, kinds, fruitful, and multiply. Plant and animal groups appear sequentially in ascending order. As in other biblical genealogies known as "tables of nations," which enumerate various branches descending from a common ancestor, no individual procreative acts are mentioned, but some important events—like the appearance of the dry land—are worked into Genesis 1.

By linking descent, implying development over long periods, with the expression "in their being created" (*bara*; "their" in Hebrew unambiguously refers to *toledoth!*), the text makes it clear that the evolution of life is closely interwoven with specific creative acts of God, which support it like pillars. Millennia before Darwin, the Bible resolved the controversy "creation or evolution" by means of the shortest possible formula, "These are the generations (descent, evolution) of the heavens and the earth in their being created [*bara*]." By "evolution," we just mean descent of all life from a common ancestor. Of course, we reject the atheistic world view of evolutionism.[16]

Creation Developing

"In the beginning, God created the heavens and the earth" (Gen. 1:1).

God created the universe, called "the heavens and the earth," including time, space, and energy.[17] Science models the history of the universe back to shortly after the Big Bang about 13.5 Ga (billion years) ago,[18] but is unable, in principle, to elucidate its cause.[19]

"The earth was *tohu wa-bohu*, and darkness was over the deep" (Gen. 1:2).

Starting with verse 2, the existence of the sun, moon and stars is taken for granted.[20] Now the scope narrows to the surface of the planet Earth. Its description as *tohu wa-bohu* (formlessness and emptiness) will be discussed later. The entire earth was covered by water and darkness. As the sun already existed, the reason for the darkness appears to have been a cloud cover. The darkness was restricted to the earth, excluding "the heavens."

This description strikingly resembles the scientific picture of the early earth. It accreted 4.55 Ga ago, and the moon apparently formed by the impact of a Mars-sized body 4.5 Ga ago.[21] The earth was bombarded by planetesimals, differentiated into an iron core and a siliceous mantle in the molten state, and collected a secondary atmosphere and hydrosphere from volcanic outgassing and meteorite impacts. Sufficient cooling let a global ocean condense.[22] At a relatively high temperature, a thick cloud of water vapor enveloping the whole earth prevented the penetration of any light to the ocean surface.

"The Spirit of God hovered over the surface of the waters" (Gen. 1:2).

The Hebrew *righeph* translated "hover" occurs only once more in the Bible: "As an eagle stirs up its nest, hovering over its young, spreading its wings to catch them and bearing them on its pinions ..." God is pictured as protecting Israel in a hostile situation. The similarity to Gen. 1:2 extends to the use of *tohu* describing the environment: "He found them in a desert land, in a *tohu* ..."[23] As the Arabic and Syrian words cognate with *righeph* mean "protectively extend the wings," "lie down over ...," "brood," "hatch," it appears reasonable to assume that Gen. 1:2 indirectly points to early life. What else should God's Spirit have protected or brooded in the waters of the primitive earth, suitable for the beginning of the "*toledoth* of ... the earth"? God's Spirit always has to do with life. The phenomenological language of the Bible is not expected to mention microscopic life more specifically.[24]

Scientific evidence suggests that life appeared very soon after the earth's formation. Geochemical signatures believed to be specific for life have been dated at about 3.85 Ga.[25] Fossils of probable cyanobacteria, the first photosynthesizers, were

Peter Rüst holds a diploma in Chemistry and a doctorate in Biochemistry from the Swiss Federal Institute of Technology in Zürich. He did post-doctoral research in DNA chemistry at Columbia University in New York (with E.Chargaff) and at Hawaii University, in molecular biology at the California Institute of Technology (with R. L.Sinsheimer), and in virology at the Swiss Institute for Cancer Research in Lausanne. Recently, he retired from heading the Computer Group at the Swiss Dairy Research Institute in Bern. The creation/evolution question has been his special interest for many years.

found in rock 3.5 Ga old.[26] Scientists feel uneasy about the short time span left for the emergence of these "primitive" organisms, whose complexity eclipses modern technology. But even the age of the universe is by far insufficient for making plausible an *accidental* origin of the information required for life.[27]

Day 1: "Let there be light!" (Gen. 1:3–5).

Further cooling and chemical change of the atmosphere later permitted the sun's light, still diffused by a permanent cloud cover,[28] to reach the surface, producing day and night. Does the statement that this was "day one" indicate 24-hour days?

Days—Ages

The Hebrew *yom* may be used for an earthly day, as well as for a period of unspecified length. "Days of God" are usually lengthy periods, like the day of God's rest, the day of salvation, the day of the Lord.[29] Creation days were certainly days of God, and the context establishes them as long epochs. Squeezing the rising of the continents and their colonization by plants into one day, or to expect marine animals multiplying naturally to fill the oceans within twenty-four hours, would do violence to the text! The explanation of the Sabbath command, "for in six days the Lord made heaven and earth," does not equate creation days with our work days. "Sabbath" is also used for a year and for a seven-year period. The human work week is but a shadow of the divine work. Biblical writers are emphatic about the impossibility of directly equating human and divine time scales.[30]

Creation days were certainly days of God, and the context establishes them as long epochs.

Scientifically, the general time frame of the history of the universe and of life is securely established.[31] Possible errors vary from less than 1% for many radiometric dates to perhaps 10% for the age of the universe. The fact that *none* of the radioactive isotopes having half lives below 500 ka (thousand years) is found on earth (apart from some formed continuously), while *all* of the ones with longer half lives do occur, is explainable only by their formation about 5–6 Ga ago. This gives us a solid clue for the order of magnitude involved—concordant with many independent dating methods. The short-day interpretation is therefore wrong.

It is quite legitimate to reconsider, in view of new findings, a long-standing traditional interpretation of biblical texts. The Bible itself presents some striking examples of such reinterpretations. Job's friends were mistaken in their orthodoxy. Even Job himself had to "retract and repent in dust and ashes." The Pharisees, very serious Bible students, separated the prophecies about the suffering Servant of God from the Messiah. They were wrong, as could be seen in Jesus Christ. Even his own disciples had to be led to a fresh view of Bible passages they "knew" very well, when they found his tomb empty, and when he "explained to them in all the Scriptures what referred to himself."[32]

A day-age interpretation of Genesis 1 provides the possibility of correlating scientific data with the biblical text. Of course, the correctness of the concordant interpretation suggested does not automatically follow.[33] Interpretations need continual readjustment to relevant findings.

Day 2: Atmospheric expanse separating the waters (Gen. 1:6–8).

The Hebrew *raqia*, "expanse," often erroneously translated "firmament," specifies a thin, drawn-out layer, e.g., of plants on the earth's surface. Not solidity, but surface coverage and being thin is the basic idea, as evidenced by all cognate words.[34] Flying animals are said to move "on" the *raqia*,[35] certainly not a solid dome. It is the relatively thin layer, the lower atmosphere formed around the earth. The ancients knew the water cycle and would easily understand the *raqia* between the waters as the air space between oceans and clouds.[36] The two were separated when the atmosphere cleared, after its temperature fell below the dew point, generating the global water cycle.[37]

Day 3: Emergence of dry land (Gen. 1:9–10).

Genesis describes the early earth as covered by water, and the dry land as emerging later—a fact one would suppose to have been unknown until recently! Mantle convection and associated tectonic activity caused land masses to rise out of a global ocean. Almost 4.0 Ga old continental remains have been found.[38] The oldest dated sediments derived from eroded land are 3.87 Ga old.[39]

Plants (Gen. 1:11–13)

God told the land to produce plants. Did it have the capacity to do so? The verb *yatza* never designates creation, but the coming forth of preexisting

things out of an environment, which is given by the context. Just previously, the oceans were mentioned, over which God's Spirit had "brooded" earlier. They must have contained life which, after the emergence of the dry land, "came out." Continental weathering produced nutrients which drained into the oceans, "attracting" aquatic plants.

Diffuse light, penetrating the clouds since day 1, enabled cyanobacteria to produce oxygen by photosynthesis, as the plants did later. Oxidation led to geochemical changes and, almost 3 Ga later, to a substantial change in the atmosphere. Macroscopic marine algal fossils date from about 1.8 Ga ago.[40] The first terrestrial microfossils are 1.2 Ga old.[41] After 0.5 Ga ago, the atmospheric composition had stabilized sufficiently[42] to allow colonization of the dry land by plants about 475 Ma (million years) ago.[43]

The concept of "kind" (Gen. 1:11–12)

The land made plants "according to their kinds [*min*]" come forth. *Min* has the primary meaning "split," "separation," "descent" and therefore emphasizes the derivation from a common origin and a permanent separation from it. In modern Hebrew, *min* designates sectarians, used for Jewish Christians, who derived from Jewish stock, but have, by their Christian conversion, deviated from Jewish doctrine and can no longer be received into their community of origin. "Kinds" [*min*] were neither created nor fixed, but originated through change and separation, becoming unable to merge again with their progenitor kinds.[44]

This parallels a biological species definition. Individuals belong to the same species if their union results in fertile descendants. Separation of populations, followed by divergent evolution, is believed to be a main cause of speciation. Different species have a common origin, but have become separate and incompatible.

Day 4: Lights in the sky (Gen. 1:14–17).

On day 4, celestial bodies were not created, but became visible as "lights." Their origin goes back to the cosmological development initiated "in the beginning." Here, the earth is in focus; "sun" or "moon" are not named.

Previously, light of celestial bodies had reached the earth's surface only in scattered form, such as on an overcast day. The text does not say that bodies were "affixed to the firmament," but that God "gave" the lights (the light rays, *not* their sources) "into the *raqia* of the skies," the region which previously could not be reached by direct light. Now changed atmospheric conditions caused the previously permanent cloud cover to break open, so that for the first time the celestial bodies appeared as "lights in the sky." Over some time, the lights were being "prepared" [*asah*], coming through hazily first, more clearly later. Literally, God said, "Let it be (singular) lights (plural)!" The single process of the atmospheric change caused the appearance of a multitude of lights. They were to provide space and time indications required by many organisms.

Day 5: Creation of "living souls" (Gen. 1:20–23).

In the waters of the oceans, the second act of creation produced "living souls" [*nephesh ghayah*]. This designation apparently implies sensation, instincts, and deliberately controlled movements. The soul represents a fundamentally novel dimension, the psychological domain. According to biblical understanding, such animals are the first genuinely living beings; plants are never called "living." Noah and Israel were forbidden to eat blood, because "the soul is in the blood," which is "given for atonement."[45] Apparently, only what we loosely call "higher" animals, with a blood circulation and with a brain serving more than minimal sensory functions, are "living souls," unlike most invertebrates. Although some sensory functions directing movements are found in all lower organisms, the integrated set of sentient capacities characterizing "living souls" originated perhaps with rapidly swimming cartilaginous fish, about 385 Ma ago.[46]

The creation of "living souls" did not imply the creation of their bodies, but represented a new dimension bestowed on them.

The creatures of day 5 are described as "great monsters," "living souls, the creeping ones [*remes*] which swarm [*sharatz*]," and "winged flyers." *Sharatz* is sometimes translated "creep," "bring forth abundantly," "teem," *remes* also "moving." These terms specifically qualify the expression "living souls," so they may hint at the existence of earlier "creepers which swarmed" to a certain degree, but were not "living souls." The mention of flying creatures as early animals, reproducing on the dry land, is interesting. The Hebrew noun *oph* is derived from *ooph*, to fly, and designates any flying animal.[47] Although birds appeared much later, insects arose about 385 Ma, winged ones 330 Ma ago.[48]

The creation of "living souls" did not imply the creation of their bodies, but represented a new dimension bestowed on them. Previously evolved animals were now "ensouled." Similarly, the "natural" procreative origin of individual animals of preexisting species is described as God "creating" them [*bara*].[49] Apparently, the creative act of day 5 concerned the psychological domain, which transcends the physical features, like the brain, circulation, and hormones used by it. These genetically determined aspects would be the product of evolution, but consciousness of each *individual* "living soul" is created. Thus, the first "living souls" exemplify two of the four modes of God's creating mentioned earlier: *generic* and *individual* non-evolutionary novelty.

Day 6: "Let the land produce living souls!" (Gen. 1:24–25).

The land, now sufficiently prepared, "caused" already existing animals "to come out" [*yatza*] onto the dry land. They would have come from the oceans, which immediately beforehand were said to be "teeming" with "living souls." No new dimension is created, nor is a blessing mentioned. As a tree of descent suggests, the terrestrial animals descended from aquatic ones, inheriting their psychosomatic capacities. They were then purposefully "prepared" [*asah*] by God.

Chronology

Does the fossil record agree with the sequence of events in Genesis? Some atmospheric oxygen, first produced by cyanobacteria (3.5 Ga, day 2) and marine algae (1.8 Ga), was required for the emergence of macroscopically visible animals (565 Ma).[50] It is believed that the spectacular "Cambrian explosion" (530 Ma), producing representatives of all animal phyla, was occasioned by a further surge in oxygen, itself caused by the sedimentary burial of large amounts of carbon of earlier organisms. Yet all these lower animals are not explicitly mentioned in Genesis, not being "living souls." Later, plants colonized the dry land (475 Ma, day 3), providing more oxygen, which was needed for larger, active animals called "living souls" (385 Ma, day 5), winged insects (330 Ma, day 5), and terrestrial animals (335 Ma, day 6).[51] Animals had long been restricted to the water, until land plants had produced sufficient oxygen, an ozone shield, and a basis for the terrestrial food web.

The time of the first breaking of the cloud cover (day 4) is not yet known. The first known flying creatures (day 5) and the first known terrestrial animals (day 6) have about the same age. Even correctly dated fossils can only give the latest possible date of emergence of a group, as earlier representatives may still be found. Flying insects are much less likely to get fossilized than amphibians, yielding a late bias for their first fossils.[52] With this possible problem, the sequence of appearance is the same in Genesis 1, in the fossil record, and by bio-geochemical logic.

"Let us make man! ... Then God created man" (Gen. 1:26–27)

Anthropogenesis proceeded in two steps. God declared that he was going to prepare [*asah*] humans, then he created [*bara*] them. Apparently God prepared humans by an evolutionary process (tree of descent, Gen. 2:4) out of animals.[53] A preexisting entity required some additional preparation [*asah*] to become what it was intended to be.[54] The human body is constituted like animal bodies, and the sentient domain is a refinement of capacities given to other "living souls."

Then God "created man in his image" by creating, in preexisting hominids, the spiritual dimension, which, being of the invisible world, could not emerge from the visible one. Humankind has aspects of both worlds, just as each child is also God's creation. The "image of God," or personhood, implies language, free will, responsibility, abstract thinking, logic, creativity, deliberate planning, design of tools, dominion over other creatures, and, most important of all, the ability to enter into a personal faith relationship with God. Humans were told to fill the earth, and "it was so" within day 6, which therefore must contain a long human history.

Then God "created man in his image" by creating, in preexisting hominids, the spiritual dimension, which, being of the invisible world, could not emerge from the visible one.

This twofold origin of humans—descended from animals and created in the image of God—is the basis for their special status as representatives between God and the earthly creation. Their mandate of lordship over the creation presupposes an attitude of stewardship given by the "image of God."

The fossil record shows *Australopithecines*, which were more human-like than chimpanzees.[55] It is uncertain where *Homo habilis*, at 2 Ma, belongs.[56] *H.*

erectus dates from almost 2 Ma to possibly 50 ka ago,[57] *H. sapiens* from perhaps 500 ka to today. Coarse stone tools from Ethiopia have been dated at 2.5 Ma.[58] *H. erectus* fossils from Africa and Indonesia are 1.8 Ma old,[59] archaic *H. sapiens* fossils from England 500 ka.[60] Fire may have been intentionally used 500 ka ago.[61] "Modern" humans lived in Israel and Africa 100 ka ago.[62] All living humans apparently descend from them.[63] Carved objects and human burials with flowers from Europe and the Middle East have been dated at 60 ka. Cave bear skulls were possibly presented as offerings in a Swiss cave approximately 50 ka ago.[64] Human fossils from Australia and sophisticated stone tools from Europe are 40 ka old, exquisite cave paintings and carved figurines in Europe 30 ka,[65] human fossils from both Americas 12 ka.[66] Agriculture dates from 11 ka[67] and bronze use from 5 ka ago,[68] both in the Middle East.

H. erectus and archaic *H. sapiens* look quite human. If they are not biblically human, they must be precursors of our species, if God's "book of nature" is not to be charged with deception. That the industry remained rather crude for 2 Ma puzzles scientists. Sophisticated tools, art, and possible indications of a spiritual consciousness appeared after 100 ka ago. Our conclusion that the creation of humans in God's image occurred then is tentative, as any evidence for spirituality is scientifically ambiguous.[69]

Life and Death Manifest

Day 7: Calling of Adam (Gen. 2:5–25).

"These are the generations
of the heavens
and the earth
in their being created
in the day
of preparing Yahweh God
earth
and heavens" (Genesis 2:4).

This concludes and summarizes 1:1–2:3. As it uses "*Yahweh*," those who call Gen. 2:5–25 a second "creation story" join 2:4 (or its second half) to what follows, separating it from what goes before. But the deliberately symmetrical construct of 2:4 cannot be reasonably cut in the middle. Its contents, "generations," "the heavens and the earth," and "created," refer to Gen. 1, *not* Gen. 2:5–25, the "forming" of Adam and the restricted "land" of the garden of Eden. Yet the name Yahweh opens up the personal-level relationship dealt with in Gen. 2:5–25. Therefore, Gen. 2:4 links the two chapters into one continuous narrative. The creation of humans (day 6) and the forming of Adam (day 7) were different events! In day 7, God "ceased" from his work of preparing a habitable earth.[70] He blessed this day, consecrating it for the purpose of realizing his fellowship with humans. Day 7 continues today, and believers are to enter into this "rest" of God,[71] recalling Adam's initial state.

In Gen. 2:7, God did not create humans, but "formed" Adam. *Yatzar* means to form, design and commit, plan and realize.[72] When used of God, it may be a "technical term" for formation in one's mother's womb, suggesting that Adam had parents.[73] God "committing" to realization his specific "design" does not exclude Adam's descent from earlier humans. He was formed of *afar*, used of any kind of unstructured matter,[74] referring either to the physical matter at the origin of life 4 Ga ago, or to the chemicals forming the basis of his own body. In any case, his whole preparation was God's work. Agriculture and bronze use in Genesis 4 may date Adam's immediate descendants about 6 ka ago.

We postulate that Adam was not the first genuine human, but that he belonged to the human species already 100,000 years old.

Thus, we postulate that Adam was not the first genuine human, but that he belonged to the human species already 100,000 years old. In spiritual terms, he was the typical representative of the old (fallen) human species, both before and after his time, just as Christ is the risen "firstfruits" of the new humanity of those "born of the Spirit," both before and after his time on earth.[75]

There is an obvious contrast between (a) Gen. 1:26ff and (b) 2:7ff. In (a), God is called *elohim*, representing his general relationship to the creation; in (b), *Yahweh elohim*. *Yahweh*, freely translated "I AM,"[76] is his name used in the context of his covenants with humans, implying a personal relationship. While (a) deals with "man" [*adam*] in a collective sense, or humankind, (b) deals with "*the* man" named Adam. In (a), God *created* "them," collectively; in (b), he *designed* "him" individually. In (a), humans are declared to be created "male and female," two collective terms; in (b), the Lord deals with "Adam and his wife," an individual couple. Consistently, (a) uses general, collective language; but (b) uses specific, personal terms. These and other features are explainable if (a) and (b) deal with

different epochs, whereas making them versions of the same story creates problems.

Each human being is individually created [*bara*], designed [*yatzar*], and prepared [*asah*] by God.[77] Particular genetic complements, derived from molecular contingencies of extremely low probability, as well as individual psychological and spiritual constitutions, are presumably selected by God. Adam had a dual nature, a close relationship to the animals, and the *neshamah*, breath or "spirit of understanding," which God "breathed into his nostrils." It differs from *rooagh*, the usual word for spirit.[78] Every human being is "spirit," capable of entering into communion with God. However, this fellowship is not realized automatically, but requires a conscious conversion and a "new birth"—or its equivalent in the appropriate divine economy. Did Adam, in the *neshamah*, receive this "new life"?[79]

What distinguishes Adam from earlier humans? We believe he was called to deal with the problem of evil, death, and corruption in creation, to open for humanity the way into spiritual communion with God.[80] Adam is called "the first man," Jesus "the second man" (both *not* in a biological sense!); only Adam (before the fall) and Jesus had the undisturbed communion with God intended for humans. The biblical genealogies cover the time from "the beginning" to Jesus Christ, the "last Adam," who became a "life-giving Spirit," originating a new, spiritual humanity.[81]

Is evolution unfit for creation?

Evolution is supposedly "red in tooth and claw," death being its tool. Equating evolution with this evolutionism is unrealistic. Natural selection occurs by differential reproduction, due to different stress incidence, sensitivity of reproduction to stress, numbers of progeny attainable, and survival before reproduction ends. Only the latter factor has to do with death at all. Some kinds of biological "death" are unavoidable and theologically unobjectionable. Microorganisms are required as symbionts and food additives, and within a few billion years a habitable environment was prepared from their activity and substance.[82] Plants are needed for food. Programmed resorption of cells is required in developmental and maintenance processes in animals.[83]

The biosphere does contain violent death, but this is a feature of ecology, not evolution as such. Since what God had done in the creation was declared "very good," some conclude that before Adam's fall there could not have been death, which would be an unworthy "means of creation."[84] This claim has unacceptable implications. By ignoring an enormous amount of observational support for the length of the history of life,[85] it compromises God's veracity, because reliability of scientific observation is a prerequisite for obeying his "cultural mandate." A biosphere without population steady states cannot last. Insinuating that pre-human ecology was bound to terminate shortly makes God responsible for Adam's sin. Also, a biosphere without death and suffering due to carnivory, disease, and parasites would imply radically different food webs, metabolism, and reproduction. God alone would be capable of realizing such an instant new creation after the fall, restructuring all species, making him the author of death. Both scientifically and theologically, this is preposterous. There is no hint for it in the Bible.

Death's real background

Natural agents damage genomes, limiting animals' life spans, implying death. Most marine and many terrestrial species are carnivores. Humans were given animals for food, being told to "rule over the fish,"[86] which cannot be used alive. God's warning to Adam implied that he knew what death is. Why did the "living souls" created by God have to die?

It was Satan's fall that corrupted creation, resulting in the tohu wa-bohu of Gen. 1:2, natural evil, and death and suffering of "living souls."

Adam was to guard [*shamar*] the paradise, designating some danger, and the "tree of knowledge of good and evil" implied that evil existed. It was Satan's fall that corrupted creation, resulting in the *tohu wa-bohu* of Gen. 1:2, natural evil, and death and suffering of "living souls." In the Bible, *tohu* is invariably negative: formlessness, waste, vanity by turning to idols; and *bohu*, emptiness, always occurs together with *tohu*, in situations of destruction. God did not cause suffering and death, but mercifully he continued on this new basis, incorporating even these to the best end.[87] After Satan's fall, God's preparing the creation and Satan's corrupting it (under God's permission) proceeded concomitantly.[88] From now on, what God did was explicitly declared "good." When, with the creation of humanity, a "very good" state was reached, "the heavens and

the earth and all their host" were completed. Hosts [*tzava'*] usually denote armies. Was the creation now ready for the final battle rescuing it from corruption?

Humans before Adam were mortal like other "living souls." Now Adam and Eve were called out to immediate community with God, in order to set up his kingdom, with the "tree of life" presaging eternal life to be manifested. But with their sin, they fell. Unlike animals and earlier humans, they willfully chose the realm of death. God's plan for his creation appeared doomed again. The fall translated into immediate spiritual death, while physical death was deferred, providing an opportunity of repentance and restoration.[89] In the death of sacrificial animals, Adam and Eve received a symbol of redemption, and God promised that the woman's offspring would crush Satan's head. The drama was initiated which led to the propitiatory death of God's Son on the cross, where death was "swallowed up in victory."[90]

Mythologizing the Bible

Some interpreters exclude inspiration, and thus the possibility of a harmony like the one suggested. Perceiving the text to conflict with scientific evidence, or with their own world view, they disregard it as a source of useful information for all but a fuzzy "religious" background.

Divine revelation is one possible source of a prescientific creation story, and Genesis 1 presents itself as prophetic narrative.[91] Babylonian myths like *Enuma Elish* contain some formulations resembling biblical ones. These myths are said to be a source of Genesis 1, which is made a derived myth and dated at 500 BC. Claiming to demythologize the Bible, such interpreters in fact mythologize it. But unlike myths, Genesis yields an interpretation compatible with scientific observation. Not only is its theological background of incomparably higher quality than that of myths, but so is the content of its narrative. Thus, Genesis must be a source of some formulations in *Enuma Elish*, not vice versa. As Abraham's ancestors lived in Chaldea, the real source of Genesis 1 may have been known there in 2000 BC. Thus, Genesis 2 is not a conflicting later version of the creation story, but rather a logical sequel of Genesis 1.

The reversal of perceived influence goes hand in hand with an uncritical acceptance of evolutionism. Within a mere 100 ka, only some microevolution of humanity could have occurred, with negligible effect on history. History must be understood within the framework of free will and responsibility. The application of evolutionary ideas to spiritual reality is even less reasonable, especially if revelation occurred. Theologians invented "evolution" from animistic religion to monotheism within a few centuries! In this vein, the "historical critical method" rewrote a large part of Israel's history presented in the Bible. It claims plenty of manipulation by unthinking redactors, producing innumerable contradictions, mostly based on circular reasoning.[92]

Thus, Genesis 2 is not a conflicting later version of the creation story, but rather a logical sequel of Genesis 1.

As part of this process of mythologizing the Bible, the myth of the "three-stories universe" was forged as the world view before the Enlightenment, with the celestial bodies fixed to a solid firmament above a flat earth, and hell underneath. Yet the sphericity of the earth was known at least since Pythagoras in the sixth century BC, and not much later all educated persons in the ancient world and throughout medieval times accepted it. Sun, moon and planets can be seen to move with respect to the other stars, which circle the earth. The spherical shape of the earth is also indicated by the fact that with decreasing distance, a mountain seems to rise higher and higher above the sea or a plain. In the third century BC, Eratosthenes estimated the earth's diameter from the relationship between geographical latitude and solar elevation. Around 1830 Letronne and Irving perpetrated the lie of the belief in a flat earth as a derision of creation.[93]

The contrasts between Genesis 1 and 2 were attributed to different sources. Radical criticism widely destroyed confidence in biblical reliability. But an unprejudiced reading of the text resolves the imagined contradictions and avoids making myths out of texts which do not present parables but prophetic narrative. ❄

Notes

[1] To whom correspondence should be addressed. This paper includes ideas from "Mechanisms of Creation in Biology," a presentation by Peter Rüst at the ASA Annual Meeting 1997, Santa Barbara, CA, and analyses of the biblical Hebrew texts by Armin Held, cf. note 6.

[2] 2 Tim. 3:16; 2 Peter 1:16.

[3] We consider the immediate and wider contexts, up to the entire Bible, including the New Testament.

[4] We realize that our interpretations are not in line with the customary ones, but we want to present them for discussion, as we consider them, on the whole, to be more satisfactory, or, at least, to aid meaningful interpretation in a significant way. Also, we think that historical and allegorical interpretations need not necessarily exclude each other, as they may both result from the Creator's design (cf. Gal. 4:21–31).

[5] *The Englishman's Hebrew and Chaldee Concordance of the Old Testament* 5th ed. (London: Samuel Bagster & Sons, 1890), 270. *Bara*, translated "to clear (forest)," is used of people in Josh. 17:15, 18; 1 Sam. 2:29; Ezek. 23:47; 21:19 (24). J. R. Kohlenberger III, ed. *The NIV™ Interlinear Hebrew-English Old Testament* (Grand Rapids, MI: Zondervan, 1987).

[6] K. Claeys and A. Held, *Die Evolution aus biblisch-theologischer Sicht* (unpublished manuscript,1985), 44–67; K. Claeys, *R-Evolution in der Genesis, ed. A. Held & G. Claeys (to be published, 1998).*

[7] Gen. 1:31; 2:2.

[8] Isa. 43:7, cf. Job 10:8–12, 18; Ps. 102:18; 104:30; 139:13–18; and Mal. 2:10.

[9] Isa. 43:15; 41:10.

[10]The Bible talks of two fundamentally different dimensions: the "invisible" and the "visible" (Col. 1:16; John 3:31; 2 Cor. 4:18; 1 Cor. 2:14–15; 1 Cor. 15:40; Rom. 8:5; 1 Cor. 3:1; and John 3:7–8).

[11]P. Rüst, "*Spezielle und allgemeine Evolutionstheorie: Fakten und Spekulation*," in *Zur Diskussion um Schöpfung und Evolution*, eds. E. Gutsche, P. C. Hägele, & H. Hafner (Marburg, Germany: Symon & Wagner, 1984), 59–115; P. Rüst, "The unbelievable belief that almost any DNA sequence will specify life," unpublished paper (1988) presented at the Conference on *Sources of Information Content in DNA* in Tacoma, WA; P. Rüst, "How Has Life and Its Diversity Been Produced?" *Perspectives on Science and Christian Faith (PSCF)* 44 (1992): 80–94; M. J. Behe, *Darwin's Black Box* (New York: The Free Press, 1996); W. A. Dembski, "Intelligent Design as a Theory of Information," *PSCF* 49 (1997): 180–90; and P. Rüst, updated version of "*Spezielle und allgemeine Evolutionstheorie: Fakten und Spekulation*," *Zur Diskussion um Schöpfung und Evolution* 4th ed. (Marburg, Germany: Studentenmission in Deutschland, 1998), 51–112.

[12]Rom. 1:20.

[13]For a similar idea cf. J. Polkinghorne, *Quarks, Chaos, and Christianity* (London: Triangle, 1994).

[14]Gen. 2:4; K. Claeys, *R-Evolution in der Genesis.*

[15]All occurrences: Gen. 2:4; 5:1; 6:9; 10:1, 32 (This is an example of a "table of nations."); 11:10, 27; 25:12, 13, 19; 36:1, 9; 37:2; Exod. 6:16, 19; 28:10; Num. 1:20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42; 3:1; Ruth 4:18; 1 Chron. 1:29; 5:7; 7:2, 4, 9; 8:28; 9:9, 34; 26:31.

[16]J. L. Wiester, "The Real Meaning of Evolution," *PSCF* 45 (1993): 182–6.

[17]We are not claiming Genesis 1 to "teach modern cosmology," but we want to show that a very good case can be made for non-contradiction between the biblical narrative and scientific data. The opinions that Genesis 1 reflects an ancient mythological world view, and that this view implied a flat earth and a solid firmament are popular. We consider both of these opinions to be in error. P. H. Seely, "The Firmament and the Water Above; Part I: The Meaning of *raqia* in Gen 1:6–8," *Westminster Theological Journal* 53 (1991): 227–40; "The Firmament and the Water Above; Part II: The Meaning of 'The Water above the Firmament' in Gen 1:6–8," *Westminster Theological Journal* 54 (1992): 31–46; and "The Geographical Meaning of 'Earth' and 'Seas' in Gen 1:10," *Westminster Theological Journal* 59 (1997): 231–55, interprets Hebrew concepts on purely external ethnological grounds, concluding from non-Hebrew "primitive" views that the correct interpretation of Genesis 1 must be a flat-earth mythological one. He assumes without discussion that even divine inspiration would make do with the world view of a prophet's cultural background, however erroneous it might happen to be. On the other hand, J. B. Russell, *Inventing the Flat Earth: Columbus and Modern Historians* (Westport, CT: Praeger, 1997) demonstrates the recent origin of the "three-story-universe" myth. We further consider this question in the last section of our paper.

[18]J. P. Huchra, "Determining the age of the universe," *Endeavour* 20 (1996): 139; D. N. Spergel, et al., "The age of the Universe," *Proceedings of the National Academy of Sciences* 94 (1997): 6579–84; A. Watson, "The Universe Shows Its Age," *Science* 279 (1998): 981–3; J. G. Cohen, J. P. Blakeslee, & A. Ryshov, "The Ages and Abundances of a Large Sample of M87 Globular Clusters," *Astrophysical Journal* 496 (1998): 808–26; and L. M. Krauss, "The End of the Age Problem, and the Case for a Cosmological Constant Revisited," *Astrophysical Journal* 501 (1998): 461–6.

[19]L. Smolin, "Did the universe evolve?" *Class. Quantum Grav.* 9 (1992): 173–91; J. Maynard Smith, & E. Szathmáry, "On the likelihood of habitable worlds," *Nature* 384 (1996): 107; and P. Rüst, H. R. Brugger, & H. Ross, "On the unlikelihood of habitable worlds," (unpublished, 1997).

[20]This is implied in what we believe to be the most sensible interpretations in the entire context of Genesis 1–2, as shown in our subsequent exposition. We do not take Gen. 1:1 to represent a title, but the beginning of what happened. After this "beginning," "the heavens and the earth" existed. It would be odd if here, "the heavens and the earth" did not include the sun, moon, and stars, while it does in all other places. Furthermore, verse 2 specifically localizes the darkness to the surface of the earth's ocean, implying light (and light sources) elsewhere.

[21]S. Ida, et al., "Lunar accretion from an impact-generated disk," *Nature* 389 (1997): 353–7; and D. C. Lee, et al., "Age and Origin of the Moon," *Science* 278 (1997): 1098–103.

[22]M. J. Gaffey, "The Early Solar System," *Origins of Life and Evolution of the Biosphere* 27 (1997): 185–203; and D. C. B. Whittet, "Is extraterrestrial organic matter relevant to the origin of life on Earth?" *Origins of Life and Evolution of the Biosphere* 27 (1997): 249–62.

[23]Deut. 32:10–11. An interesting parallel to the Hebrew *righeph* is found in the Greek θαλπω, to cherish, to keep warm, found in Eph. 5:29 and 1 Thess. 2:7 for Christ cherishing his Church, a husband cherishing his wife, a man protecting his natural life, an apostle caring for his spiritual children, and a nurse taking care of the children she has been entrusted with. Originally, θαλπω was used for birds' brooding, cf. F. Rienecker, *Sprachlicher Schlüssel zum Griechischen Neuen Testament* (Giessen, Germany: Brunnen-Verlag, 1952), 454.

[24]H. Ross, *Genesis One: A Scientific Perspective* (Pasadena, CA: Reasons to Believe, 1979), 10. Today, the only origin-of-life theory based on a somewhat plausible chemistry assumes a hot, dark environment in suboceanic conduits: G. Wächtershäuser, "Groundworks for an Evolutionary Biochemistry: The Iron-Sulphur World," *Prog. Biophys. Molec. Biol.* 58 (1992): 85–201; G. Wächtershäuser, "Life in a ligand sphere," *Proceedings of the National Academy of Sciences* 91 (1994): 4283–7; criticized by R. Österberg,

"On the prebiotic role of iron and sulfur," *Origins of Life and Evolution of the Biosphere 27 (1997): 181–4.*

[25]E. Wilson, "Earth had life earlier than previously thought," *Chemical & Engineering News* (Nov. 11, 1996): 10; and H. D. Holland, "Evidence for Life on Earth More Than 3850 Million Years Ago," *Science* 275 (1997): 38–9.

[26]D. Edwards, "Monera (Bacteria, Blue-green algae)," in *The Fossil Record* 2, ed. M. J. Benton (London: Chapman & Hall, 1993), 3–7; L. Kump, "Bacteria forge a new link," *Nature* 362 (1993): 790–1; and A. O. Mooers, & R. J. Redfield, "Digging up the roots of life," *Nature* 379 (1996): 587–8. J. P. Grotzinger, & D. H. Rothman, "An abiotic model for stromatolite morphogenesis," *Nature* 383 (1996): 423–5 dispute a cyanobacterial interpretation.

[27]P. Rüst, (1984; 1988; 1998), note 11; C. B. Thaxton, W. L. Bradley, & R. L. Olsen, *The Mystery of Life's Origin* (New York: Philosophical Library, 1984); J. Cohen, "Novel Center Seeks to Add Spark to Origins of Life," *Science* 270 (1995): 1925–6; and M. Balter, "Looking for Clues to the Mystery of Life on Earth," *Science* 273 (1996): 870–2; S. Lifson, "On the Crucial Stages in the Origin of Animate Matter," *Journal of Molecular Evolution* 44 (1997): 1–8. C. De Duve, *Vital Dust* (New York: Basic Books, 1995), 9; and "The Beginnings of Life on Earth," *American Scientist* 83 (1995): 428–37, believes, on the basis of circular reasoning, the probability of a spontaneous origin of life to be high.

[28]J. F. Kasting, "Earth's Early Atmosphere," *Science* 259 (1993): 920–6; R. Rye, et al., "Atmospheric carbon dioxide concentrations before 2.2 billion years ago," *Nature* 378 (1995): 603–5; W. L. Davis & C. P. McKay, "Origins of Life, a Comparison of Theories and Application to Mars," *Origins of Life and Evolution of the Biosphere* 26 (1996): 61–73; C. Saga & C. Chyba, "The Early Faint Sun Paradox: Organic Shielding of Ultraviolet-Labile Greenhouse Gases," *Science* 276 (1997): 1217–21; and F. Forget & R. T. Pierrehumbert, "Warming Early Mars with Carbon Dioxide Clouds That Scatter Infrared Radiation," *Science* 278 (1997): 1273–6.

[29]In Gen. 2:4, the singular *yom* stands for all of the "beginning" and the six "days" of Genesis 1. Thus, it cannot be a single day. In Isa. 23:15, "that day" comprises seventy years. In the "day" of Ezek. 36:33, cities will be inhabited and waste places rebuilt. For explicitly long "days" cf. further Eccles. 12:3; Ps. 90:4; 2 Peter 3:8; Heb. 4:3–11; 2 Cor. 6:2; 1 Cor. 1:8; and F. Rienecker, *Lexikon zur Bibel* (Wuppertal, Germany: Brockhaus, 19. Aufl., 1991), 1363–4. *The Scofield Bible*, ed. C. I. Scofield, (New York: Oxford University Press, 1967), 1372 correctly identifies the "day of the Lord" with a lengthy period. In the prophets, there are many references to the "day of the Lord" which, in their context, make it plain that it must cover an extended period. The claim that *yom* must be restricted to a 24-hour day when used with a numeral (or, especially, an ordinal) cannot be substantiated, cf. R. C. Newman & H. J. Eckelmann, *Genesis One and the Origin of the Earth* (Hatfield, PA: Interdisciplinary Biblical Research Institute, 1989), 61–2. The same expression [*yom eghad*] which is used for "day one" in Gen. 1:5 is also found in Zech. 14:7, where the context of chapters 12–14 shows that this "day of Yahweh" cannot be a normal 24-hour day. The idea that numerals would influence the length of the days conflicts with all normal language use.

[30]Exod. 20:10–11; Lev. 25:4, 8; Matt. 6:30; 24:36–44; Acts 1:7; 2 Peter 3:8. The expression "there was evening [*erev*] and there was morning [*boqer*]" does not justify 24-hour days, as the sequence would be wrong; a more precise translation, "a transition (mixing between two states) and a dawning (of a new age)," is compatible with ages.

[31]D. Wonderly, *God's Time-Records in Ancient Sediments* (Flint, MI: Crystal, 1977); H. R. Brugger, "Die Geschichte der Schöpfung: Ist die Erde ein junger Planet?" *Reformatio* 31 (1982): 160–75; D. A. Young, *Christianity and the Age of the Earth* (Grand Rapids, MI: Zondervan, 1982); D. E. Wonderly, *Neglect of Geologic Data: Sedimentary Strata Compared With Young-Earth Creationist Writings* (Hatfield, PA: Interdisciplinary Biblical Research Institute, 1987); W. B. Harland, et al., *A Geologic Timescale 1989* (Cambridge, England: Cambridge University Press, 1990); G. B. Dalrymple, *The Age of the Earth* (Stanford, CA: Stanford University Press, 1991); and H. Ross, *Creation and Time* (Colorado Springs: Navpress, 1994). For the age of the universe cf. note 18.

[32]Job 42:6; Luke 24:27. We are to study God's Word (Isa. 34:16; Ezra 7:10; Ps. 119) and his works (Ps. 111:2; Eccles. 1:13), and to judge tradition and teaching on the basis of external facts (Luke 7:19–22; Matt. 7:15–20; cf. 13:26) and Scripture (Acts 17:11).

[33]G. L. Schroeder, *The Science of God* (New York: The Free Press, 1997) presents an alternative concordant interpretation. Taking the universe at the "beginning" (the time of the origin of matter, or quark confinement) as the relativistic reference frame, six days correspond to sixteen billion earth years. Harmonization between modern scientific literature and the Bible is based on thirteenth century AD and earlier Jewish interpretations, in order to be free of modern prejudice.

[34]The verb *raqa*, "to spread out," from which the noun *raqia* is derived, designates covering a support with a thin layer of a substance whose nature is irrelevant. Of course, if a metal sheet is "spread out," this may be achieved by hammering, but in other cases, "hammering" or "making firm" cannot apply. Thus, a *raqia* may be a thin gold layer covering an idol (Isa. 40:29), but also a layer of vegetation covering the land (Isa. 42:5 uses *raqa* for both the land and what comes out of it). The basic meaning of *raqia* is a thinly spread-out layer. Some cognate words in Hebrew are: *raq*: (1) thin, slight, (2) a little, only; *raqiq*: flat bread; *riqqu-im*: spread-out (metal sheets, cf. Num. 16:38); in Assyrian, *rakaku*: to make thin; *rukku*: sheet, plate; in Arabic, *raqqa*: to be thin; *marquqa*: farmers' flat bread; *rakaâh*: to spread out a stain; *rukâh*: extension of an area; in Syrian, *riqo*: to make thin.

[35]In Gen. 1:20, the flying creatures, such as birds and insects, move "above" the land, "across" the face of the *raqia* of the heavens. As both "above" and "across" represent the same Hebrew *al*, a similar meaning may be assumed. Translating "in front of" or "before" (in order to accord with a solid firmament) would certainly make no sense with respect to the land. As the flying creatures are supported by air, and "heavens" is used for the air space, outer space, or God's abode, flying "on" the air seems to be the most reasonable translation. See also, K. Claeys, *Die Bibel bestätigt das Weltbild der Naturwissenschaft* (Stein am Rhein, Switzerland: Christiana-Verlag, 1979), 630–49.

[36]Eccles. 1:7 clearly describes the water cycle between sea and clouds, indicating that for ancient Hebrews it would have been most natural to take the "waters above the *raqia*" to be the clouds above the air space.

[37]H. Ross (1979), note 24, 7.

[38]F. Press & R. Siever, *Earth* (New York: Freeman, 1981); S. A. Bowring & T. Housh, "The Earth's Early Evolution," *Science* 269 (1995): 1535–40.

[39]J. M. Hayes, "The earliest memories of life on Earth," *Nature* 384 (1996): 21–2; E. Wilson, (1996), note 25.

[40]D. Edwards, et al., "'Algae,'" in *The Fossil Record 2* (1993), note 26, 15–40.

[41]R. J. Horodyski & L. P. Knauth, "Life on Land in the Precambrian," *Science* 263 (1994): 494–8.

[42]D. J. Des Marais, et al., "Carbon isotope evidence for the stepwise oxidation of the Proterozoic environment," *Nature* 359 (1992): 605–9; G. A. Logan, et al., "Terminal Proterozoic reorganization of biogeochemical cycles," *Nature* 376 (1995): 53–6; A. H. Knoll, "Breathing room for early animals," *Nature* 382 (1996): 111–2; D. E. Canfield, & A. Teske, "Late Proterozoic rise in atmospheric oxygen concentration inferred from phylogenetic and sulphur-isotope studies," *Nature* 382 (1996): 127–32; P. Van Cappellen & E. D. Ingall, "Redox Stabilization of the Atmosphere and Oceans by Phosphorus-Limited Marine Productivity," *Science* 271 (1996): 493–6.

[43]D. Edwards, "Bryophyta," in *The Fossil Record* 2, note 26, 775–8; P. Kenrick & P. R. Crane, "The origin and early evolution of plants on land," *Nature* 389 (1997): 33–9.

[44]Gen. 1:11, 12, 21, 24, 25. K. Claeys & A. Held, note 6, 47–8. P. H. Seely, "The Meaning of Mîn, 'Kind'," *Science & Christian Belief* 9 (1997): 47–56, interprets differently.

[45]Gen. 9:4; Lev. 17:11–14.

[46]R. L. Carroll, *Vertebrate Paleontology and Evolution* (New York: Freeman, 1988), 16–61; L. Margulis & K. V. Schwartz, *Five Kingdoms* (New York: Freeman, 1988); H. Cappetta, et al., "Chondrichthyes," in *The Fossil Record 2*, note 26 (1993): 593–609.

[47]Deut. 14:11–20.

[48]A. J. Ross & E. A. Jarzembowski, "Arthropoda (Hexopoda; Insecta)," in *The Fossil Record 2*, note 26 (1993): 363–426.

[49]Ps. 104:30.

[50]J. P. Grotzinger, et al., "Biostratigraphic and Geochronologic Constraints on Early Animal Evolution," *Science* 270 (1995): 598–604; D. Erwin, et al., "The Origin of Animal Body Plans," *American Scientist* 85 (1997): 126–37; and R. A. Fortey, "The Cambrian evolutionary 'explosion' recalibrated," *BioEssays* 19 (1997): 429–34.

[51]A. R. Milner, "Amphibian-Grade Tetrapoda," in *The Fossil Record 2*, note 26 (1993): 665–79; A. S. Moffat, "Teeth and Bones Tell Their Stories at Chicago Meeting," *Science* 278 (1997): 801–2.

[52]Of course, we leave the flying creatures in day 5, but expect that a solution to the relative dates of first appearance in the fossil record of flying creatures and of amphibians will be found, most likely through earlier "flyer" fossils, or possibly by a more precise ecology of the first amphibians (A. R. Milner, [1993], note 51, places the *Lethiscidae* and the first *Ophiderpetontidae* in the Visean Series, dated 349.5–332.9 Ma ago, and localizes them as "terrestrial/flowing-water." The first clearly "terrestrial" animals were the *Caerorhachidae* and earliest *Dendrerpetonidae* in the Serpukhovian Series, dated 332.9–322.8 Ma ago).

[53]Eccles. 3:18–20 indicates that man is (biologically) an animal [*behemah*] like those of Gen. 1:24.

[54]K. Claeys, note 35 (1979): 279; Claeys' note 27.

[55]H. M. McHenry,"Tempo and mode in human evolution," *Proceedings of the National Academy of Sciences* 91 (1994): 6780–6; B. Wood, "The oldest hominid yet," *Nature* 371 (1994): 280–1.

[56]B. Wood, "Human evolution," *BioEssays* 18 (1996): 945–54.

[57]A. Gibbons, "A Rare Glimpse of an Early Human Face," Science 274 (1996): 1298; A. Gibbons, "*Homo erectus* in Java: A 250,000-Year Anachronism," *Science* 274 (1996): 1841–2.

[58]S. Semaw, "2.5-million-year-old stone tools from Gona, Ethiopia," *Nature* 385 (1997): 333–6.

[59]A. Gibbons, "Rewriting—and Redating—Prehistory," *Science* 263 (1994): 1087–8.

[60]M. B. Roberts, C. B. Stringer, & S. A. Parfitt, "A hominid tibia from Middle Pleistocene sediments at Boxgrove, UK," *Nature* 369 (1994): 311–3. A 1-Ma-old fossil may show *H. sapiens* features (E. Abbate, et al., "A one-million-year-old *Homo* cranium from the Danakil (Afar) Depression of Eritrea," *Nature* 393 [1998]: 458–60).

[61]M. Balter, "Did *Homo erectus* Tame Fire First?" *Science* 268 (1995): 1570.

[62]F. McDermott, et al., "Mass-spectrometric U-series dates for Israeli Neanderthal/early modern hominid sites," *Nature* 363 (1993): 252–5; D. M. Waddle, "Matrix correlation tests support a single origin for modern humans," *Nature* 368 (1994): 452–4.

[63]A. Gibbons, "Y Chromosome Shows That Adam Was an African," *Science* 278 (1997): 804–5.

[64]H. Bächler, *Die ersten Bewohner der Schweiz* (Bern, Switzerland: Francke Verlag, 1947), 75–6, 141–54; H. Müller-Beck, "Das Altpaläolithikum," in *Ur- und frühgeschichtliche Archäologie der Schweiz* Vol. 1 (Basel, Switzerland: Verlag Schweiz.Ges.Ur-u.Frühgesch., 1968), 89–106.

[65]J. Hahn, "Der Schatz aus dem Hohlenstein," *Kosmos - Bild unserer Welt* 66 (1970): 362–4; J. Fischman, "Painted Puzzles Line the Walls of an Ancient Cave," *Science* 267 (1995): 614; D. Bjerklie, et al.,"Behold the Stone Age," *Time* (Feb. 13, 1995): 34–44; M. Balter, "Cave Structure Boosts Neanderthal Image," *Science* 271 (1996): 449.

[66]I. Amato, "American Family Tree Gets New Root," *Science* 260 (1993): 22.

[67]L. L. Cavalli-Sforza, et al., "Demic Expansions and Human Evolution," *Science* 259 (1993): 639–46; J. Diamond, "Location, Location, Location: The First Farmers," *Science* 278 (1997): 1243–4.

[68]K. M. Kenyon, *The Bible and Recent Archaeology* (London: British Museum Publication, 1978).

[69]G. R. Morton, "The Mediterranean Flood," *PSCF* 49 (1997): 238–51, equates Noah's flood with the catastrophic refilling of the Mediterranean basin 5.5 million years ago, cf. K. Hsü, *The Mediterranean Was a Desert* (Princeton, NJ: Princeton University Press, 1983). This would require biblical humanity to begin with hominids having brain sizes hardly larger than those of chimpanzees, as well as over five million years of "human" history without any culture. Another catastrophic flood occurred about 7,500 years ago near the Ararat region, cf. R. A. Kerr, "Black Sea Deluge May Have Helped Spread Farming," *Science* 279 (1998): 1132.

[70]This includes his three acts of creation of generic non-evolutionary novelty marked by the use of *bara* in Genesis 1. Of course, the other three modes of God's creating, discussed in the section on the meaning of creation, did not cease.

[71]Gen. 2:2; Heb. 4:3–11. Hebrew *shabath* means to cease, to end, to bring to rest. God doesn't need rest; he continued to work on the Sabbath (Isa. 40:28; John 5:17). The purpose of the Sabbath is communion with God, not inactivity. Unlike the six days of Genesis 1, the seventh day is nowhere said to have ended.

[72]K. Claeys, note 35 (1979): 513–56: Hebrew *yatzar* = German "*entwerfend festlegen*" (to commit by designing).

[73]Literally, Gen. 2:7 reads: "And God Yahweh formed [*yatzar*] the Adam, dust [*afar*] from the ground [*'adamah*]," i.e., the Adam who *was* dust, derived from the ground. God did not form him *out* of dust. In Gen. 3:19, God tells him: "dust [*afar*] you *are* [present tense!], and to dust [*afar*] you will return." The same thing is said in Eccles. 3:20 of *all* humans and animals. Ps. 103:14 reads: "He knows our frame [or formation, *yetzer*, derived from *yatzar*], he remembers that we *are* [present tense!] dust [*afar*]." Isa. 64:8 says: "We are the clay [not *afar*] and you are our potter [participle of *yatzar*], we are all the work of your hand." And Job agrees: "I too was taken from clay" (33:6). He pleads with God: "Your hands shaped me and made me ... Remember that you molded me like clay. Will you now turn me to dust [*afar*] again?" (10:8–9). But he also specifies: "Did not he who made me in the womb make them? Did not the same one form [not *yatzar*] us both within the womb?" (31:15). Similarly, Jeremiah (1:5) was formed [*yatzar*] in the womb by God. Thus, "to be formed out of dust" by God, or "formed out of clay" (as a potter does) was a customary metaphor for growing in one's mother's womb. The formation of Adam's body is couched in the same terms. Whatever constitutes the bodies of each human being is ultimately derived from nonliving matter, "dust" of the ground.

[74]Cf. Prov. 8:26: "... before he had made the earth with its fields, or the first of the *afar* of the world ..."

[75]Rom. 5:12–21. In this context, physical descent is irrelevant for the old humanity (not necessarily for old Israel), just as it is for the new. Adam's being called "the first man" does not refer to biological genealogy, as can be seen in Christ's being "the second man" and the "last Adam" (1 Cor. 15:45–47). John 3:8.

[76]Cf. Exod. 3:14: "God said to Moses, 'I AM who I AM. ... Say this to the people of Israel, I AM has sent me to you,'" cf. Jesus' use of "I AM," shocking his Jewish listeners, e.g., John 8:58.

[77]Isa. 43:7, cf. note 8.

[78]Gen. 2:7; cf. Job 33:4, "The *rooagh* of God has made me; the *neshamah* of the Almighty gives me life." Job 32:8, "It is the *rooagh* in man, the *neshamah* of the Almighty, that gives understanding." Cf. Prov. 20:27.

[79]We obviously do not have a mature theory for our suggestion that Adam's receiving the spirit [*neshamah*] of life represents his being born again, nor for our support of the postulate of Adam not being the first man. But neither have we encountered any other satisfactory theory which does not make myths out of inspired Scripture or conflicts with science. M. G. Kline, "Space and Time in the Genesis Cosmogony," *PSCF* 48 (1996): 2–15 allegorizes Gen. 1–2 by his "Two-Register Cosmogony," agreeing with scriptural theology and avoiding contact with science. But if God is the Author of both creation and Scripture, the implication that this poetic-spiritual interpretation rules out a parallel interpretation on an historical-narrative level is not compelling. It is on this level that we want to propose an interpretation for discussion, without denying the feasibility of a spiritual-allegorical reading.

[80]Whenever the Bible talks of humans (or even animals) being formed [*yatzar*] by God, it also mentions their particular mission, cf. Ps. 139:13, 16 (David); Isa. 43:7, 21 (God's sons and daughters); 49:5 (the Messiah); and Jer. 1:5.

[81]1 Cor. 15:47, 45.

[82]N. R. Pace, "A Molecular View of Microbial Diversity and the Biosphere," *Science* 276 (1997): 734–40.

[83]H. Steller, "Mechanisms and Genes of Cellular Suicide," Science 267 (1995): 1445–9; C. B. Thompson, "Apoptosis in the Pathogenesis and Treatment of Disease," Science 267 (1995): 1456–62.; R. A. Raff, *The Shape of Life* (Chicago: University of Chicago Press, 1996); J. M. Frade & T. M. Michaelidis, "Origin of eukaryotic programmed cell death: a consequence of aerobic metabolism?" *BioEssays* 19 (1997): 827–32; and D. Wallach, "Placing death under control," *Nature* 388 (1997): 123–6.

[84]R. Junker, *Leben durch Sterben?* (Stuttgart-Neuhausen, Germany: Hänssler, 1994) claims Rom. 5:12–21 and 8:19–23 require all death to result from Adam's fall. But (1) Old Testament believers are saved through Christ's substitutionary sacrifice apparently effective backwards in time. Christ, "the second man," is the first and typical representative of the new human race of those having spiritual life—before and after his time; Adam, "the first man," is the typical representative of the old human race of the spiritually dead, presumably before and after his time. (2) Sin is seldom followed immediately by death, but by occasions for repentance. (3) Sin is not inherited, but all die because "all men sinned." Death entering the human world "through Adam" and spreading "to all men" is a spiritual-typological link. (4) Satan sinned "from the beginning" (John 8:44) before Adam; he tempted Adam. Death was possible and plausible before Adam. (5) The non-human creation's predicament is not linked to Adam's fall, but to Satan, "the god of this world" (2 Cor. 4:4).

[85]Cf. note 31.

[86]Gen. 1:26; 1 Tim. 4:4.

[87]Rom. 8:28.

[88]A "gap theory" is not implied, nor is a primeval or intermediate "chaos" in the mythical sense. God's entirely good creative activity is continually operative from the Big Bang 13.5 Ga ago to this day, while Satan's corrupting creation began with his fall before the primeval earth's state depicted in Gen. 1:2 and continues today.

[89]Gen. 2:17; 3:16, 20–21.

[90]Gen. 3:15, 20, 21; 1 Cor. 15:54.

[91]Prophecy may refer to past, present, or future.

[92]O. T. Allis, *The Five Books of Moses* (Phillipsburg, NJ: Presbyterian and Reformed Publishing Company, 1949); G. L. Archer, *A Survey of Old Testament Introduction* (Chicago: Moody Press, 1964); G. Maier, *Das Ende der historisch-kritischen Methode* (Wuppertal, Germany: Brockhaus, 1975); R. C. Newman, *Evolution-Religion and the Genesis Account* (Hatfield, PA: Interdisciplinary Biblical Research Institute, Res. Report Nr. 23, 1984); E. J. Young, *An Introduction to the Old Testament* (Grand Rapids, MI: Eerdmans, 1989); A. A. MacRae, *JEDP: Lectures on the Higher Criticism of the Pentateuch* (Hatfield, PA: Interdisciplinary Biblical Research Institute, 1994); and R. C. Newman, "Scientific and Religious Aspects of the Origins Debate," *PSCF* 47 (1995): 164–75.

[93]P. H. Seely, note 17 (1991, 1992, 1997); J. B. Russell, (1997), note 17; and W. F. Tanner, "'Planet Earth'? or 'Land'?" *PSCF* 49 (1997): 111–5.

Design Up to Scratch? A Comparison of Design in Buckland (1832) and Behe

Michael B. Roberts
topper@robertschirk.u-net.com

Chirk Vicarage
Trevor Road
Chirk
Wrexham, Wales LL14 5HD

Intelligent Design has attracted both its supporters and denigrators. Behe's Darwin's Black Box *has been a secular best seller. This paper[1] compares Intelligent Design with nineteenth century Paleyan design, by comparing the philosophy and methods of Buckland's lecture on "Megatherium" in 1832 with Behe's philosophy in* Darwin's Black Box. *Buckland regarded every detail as showing design and practiced* reverse engineering, *but Behe regards only the unexplained to show design. To put it pithily; Buckland saw the demonstration of design in explaining. Behe sees the demonstration of design in not explaining.*

"The result of these cumulative efforts to investigate the cell ... is a loud piercing cry of 'design.'" So wrote Michael Behe in *Darwin's Black Box* and continued by saying: "But no bottles have been uncorked, no hands slapped."[2] This best-selling volume is the most well-known work on Intelligent Design and the ripples from it have reached my side of the pond. Many pages—on and off the web, both critical and censoring—are devoted to it. As there are hundreds of web pages, this contribution may be superfluous. *Darwin's Black Box* has gained attention from the National Center for Science Education and Dr. Eugenie Scott has called exponents of Intelligent Design, the *Neo-Creationists*.[3]

Among all the controversy Behe and other Intelligent Designers have raised, it is assumed that they have relaunched the Argument from Design. This paper considers whether or not Intelligent Design is a revival of the design argument of William Paley and his successors. Ideally one needs to trace out the history of the design argument and deal at length with Paley and Hume, the Bridgewater Treatises, and other early nineteenth-century design arguments. Then one should deal with the challenge raised by Darwin and the response of thinkers such as Asa Gray, T. R. Birks, and Julia Wedgwood (Snow), whose precise relationship to Darwin would, according to Jim Moore, make an interesting paper in itself. Each of these arguments is worthy of a critical, yet sympathetic re-appraisal without stooping to a pejorative approach such as used by Altholz, when he patronizingly dismisses Paley by saying: "The smoothness and closeness of Paley's arguments had a certain fatuous charm."[4]

One may question how far those who criticize Paley have actually read his works. It is certainly fatuous to criticize him and his successors without a careful consideration of the design argument in a historical context. Rather than present a long, historical exposition and comparison, I shall focus very narrowly and compare Behe's *Darwin's Black Box* with William Buckland's expositions of the design of *Megatherium*, an enormous extinct relative of the sloth.

Unlike Paley who was a competent theologian, Buckland was a first-rate, nineteenth century scientist and one of the strongest proponents of design. He was a leading geologist and was Reader of Geology and Mineralogy at Oxford University from 1818 to 1845, when he was also Canon of Christ Church. From 1845 he was Dean of Westminster where his interests turned toward sewage and the need for sanitation in the cholera-racked capital. Sadly his latter years were marred by mental illness. He died in 1857.

Buckland is easily dismissed for his early interest in the Deluge as a key geological mechanism, but both Davis Young and Stephen Gould have stressed his superb geological competence.[5] He was the first to discover Mesozoic mammals in the Stonesfield slates near Oxford, and the one who introduced concepts of an Ice Age to Britain after a field trip to Switzerland with Agassiz in the fall of 1838.[6] (Ironically Darwin recorded evidence of glaciers in Shrewsbury in July 1838, but never published his findings.[7]) Theologically he was on the edge of evangelicalism, as may be evidenced by the support he received from Anglican evangelicals, such as J. B. Sumner (Archbishop of Canterbury 1848–1862) and G. S. Faber. W. F. Cannon overstates the case by claiming Buckland was a Broad Churchman,[8] but this is probably due to the problem that many have believing an evangelical can have good scientific credentials. After all, no scientist could possibly be an evangelical!

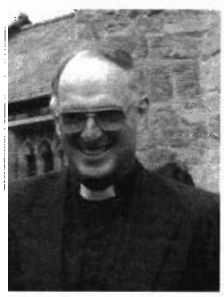
Stories abound about Buckland, from eating his way through the animal kingdom to making earrings for lady-friends out of coprolite! Darwin described him as "a vulgar and a most coarse man. He was incited more by a craving for notoriety, which sometimes made him act like a buffoon."[9] His friends were more appreciative. Thomas Sopwith, who traveled with him to North Wales in October 1841, wrote in his diary: "with Dr. Buckland for a companion, fatigue was impossible" even when traveling through North Wales in torrential rain.

Of all Paley's contemporaries, Buckland was his most loyal disciple and the strongest scientific exponent of design, even while friends and colleagues such as Whewell and Sedgwick were moving away from Paley.[10] No one was better qualified to write a Bridgewater Treatise than Buckland for both scientific and theological reasons. His volume entitled *Geology and Mineralogy Considered with Reference to Natural Theology*[11] was the best seller of the eight and found its way into many Mechanics Libraries and George Eliot's *Mill on the Floss*. (The Bridgewater Treatises were commissioned because the Earl of Bridgewater, an eccentric Anglican clergyman, who had a parish in Shropshire, left £ 8,000 in his will when he died in 1829 for the publication of works to demonstrate "the power, Wisdom and Goodness of God as manifested in the Creation.") As well as being a compendium of geology, Buckland's volumes were full of design in the geological world.

Buckland on *Megatherium*

To Buckland *Megatherium* was an excellent creature to demonstrate the design of God for reasons which shall become apparent. Some years earlier, an almost complete skeleton of the extinct *Megatherium* had been brought back from the Pampas in South America. Its very grossness and bizarre structure made it remarkable. It was a good twelve feet in length, stood eight feet high, and had enormous feet a yard long. Being covered in bony armor with an unusual snout and interlocking teeth, it could not fail to attract attention. The *Megatherium* also gave a considerable challenge to any who wished to demonstrate design from its odd anatomy. That was a challenge Buckland could not resist.

Buckland's first demonstration of the design of *Megatherium* took place at the second annual meeting of the British Association held in Buckland's home city of Oxford in 1832. On the night of June 23, he lectured until midnight to the edification and entertainment of all present at the Holywell music room. The lecture was never published but is still extant in the form of seventy-two pages of beautiful copperplate handwriting. Whether this represents the text of the lecture Buckland prepared or a transcript, one cannot know. It is probably a full transcript by someone else as the writing is very legible in contrast to Buckland's scrawl, which his wife described as "shapeless characters in lieu of legitimate letters."[12] Most likely Mary Buckland, a competent naturalist herself, transcribed the lecture. The transcript also contains many obviously unscripted asides and a few illegible insertions of Buckland scrawl. Later the substance of the lecture was pub-



Michael B. Roberts spent his earliest years in India and his school years in Surrey. He received a B.A. from Dunelm and a M.A. from Oxon. After studying geology at Oxford, he spent three years in Africa as an exploration geologist. He studied theology at Durham and was ordained into the Anglican Church in 1974. For the next thirteen years, he ministered in parishes in Liverpool before becoming the Vicar of Chirk, near Llangollen in 1987. Michael is a keen mountain walker and has written articles on science and religion (one on Darwin and Design received a Templeton Award in 1997) and Darwin's geology. He and his wife, Andrea, have two, almost-grown-up children.

lished in a more restrained form in the *Transactions of the Linnaean Society* and in his Bridgewater Treatise. The latter contains all the *scientific* substance of the 1832 lecture, but none of the humor.[13]

At times Buckland's lecture is long-winded, but it is always larded with wit. He introduced his audience to this creature, "the most monstrous of the monstrous kind" (p. 2). Buckland pointed out that *Megatherium* was related to the sloths and then stressed that the sloths were "a family whose structure is very anomalous, and has been misunderstood by almost every naturalist including Buffon, even the immortal Cuvier himself" (p. 8). (Cuvier had recently died of cholera and his death was deemed a great loss to science.) Cuvier and Buffon had been arguing that sloths are a very bad design and, if we speak anthropmorphically, are examples where God's designing abilities are simply not up to scratch, or, in today's terms, reflect *unintelligent* rather than *intelligent* design. Buffon, after describing the clumsy nature of sloths in his *Natural History*, wrote: "All these circumstances announce the misery of the sloths, and recall to our minds those defective monsters, those imperfect sketches of Nature ..." And he later wrote: "To regard those bungled sketches as beings equally perfect with others ..."[14] Buckland was determined to show that sloths and their big brother, Old Scratch, were carefully designed creatures rather than bungled attempts at creation.

Fig. 1. Megatherium from William Buckland, *Geology and Mineralogy Considered with Reference to Natural Theology* (London: 1836).

Having taken on Buffon and Cuvier, Buckland apparently had talked himself into a corner and then had to talk himself out of it by demonstrating the wonderful design of *Megatherium*. It is impossible to read the lecture without feeling what marvelous theater Buckland's lectures were. Buckland showed that he had the confidence and skill to talk himself out of a corner because of both his scientific skill and of his faith in the Creator: "from first to last, the same hand that has framed, and the same Almighty mind that has designed the smallest and most complicated of existing creatures" (p. 10). (Do we detect echoes of Blake's Tyger here?)

Finally after a mere twenty pages of introduction, he began to discuss *Megatherium*, saying: "We will begin at the beginning with the nose the most important feature in all animals" (p. 20)—though I smell the aroma of burlesque at this point! From there he expounded a detailed anatomy of the big beastie. Behind the humor and buffoonery is a deadly serious purpose as he sought reasons for Design in every aspect of *Megatherium*'s anatomy, commenting: "I before observed nature is prodigal of contrivance where contrivance is necessary and most rigidly economical when it is unnecessary" (p. 22).

From the nose, Buckland worked through the teeth, on to the fore legs, and finally to the rear legs and the armor. On each he gave both ribald humor and detail, pointing out that "we have here marks of intention and design" (p. 36). He likened the interlocking teeth in the jaw with iron teeth in a rat- or man-trap, commonly known as a gin-trap. The purpose of the alternating "angular projections of iron" was to lay "hold of a Boys or a rats leg" (p. 32). Then he indicated that the jaw was "not a rat trap but a potatoe (*sic*—the spelling makes one Quayle!) trap as I will show you presently" (p. 32).

Next Buckland moved to the front legs, which are massive and designed for the support of an enormous weight rather than for locomotion. He called attention to the unusual shoulder blade that gave

"him a free, playful, roundabout motion with his fore leg" (p. 34) and to the fore leg that is larger than its hind leg. He then observed that Old Scratch's equivalent of a funny bone was huge, for the purpose of attaching an enormous muscle necessary to support the massive digits on its front feet. With typical Bucklandian buffoonery and almost sexist humor, he observed that if a lady pianist had a proportionally large funny bone "that with her hand she could cover the whole length of a piano" (p. 37)! On the meter-long feet, he could not resist humor in describing the size of the heel bone which was more than a foot in diameter: "The bone on which rests the animal is as big as the head of Professor Babbage" (p. 38). One may imagine the ribald laughter at this point, but fortunately the serious, young Darwin was at the antipodes as, like the future queen, he would not have been amused. Buckland continued to expound the structure of the rear limbs, tail, and armor and to emphasize and argue that *Megatherium* was very well designed for its station in life.

Finished with the anatomical description, he next explained the function of *Megatherium*. His buffoonery, so hated by the prim and proper Darwin, came to the fore. It "has been suggested by Professor Sedgwick who thinks we have found old Scratch himself ... That he could scratch and did scratch is quite evident and that without scratching he would have died is a fact I will endeavour to show you. If he did scratch, then arises the question, what did he scratch?" (pp. 40–1). And so over the next pages, Buckland gave a lively interpretation of *reverse engineering* applied to Old Scratch. His *reverse engineering* or *artifact hermeneutics* was also painstaking and rigorous, and is as fine an example as anything Dennett may give us.[15] Buckland concluded with a flourish:

> Gentlemen his teeth indicated a peculiarity of structure; they were not calculated to eat leaves or grass; they were not calculated to eat flesh; he was an eater of vegetables. What then remained for him but roots? He has a spade, and he has a hoe and a shovel in those three claws in his right hand ... He is the Prince of Sappers and miners—I speak in the presence of Mr. Brunel the Prince of Diggers ... (p. 50).

Old Scratch was *designed* to gather potatoes and other roots at a depth of eighteen inches and relied on armor to repel predators. Buckland could have argued that the armor was *compensation* for the large cumbersome feet that inhibited its movement. As neither fight nor flight was an option for Old Scratch, he had to envelop himself in armor to keep predators at bay. In contrast to Buffon's miserable sloths, Buckland presented a creature ideally suited to its lot, and since it was designed to scratch, it was happy to scratch. Finally after midnight, Buckland concluded: "Gentlemen, as time is advancing, I must put an end to the present discussion, and I hope you will accept any apology for having detained you so long" (p. 70).

Design for Paley and Buckland was the design of* all *aspects of a living creature.

Thus Buckland had chosen an animal which leading anatomists like Buffon and the immortal Cuvier regarded as having a poor and *bungled* design to show, by the careful and rigorous anatomical description and then the application of *reverse engineering*, to be perfectly designed or adapted for its environment. It is almost as if Buckland used his faith in God as a Designer to provide the starting-point for his search for design. One may see this as a particular expression of a theistic outlook, where one expected to find design in creation. Here, for Buckland, design was not so much a scientific theory, but rather a metaphysical or theological outlook, which gave confidence or grounds for applying reverse engineering procedures. In his Bridgewater Treatise, Buckland applied similar techniques for other extinct creatures, but design for inanimate geology was more problematical.

As a progressive creationist, Buckland considered all living creatures to be directly created by God and thus all were designed by the Almighty. Therefore he did not raise issues due to descent and whether the detailed lifestyle of a creature may be due to adaptation rather than design. That is another issue and does not concern us here. The key issue here is that design for Paley and Buckland was the design of *all* aspects of a living creature.

Darwin's Black Box

We now move forward 164 years to the publication of *Darwin's Black Box* in 1996, which is probably the most discussed work on Intelligent Design and attracts almost equal measure of acclamation and denigration in vast quantities. As a biochemist, Behe spends the major part of the book describing and explaining biochemical processes. He stresses that some, e.g., cilia and blood clotting, have proved very resistant to "Darwinian" explanation and like his irreducible mousetrap represent an irreducible biochemical design. Since my biochemistry is of a rudimentary nature, Behe's biochemistry will be taken as read. My purpose is to consider the wider

implications of his argument for the nature of the creation and his concept of design. I am aware that some question his biochemistry, but that does not effect his basic argument.

Behe's biochemical exposition leads up to the crux of his argument found in his key chapter on "Intelligent Design" (chapter 11) correctly pointing out: "The impotence of Darwinian theory in accounting for the molecular basis of life ..." (p. 187). I say correctly, as there is so much on the origin of life and biochemical systems that is unknown. From there he leads into his understanding of design and defines design as "simply the *purposeful arrangement of parts*" (p. 193). Next he asks: "The scientific problem then becomes, how do we confidently detect design?" He answers in part: "For discrete physical systems—if there is not a gradual route to their production—design is evident when a number of separate, interacting components are ordered in such a way as to accomplish a function beyond the individual components" (p. 194). And then he says, for design *"there must be an identifiable function of the system"* (p. 196).

In discussing the laws of nature, Behe states: "If a biological structure can be explained in terms of those natural laws, then we cannot conclude that it was designed" (p. 203).

After discussing how biochemists "design" new chemicals by using mutation and selection, Behe moves to a natural/created world that is part designed and part not. In discussing the laws of nature, Behe states: "If a biological structure can be explained in terms of those natural laws, then we cannot conclude that it was designed" (p. 203). Thus if a biochemical system can be explained by mutations or by any other mechanism, then it was not designed. But if it cannot be explained, then it was designed. Therefore, for Behe, cell membranes and hemoglobin are not designed, but cilia and the mechanism of blood clotting are designed.

Behe argues that some other biochemical mechanisms are designed and discusses these at length in chapter 3 to chapter 6. As well as the blood-clotting system mentioned above, he brought forward the function of the cilium as a motorized paddle and as the intracellular transport system. His conclusion at the end of this long section of several chapters was to go "into a lot of detail to show why they could not be formed in a gradualistic manner" (p. 160). He claims that these "are a problem for Darwinism." They both are and are not. In a relatively young science like biochemistry, much is still unexplained. However, a comparison of biochemistry in the 1930s, when my father isolated lysosyme and a colleague estimated its molecular weight as about 18,000, and today does support Darwinians (whoever they are!) in their optimism of future breakthroughs.[16] In the words of Sir Peter Medawar, no scientist can go beyond "the Art of the Soluble." What is insoluble today is often soluble tomorrow.

Now let us consider the non-designed structures. Every form of life depends on the cell and thus membranes to contain cells. Behe points out that the membranes are formed in a manner akin to the way detergent molecules associate to form bubbles. "Because these molecules form bubbles *on their own* (my italics) ... it is difficult to infer intelligent design from cell membranes" (p. 206). There is an illogic here. No one would challenge that there is *"an identifiable function of the system"* (p. 196) in that the cell membranes have a clear function. As the function is apparent (in containing the cell material) this surely shows "a function beyond the individual components" (p. 194). As there is *"an identifiable function of the system,"* then the cell membrane reflects design according to Behe's previous argument. Yet he claims cell membranes do not show design because their origin can be explained.

Behe gives a similar argument for hemoglobin and holds that "the case for design (of hemoglobin) is weak" (p. 207) because the starting point, myoglobin, already can bind oxygen. So he concludes: "I would say that hemoglobin shows the same evidence for design as does the man in the moon: intriguing, but far from convincing." In contrast, Behe argues that the blood-clotting system is designed as "fibrinogen, plasminogen, thrombin, protein C, Christmas factor, and the other components of the pathway together do something that none of the components can do alone" (p. 204). His argument here seems to be that as biochemists have intelligently designed alterations to the blood-clotting system to prevent unwanted blood clots, i.e. thromboses, blood clotting must have been intelligently designed in the first place. It is odd, to say the least, that the transport of oxygen in our bodies by hemoglobin is *not* designed, yet, when we cut ourselves, the clotting of blood in the wound is design. One may ask, "Is only the clotting of blood *fearfully and wonderfully made,* but not hemoglobin itself?"

While on holiday in the Alps, I meditated on the implications of Buckland's and Behe's concepts of design as I was walking at about 10,000 ft. That is the height at which I begin to feel the effects of altitude and have to slow down. One morning I ascended a pass, the *Col du Lame* at 3,040 meters, which is overshadowed by *le Petit Combin* with its glaciers. Despite the length and steepness of ascent up some immense lateral moraines, I kept up a good pace exhilarated by feeling fit. I thought about Behe's argument that hemoglobin is not designed. As I scrambled up the last few hundred feet of steep and very unstable scree, I kept saying to myself, "Hemoglobin is not designed, thus my good aerobic condition is not God-given." Then I realized that if I slipped off the loose rock onto the glacier headwall below, I would be shredded on the rapid descent. And as I lay bleeding at the foot of the slope, design would come into action as my bleeding wounds began to clot. Fortunately, I did not slip. At the summit of the col, I continued to think of design as I contemplated the panoramic view with Mont Blanc to the west and the Great St. Bernard Pass below me. The beauty was breathtaking. I asked myself, "Is all this designed? Are glaciers designed?"

The last few hundred feet of my climb had been over steep scree with irregular, easily dislodged boulders lying at about the angle of rest, which was simply dumped by the retreating glacier in the last fifty years. It would be hard to suggest that moraines are designed as they contain all the subtleties of a fleet of dumper trucks unloading. That is not to say that a competent glacialogist cannot explain their origin and the physical laws which were called into play. It would be interesting to consider how Buckland would have considered the design of glaciers, as it was he who brought glacial theory to Britain in 1838. In fact, none of his writings on glaciation, published or unpublished, make any mention of design. Glaciers seem to lie outside Buckland's concept of design. I consider glaciers to be some of the most wonderful parts of creation, but I cannot see how design comes into it.

Though one might argue that we should restrict design to life structures, most advocates of design—past and present—do argue that the planet, for example, is *designed* for life to exist. Undoubtedly glaciers are an extreme case, but the question of design must be considered. The example of hemoglobin, however, as undesigned and blood clotting as intelligently designed does pose a problem and I hope I have focused the issue in a personal and not too rarefied way. Behe's proposed solution concludes that explainable biochemical processes are not designed and unexplainable ones are designed. That belief is contrary to a biblical doctrine of creation in which *everything* is created, as we say in the Nicene Creed: "I believe in one God, the Father Almighty, maker of heaven and earth, and of *all* things, visible and invisible." If not actually contrary to the doctrine of creation, Behe's explanation does create a serious theological problem, as some of creation is *designedly* created whereas the rest is *undesignedly* created. We, therefore, end up with a two-tier creation where some life systems, which are due to the process of natural laws, are not designed and where others, which are not due to the process of natural laws, are supernaturally designed.

Behe's proposed solution concludes that explainable biochemical processes are not designed and unexplainable ones are designed.

This is in total contrast and contradiction to the design theory of Buckland. As we saw in his *Megatherium* lecture, he challenged the "unintelligent design" theories of Buffon and Cuvier, and insisted that if God created, he must have designed. And if God had designed, he designed well. Buckland sought to explain every last detail of Old Scratch and how he was designed. There was no two-tier creation for Buckland; God had created (and thus designed) "all things, visible and invisible." To Buckland the work of a scientist was to work out how God had designed whatever creature one was studying.

Behe has totally misunderstood the classic design arguments of William Paley (pp. 210–19). Behe's refutation relies on ridicule rather than engagement. Paley and his successors are worthy of far more respect, especially when considered in their historical context. Though Paley was no practicing scientist and made no claims to be one, the "mixed bag" dismissed by Behe reflects a wide understanding of contemporary anatomy. Behe mocks Paley's use of *compensation* to explain certain aspects of anatomy, but, in fact, his (or, rather, everyone else's!) principle of *Compensation* resurfaces in Cuvier's *Recherches sur les ossements fossiles de quadrupedes* and in Buckland's lecture on *Megatherium* and his Bridgewater Treatise as discussed above.[17] Behe's lack of biological understanding lets him down badly here, both in consideration of historical and contemporary issues. Further, Paley and Buckland were convinced that God had designed everything down to the last

detail, which is a reasonable inference from their particular creationist belief. Paley wrote as an informed theologian, but Buckland was a geologist of the first rank. One may say that Paley and Buckland followed a total design theory. They simply practiced *reverse engineering* or *artifact hermeneutics*—so well described in Dennett's *Darwin's Dangerous Idea*—and looked for the function of biological features. The more skeptical of Paleyan design such as Sedgwick and Whewell went for a partial design theory. Darwin had questioned design from 1838 when he dismissed Macculloch's book on design with comments such as "What Bosch!!"[18]

Buckland saw the demonstration of design in explaining. Behe sees the demonstration of design in not explaining.

It is essential to see what Behe and other exponents of Intelligent Design are actually saying. They adopt *reverse engineering* and where this explains a feature, then that feature is *not* designed. *Design is reserved only for those features that cannot be explained.* By this they think they ensure a place for the creative activity of the Intelligent Designer—God. Our two advocates of *reverse engineering*, Buckland and Dennett, would concur, though for very different reasons, that ultimately a reason for any structure will be found. Dennett always pushes for a Darwinian or rather a naturalistic origin, while Buckland usually stops at explaining the design without considering the origin. Behe at times considers both the design and the origin as in hemoglobin, but if the origin can be explained, that means it had a naturalistic rather than a designed origin.

If Behe's Intelligent Design argument is followed consistently, the result is to have two aspects of creation or nature: (1) those aspects whose origins can be explained by gradual steps, which are thus due to natural laws but *are not designed;* and (2) those aspects which cannot, and will not, be explained by natural laws, and *these have been designed.*

To put matters as baldly as possible: *Buckland saw the demonstration of design in explaining. Behe sees the demonstration of design in not explaining.* So much for Behe's claim that "the result of these cumulative efforts to investigate the cell ... is a loud piercing cry of 'design.'" Thus it is quite fitting that "no bottles have been uncorked, no hands slapped."[19] *Intelligent* Design in Behe's hands is a far cry from the design arguments of previous centuries and compare unfavorably with them, because much of creation is removed from the domain of the Intelligent Designer.

Rhetoric and Restatement in Design and Evolution

In their recent Gifford Lectures, John Brooke and Geoffrey Cantor discuss *Natural Theology as Rhetoric* and expound several examples from the eighteenth and nineteenth centuries including Buckland on *Megatherium.* They point out: "It is important to re-emphasize that natural theologians did not deploy such evidence (from Design) to 'prove' (in the strong deductive sense) the existence and attributes of God." The design argument was an *inductive* argument and its conclusion was deemed a "moral" truth. They cite Campbell, a contemporary writer: "In moral reasoning we ascend from possibility ... to probability ... to the summit of moral certainty." With shades of Phillip Johnson they suggest that "the persuasiveness of arguments suggest a close similarity between natural theology and the proceedings of the courtroom ... Persuasion becomes the name of the game."[20]

Considered in this light, the design argument as employed by Buckland and Behe becomes a rhetorical argument with shades of a persuasive advocate and lawyer. The rhetoric gives design both its strength and its fatal flaw. This highly charged courtroom atmosphere was present in the music room at Holywell when Buckland gave his *tour de force* on *Megatherium.* Buckland gave a superb scientific account of its peculiar anatomy which would have impressed the lately departed "immortal Cuvier," but throughout the lecture was the implicit message: "the adaptation of Old Scratch is so wonderful and demonstrates the skill of the Designer, who is none but the Father of our Lord Jesus Christ." Buckland began with the *possibility* that sloths were not as poor a design as Buffon and Cuvier insisted. As he described Old Scratch so favorably, he moved to *probability* and then to the *moral certainty* of his theistic conclusion. This worked well as Buckland was able to give an explanation of every part of its anatomy, but he could not have done so if he had chosen or found vestigial organs.

In *The Origin of Species,* Darwin picked up this flaw and showed how this was swept under the carpet by appeals to the Divine Plan. He wrote: "In works on natural history rudimentary organs are generally said to have been created 'for the sake of symmetry,' or in order 'to complete the scheme of

nature,' but this seems to me no explanation, merely a restatement of fact." The fact is that God is the Creator.

Behe also makes great use of rhetoric above and beyond his biochemistry, but his rhetoric is of a different nature. Having led the reader through many explainable and unexplainable biochemical functions and the rhetorical appeal of his mousetrap, he uses an inductive rhetorical argument and argues that the absence of an explanation, as in the case of blood clotting, indicates the direct activity of a Designer. He rapidly moves from possibility to probability to moral certainty, but that certainty is only certain until an explanation is found. What Behe has done is to base a rhetorical argument on his mousetrap and thus his conclusion of a Designer is only a "restatement of fact" based on his original argument.

At the end of *The Origin of Species*, Darwin wrote: "It is so easy to hide our ignorance under such expressions as the 'plan of creation,' 'unity of design,' etc., and to think that we give an explanation when we only restate a fact." To argue rhetorically, surely Intelligent Design is a restatement of fact?

We may also see argument by rhetoric in the work of Richard Dawkins, most notably with his computer-simulated, evolving biomorphs in *The Blind Watchmaker*. Here the rhetoric is based on contemporary faith in computer simulation rather than God, but is ultimately no proof of evolution and likewise is "a restatement of fact." This time the fact is the fact of evolution. Proof would require an actual sequence of evolving plants or animals.

Conclusion

On an initial consideration, it does appear that Behe and other Intelligent Design theorists are reviving the Argument from Design, which has been largely in eclipse since 1859. My purpose has been to compare two competent scientific examples, one from today and one from the heyday of design.

Buckland was, perhaps, the strongest scientific disciple of Paley and his lecture on *Megatherium* demonstrates a relentless searching for design in the most unpromising of animals. Buckland made a convincing case for demonstrating the function and thus the design of the anatomy of *Megatherium*. However, a consideration of his approach shows that he was arguing *from God to design*, in that his belief in a Creator, who was a Designer, gave him the confidence to look for design.

Behe takes a very different approach. When a biochemical process can be explained and its path of origin delineated, then he argues against design. Design is restricted to those processes which defy naturalistic explanation. In contrast to Buckland, Behe argues *from design to God* and argues from a position of ignorance. His demonstration for design depends on ignorance, and thus it is impossible to consider Behe's understanding other than a God-of-the-Gaps wrapped in designer clothing, or, more flippantly, wrapped up in amino acids.[21]

***Buckland was arguing* from God to design ... *Behe argues* from design to God.**

Both Buckland and Behe have adopted vulnerable positions. Buckland, as a pre-Darwinian creationist, believed animals were created instantaneously rather than after a period of evolution. Thus from an evolutionary perspective, his design should be seen as adaptation, but like an evolutionist he adopted reverse engineering. Asa Gray and his successors, the theistic evolutionists, would not see this as a major problem. However many—whether theist, atheist, or agnostic—have seen this as a serious problem.

Behe's principle of Intelligent Design is vulnerable in several places. First, he assumes too readily that biochemistry has reached such a position of maturity that further advances will not explain what is inexplicable today, hence my charge of God-of-the-gaps. If cilia or blood clotting are explained in a few years, where does that leave his Intelligent Designer? Dawkins and Provine will be most interested! Theologically, the greatest deficiency is his two-tier view of creation, part designed and part naturalistic. This can hardly be considered the biblical or traditional view of creation, which considers God to be the Creator of all creation.

Behe says of evolution: "I find the idea of common descent ... fairly convincing" but his suggestion of the discrete creation of certain biochemical processes due to Intelligent Design creates a serious problem. This belief undermines his evolutionary perspective as it implicitly adopts a semi-deism, in which God intervened at intervals to introduce another process, e.g. blood clotting, deemed to be due to Intelligent Design. The rest of the time creation, e.g. hemoglobin, was allowed to get on with its evolving in an undesigned fashion.

Finally, one should ask whether design is a biblical idea. I think not and also consider that a strong notion of design, whether of the Paley School or Intelligent Design pushes the concept beyond breaking point. The emphasis should be on God the Creator, not God the Designer. If we follow the former and emphasize the Creator, we can say with Gerard Manley Hopkins:

The World is charged with the grandeur of God.
It will flame out, like shining from shook foil;
It gathers to a greatness, like the ooze of oil
Crushed. Why do men then now not reck his rod?

However, if we follow Intelligent Design, to represent Behe's dual world of designed and undesigned, we must parody Hopkins' poem:

The clotting of blood is charged with the grandeur of God
It will ooze out, like shining from shook foil.
But hemoglobin is not charged with the grandeur of God.
We know not when to reck his rod. ❄

Acknowledgments

The author especially thanks Mrs. D. K. Harman, a descendent of William Buckland, for permission to quote from Buckland's lecture and for sending me a photocopy. Also to the organizers of the ASA/CiS conference in August 1998 for giving me the opportunity of presenting this paper. Grants from the Isla Johnston Trust, administered by the Church in Wales, facilitated this research.

Notes

[1] This paper was prepared for the joint ASA and Christians in Science conference at Churchill College, Cambridge in August 1998.
[2] Michael J. Behe, *Darwin's Black Box* (New York: Simon and Schuster, 1996), 232–3.
[3] Eugenie C. Scott, "Creationists and the Pope's Statement," *The Quarterly Review of Biology* 72 (1997): 403.
[4] J. L. Altholz, "The Warfare of Conscience with Theology" in J. L. Altholz, ed., *The Mind and Art of Victorian England* (Minnesota: University of Minnesota Press, 1976).
[5] S. J. Gould, *Time's Arrow, Time's Cycle* (Harmondsworth: Penguin, 1988). Passim.
[6] N. A. Rupke, *The Great Chain of Being* (Oxford: Oxford University Press, 1983). This is the most useful recent treatment of Buckland, but is not a biography.
[7] M. B. Roberts, "Buckland, Darwin and the discovery of Glaciation in Wales and the Marches," forthcoming.
[8] W. F. Cannon, "Scientists and Broad Churchmen," *Journal of British Studies* 4 (1964): 65–88.
[9] C. R. Darwin and T. H. Huxley, *Autobiographies* (Oxford: Oxford University Press, 1983), 60.
[10] J. Wyatt, *Wordsworth and the Geologists* (Cambridge: Cambridge University Press, 1995), 108.
[11] W. Buckland, *Geology and Mineralogy Considered with Reference to Natural Theology,* 2 vols. (London: 1836).
[12] "Mary Buckland to Whewell, 12 May 1833" in *Gentlemen of Science: Early Correspondence* (London: 1984), 169.
[13] Those wishing to follow up Buckland's argument will find his treatment in the Bridgewater Treatise more than adequate—but not so enjoyable, see ref. 11, 139–64.
[14] Count de Buffon, *Natural History: General and Particular,* vol. IX, ed. W. Wood (London: 1812), 7, 8.
[15] D. C. Dennett, *Darwin's Dangerous Idea* (Harmondsworth: Penguin, 1995), 212–3 passim.
[16] M. B. Roberts, "Correspondence; *Darwin's Black Box* Reconsidered," *Science and Christian Belief* 10 (1998): 189–95.
[17] G. Cuvier, *Recherches sur les ossements fossiles de quadrupedes, Discours preliminaire* (Paris: Flammarion, 1992), 81ff.
[18] Barrett, Gautrey, Herbert, Kohn & Smith, *Charles Darwin's Notebooks, 1836–1844* (Cambridge: Cambridge University Press, 1987), 634.
[19] Behe, *Darwin's Black Box,* 232–3.
[20] This is based very closely on J. Brooke, & G. Cantor, *Reconstructing Nature* (Edinburgh: T & T Clark, 1998), 181–2.
[21] H. Van Till, "Special Creationism in Designer Clothing: A Response to *The Creation Hypothesis," Perspectives on Science and Christian Faith* 47 (June 1995): 123–31; and M. B. Roberts, "Review of Behe, *Darwin's Black Box," Science and Christian Belief* 9 (1987): 192.

The Center for Theology and the Natural Sciences

2000 Science & Religion

COURSE PROGRAM

Up to 100 awards of $10,000 each
Introductory and Advanced Workshops

The Center for Theology and the Natural Sciences announces the 2000 Science & Religion Course Program, which includes a course competition granting awards for outstanding courses in science and religion, and a series of workshops on science and religion, course development, and pedagogy. Funded by the John Templeton Foundation, the program will award up to 100 prizes for outstanding science and religion course proposals in colleges, universities, and seminaries. Each prize includes an award of US $10,000, to be divided evenly between the course instructor and the host institution. The preliminary application deadline for applicants is ***December 1, 1999***. Late submission of the preliminary application will be accepted only with attendance at one of the January workshops.

January 2000 Workshops *Apply By December 17, 1999*		*June/July 2000 Workshops* *Apply By April 14, 2000*	
Oxford, England	January 8-12	Philadelphia, Pennsylvania	June 3-8
Berkeley, California	January 13-18	Berkeley, California	June 8-13
		Chicago, Illinois	June 23-27
		Boston, Massachusetts	July 9-12
		Oxford, England	July 9-13

For program information and application materials or workshop registration forms, please visit our web site at **www.ctns.org** *or contact CTNS at:*

2380 Ellsworth Street ▪ Berkeley, CA 94704 ▪ 510.665.8141

Fax: 510.665.1589 ▪ E-mail: SRCourse@ctns.org

Reference: **PERSP Dec99**

Funded by the

JOHN TEMPLETON FOUNDATION

www.templeton.org

Communications

The Origin of Antibody Diversity

Gordon C. Mills*

Leeward Manor
One Fleet Landing Blvd.
Atlantic Beach, FL 32233

A recent article in *Science News* began with the following statement: "Immunologists have wrestled with the origin of GOD for several decades."[1] The author of the article went on to explain that: "This spiritual-sounding acronym stands for 'generation of diversity' and emerged in the jargon of scientists after their realization in the 1970s that the human immune system manufactures tens of millions of distinct antibodies." The above quotations, the article's title, "The Accidental Immune System," and its subtitle "Long ago, a wandering piece of DNA—perhaps from a microbe—created a key strategy," suggested to me that the process of antibody formation merited further examination from a theistic viewpoint.

In a 1995 *PSCF* paper proposing a theory of theistic evolution as an alternative to the naturalistic theory, I chose not to include antibody formation in my theory.[2] I noted: "Our understanding of this fascinating process is not sufficiently complete for me to suggest which genes, or portions of genes, might involve new genetic information."[3] Now I believe my understanding of this process, too, may be readily incorporated into my design theory of theistic evolution. As proposed in 1995, this theory is as follows:

> ... in the history of the origin and development of living organisms, at various levels of organization, there has been a continuing provision of new genetic information by an intelligent cause.[4]

ASA Fellow

In a 1998 *PSCF* paper, I considered the possible role of protein modules in a theory of theistic evolution.[5] As defined in that paper, protein modules are usually 80–250 amino acids long, contiguous in sequence, and used as building blocks in functionally diverse protein molecules. The diversity of antibodies is a consequence of the building up of antibody genes in mature lymphocytes from smaller gene segments. Hence antibody gene formation is a special case of modular transfer of gene segments. A major difference in modular transfer for antibody formation is that this process is occurring whenever the immune system is challenged by a foreign substance. The modular transfer discussed in my earlier paper would occur only rarely over extended periods of geologic time. The two modular processes, i.e., modular transfer in the building of new protein molecules and modular transfer in formation of antibodies, appear to have many similarities in regard to necessary recognition factors and enzymes.

Mechanisms of Antibody Formation

In order to evaluate possible roles of chance and design, let us consider in more detail what occurs in antibody formation, and how the tremendous diversity of antibodies is achieved.[6] The cells responsible for production of antibodies are the lymphocytes, a particular type of white blood cell. They produce protein antibodies in response to foreign substances (antigens) taken into the body. A unique aspect of

this process is that the organism does not need prior exposure to the antigen to produce an antibody that will combine with it. A million different synthetic chemical compounds may serve as antigens and cause the production of antibodies. Since the genetic information for protein production resides in the genes, it might appear that a corresponding number of genes would be required to produce a million different antibodies. By using modular gene segments, however, antibody diversity may be achieved with a much smaller gene pool.

The antibodies all fall into a group of plasma proteins known as immunoglobulins, of which there are five major classes (IgG, IgA, IgM, IgD, and IgE). Of these, I will consider only IgG in some detail. Each IgG molecule is a tetramer and consists of two heavy (H) and two light (L) chains. The L chains are of two types (designated by Greek letters κ and λ), each 214 amino acid residues in length. Of these amino acids, 108 at the N-terminus are variable and the remaining 106 are constant. By variable, we mean that if L chains of a particular type were isolated from a pool of lymphocytes and sequenced from the N-terminus, we would find variations in amino acids at a given position for the first 108 amino acids of the molecule, with no variation in the remaining portion. The two IgG H chains are of the τ type, with 446 amino acid residues; of these, 108 at the N-terminus are variable and the remainder are constant. Other immunoglobulins may have other types of H chains, designated as α, μ, δ, or ε.

The finding of variable amino acids in the L and H chains of immunoglobulins is unique among protein molecules. This variability can now be explained in the following manner. Each mature lymphocyte contains three different types of gene segments coding for the variable portion of the H chain, a V (for variable), a D (for diversity), and a J (for joining). In the lymphocyte stem cell, however, there are several hundred different gene segments for the V portion of the H chain; about fifteen different gene segments for the D portion; and about five different gene segments for the J portion. During the maturation of the lymphocyte, only one of each type is selected. In different lymphocyte cells, however, the single, V, D, and J gene segment retained after cell maturation appears to be randomly selected. Hence, any pool of mature lymphocytes would contain some with each of the original V gene segments, some with each of the original D gene segments, and some with each of the original J gene segments. Further, in the process of lymphocyte maturation, these three different types of gene segments are joined (V-D-J) to complete the variable portion of the H chain gene. This principle of joining gene segments is illustrated in Fig. 1. The constant portion of this gene is formed from three additional gene segments (C_H1, C_H2, and C_H3) plus a small hinge gene segment. The L chain gene formation differs slightly from that of the H chain since no D gene segments are included, but the principle remains the same: i.e., translocation of different gene segments to form the complete gene.

Two other factors further increase the possible gene diversity of H and L chains. These are (1) V and J gene segments may be spliced in several different joining frames, and (2) a terminal deoxyribonucleotidyl transferase may insert extra nucleotides between the V and D gene segments of the H chain gene. Altogether, the different joining possibilities for the various portions of the L and H chains of the five classes of immunoglobulins, together with the variable joining frames and chain lengthening, give the genes for the five different immunoglobulins the possibility of producing something like 10^8 different

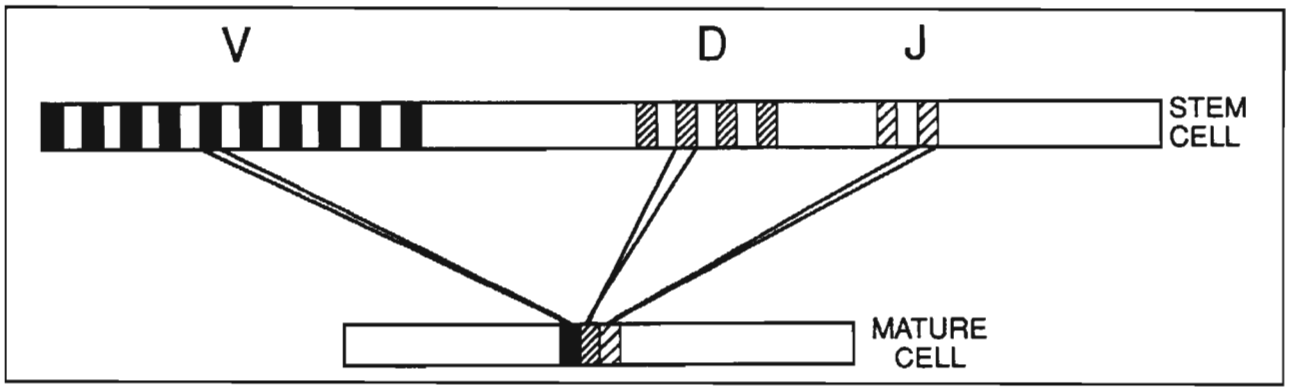


Fig. 1. A simplified illustration to demonstrate the principle of selecting V, D, and J gene segments. This shows one possible V-D-J combination being formed for the variable portion of the immunoglobulin gene in a particular mature lymphocyte. For this illustration, with ten V segments, four D segments and two J segments, there would be 10 x 4 x 2 or 80 possible V-D-J combinations. With different joining frames and chain lengthening, this number might be multiplied as much as four-fold.

antibodies. This is clearly enough to account for the 10^6 postulated different antibodies.

An additional aspect of antibody formation, critical for the successful production of antibodies, is recognition of an antigen by a particular lymphocyte immunoglobulin. For this recognition, each lymphocyte has a surface receptor made up of the variable portion of an immunoglobulin molecule that spans the lymphocyte membrane. The matching of this receptor with a foreign substance (antigen) triggers production of additional antibody molecules to meet the requirement for inactivation of the foreign substance.

Chance or Design?

Although certain aspects of this fascinating process of antibody formation may be due to random chance events (e.g., the selection for each cell of the one active V gene segment, the one active D gene segment, and the one active J gene segment), many other aspects clearly require genetic information. A few of these are: (a) only gene segments belonging to the V, D, and J types are joined together. Other sequences are rejected. There is a clear requirement for specific recognition sites adjacent to the V, D, and J segments for the cleavage and joining reactions to occur. These recognition sites range from 7 to 23 nucleotides in length. (b) There is a requirement for genetic information in the nucleotide sequences of the many different V, D, and J gene segments found in the lymphocyte stem cell. (c) There is surely a genetic requirement for the various controlling factors that permit the cleavage and joining events to occur in a synchronous manner; and (d) there is the genetic information requirement in the nucleotide sequences for the many different specific enzymes involved in these processes. These would include the nucleases carrying out the initial cleavage of the stem cell immunoglobulin gene to free the V, D, and J gene segments, as well as the ligases or nucleotidyl transferases required for the final rejoining of the single V, D, and J gene segments. Recent studies have identified two specific proteins, RAG1 and RAG2, that play a role in the splitting and joining of the V, D, and J gene segments.[7] The information requirement would also include other enzymes participating in the activation of precursor molecules and cofactors.

Did this whole process come about suddenly in the jawed vertebrates 300 million years ago as a consequence of incorporation of a "wandering transposase" from an unknown virus or bacterium into a vertebrate gene—as suggested in the *Science News* article?[8] That seems unlikely. The author notes that there is only the slightest resemblance between the RAG proteins and known bacterial transposases; translocation of a transposase by itself would not produce antibodies.

I have tried to demonstrate that the system of antibody formation is much too complex to be accounted for by a simple transposase gene transfer from a virus or bacterium to a vertebrate organism. I believe that the system of antibody formation clearly qualifies as "irreducibly complex" as defined by Behe: i.e., "a simple system composed of several well-matched interacting parts that contribute to the basic function wherein the removal of any one of the parts causes the system to effectively cease functioning."[9] The interacting parts in this case would be the many immunoglobulin gene segments, the recognition factors, and the enzymes required for translocation of the different gene segments. In addition, they would necessarily include mechanisms for formation of the immunoglobulin surface receptor, which is critical to the production of adequate amounts of antibodies. ❄

Notes

[1] J. Travis, "The Accidental Immune System," *Science News* 154 (1998): 302–3.

[2] G. C. Mills, "A Theory of Theistic Evolution as an Alternative to the Naturalistic Theory," *Perspectives on Science and Christian Faith* 47 (1995): 112–22; also see ____, "Theistic Evolution: A Design Theory Utilizing Genetic Information," *Christian Scholar's Review* XXIV (1995): 444–58.

[3] Ibid., 117.

[4] Ibid., 114.

[5] G. C. Mills, "Possible Role of Protein Modules in a Theory of Theistic Evolution," *Perspectives on Science and Christian Faith* 50 (1998): 136–9.

[6] The primary source for this discussion is: L. Stryer, *Biochemistry*, 3d edition (New York: W. H. Freeman & Co., 1988), 897–911.

[7] A. Agrawal, Q. M. Eastman, and D. G. Schatz, "Transposition Mediated by RAG1 and RAG2 and its Implication for the Evolution of the Immune System," *Nature* 394 (1998): 744–51.

[8] Travis, "The Accidental Immune System," 303.

[9] M. Behe, *Darwin's Black Box: The Biochemical Challenge to Evolution* (New York: Free Press, 1996), 39.

SUBJECT: CALL FOR PAPERS, ASA/CSCA ANNUAL MEETING

FROM: Richard T. Wright (ASA) and Harry Cook (CSCA) — Program Co-Chairs

TO: Colleagues

Be sure to put the ASA/CSCA Annual Meeting (August 4–7, 2000) on your calendar now! We welcome contributed papers and poster presentations on all topics related to Science and Christianity, with special consideration given to those that focus on marine environments and resources. Please observe the **Requirements and Guidelines for Abstracts** presented below. If you have a proposal for a symposium or group of papers, please contact one of the Program Chairs (rtwright@mediaone.net or hcook@KingsU.ab.ca).

Requirements and Guidelines for Abstracts

1. Contributions must be submitted as abstracts of 200–250 words to the ASA office for review by **January 10, 2000**.
   a. The abstract should emphasize what is the **new and important** material in your presentation and contain as much **detail** of the work as possible.
2. Author's (or authors') full name, address, phone numbers (daytime and evening) and e-mail address should appear with the title centered at the top of the page. Indicate preferred mode of presentation: **oral** or **poster**.
3. Specify any special audio visual equipment you will need.
4. Due to schedule limitations, authors may present only **one** paper, but they can be included on other multiple-author papers.
5. Please send abstract and above information via e-mail to: **carol@asa3.org**; or mail a IBM compatible disk copy formatted as a WordPerfect, Word, or ASCII file named ABSTRACT.WPD, ABSTRACT.DOC, or ABSTRACT.TXT to: **ASA, P.O. Box 668, Ipswich, MA 01938-0668.**
6. Contributed oral papers will be accorded a time slot of **25 minutes**, 20 minutes for presentation and 5 minutes for discussion.
7. A separate time and space has been set aside for the poster paper session.
8. Authors of poster exhibits will be supplied with detailed instructions upon acceptance of their abstract.
9. To be included in the final program, **presenters must register** for the meeting when they receive the Registration Brochure.

A True Creation

George Blount*
geonan@cdsnet.net

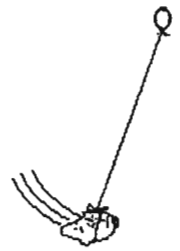
12340 Highway 66
Ashland, OR 97520

In the beginning God created the heavens and the earth and, in his likeness, we too create. Is it possible that by considering our own inventions, we can gain insight into the way in which God has structured his creation? To show that the answer to this question is affirmative, we will investigate a simple, but significant product of human ingenuity and then compare it with an important aspect of God's universe.

Let us look at the Grandfather Clock. Where do we find its heart? It is the pendulum, composed of a weight and a freely swinging arm, that is the essential (time marking) part of the clock. (The earth, which provides the necessary gravitational force for the pendulum's operation is, of course, also a "part.") The rest of the clock primarily serves to make the device more user-friendly by keeping the clock running, summing increments of time, and displaying them for us. The grandfather clock has a mechanism that keeps the swinging motion from rapidly diminishing as it normally would; and the time it takes the weight at the end of the pendulum to complete a swing and reverse direction forms the basis for counting time.

We can make a pendulum of very simple materials, such as a rock and string. First we tie one end of the string to a hook overhead. Then we tie a rock to the other end of the string. If the rock is grasped and pulled up and outward with the string kept taut (like a tire swing on a rope), and then let go, gravity will cause it to swing back and forth. This simple pendulum illustrates how one level of created reality depends upon, but transcends, another lower level.

Consider the above description. The pendulum is constructed of (and depends upon the properties of) a rock and a string combined in a certain way and positioned in a particular relationship to the earth. It is not difficult to see that the description of the whole demands a larger vocabulary than a description of the parts. Time and motion enter a discussion of the whole pendulum, or clock, but are irrelevant to a discussion of rock or string (or of earth as a gravity establishing mass). This quality is key in deciding if a construction is truly a new "creation." New creations have new objective properties that require new descriptive terms.



Let us compare the example of a homemade pendulum to the God-made structure of an atom. The simplest atom is the hydrogen atom. Its "parts" are an electron and a proton. It is clear that a vocabulary adequate for the parts is not sufficient for the whole atom. Atoms have chemical properties, for example, that electrons and protons do not share. Atoms are true creations exhibiting properties unknown to electrons and protons. This fact of distinction in the descriptive vocabularies sharply divides one level from another. A pendulum is not merely a rock plus a string (and the earth), and a hydrogen atom is not merely an electron plus a proton.

In the homemade pendulum and the God-made atom, the parts are put together in a definite way. In each, the relationship between the parts is dynamic. A dynamic relationship involves energy. A clock with a still pendulum is "dead." Atoms that have no energy associated with their configuration are simply impossible. To be dynamic, or to have energy, implies that there are rules governing permissible deformations of configuration. In other words, the assembly of the parts is governed by laws and by the strictures of natural constants. The laws that apply to the pendulum are known as Newton's Laws; and the laws that apply to an atom are often called

*ASA Member

Wave Mechanics. These laws that govern the configuration are an essential component of every level of creation. The effect of the laws and constants propagates up through the levels. Different laws and/or natural constants would lead to different creations, or to no creations at all.

The fact that higher levels of creation are created using parts from a lower level does not necessarily mean that the objective properties of the lower level may be described by using a truncated vocabulary drawn from the higher level. For example, in going from the realm of atoms to the level of sub-atomic particles, we find that the notion of particle becomes blurred, and the ideas of "place," "velocity," and "time" cannot be said to have the same meaning as in our everyday world. But since we only have objective experience in our everyday world, we must invent ways of dealing with the objective reality of the micro-world. One such invention is "complementarity" where we acknowledge that the electron, for example, may exhibit itself to us as a particle or as a wave. We have no everyday-world description as to what the electron actually *is*.

Even with the occasional addition of a term, the vocabulary becomes more and more reduced as we progress downward to lower levels of creation. At the sub-atomic level, terms such as "charge," "plus, minus, or neutral," "spin," "mass," "matter," and "anti-matter" are useful. For the lowest level imaginable, with the most limited vocabulary, we have only "exists" and "does not exist." The laws that would govern such an entity, or entities, would be awesome in that they would naturally lead to the universe as we see it.

In summary, different levels of creation are distinct and give little, or no, hint of their dependence on the laws governing their parts, yet their dependence on such laws is fundamental. Not giving sufficient weight to both of these aspects of creations may have led to disagreement over the value to society of fundamental research.[1]

A person of faith, like the nuclear scientist, deals with a reality that underlies our everyday physical world. It is not surprising that the difficulties in describing the most basic aspects of the created universe are mirrored in the struggles of theology. For example, how can we describe God? Must we resort to complementary terms such as "Trinity"? How are we to regard the human being? Does the crucial fact concern the result but not how the result was orchestrated? Should not our discussion of the nature of what was created when God said, "Let us make man in our image" be informed by a consideration of creations in general?

A spiritual application that can be made concerns the fundamental difference between a Christian and a non-Christian. When a person puts his or her trust in the grace of God as expressed through the life of Jesus Christ, he or she becomes a new person, a "new creation."[2] Jesus told Nicodemus that the person is "born again."[3] If this is so, then there should be a distinction between the vocabulary required to describe a person not yet born again and the one born again. Faith, hope, and love should have a quality in the new creation that is not found in the "old."[4]

The laws of the spirit that form the possibility of the new creation are dynamic, and can be found in the guidelines for living laid down in the Scriptures. One such law is the law of giving thanks.[5] The thankful heart has a faith, which like Job's is able to withstand tragedy, and yet when elevated is humbled by the knowledge that all one has is a gift from God. The thankful heart has a joy that rises above the very real sorrow that is a part of any honest life. The thankful heart leaves no room for despair or depression. The thankful heart has a love that is universally wide and gladly sacrifices self for the sake of the loved.

Thus the Christian is a true creation. He or she has new objective properties not found in the non-Christian, and has a new dynamic relationship with the Creator. ❄

Notes

[1] J. D. Bernal, *The Social Function of Science* (Cambridge, MA: MIT Press, 1939), 9. This is a reference to Ernest Rutherford's statement that elevates physics as the only real science. R. N. Cahn, *Rev. Mod. Physics* 68 (1996): 951 as cited by P. Jensen, "Particle Physics and Our Everyday World," *Physics Today* 51 (July 1998): 58; and R. N. Cahn, "'Particle Physics and Our Everyday World': A Reply," *Physics Today* 51 (November 1998): 57. See also the *Letters* column, *Physics Today* 51 (November 1998): 15.

[2] 2 Cor. 5:17.

[3] John 3.

[4] 1 Cor. 13.

[5] 1 Thess. 5:17, Rom. 1:21.

Book Reviews

Environment

CHRISTIAN FAITH AND THE ENVIRONMENT: Making Vital Connections by Brennan R. Hill. Maryknoll, NY: Orbis Books, 1998. 318 pages, notes, index. Paperback; $22.00.

Hill is professor of theology at Xavier University in Cincinnati, Ohio. This book is a part of the Orbis Ecology and Justice Series. The goal of this series is to publish books that seek to integrate an understanding of the earth as an interconnected life system with concerns for just and sustainable systems that benefit the entire planet. Hill considers this book to be a beginning, "a modest pioneering effort to join Christian scripture, doctrines, spirituality, and ethical values with our contemporary concerns for the earth." The overall goal of the book is to make "vital connections" between many areas of Christian belief and the environment. It is the author's hope that this book will stimulate Christian churches to "take their place in the vanguard of those determined to provide future generations with a healthy and beautiful world in which to live."

Hill's approach to the development of an environmental theology is first and foremost a biblical approach. In the second chapter of the book, the "Hebrew scriptures" of the Old Testament are examined for their perspectives on human life, the nature of the earth, and the relationships between the Creator and the creation. In chapter three, the "Christian scriptures" of the New Testament are surveyed with most of the attention given to the teachings of Jesus in the Gospels. While Hill believes that Christian environmental theology must draw from the Old and New Testament as its primary source, he goes on to suggest that biblical views must be critiqued when they either fall short or are detrimental to sustaining the earth.

Besides being biblical, the author's approach could also be described as doctrinal. In chapter four, Hill discusses in depth the doctrine of the incarnation and its implications for the development of an environmental theology. The focus in chapter five is the sacramental theology of the Catholic Church, which Hill believes can "put us in touch with the sacred dimensions of the cosmos itself." In chapter seven, after presenting the development of modern atheism and its role in the degradation of the environment, Hill outlines several positive approaches to the "God question" and reflects upon how they might affect attitudes toward creation.

A third way to describe the author's approach is that it is deeply spiritual. The type of spirituality advocated in this book is both contemplative and active. It is contemplative in that it seeks to "experience the Divine within the self, others, and in the world." It is active in that it strives to "bring love, peace, and justice into a troubled world." It is a spirituality centered on Jesus Christ and looks to his Spirit with hope for the restoration of creation. It is also prophetic in that it proclaims the reign of God and challenges those forces that oppress both people and the earth. These and other aspects of the spiritual nature of the author's environmental theology are presented in depth in chapter nine, which is entitled "Christian Spirituality."

One other way to summarize Hill's approach is that it is correlational, linking Christian beliefs and moral values with environmental issues. He draws from the pioneering work of Paul Tillich, who wrote extensively about the intimate relationship between religion and culture. In the final chapter of the book, Hill suggests that Christians need to move away from a morality that is private and otherworldly and toward an ethic that resists self-centeredness, greed, and consumerism. It is an ethic which encourages all people to live simply, to be generous toward others, and to act responsibly toward the environment.

Anyone with an interest in the ongoing development of a "Christian environmental theology" should take the time to read this book. Although the book is written from a Catholic perspective, Hill prefers to use the word "Christian" as he attempts to bring theology and ecology together. While he draws at times from the writings of Catholic theologians, such as Karl Rahner, David Tracy, and Pierre Teilhard de Chardin, his emphasis on developing an environmental theology that is biblically based and centered upon the example of Christ makes this book a useful resource for Christians from a variety of denominational backgrounds. Hill also addresses contemporary issues including the shortcomings of a dualistic world view, the strengths and weaknesses of panentheism, and the positive contribu-

tions from ecofeminist theology. The breadth and depth of the topics covered in this book make it a valuable resource for scientists and theologians who have an interest in the ongoing development of a Christian environmental theology.

Reviewed by J. David Holland, Biology Instructor, Springfield College in Illinois, Springfield, IL 62702.

REMEMBER CREATION: God's World of Wonder and Delight by Scott Hoezee. Grand Rapids, MI: Eerdmans, 1999. 144 pages. $14.00.

In the Introduction of this short, well-written book, Hoezee, a Christian Reformed Church minister, emphasizes how many books on "creation" deal with the creation/evolution controversy and how few books deal "with Christian ecology for the world today." Furthermore, of the books which do consider the subject most "tend toward the academic end of the reading spectrum." Therefore, we need books for "the popular evangelical readership." *Remember Creation* is just such a book.

Relying heavily upon Scripture, Hoezee emphasizes: (1) that God delights in his creation, (2) that we likewise should enjoy the beautiful world God has given us, and (3) that we, as his stewards, should be concerned about its wise use and preservation. The two great themes of the Bible are creation and redemption and we need to emphasize *both*. The emphasis on creation should not be limited to debating evolution. If we are lovers of God, we should love his creation, which includes "the big things like distant galaxies" and "the small things like protozoa and subatomic quarks."

In his second chapter entitled "Let's Play: Making God's Delight in the Creation Our Own," Hoezee urges us to spend more time enjoying and marveling at God's creation because God wants us to share his handiwork.

> Do some today spend more time looking at colorful home pages on the Internet than they do absorbing the natural color on bird wings and tulip petals? ... Why do so many people travel to the West, not to grasp at the majestic deserts and mountains, but instead duck into darkened Las Vegas casinos to gamble their life away?

In his third chapter, Hoezee emphasizes that we should enjoy God's creation, care for it, and preserve it. It is heretical to allow it to be plundered and polluted. In discussing this, he carefully urges us to avoid the extremes: there is no problem vs. it is so bad we cannot do anything about it. We need to appreciate creation but avoid any pantheistic worshiping of it. Furthermore, animals are God's creation (like humans) but biblically are not on the same level. In the fourth chapter, he emphasizes that "Saving Nature, but Only for Man" (as considered by Charles Krauthammer) is not a Christian approach. We are to be servant/stewards of nature. We are also to avoid the radical environmentalist claim that we do not count.

In the fifth chapter, Hoezee gives us some practical suggestions on how we can enjoy *and* preserve God's creation. He again emphasizes the need to avoid extremes whether New Age or Gnostic. Neither atheists nor pantheists are right. He closes this chapter with some suggestions for simple ways to be stewards: recycle, carpool, support efforts to preserve, and give money and time to environmental projects. In chapter six, he concludes with a meditation on 2 Peter 3. This passage reminds us of God's power for destruction and renewal, and that we should live holy, righteous lives. We should also remember that we were created to take joy in God's creation.

This is a book that is easy to read, Bible-based, stimulating, and challenging. It is a book that I'm sure I will enjoy for many re-readings. I enthusiastically recommend it whatever the reader's previous impressions of "creation" or "environment." And the index to Bible references will be most helpful.

Reviewed by Wilbur L Bullock, 13 Thompson Lane, Durham, NH 03824.

THE ENVIRONMENTAL CRUSADERS: Confronting Disaster and Mobilizing Community by Penina Migdal Glazer and Myron Peretz Glazer. University Park, PA: Penn State Press, 1998. 193 pages, notes, index. Paperback.

Myron Glazer, a professor of sociology at Smith College, co-authored this book with his wife, Penina Glazer, who is a professor of history at Hampshire College. They have written a similar, highly acclaimed book, *Whistleblowers: Exposing Corruption in Government and Industry* (Basic Books, 1989). This time the Glazers have attempted a sociological analysis of grassroots environmentalists, looking for similiarities in experience which transcend national borders and certain issues. Each chapter focuses on a specific aspect of the environmental movement (e.g., secrecy, the role of mothers, fighting toxic landfills, and protecting natural resources) and includes analyses by environmentalists from the United States, Israel, and Czechoslovakia.

The Glazers seem supportive of grassroots environmentalists, yet do a good job of detaching themselves to look for common experiences. They point out that many environmentalists started out as unconcerned citizens who believed everything authority figures told them about the environment. For instance, the government was not questioned about the health effects of radiation exposure to residents of Hanford, Washington, until a local farmer began to relate stories of health effects on animals and, over the long term, people who lived in the community. Many times, communities became bitterly divided over the economic benefits of an industry's interests (e.g., logging in California) and the value of protecting natural resources or public health. People had to balance the prospect of losing jobs with adverse environmental effects. Activists frequently found themselves ostracized until they could build "alternative networks of power" by using the media, university professors, and national groups to focus attention on the environmental problems.

In cases of public health, it was easier to mobilize the community when the adverse effects were obvious to all. They did, however, have to master complex technical issues and argue in legal proceedings with well-funded experts hired by industry or government. These battles sometimes lasted years and involved significant commitment; some even lost their families because they were so personally involved. In one case, (Czechoslovakia) environmental activists served as the core group of dissidents responsible for the Velvet Revolution that displaced communism in 1989.

The book gave me an appreciation for the courage ordinary people can show in the face of overwhelming opposition. It also made it obvious that government and industry have not always been forthright about the effects industrialization has had on modern society. The environment has too often been an afterthought or regarded as the price to be paid for progress. It would be interesting to examine any cases of excesses by the environmentalists themselves. Unfortunately, the Glazers did not include this in their study.

This book could also be viewed as a textbook or "lessons learned" on grassroots political activism. I found myself noting how some of the principles could equally apply if one were protesting the establishment of a local abortion clinic. For instance, the Freedom of Information Act was a powerful tool in securing the data necessary to inform the public about environmental dangers. This highlights the fact that grassroots political activism is heavily dependent on information. In effect, activists are conducting "information warfare" by attempting to alter commonly held views or misconceptions. In a sense, this is the "spiritual warfare" we are called to as Christians: to bring the good news of Christ to a complacent world unaware of the spiritual disaster of sin.

I recommend this book to anyone interested in how to organize a community of ordinary people to confront controversial issues. It will be of particular value to those who believe Christians are called to be public advocates of justice, whether social or environmental. In a sense, justice is God's political platform.

Reviewed by David Condron, Engineer, Naval Surface Warfare Center, Dahlgren, VA 22448.

TURNING OFF THE HEAT: Why America Must Double Energy Efficiency to Save Money and Reduce Global Warming by Thomas R. Casten. Amherst, NY: Prometheus Books, 1998. 274 pages, foreword, glossary, notes, index. Hardcover; $26.95.

The unspoken question behind much of the environmental policy debate is, "How do we save the earth without ruining the world?" Casten offers an answer in this book. Casten is the founder and CEO of Trigen Energy Corp., a company that specializes in improving the efficiency of electric power generation. He participated in the White House conference on global climate change. *Common Purpose* named his 1997 report, "Barriers to Efficiency," the best policy paper of the year. This book is an elaboration of that report.

The book consists of ten chapters. The first three chapters are intended to make the scientific, economic, and ethical cases that global warming is a problem that needs to be solved. The next six chapters go into greater detail about the nature of the problem, obstacles that stand in the way of a solution, and recommendations for surmounting those obstacles. The last chapter is a proposed act of legislation that summarizes Casten's recommendations.

Casten's message is that anthropogenic carbon-dioxide-induced global warming is a problem that demands a solution. In the U.S., electric power generation accounts for one-third of the carbon dioxide emissions. Current approaches to solve global warming rest on the faulty assumptions that electric power is generated with optimal efficiency and that a decrease in fossil fuel use necessarily entails a de-

crease in the standard of living. Casten argues that monopoly protection of the generators of electric power prevents maximum efficiency from being achieved. Thus, the cornerstone of his proposed solution is deregulation of the electric power industry. Deregulation alone, though, is not enough because both consumers and generators of power need stimuli to see that conservation of fossil fuels is in their self-interest.

To stimulate consumers to lessen energy waste, Casten recommends a combination of economic incentives, such as tax credits for energy-efficient cars and appliances, and initiatives like a national shade-tree-planting program. To stimulate the power industry to lessen fossil fuel use, Casten urges the adoption of a Fossil Fuel Efficiency Standard, which is defined as the ratio of all fossil fuel burned to generate electricity to all electric and heat energy generated. This standard, based on statistics already compiled in fulfillment of various paperwork requirements, will be reduced to 1.0 (about half of today's level) over twenty years. Businesses that fail to meet the standard will pay fines.

Casten persuasively shows that the electric power industry is a monopoly and that protection of this monopoly no longer makes sense because of technological advances in the last 35–40 years. Moreover, this monopoly prevents the correct price signals from being sent to consumers and producers alike. Casten acknowledges that political realities prevent the rapid and complete deregulation of the power industry, so he includes some less dramatic but more feasible proposals that will reward efficiency.

Although far superior to other books, such as Vice President Gore's *Earth in the Balance*, this book has weaknesses. The irony is that Casten advocates a government regulation to correct a situation caused by government regulation. Another irony is that Casten faults economic models that rest on invalid assumptions and fail to account for observed data, yet he accepts the predictions of climate change models that are subject to the same criticisms.

Casten begs several questions. For example, he never explicitly states to whom businesses will pay their fines for noncompliance with the Fossil Fuel Efficiency Standard. If the answer is the government, a real risk will be that the government will come to depend on the fines as a source of revenue and take measures to ensure that the fines persist. Payment of the fines to competing power companies or to consumers would seem to be better options. Another unanswered question deals with other countries. Casten thinks they will follow the lead of the U.S. so as not to lose competitive advantage, but what if countries like China do not change their power industries?

Because Casten is neither a climatologist nor an ethicist, the weakest chapters of the book are the first and the third. Chapter one is an attempt to summarize the scientific case for global warming. Casten relies heavily on a study of 160,000 years' worth of ice core data that relate atmospheric carbon dioxide concentration to temperature. The graph he includes (p. 19) clearly shows a large increase in carbon dioxide concentration long before industrialization took place. A similar increase since 1700 is not accompanied by a corresponding temperature increase. These data also suffer from a failure to distinguish whether the temperature changes are primarily regional or global, in winter or summer, at night or day. In addition, there is at least one recent study that suggests carbon dioxide concentrations increase after temperatures increase.

Chapter three covers the ethical reasons for reducing carbon dioxide emissions. Casten's guiding dictum is, "To whom much is given, much shall be required." He attributes this precept to his mother (p. 70), but it is not clear if he knows the biblical origin of the teaching. In Casten's estimation, the human race has gained godlike powers over nature and now faces godlike responsibilities. To meet these responsibilities, "we must find a way to increase human thinking power" to develop a deeper sense of ethics (p. 80). In order to move forward responsibly, we must have "collective, global cooperation" to pursue knowledge (p. 80), and "we must work as a collective thinking organism" (p. 81). According to Casten, this organism already exists in the form of a free market. Some readers of this journal might find Casten's faith in the free market bordering on or constituting idolatry. Others might see him as appealing to the baser instincts of people. Also, many might be suspicious of his humanistic approach or offended by his reference to God as "she" (p. 72). Readers will be relieved that Casten does not promote Gaia-worship but that he does advocate responsible stewardship.

Despite its weaknesses, this book should be essential reading for anyone who shapes energy policy and for civic-minded citizens who are interested in environmental issues. With a fairly non-technical writing style, Casten charts a course that does not pit the economy against the environment in a false dichotomy. His proposals merit serious consideration.

Reviewed by George D. Bennett, Assistant Professor of Chemistry, Millikin University, Decatur, IL 62522.

Ethics

IS GOD A VEGETARIAN? Christianity, Vegetarianism, and Animal Rights by Richard Alan Young. Chicago: Open Court Publishing Company, 1999. 187 pages, indexes. Paperback; $19.95.

Young is professor of New Testament Studies at Temple Baptist Seminary and founder and board member of EarthCare, an ecumenical Christian environmental organization. He is also the author of *Healing the Earth: A Theocentric Perspective on Environmental Problems and Their Solutions* and *Intermediate New Testament Greek.*

Biblical characters ate meat and vegetables. They also made use of animal and plant products for clothing, tools, and decorations in accordance with God granting humans dominance over every living creature. Even Jesus ate fish and, mostly likely, the flesh of other animals. The Bible records numerous animal sacrifices as well as God's occasional destruction of his own creation to show his righteousness, including the killing of humans, animals, and plants. Given these settings, how can anyone justify Christian vegetarianism and advocate animal rights on the basis of our Holy Scripture?

In his book, *Is God a Vegetarian?* Young comprehensively describes the dilemmas of following the Bible and justifying vegetarianism. He also discusses the conflicts between our dominance over animals and animal rights. Instead of resolving these dilemmas and conflicts, Young offers an escape approach. He first points out that our present world is different from the ancient world. Thus, we no longer need to follow the customs, traditions, and lifestyles of biblical times. He insists that we not focus on particular Bible verses and not search for historical accuracy in the Bible. Young then suggests that we look at the grand picture of God's creation plan and aim at building a community, the "kingdom of God," in which there will be no killing and suffering of any kind. He believes that God is guiding and leading us in this endeavor toward that peaceful goal, and that Christians can accomplish that task by becoming vegetarians and stopping animal abuses.

Two basic issues in Young's thesis bother me. First, he over-emphasizes God's love and neglects to mention his righteousness. Some of those biblical particulars that Young quotes in his discussions are truly God's commands that we Christians must obey. If one can ignore certain particulars in the Bible, as Young suggests, then a Christian can surely argue for any kind of lifestyle he or she prefers, such as homosexuality, alcoholism, and celibacy, even though many preachers say the Bible clearly indicates that these lifestyles are not permitted. There is also the big question of who has the authority to determine which biblical particulars Christians can overlook and which we must follow.

Secondly, I, for one, believe that plants have as much life and as many rights as animals. Indeed, all living organisms, whether humans, animals, plants, bacteria, or virus, have lives of their own and have rights to survive as God's creation. In this book, Young talks about animal life, animal suffering, animal abuses, and animal rights only, but not about those of plants, To me, this is rather one-sided and is unfair to plants. When we harvest vegetables, we also kill them. Plants can be abused by humans and, in some cases, suffer more than animals. For example, maple syrup is obtained by scoring the skin (bark) of a maple tree, sticking tubes into the wounds (notches), and bleeding (collecting) its blood (sap). The bleeding (collection) takes days and the tree is left to suffer the pain. One may maintain that this is a clear case of plant abuse. Animals are rarely abused that badly.

Without death, there will be no life; without suffering, there can be no gain. That is why Jesus must suffer a painful death so that we believers may have everlasting life. My understanding of God's creation plan is this: Certain plants must die (be eaten) to give life to herbivores, and animals must die (be devoured) to give life to carnivores. God commands us to rule over all creatures, living and nonliving, so that we may live well, remain healthy, and serve him thankfully. Without the maple tree's suffering, how else can we get real maple syrup?

If we follow Young's arguments and take the position that we should not kill and abuse any living organism for food, then what is left for Christians to eat? The answer obviously is synthetic food. It is now feasible to chemically synthesize carbohydrates, amino acids, fats, vitamins, minerals, and even some active ingredients in condiments and seasonings, all from nonliving materials. The major problems with synthetic food at present are the high costs of producing most of these food items and the public's reluctant acceptance of them. When synthetic food becomes readily available, affordable, and acceptable, it will challenge chefs and gourmet cooks to come up with recipes for preparing delicious and nutritious meals with it. Would anyone want to take up that challenge?

Reviewed by James Wing, 15107 Interlachen Drive, Unit 1014, Silver Spring, MD 20906-5635.

PROFESSORS WHO BELIEVE: The Spiritual Journeys of Christian Faculty by Paul M. Anderson, ed. Downers Grove, IL: InterVarsity Press, 1998. 238 pages. Paperback; $14.99.

Professors Who Believe is a collection of twenty-two essays whose theme is the relevance of the Christian faith to academic life or life in general. This riveting book chronicles God's action in the lives of some excellent scholars, from a range of academic disciplines and theological persuasions. The editor is a professor of biochemistry at the University of Minnesota, Duluth, who seeks to show that Christianity is as valid and relevant today as it was 2,000 years ago.

The title of this book is enough to tantalize even the most restrained book-buyers, but what lies inside the covers? Many of the essays provide testimonies of God's providential ordering in events that appeared inconsequential at the time but later exerted a profound effect in personal or professional development. "I ascribe many of my best ideas to divine inspiration—the 'Aha!' Insight" (Patricia Reiff, p. 61). In this sense, the essays are an excellent encouragement for Christian professors trying to seek God's relevance in the university. They are particularly valuable for those in positions where reflection on the interaction between faith and their academic discipline is lacking.

The essays are generally very personal in style. Reading the collection is like an intimate conversation with a friend, at times intense, at times hilarious, but always with the aim of illustrating God's faithfulness. The book does not seek to elaborate deep theological insights—although there are some—but rather describes the more difficult task of integrating theology and vocation. "Mere Christianity is much harder in the living than in the thinking" (Keith Yandell, p. 215). The result is a book that serves to stimulate self-reflection and an evaluation of one's own openness to God's leading. Several of the testimonies are a source of ideas on approaching delicate issues from a Christian perspective.

This book is an excellent resource for all Christian professors. Several essays are ideal articles for non-believing academics, and others might be useful for leading discussions. ASAers should consider giving copies to Christian colleagues and students embarking on academic careers, but remember to keep a copy for yourself!

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

THE COMPLETE BOOK OF EVERYDAY CHRISTIANITY by Robert Banks and R. Paul Stevens, eds. Downers Grove, IL: InterVarsity Press 1999. 166 pages. Paperback; $24.99.

This volume is billed as an A-to-Z guide to following Christ, a down-to-earth guide showing how Christianity illuminates everyday life. Many areas of daily existence are explored including family, church, job, money, relationships, entertainment, sports, and politics. This could be categorized as a how-to book: how to resolve conflict, how to age gracefully, how to find God's will, how to choose entertainment, how to be healthy, and so forth.

Topics of particular interest to readers of this journal include creation, ecology, education, global village, leadership, nature, and technology. Cross references and end-listings are helpful in locating particular subjects. The editors, who have also authored other books, wrote some of the articles. They were assisted by dozens of other writers. The book might be used as a text in churches or schools, as a resource in preparing a talk, and as a source for information to satisfy curiosity or solve a problem.

Reviewed by Richard Ruble, John Brown University, Siloam Springs, AR 72761.

Faith & Science

SCIENCE, LIFE AND CHRISTIAN BELIEF: A Survey and Assessment by Malcolm A. Jeeves and R. J. Berry. Leister, England: Apollos, 1998. 304 pages, notes, index. Paperback.

Jeeves and Berry have furnished a delightful smorgasbord of topics with both meat for the intellect and wine for the soul. This book updates and expands Jeeves' earlier book, *The Scientific Enterprise & Christian Faith* (1969), with a synthesis of their more recent work. The earlier volume synthesized discussion at a 1965 Oxford conference organized primarily by members of Christians in Science and ASA. Both works explore the link between science and faith by pointing the reader to God's two great books.

Jeeves and Berry, both active in Christians in Science, are Fellows of the Royal Society of Edinburgh. Jeeves, a neuroscientist and psychologist, is currently president of the latter organization and professor emeritus at St. Andrews. Berry, an ecological geneticist, is Professor of Genetics at University Col-

lege London. Jeeves' integrative work on psychology and faith includes *Mindfields: Human Nature at the Millennium* and *Psychology and Christianity: The View Both Ways*. Berry's recent volumes include *God and the Biologist* and *God and Evolution*.

The book opens with a discussion of the nature of science and its relationship to a Creator who seeks to make himself known. Later chapters address specific topics, especially within the life sciences, and their implications for Christians. The level of discussion presupposes some prior understanding of science and is appropriate for an advanced undergraduate course. The twenty-five pages of detailed endnotes flesh out many arguments for the more advanced reader. Finally the bibliography, lacking in Jeeves' earlier books, is a helpful addition.

Chapter one explores the role of the Greek and Hebrew-Christian traditions in shaping modern science. Although the relationship between science and faith is complex, they maintain that it is not primarily one of warfare, but of complementarity and affirmation. This chapter adds an informative short history of the ASA and a footnote on the breaking away of the Christian Research Society.

In chapter two, Jeeves and Berry discuss the relationship between the Creator and the laws of nature. They draw extensively from the work of Donald MacKay, neuroscientist and contributor to the original conference. MacKay's view of God as Creator-participant is especially helpful here in stressing a theistic, as opposed to a deistic, understanding of God's constant action in upholding the universe. Our God is one who self-reveals by stepping into his creation in order to be known personally by his created beings. Because the laws of nature are descriptive, rather than prescriptive, it is misleading to think of miracles as interventions in which God suspends natural laws; instead, all existence depends on his continuing to uphold the universe.

Chapter three centers on the scientific method. I found the link between Kuhn's theory of knowledge and the development of subjectivism in postmodern thought particularly insightful.

Drawing from MacKay's discussion of parallel levels of explanation, chapter four deals with the use of models and analogies in both science and religion. They contend that a misunderstanding of the use of models in science may have led theologians to an overly zealous demythologizing of Scripture.

The next three chapters assess current debates on origins. Further study in Big Bang cosmology, the Anthropic Principle, and/or chaos theory may provide insight into God's relationship to the physical universe. The scientific and biblical accounts should be seen as complementary, with science addressing the mechanism, but not the ultimate reason for creation. We are reminded that science is "thinking God's thoughts after him," a way of describing his normal mode of operation in the world as he sustains it moment by moment. The biblical account reveals the derived and temporal nature of matter dependent on God for its existence. Yet we must be careful not to limit his freedom to surprise us with unexpected acts. This discussion draws on the ideas of Houghton and Polkinghorne besides those of MacKay. An extensive endnote details the exegetical possibilities for the use of "day" in Genesis. Most of the discussion on Genesis, however, deals with the origin of our now-fallen sexual and social nature and its implications for obedience to God.

Chapters 8–11 deal with the nature and behavior of human beings. An extensive discussion of *nefesh*, psyche, *ruach* and *pneuma* support the authors' claim that the biblical portrait of human nature is of an embodied soul, dependent on God for existence, redemption, and resurrection. This is in contrast to a Platonic view of a naturally immortal soul which inhabits a mortal body. The resurrection thus becomes a divine creative act in which God recognizes us on the basis of our previous relationship with him. This discussion underlines the importance of our bodies and the necessity of avoiding a body/soul dichotomy in our Christian walk. The evidence from psychology shows that our outward actions actually come to shape our beliefs, attitudes, and character. Freely pursued behavior becomes written in the brain as part of personality.

Jeeves and Berry provide no easy answers for complex dilemmas at the beginning and end of life, but they aver that the image of God resides in our capacity for relationship with him rather than in our DNA. For example, they feel the strongest argument for protection of the early fetus may be our uncertainty of its degree of personhood, while maintaining that historically the church has given increasing protection to the fetus as development proceeds. Another challenging discussion involves biological determinism and free will. The authors emphasize the ever-tightening mind-brain link and MacKay's view of logical indeterminacy. On the mind brain problem, they reject both substance dualism and reductionist physicalism, adopting an emergentist position not unlike popular, functionalist accounts. Regarding free will, they argue that it is compatible with determinism, a view consistent with a Calvinist position on the sovereignty of God, but one which in

my opinion entails a weakened understanding of human freedom. I also felt that at points (e.g., sexual orientation, aggression in XYY individuals) they overemphasized the role of genetic and hormonal determinism at the expense of environmental influences and free will.

The closing sections remind us that the primary purpose of creation is the glorification of the One who is its Creator, Redeemer and Sustainer, rather than our own convenience. Various spiritualist approaches to environmentalism are discussed in contrast with the Christian view which emphasizes *both* God's immanence and transcendence. Through adept use of Scripture, the authors confirm our role in creation as stewards responsible to him (e.g., Luke 20:9–19 can be read secondarily as a condemnation for failure to practice responsible management of renewable resources).

This well-documented analysis of the complementarity of faith and science successfully challenges the reader to evaluate some contemporary issues. I found much with which I agree. In other areas, such as the discussion of free will, I was stimulated to reappraise my own position in the light of Scripture. I thoroughly recommend this enjoyable volume to both students and researchers.

Reviewed by Judy Toronchuk, Trinity Western University, Delta, BC V4C 1R2, Canada.

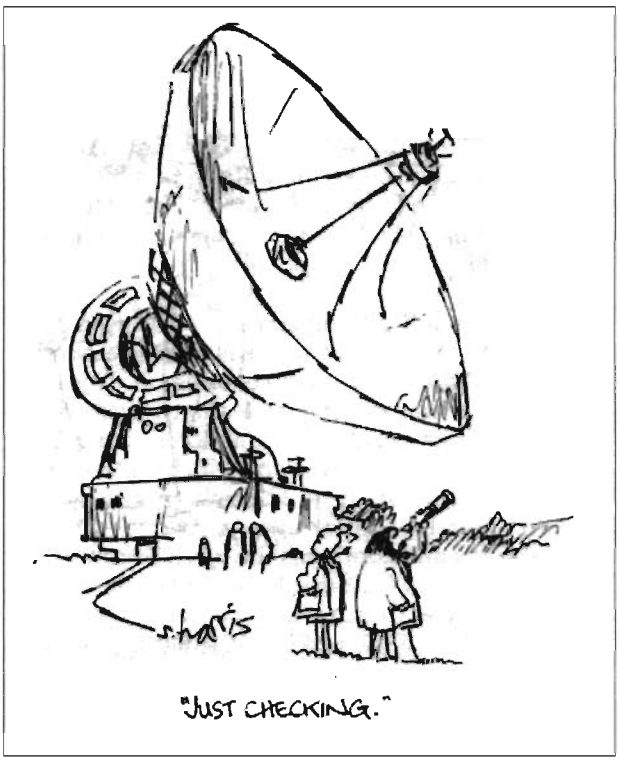
BEYOND THE COSMOS by Hugh Ross. Colorado Springs, CO: Navpress, 1996. 265 pages, sketches, index, endnotes. Paperback; $12.00.

In *Beyond the Cosmos*, Ross examines how the discovery of multiple dimensions beyond our own realm of space and time explain some paradoxes of the Christian faith including free will, miracles, hell, and the Trinity. He explores the wonder of God in eleven dimensions of space and time as defined by the work of modern-day scientists. While our lives are constrained by four distinct dimensions, Ross claims that it is time to go beyond that limit to understand God's abilities. The bottom line is that this is a book about thinking beyond the realms of our physical existence.

Right away critics will claim that Ross "answers the fools according to their folly," and correspondingly, he finds himself emulating them by trying to reason science into theological terms. Nevertheless, theological questions have been around since the "beginning of time" and have provoked traditional teachings by the churches of the world. This book addresses the many subconscious uncertainties Christians and others may have. Even if his assessments and analyses are totally inaccurate, it does no harm to believe that God has a multidimensional role in our lives. Scriptures will attest to it and Ross attempts (very convincingly) to give us a scientific connection.

A noted astronomer and an associate minister for the Sierra Madre Congregational Church, Ross is a highly respected orator on the topics of faith and science. His weaving of Scripture and science as complements to each other bring the realms of both to feasible, viable, and realistic perspective. While the "lay person" may not comprehend all the technical aspects of the book, much knowledge, discernment, insight, and faith will be gained from perusing it. This book is wonderful in the context of applying science facts to the philosophy of creation.

Beyond the Cosmos sheds serious doubts on theories of human evolution and greatly strengthens the creation theory. It offers profound concepts with which we can think about the unknowable. Using analogies, paradoxes, and contradictions, Ross adds new meaning to many curious aspects of our existence. After reading this book, one will gain a real feeling of the close personal presence of Christianity.



In short, *Beyond the Cosmos* should be a required study for fundamentalist ministries. It demonstrates rather than contradicts the truth of the Bible. Ross does nothing more than articulate the evidence that the Creator has given us to heed. The book fortifies rather than threatens and provides greater insight into the meaning of the Scriptures.

While some may get wrapped up in the mathematical theorems presented in *Beyond the Cosmos*, what is important are the superimposed meanings behind each analytical model. To be sure, Ross does not provide perfect insight into the physics of the cosmos nor the "ground truth" in scientific terms which, arguably, will forever remain beyond our capabilities. However, what stands out, as strikingly salient in this book, as stated by Ross, is that "the limits on our abilities to know the truth and visualize truth merely remind us that we are the creatures, not the Creator."

God is alive and well on planet Earth, and Ross provides some excellent food for thought in *Beyond the Cosmos*. Interjecting Scriptures and balancing scientific proofs about God's existence are what makes this book most intriguing. Ross offers new relevance to the most difficult ideas in Christian teachings and presents us with an avenue to better seek the Lord and understand his interaction in our lives.

Reviewed by Major Dominic J. Caraccilo, Regimental Plans Officer, 75th Ranger Regiment, Fort Benning, GA 31907.

THE ROOTS OF SCIENCE: An Investigative Journey through the World's Religions by Harold Turner. Auckland, New Zealand: The DeepSight Trust, P.O. Box 87-362, 1998. 204 pages, index. Paperback; $29.95.

Turner is a retired university professor of theology and religious studies who has written a number of books and scholarly papers on religion. This book is one of the first in the publication series of The DeepSight Trust, a New Zealand "cross-denominational missionary organization" which seeks to be "a gathering point for those wishing to engage our modern Western culture at a deeper level." This Trust absorbs and continues the work begun by the earlier Gospel and Cultures Trust, and so traces back to the Gospel and Culture Movement in Britain from the early 1980s.

The first few chapters of the book describe three distinct families of religions and their corresponding cosmologies. The first family, described in chapter two, includes the "primal religions," which are characteristic of tribal cultures around the world and which extend deep into the historical past. Turner describes their view of the universe and its contents as a "unitary, closed cosmology" that can be summarized by the term "encapsulated." The second family of religions, which are referred to by the author as "axial religions," are presented in chapter three. This family consists of the new religions that arose in Asia during the first millennium BC and became major faiths extending beyond any one tribe. These include the Hindu and Buddhist faiths in India as well as Taoism and Confucianism in China. These religions are characterized by a "dualist cosmology" which separates the spiritual realm of the divine from the material realm of nature. The third family, discussed in chapter four, includes the three Semitic or Abrahamic faiths of Judaism, Christianity, and Islam. Turner suggests that the cosmology of these faiths is characterized by "duality," which is different from a "dualist" world view in a subtle but very important way.

While describing the important characteristics of these three families of religions, Turner introduces the main thesis of the book: the roots of science could only have taken hold in one of these three families of religion, that being the fertile soil of the Abrahamic faiths. He argues that science could not develop among the tribal religions with their encapsulated world views because there was no room for the concepts of rationality, regularity, consistency, and coherence in a natural world permeated by a host of uncoordinated gods and spirits of ambivalent and uncertain temper. Neither could science develop among the axial religions because of the distinctions they make between the spiritual and the material world, with the material world being depreciated because of its "lower, shadowy" nature.

While Turner admits that technology existed among tribal peoples and even flourished among the great civilizations which adhered to various axial religions, he stresses in chapter four that true science could only develop within the cosmology of the Abrahamic faiths. This chapter, which is entitled "The Hebrew Revolution: De-sacralization," describes the necessary ingredients of a world view conducive to the development of science. These ingredients include the Hebrew belief in one supreme God, who was not only personal but was a rational and consistent God, whose creation is orderly and therefore comprehensible.

Two other important prerequisites for science are also discussed in chapter four: contingency and de-

sacralization (of matter, time, and space). According to Turner, these revolutionary developments in Hebrew religion, including the replacement of the sacred temple with secular synagogues, produced a paradigm shift which was inherited by the early Christian fathers (chapter five) and eventually passed on to the Christian "scientists" of the Middle Ages (chapter 7). The contributions of the Christian scientist John Philoponus (ca. 490–566) and the creed drawn up by the Council of Chalcedon in 451 are highlighted as evidence for the author's thesis in chapter five.

After establishing that the roots of science could only have flourished in the fertile soil of the Hebrew (and subsequent Christian) cosmology, Turner goes on in chapter six to explain why science reached an impasse within the context of Islam. Further confirmation for Turner's thesis is provided in chapter nine, which describes several examples of modern day tribal responses to Christian missions. Twentieth-century religious and scientific reversions to unitive and dualist cosmologies are critiqued in chapters ten and eleven. Developments cited in these chapters include the panentheism of process theology, Asian mysticisms, the New Age movements, the postmodern movement, cultural relativism, and constructivist education. In chapter twelve, the last chapter of the book, the author argues that science and Judeo-Christian theology face the same threats and must therefore present very similar defenses. He firmly believes that science and theology can and should be in partnership since they share the same struggle for truth.

Turner presents his thesis in a clear and concise manner. Throughout the book, a number of charts provide visual overviews of main points and important relationships. One criticism of the book is that it should be longer, considering the vast historical timetable that is addressed. However, Turner freely admits in his postscript that the main purpose of this book is to provoke further investigation into his thesis. He has provided us with a panoramic overview of the relationship between science and theology, leaving to others the task of filling in the remaining gaps in our knowledge. Turner realizes that not everyone will agree with his thesis that only the Judeo-Christian tradition provides the necessary basis for science, but he is content to let the facts of history speak for themselves. Anyone with an interest in the historical and contemporary relationships between science and religion should take the time to read this book.

Reviewed by J. David Holland, Biology Instructor, Springfield College in Illinois, Springfield, IL 62702.

THE SACRED DEPTHS OF NATURE by Ursula Goodenough. New York: Oxford University Press, 1998. 197 pages, notes, index. Hardcover; $24.00.

Goodenough has written a very interesting and very readable book. In twelve chapters, each ending with reflections or meditations, she describes biological facts. At the end of the first chapter, she confesses that Deism does not work for her since she can only think of a creator in human terms. A God creator would spoil her covenant with Mystery. Thus, she can use Christian hymns and Lao Tzu's writing in the same breath. At the end of chapter four, she describes a baptismal service and concludes that she is in charge of her own emergence. In the reflections of chapter eight, she writes: "Each crucifix calls us to the pathos of Christ. Each image of the Buddha invokes a reflective serenity." For her all religions are on the same level.

This book is worth reading as it shows how a part of creation, in this case biology, can become so important that it becomes one's religion. Thus everything is seen in the light of the part of creation that gives rise to our musings. This book shows how dangerous it is to let life be guided by a little though important part of life, which then becomes a religion.

Reviewed by Jan de Koning, 20 Crispin Crescent, Willowdale, ON M2R 2V7, Canada.

HEAVEN IS NOT MY HOME: Learning to Live in God's Creation by Paul Marshall with Lela Gilbert. Nashville: Word Publishing, 1998. 269 pages, index. Hardcover; $17.99.

Heaven Is Not My Home is touted as a book "that will first inspire you, then challenge you to take a closer look at the role we have been called to play in the restoration of the world" (front flap). In seventeen chapters, Marshall moves from the nature of creation, sin, and redemption (Parts I and II), through work and rest (Part III), and culminates in "Our hope for the world" (Part V, the final five chapters). Marshall has previously written in the area of work and vocation, and more recently has focused on religious persecution.

Marshall's aim is to give a "spiritual orientation as we live as God's people in God's world" (p. x). He devotes a significant number of pages to broadly-accepted evangelical themes, such as sin, redemption, and salvation and this limits the discussion of the very ideas that he wants to address. The problem of content is further compounded by his desire to

provide general ideas for reflection, rather than focusing on the ramifications of a fallen, but essentially good, creation. Unfortunately, many of the ideas are underdeveloped, often resulting in conclusions that are trite and unhelpful. The following quote is typical:

> Many women and men struggle to survive financially and are burdened with heavy fiscal responsibilities. They are forced to work long and hard. But it does not add to our financial burdens to remember that Jesus has called us to absolute dependence upon him. This does not mean that we stop working, stop trying, stop caring. But it does mean that we must entrust our financial concerns to him and not immerse ourselves in work simply because we are obsessively afraid of humiliation or financial disaster (p. 96).

This paragraph would be a good introduction to financial stewardship but occurs at the end of a section without any further elaboration.

The book is a call to a balanced theology of creation; it is easily read and may be of interest to those who have never spent time reflecting on these issues.

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

GOD AND CONTEMPORARY SCIENCE by Philip Clayton. Grand Rapids, MI: Eerdmans Publishing Company, 1997. 274 pages, notes, index. Paperback; $25.00.

This book is part of the series "Edinburgh Studies in Constructive Theology" edited by Clayton and K. J. Vanhoozer. Clayton is Associate Professor and Chair of Philosophy at Sonoma State University in California. He has produced a valuable book that, while rough going at times because of the complexity of his arguments, should prove interesting and useful to those concerned about the dialogue and interaction between science and theology.

The title is a little misleading. While Clayton does present a comprehensive discussion of both theological thought and current cosmology, the book's main purpose is to defend panentheism as a way to think about the problem of divine action in the universe. Not to be confused with the highly problematic concept of pantheism, in which God is basically identified with the universe, panentheism is the idea that, in Clayton's words, "the world is in God, although God is also more than the world." Clayton sees panentheism as a suitable way to reconcile scientific discovery with theological concepts.

The book is in three parts. The first part, "The God Who Acts: Towards a Biblical Theology of God and the World," is concerned with laying the foundations of the science-theology debate. Much of the material in this section will be familiar to ASA members, and can serve as a good introduction or review of these foundations. One chapter is devoted to the biblical view of creation as set forth in the Hebrew Bible, focusing on the importance of the concept of God's creative power as an integral component of the science-theology conversation. In the next chapter, Clayton examines the claims of Christianity and its own special problems in resolving conflicts with scientific knowledge of the world. The thesis of the book is fully introduced in the last chapter of Part One, where Clayton carefully draws historical and conceptual connections from polytheism to monotheism to radical monotheism, finally ending at the concept of panentheism. In this chapter, the reader receives the most detailed (yet highly readable) discussion of panentheism and the arguments in favor of it.

Part Two is devoted to a single chapter concerning current research and thinking in cosmology. Clayton provides an informative review of the field, highlighting the work of notable figures such as Davies, Jastrow, Tipler, Wesson, and others. By doing so, he strives to make his point that even our current knowledge of the universe, as impressive as it seems to be, is not complete or fully understandable without the contributions of theology.

This leads directly to Part Three of the book which is devoted to the use of scientific knowledge and the already-introduced idea of panentheism in deriving a theological theory of divine action, which Clayton sees as one of the most intractable problems in theology today. This section of the book contains Clayton's most closely reasoned arguments and may be difficult for many. He begins with a chapter entitled "The Presumption of Naturalism." Here he examines the difficulties of the idea of divine action in the face of a prevailing assumption that every event in the natural world has a natural instead of a supernatural explanation. In the chapter entitled "Scientific Causality, Divine Causality," Clayton uses concepts borrowed from quantum physics to explore the possibility that God can guide events without violating natural laws, avoiding the tempting "God of the gaps" pitfall. The final chapter of the book, "Understanding Human and Divine Agency," is Clayton's discussion of what he calls the "panentheistic analogy," a way of understand-

ing how God relates to the universe by understanding how the human mind relates to the body with, of course, attention to how God's relationship to the universe is also different from that of our minds and bodies. This is in an effort to be true to both theological tradition and current thought in science concerning the mind-body relationship.

I highly recommend this book; it serves as an excellent introduction to many of the important topics in the science/theology reconciliation, while advocating an intriguing solution to some of the inherent problems. Because Clayton takes the time and effort to carefully build his argument using the work of some of the greatest thinkers in the field, this book would be suitable for advanced students at the graduate or even the undergraduate level, as well as for readers who are already familiar with the field. The book also contains exhaustive notes; these would serve well as a "reading list" for readers wishing to dig deeper.

Reviewed by Randall K. Harris, Associate Professor of Biology, William Carey College, Hattiesburg, MS 39401.

Origins

THE DOCTRINE OF CREATION by Colin E. Gunton, ed. Edinburgh: T. & T. Clark, 1997. 176 pages, index. Hardcover; £19.95.

Gunton begins his introduction by saying: "It is not too much of an exaggeration to say that in the modern world the doctrine of creation has in many places given way to discussions of the relation between science and religion." Most readers of this journal are interested in such discussion, and this collection of papers from a conference called by the Research Institute in Systematic Theology is relevant to them. It does not, however, deal directly with topics such as biological evolution or the expanding universe. The essays concentrate on the theological issue of how the doctrine of creation has been and should be understood. As the subtitle says, this is a collection of "essays in dogmatics, history and philosophy."

One of the basic issues in today's theological discussions of creation, and indeed in all of theology, has to do with God's involvement in time. The first two essays take up that issue. Robert W. Jenson is critical of the Augustinian tradition of divine timelessness and argues that "God's eternity is not his immunity to time but his having all the time he needs" (p. 24). Paul Helm, on the other hand, argues for what he sees as a proper way of understanding God as timeless.

Gunton himself offers two essays that focus on the history of the doctrine. The first, on the tradition of spiritualizing Genesis, brings out the fact that some Jews and Christians were bothered by aspects of the Genesis creation accounts and tried to interpret them as other than literal history long before Darwin and Wallace proposed their theories. Gunton clearly points out the problems that the platonic tradition has introduced into the doctrine of creation. This is, however, a place where greater contact with the natural sciences would have been helpful, for the platonic views of some modern theoretical physicists should be considered here. In his second essay, Gunton describes the way the doctrine developed through the Middle Ages and Reformation, and argues that Luther and Calvin were able to give the doctrine stronger connections with Trinitarian thought than their predecessors had.

Alan J. Torrance provides an appreciative but critical discussion of the way in which Jürgen Moltmann in *God in Creation* has dealt with the idea of *creatio ex nihilo* in terms of divine "withdrawal" in order to make "room" for creation. Daniel W. Hardy's essay addresses the relationship between creation and eschatology. Scientific developments have drawn a great deal of attention to issues of origins, and for some time theologians, such as Moltmann and Wolfhart Pannenberg, have been emphasizing eschatology. Making connections between these two aspects of theology in a way which is adequate to the modern understanding of the world, however, is just getting under way.

The last two papers turn to ways in which humans respond to divine creation. Brian Home writes about "Divine and Human Creativity" with some consideration of Dorothy Sayers' *The Mind of the Maker*. Christoph Schwöbel concludes by offering a "dogmatic basis of a Christian ethic of createdness."

Serious discussion of a topic such as "creation and evolution" requires that participants know what mature doctrines of creation really are. The authors whose contributions are collected here focus on the biblical material and theological themes which are germane to creation while still casting their nets widely enough to bring out important connections with other doctrinal areas. The book can provide a good orientation to what modern theologians are saying about the doctrine of cre-

ation, and will supply a basis for study of more specialized aspects of that doctrine.

Reviewed by George L. Murphy, 538 Cynthia Lane, Tallmadge, OH 44278.

CONSTRUCTING THE BEGINNING: Discourses of Creation Science by Simon Locke. Mahwah, NJ: Lawrence Erlbaum Associates, 1999. 235 pages, index. Paperback; $24.50.

The study of communications today is quite a sophisticated undertaking. The classic discipline of "rhetoric" has been supplemented by the diverse insights of discourse analysis, postmodern critiques, sociological perspectives, and constructionism. This groundbreaking study was originally part of a Ph.D. thesis in communication at a British university. Its author now holds a post at Kingston University in England. Creationism is the focus of the analysis, as exemplified by the pamphlets and other materials of the British Creation Science Movement (formerly the Evolution Protest Movement). The author's intent, however, lies much deeper. He engages in a detailed empirical analysis of the discourse of creation scientists in order to focus on public understanding of science and the "representation in sociological theory of the role and position of science in relation to modern society and culture."

This book draws heavily on the discourse analysis model of Jonathan Potter and his colleagues and the rhetorical-dilemmatic approach of Michael Billig and his colleagues. Locke gives a very fair and balanced treatment of British creationism. He points out the fundamental similarities in many of the rhetorical devices used by both them and their critics. He constructs a clear argument that there are three fundamental problems facing creationists: (1) the competing account of the world's reality in the form of evolution; (2) competing accounts of the Bible in the form of different versions of Christianity, some of whom find no incompatibility with evolution; and (3) the need for a "discursive syncretism" that ameliorates the creationists' own version(s) of the world and the Word. Locke juxtaposes these dilemmas with three recent theoretical accounts of modernity that try to account for the fragmentation that seems to describe modern culture and movements around the globe. These accounts seem to defy by word and action any framework of rationalization that spokespersons in contemporary science seek to impose.

The end result is a rich interplay of ideas and analysis that is helpful in understanding the rhetorical complexities in conversations about origins, the limits of scientific knowledge, and the limitations inherent in "scientific" discourse. Locke argues that we need to view science as a cultural resource but also acknowledge that there exist other fruitful cultural resources, such as Christianity and religions more generally. All of these resources should be appropriated to better apprehend our existence and meaning in the universe.

Reviewed by Dennis W. Cheek, Director of Information Services & Research, RI Department of Education and Adjunct Associate Professor of Education, University of Rhode Island, Kingston, RI 02881-0806.

THE GOD OF EVOLUTION: A Trinitarian Theology by Denis Edwards. New York: Paulist Press, 1999. 144 pages, notes. Paperback; $14.95.

Theological exegesis confronting conventional scientific explanations of the "big bang" theory are increasingly the subject of many who contemplate nature's evolutionary process. Theologians and scientists have long pondered the evolution of humans and nature. Given the scientists' ability to reaffirm what has historically been believed to be "ground truth" there appears to be a larger void in the two conclusions. Edwards captures the essence of this increasingly age-old examination in *The God of Evolution: A Trinitarian Theology.*

Edwards, a priest of the Archdiocese of Adelaide, Australia, and an instructor of theology at Flinders University, provides a detailed discussion to help understand the ties between the neo-Darwinist approach to human evolution and the biblical insights into the mysteries of the universe. Smartly compartmentalized and thoroughly explored, *The God of Evolution* offers a reformulation of Christian theology in light of contemporary science perspicacity by convincingly contrasting the two, and then subsequently relating both. Referring to established scientists and theologians, Edwards superimposes the patriarchal narratives over the biological theories of natural selection.

The God of Evolution is a well-documented ratiocination of the comparative biological and theological theories of evolution. Edwards' research and footnotes offer an extended level of analysis to accompany the already extensive amount of evidence offered in the main body of the book. In short, *The God of Evolution* is a well-organized and documented work.

Science clearly has the ability, through a multitude of means, to prove how the earth and the solar

system have been developed and evolved into the structure it holds today. The scientific means are so convincing it is difficult to refute the establishment of the scientific process in favor of say, the evolutionary formula offered by the Book of Genesis. Edwards challenges all presuppositions in this book by reflecting deeply into the trinity of God as Creator and Redeemer. At times difficult to follow for he leaves no stone unturned in his excruciating analysis, in the end *The God of Evolution* illuminates what the Trinity means to the evolutionary process.

Exploring the first eleven chapters of Genesis, the methodologies surrounding pedagogical constructs aimed at teaching theological *truths*, and the relationship each theory contributes to the world view offered by contemporary science, Edwards pleas for Christians to embrace both the theological teachings of Genesis and the theory of evolution. His analysis takes a stance that "it is reasonable, coherent, and enlightening to hold both sets of insights together in one unified view."

By accepting his "mutual relation" theory as found in the Trinitarian vision of God as a God of the such, Edwards believes that "it might be helpful to situate [this approach] in the context of recent approaches to evolutionary theology that concentrate on God as the principle of altruism." Using the writings of Theissen and Hefner to expound the connection between biological and cultural evolution, and on the emergence of altruistic or self-sacrificing love, Edwards claims that it is better to "look beyond altruism to express the ultimate Christian vision of the reality that is behind our evolutionary history."

These principles and others offered by Edwards are not easy to grasp without some deep thought and an imagination to interpret how God works in and through the laws of nature and in and through the randomness of the process. Nonetheless, if we believe that God is indeed self-limited by love and respect for finite creatures and that creation is a *sacrament* of the divine presence, we can begin to understand the connection Edwards has made in this book.

The diversity of life on Earth, interconnected and interdependent in the biosphere of our planet, is a sacrament of divine Wisdom. *The God of Evolution* articulates a theology of God, one that stands in the Christian tradition, but also engages with the insights and challenges offered by evolutionary biology.

Reviewed by Major Dominic J. Caraccilo, Regimental Plans Officer, 75th Ranger Regiment, Fort Benning, GA 31907.

TOWER OF BABEL: The Evidence against the New Creationism by Robert T. Pennock. Cambridge, MA: The MIT Press, 1999. 429 pages, notes, references, index. Hardcover; $35.00.

Pennock is Assistant Professor of Philosophy at the University of Texas at Austin. He has written several articles on the issue of Darwinism versus creationism, including the article, "The Prospects for a 'Theistic Science,'" that appeared in *Perspectives on Science and Christian Faith*, September 1998. These articles are incorporated into some sections of his book, *Tower of Babel.*

This book is an excellent reference on the defense of science and scientific methodology in general, and of the theory of biological evolution in particular. It is also a useful guide on arguments against creationism—but not against any religion as a whole. The main theme of the book is that Darwin's theory of biological evolution, as all other accepted scientific theories, is based on evidence. Creationism and others like it, such as creation science and theistic science, are not based on evidence and, therefore, are not science.

Pennock takes pain to describe the major aspects of and evidence for biological evolution (common descent with random modification, natural selection mechanism, and branching of lineage). He also explains the methodology that is used in scientific investigation. Readers of this book should appreciate the elaboration by this philosopher-author on the proper use of logic, inference, and argumentation that is essential in scientific research. Pennock then points out that there is neither evidence nor a need of a supernatural Omniscient Creator or Intelligent Designer for the generation of complex specified information in living organisms and for biological speciation. In addition, he shows the fallacy in the theory of a young earth that some creationists have formulated.

Those who are afraid of the idea of evolution should realize that, whether they like it or not, evolutionary processes are taking place at all times in various human activities, such as culture, language, and even religion. Pennock uses the development of human languages to illustrate the close analogy of linguistic evolution to biological evolution, and indicates that there is really no evidence for an Intelligent Designer or Creator to account for the present diversity of languages, in contrast to Gen. 11:6–9. The reason Pennock chooses to include linguistic evolution in this book for the discussion of biological evolution versus creationism is that a lot of people do not comprehend science and can easily shy

away from the discussion. However, he believes that these people should be able to understand languages and, by providing the arguments for linguistic evolution, he hopes that they will see the parallel arguments for biological evolution. Thus, the main title of this book can be rather misleading. The book does not advocate intelligent design as the origin of languages in accordance with Genesis, but, instead, it gives evidence for linguistic evolution.

Throughout the book, Pennock recounts the sophisticated tactics and strategies that creationists use in their assaults on evolution biology and, above all, science. In the last chapter, he warns about the danger of the creationists' disguised infiltration of religious ideas in public schools, especially the promotion of creationism in science teaching. He also warns of their constant attempts to introduce religion to legislation. Although the author offers no particular action that one must take to counteract these creationists' efforts, his book can be effective in inspiring readers to take initiatives to safeguard separation of church and state.

Reviewed by James Wing, 15107 Interlachen Drive, Unit 1014, Silver Spring, MD 20906-5635.

ORIGINS: Linking Science and Scripture by Ariel A. Roth. Hagerstown, MD: Review and Herald Publishing Association, 1998. 384 pages. Glossary and Technical Terms, Index. Hardcover; $29.99

Roth has a master's degree in biology and a Ph.D. in zoology from the University of Michigan. He has held appointments at several universities including chair of the biology department at Andrews University and Loma Linda University. From 1980 to 1994, he was director of the Geoscience Research Institute at Loma Linda and he has been editor of the journal *Origin* for twenty-three years. His research in various aspects of biology has been funded by several agencies including NIH and NOAA. Roth has been active in evolution-creation controversy and has served as consultant or witness in California, Arkansas, and Oregon. He has more than a hundred publications in scientific and popular journals. (I have not previously seen any of his work nor have I seen any references to any of his publications).

Origins is written in six sections: "The Questions," three chapters; "Living Organisms," six chapters; "The Fossil," three chapters; "The Rock," four chapters; "An Evaluation of Science and Scripture," four chapters; and "Some Conclusions," three chapters. Roth has chosen to discuss topics, which he believes present the greatest challenge to Scripture and to science, including historical, biological, paleontological, and geological interpretations. In his words, "a number of conclusions I present are not mainline." He states that he has "made special efforts to be fair to the data, paying special attention to the most reliable data." Of course, the most reliable data is that which is consistent with his belief that the biblical account of beginnings implies an origin of life a few thousand years ago and that the fossil record was formed by the universal flood of Genesis which reconciles the geologic column to the six-day creation week. According to Roth, "when one incorporates the Genesis flood into an earth model, and this is implicit in sacred history, a number of possibilities emerge that can resolve many of the time problems suggested for creation."

For Roth, a correct biblical view requires a recent creation, most likely less than 10,000 years ago. He maintains that in general the founders of modern science believed in a recent creation. It was not until the middle of the eighteenth century that the ideas of longer periods of time began to take root. In the nineteenth century, a slow increase in the perceived age of the earth developed. I find Roth's position on this issue very difficult to support. Roth dedicates most of the book to explaining how "reliable data" properly interpreted is consistent with a recent creation. As indicated earlier, his interpretations do not represent mainline science. For example, for the Genesis flood to have been universal, the flood stage could have been caused by the sinking of the continents and the uplifting of the oceans, then a post-flood stage with uplift and lateral compression of the continents could have been followed by deformation, erosion, and redeposition of rock types. Roth suggests that "the standard scientific literature echoes a small but persistent note of doubt about the validity of the whole plate-tectonic concept."

Roth's discussion is much broader than the few examples I have mentioned and deserves a reading. His perspective is consistent with the recent creation position, which asserts that God prepared the earth and created the various kinds of living organisms in six, 24-hour days less than 10,000 years ago and that the fossil record can be accounted for by the Genesis flood. He only mentions other possible views between creation and evolution (that the universe was formed by natural causes billions of years ago and that life arose spontaneously) near the end of the book.

> The many views between creation and evolution (e.g., gap theory, progressive creation, theistic evolution, etc.) tend to be ill-defined. Such models have

no basis in either Scripture or the data from nature and have little support from either source. The intermediate views provide a way to gradually move from belief in creation toward naturalistic evolution.

This book was interesting reading but very difficult to review. I struggled with Roth's arguments as he interprets the observations of natural data to make them consistent with recent creation. I find the arguments of someone like Hugh Ross more convincing. I was very much in agreement with Roth in his position that "an exclusively naturalistic scientific system of thought excludes many areas that, we suspect, are also part of reality ... Any wholistic worldview must account for those areas of experience beyond naturalistic explanations." I was also appreciative of the lack of rhetoric that I have often experienced in the writings of recent creationists.

Reviewed by Bernard I Piersma, Professor of Chemistry, Houghton College, Houghton, NY 14744.

Philosophy & Theology

IMPOSSIBILITY: The Limits of Science and the Science of Limits by John D. Barrow. Oxford: Oxford University Press, 1998. index. 279 pages. Hardcover.

Barrow, Professor of Astronomy at the University of Sussex, has written a very engaging and even playful book. He attempts to show how certain "laws" governing "Nature" help us to separate the possible from the impossible. Knowing what is impossible—whether in science, art, literature, logic, and theology—helps shed "new light on the nature and content of the actual" (p. vii). Impossibilities define actualities. Furthermore, Barrow offers an array of anecdotes, quotations, diagrams, and illustrations to reinforce the theme of his book.

In Chapter 1, "The art of the impossible," Barrow writes that pseudo-science claims to have an answer for everything whereas true science acknowledges limits and barriers. Science acknowledges uncertainties (such as the Heisenberg Uncertainty Principle and quantum mechanics) which "predict that we cannot predict" (p. 26).

Chapter 2, "The hope of progress," speaks about the nature of scientific progress in light of the "surprisingly few fundamental laws of Nature" (p. 26). He assesses both pessimistic and optimistic voices about science, Kant's "limits" of reason, the deleterious influence of Comte's positivism on French science, and explanations of consciousness and freedom of the will. Barrow offers an interesting glimpse at Gunther Stent, who sees the increase of leisure creating a loss of motivation for technical advance in the West, and John Horgan, who thinks that science is moving into the area of speculative ideas far removed from observation and testing.

Chapter 3, "Back to the future," reminds us of the "few" and "simple" laws of nature (e.g., the four fundamental forces), but these few laws have complex outcomes. Furthermore, there is a difference between that elusive "Theory of Everything" and understanding the complex outcomes of those laws. In this chapter, Barrow sketches four pictures of how science grows.

In Chapter 4, "Being human," Barrow offers some discussion—at times reductionistic and philosophically imprecise—regarding the human person such as mental activity, art, psychology, and language. For instance, he speaks of the brain as though there is no such thing as first-person states of subjectivity: "It learns; it remembers; it forgets; it dreams; it creates" (p. 86). But does *my brain* learn, or do *I* learn?

Chapter 5, "Technological limits," discusses various topics in physics and astrophysics such as the universe's expansion, star formation, the relationship of the four forces, thermodynamics and the energy required to obtain information. Of course, Barrow continues his theme of "impossibility" to speak of the limits of technology and the potential for breakdown and disaster that comes with technology. As humans we shall have to come to terms with the limits that Nature imposes on the speed at which we can transmit information.

Chapter 6, "Cosmological limits," gives a brief survey on important themes in contemporary cosmology such as the state of the universe just after the Big Bang, star and galaxy formation, the universe's inflation, and possible future scenarios of the universe. Again Barrow raises the questions of possibilities and limitations. For instance, there is a boundary to our visible universe ("horizon") determined by the speed of light. We can know nothing of what lies beyond this horizon.

Chapters 7 and 8, "Deep limits" and "Impossibility and us," are full of interesting discussions on the nature of time travel (including some theological musings about whether or not God could change the past and divine foreknowledge and human freedom). Primarily, however, these chapters focus on the doomed search for completeness in mathematics, which David Hilbert pursued. Gödel and

Turing—though not the first to show this was not possible—reinforced the belief that mathematical completeness is not within our grasp.

Finally, Chapter 9, "Impossibility: taking stock," is simply a summary of the book's contents.

One downside to the book is that Barrow brings a distorted picture of a theistic God into his work (pp. 7–11) without the necessary philosophical rigor to make his case. For example, Barrow states: "the presence of an omnipotent, interventionist being who is unrestricted by laws of Nature undermines faith within the consistency of Nature" (p. 10) and "Natural selection killed the idea that the world is a finished product arrived at by design. Design is unnecessary" (p. 40).

Despite minor points of disagreement, overall, Barrow's book is enjoyable, informative, and thought provoking.

Reviewed by Paul Copan, Ravi Zacharias International Ministries, 4725 Peachtree Corners Circle, Suite 250, Norcross, GA 30092.

HOW BLIND IS THE WATCHMAKER? Theism or Atheism: Should Science Decide? by Neil Broom. Aldershot, England: Ashgate Publishing Ltd., 1998. 226 pages. Hardcover; £37.50. ISBN 1 84014 517 X

This book is about the drama of living things. The author makes use of his extensive reading and understands concepts of the philosophy of science. He includes quotations from the writings of scientists and theologians which, together with the illustrations, augment the text.

Broom's thesis is that there is a meaning in nature which extends beyond the information that science has discovered. Carefully defining the terms he uses, Broom contends that the life sciences do not support the materialistic world view depicted in many books today. He challenges the claims that the findings of these studies have dispensed with the need for God in nature. Science, in his view, is inadequate to evaluate this issue. Materialistic humanists have not explained the origin of life and the cellular systems, and yet they deny any place for a transcendent personal being in the cosmos.

The author explores the function of some cellular systems along with the workings of the chloroplasts, the DNA template, and other cellular mechanisms. He agrees with many of the concepts outlined by Polyani in his writings. The highly complex biological systems of even the simplest cells function as a whole. The complexity and importance of these systems is sometimes downplayed simply because the individual components can be analyzed in isolation. They are then often fitted into a materialistic humanistic plan.

The increasing complexity of life forms in the fossil record is examined. The neo-Darwinist equates this with a nondirected, random variation in the genetic material of organisms. This view is rejected. The author assesses, then counters, the arguments of Richard Dawkins who holds this view. Broom concludes that the Watchmaker was not blind.

The book is not about a "God of the gaps." The contents invite the reader to reflect on the premise that in nature we see an intentionality of purpose. The writer's task is done well. I enjoyed reading what Broom had to say and recommend the book to others. Materialists and Christians alike will find much of interest for ongoing discussion.

Reviewed by Ken Mickleson, 21 Windmill Road, Mt. Eden, Auckland, New Zealand.

THE LORD OF THE ABSURD by Raymond J. Nogar. Notre Dame, IN: University of Notre Dame Press, 1998 (Herder and Herder, 1966). 157 pages. Paperback; $12.00.

This is one of the rare books on evolution, science, and religion that is still fresh and current one-third century after its authorship by a Dominican priest-professor. Nogar became a Catholic during his senior year at the University of Michigan. With a background in field biology and anthropology, he eventually became a philosophy professor at the Angelicum University in Rome and then at the Aquinas Institute of Philosophy in River Forest, Illinois.

This collection consists of reflections following up Nogar's lectures and discussions with students and faculty members, including George G. Simpson, that wrestle with philosophical and theological themes on the relationships between evolutionary science and Christian faith. Given on ten campuses from Harvard to Stanford and Miami to Michigan in 1964–1965, the lectures followed the 1963 publication of his book, *The Wisdom of Evolution* (reviewed favorably in *JASA* 24 [June 1972]: 69–70, as "*one* theological solution to the creation-evolution dilemma"). (Its successor, *The Problem of Evolution: A Study of the Philosophical Repercussions of Evolutionary Science* with co-author John N. Deely was published by

Appleton-Century-Crofts in 1973 after Nogar's death.)

One of his themes is: "It takes a critical thinker to disengage the scientific evolution of some men from their philosophical evolutionism which they are selling as part of an ideological system" (p. 65). In tune with the unmentioned ASA, he advocates professional dialogue between the increasingly fragmented, overspecialized academic disciplines and hopes for a language to promote communication among the intellectual "cultures within cultures" that are not speaking with each other. Interdisciplinary dialogue is one of the vehicles that can contribute "spiritual solidarity and meaning to our destiny" (p. 66).

Christian faith undergirds Nogar's work. He emphasizes that divine providence is concerned more with a change of heart than a change of place and time. "We believe in Christ, not in a world-view" (p. 110). Jesus Christ is "an inescapable datum face to face with which each man must make up his mind" (p. 137). The world needs demonstrations of God's personal presence among us, not more attempts to prove his existence that convinces only believers. His main contribution to that end was "interpreting the problems of evolution in terms of ultimate meaning and human relevance. If Christ could not convey this with ... a world-view that could be systematically formulated, but had to live this meaning out in the drama of His life, how could it be otherwise for us today?" (p. 24).

If Nogar had been a Protestant, he might have related his belief in an evolutionary unfolding of humanity, the human spirit, morals, and the cosmic order to the dispensational theology that believes God's revelation has unfolded in stages of cumulative deposits of truth. To use the words of the Scofield Reference Bible: "... the progressive order of God's dealings with humanity [reveals] the increasing purpose which runs through and links together time-periods during which man has been responsible for specific and varying tests as to his obedience to God ... [in] the divine economy of the ages." Nogar, along with dispensationalists and many other Christians (although they use diverse theological concepts and semantic labels), believes that there is an unfolding of God's action in relationship to the universe in all its parts, including humanity and the human spirit, and that this occurs in an evolutionary fashion.

Anyone who is wrestling with issues related to the conflicts and tensions that prevail between Christian faith and scientific evolution will benefit from the insights sprinkled lavishly throughout this book. It clarifies Nogar's conviction that atheistic and evolutionary humanism have failed, that religious faith is natural and science mysterious, and that the ever-increasing recognition of the intricate ways in which order succeeds order in space and time points all the more to the necessity of the existence of God as the Source of the evolution of natural development. "The Lord of the Absurd" is the God who works mysteriously to accomplish his purposes through the messiness, waste, and disorder of evolution, the paradoxical dilemmas of the human situation, and especially the "preposterous drama" of salvation through the incarnation, death, and resurrection of Christ.

Reviewed by David 0. Moberg, 7120 W Dove Ct., Milwaukee, WI 53223.

BESIDE STILL WATERS: Searching for Meaning in an Age of Doubt by Gregg Easterbrook. New York: William Morrow and Company, 1998. 318 pages, index, footnotes. Hardcover; $25.00.

Over two millennia ago, the philosopher Epicurus asked humanity's foremost question, "Is deity willing to prevent evil, but not able? Then he is impotent. Is he able but not willing? Then he is malevolent. Is he both able and willing? If so, then whence comes evil?" On the basis of this single question, many have decided that the most reasonable way out of the question is to posit no deity at all.

There are answers within Christianity to the Epicurus question. Few people I know, even those who espouse those answers, find them quite satisfying. Easterbrook proposes a unique answer, perhaps not new, but one I do not see addressed in current literature. Perhaps God is not omnipotent! Perhaps God is evolving!

In a highly readable, well-documented, surely controversial book which demands recognition, if not acceptance, Easterbrook, a contributing editor for the *Atlantic Monthly* and a distinguished fellow of the Fulbright Foundation addresses some of the most fundamental spiritual issues of our times. His central thesis is that the Bible never actually asserts an all-powerful God and that "omnipotence" is a human-made doctrine. How this works out is a well-balanced exposition of both Scripture and science in this remarkable book. It is not "normative" Christianity, to be sure, but it does suggest a clear set of answers to such questions as "Why does God allow natural disasters?" and "Why is there such a difference between the God portrayed in the two

testaments." Some of the reasoning appears (to me) somewhat strained; most of it, however, appears worth consideration, even without acceptance of the author's admittedly unconventional views.

This is a recommended read for all ASA members, as well as others within our religious fellowships who "think they think." I am always excited when a book takes me beyond my current thinking, and this one does that well.

Reviewed by John Burgeson, 6731 CR 203, Durango, CO 81301.

EVOLUTION AND EDEN: Balancing Original Sin and Contemporary Science by Jerry D. Korsmeyer. Mahwah, NJ: Paulist Press, 1998. 170 pages, notes, bibliography, index. Paperback; $14.95.

The writer states in the Introduction that "faith can benefit from our scientific knowledge of the universe, and from the insights of process philosophy." Korsmeyer refers in the first chapter to Pope Pius XII's 1950 encyclical *Humani Generis* where we read that Roman Catholics cannot support a theory which states that after Adam a human race developed which did not descend from Adam. That idea cannot be reconciled with the doctrine of original sin. Korsmeyer writes that original sin resulted from fifteen billion years of persuasive divine creativity and the co-creative response of all entities in our universe (p. 122). Original sin is the biologically and culturally inherited state responsible for the human characteristics of survival and self interest. Korsmeyer uses the fact that the Roman Catholic doctrine of the soul is based on Platonic philosophy to argue that modern science and philosophy should assist us in explaining biblical texts. He speculates about what might happen to the doctrine of original sin when we meet extraterrestrials. After all, they are also God's creatures.

The book's conclusion is that evolution shows that the Augustinian doctrine of "original sin" is incorrect. Augustine, Luther, and Calvin did not know about evolution yet, but there are theologians in their traditions who accept the facts of evolution and still believe the doctrine of "original sin." Though the book is one sided, it may be of interest to scientists and theologians who want to see connections between theology and science.

Reviewed by Jan de Koning, 20 Crispin Crescent, Willowdale, ON M2R 2V7, Canada.

Letters

On Miracles

I am not always as careful as I might be in my statements but I don't recall "expressing discomfort" with miracles or saying that I "could accept the miracle of the resurrection but not much else" (*PSCF* 51 [September 1999]: 143). I do think that many appeals to miracles, such as the notion that they are needed to explain the origin of life, are theologically unsound. What I've tried to address on the ASA listserv and in other forums[1] is not whether miracles have occurred but how they are to be understood and what they mean.

One traditional view has been that miracles are completely beyond the capacity of the natural processes with which God concurs, and must be seen purely as supernatural interventions. I believe that God works with and through all the natural processes which science understands or tries to understand, and that God's usual self-limitation to what can be done through those processes is coherent with the divine kenosis which is described in Phil. 2:5–11. In view of this, it seems to me to be worth pursuing the ideas that miracles have some continuity with ordinary natural processes. The old rabbinic speculation that miraculous phenomena of the Old Testament such as the manna were "created on the eve of [the first] Sabbath, between the suns"[2] suggests that some of what C.S. Lewis called "miracles of the old creation" might be "natural" but extremely rare phenomena whose possibility God build into creation. Though having some connection with more common phenomena (as the provision of manna and Jesus' feeding of the multitudes had with the "ordinary" work of the Creator), their rarity would mean that it would be very difficult for science ever to get a handle on them.

"Miracles of the new creation" like the resurrection are another matter precisely because they are new. Perhaps, in line with the ideas of some modern theologians and suggestions of theoretical physics,

we should think of such events as originating in the future, and thus involving some sort of time travel or signals with reversed temporal ordering.[3] Of course such a suggestion is very speculative.

It is possible that some miracles do have to be seen as simply outside the scope of the laws of physics. After all, Gödel's theorem suggests that the mathematical pattern to which those laws approximate is logically open. On the other hand, I do not think it necessary to insist that any given miracle could only have come about in a way which is completely separate from natural processes.

It is also important to discern the real theological significance of miracles. My feeling is that exploring the connections between God's miraculous works and the universe which science seeks to understand can help us to see the meaning of miracles more clearly.

Notes

[1]E.g., George L. Murphy, "Miracles – Burden of Blessing?" *Lutheran Partners* 15.5 (September/October 1999): 33–4.
[2]R. Travers Herford, ed., *Pirke Aboth* (New York: Schocken, 1962), 129–31.
[3]George L. Murphy, "What Can Physics Contribute to Eschatology?" *dialog* 38.1 (Winter 1999): 35–9.

George L. Murphy
ASA Fellow
538 Cynthia Lane
Tallmadge, OH 44278

Response to Tiscareno

Tiscareno's concern (*PSCF* 51 [September 1999]: 208) is clearly heartfelt. But is it warranted? It seems to me that he primarily wants Christians, especially in the ASA, to be nice. I have not found this to be part of the description of a believer. I know that it is a vital part of the culture of some religious groups. My folks had dealings with a member of one of them. Mom said that she had often wished that Christians could be as nice as they. But the nice was purely surface. When things did not go exactly as the member wanted, she became very nasty on the spot. Mom never again wished that the believers could be that "nice." One must also ask if Paul was nice when he chewed Peter out for compromising with the legalists, or when he called Ananias "a whited wall." Is Matthew 23 nice? Is the cleansing of the Temple nice?

In contrast, love is the first ingredient of the fruit of the Spirit. *Agape* must not be confused with liking or being likable. "Like" goes no deeper than compatible personalities, and may be even more superficial. But if I love my neighbor as myself I will become as upset over injustice done to him as I do when it's done to me. I don't have to like him for that. Nor do I have to agree with him.

Is it "wholly false that 'premillennialists ... are not concerned much with activities which would improve the world'"? They have become more concerned recently, but for a long while they opposed anything which seemed to them associated with the "social gospel." Indeed, I recently heard an elderly premillennialist asking why an organization was building an expensive structure if they believe that the Lord is soon returning.

Will civility be increased by foregoing theological commitments? Some among us remember that Luther tapped the table saying, "*Hoc est corpus meus*," which Calvin understood differently; that Arminius' views were condemned by a church council; that their fellow believers were imprisoned, chased out of Massachusetts, and sent to the galleys, massacred, or burnt at the stake. Some bear the scars of battle with usurping heretics, or of wounds from sowers of discord. Are those who for such reasons have deep commitments to be censured for stating them? Of course not, for they have the right to present their views strongly. Their statements as published seem to me polite. I have not found them indulging in personal attacks.

Finally, I must warn Tiscareno that nice lies with the individual. Unless he stands for virtually nothing, someone sometime will tell him, "That wasn't nice."

David F. Siemens, Jr.
ASA Fellow
2703 E. Kenwood Street
Mesa, AZ 85213-2384

"Evolutionism"

It was interesting to see John McIntyre's article (*PSCF* 51[Sept. 1999]: 162) in the same issue as his note celebrating the removal of the terms "unsupervised" and "impersonal" by the National Association of Biology Teachers from their definition of evolution. It is encouraging that the NABT has seen the point of McIntyre and others that such conclu-

sions about the supernatural (or lack thereof) do not logically follow from the results of natural science. However, McIntyre undermines his own point by titling his article "Evolution's Fatal Flaw." The article in fact shows no flaw in the scientific theory of evolution; the flaw is the extrapolation of the theory to produce unjustified conclusions about its meaning. By ascribing this flaw to "evolution" rather than to "evolutionism" (or perhaps "atheist misuse of evolution"), the title is guilty of the same confusion between science and metaphysical extrapolation that the article so rightly criticizes.

As McIntyre shows, the fallacious attribution of metaphysical meaning to the theory is touted by many atheist expositors of evolution, such as Richard Dawkins. Sadly, the same mistaken assumption (fundamentally, that "natural" explanations such as evolution rule out God) seems to be accepted by many Christians, including influential critics of evolution such as Phillip Johnson. When Christians accept this fatally flawed view of the meaning of evolution, they are forced to play by the atheists' rules and attack the science of evolution as though the truth of theism is at stake. I need not elaborate here on the resulting problems for our witness among the scientifically literate.

Once we recognize the flaw pointed out by McIntyre, a better way is evident. Rather than battling the *science* of evolution, Christians who are justifiably concerned that evolution is being used to promote atheism should focus on the philosophical front, opposing the erroneous Dawkins/Johnson view of the *meaning* of evolution. To that end, we should restrict our use of the word "evolution" to refer solely to the science, and use different terminology to refer to the metaphysical baggage so often fallaciously attached to the science.

Allan H. Harvey
ASA Member
1575 Bradley Drive
Boulder, CO 80303

Erratum

References 1 and 2 in "We Won" (*PSCF* [September 1999]: 144) were mistakenly interchanged. We regret any confusion this may have caused.

Editorial Staff

United States Postal Service

Statement of Ownership, Management, and Circulation

1. Publication Title	2. Publication Number	3. Filing Date
"Perspectives on Science and Christian Faith"	0 8 9 2 - 2 6 7 5	October 20, 1999
4. Issue Frequency: Quarterly	5. Number of Issues Published Annually: 4	6. Annual Subscription Price: $30.00

7. Complete Mailing Address of Known Office of Publication (Not printer) (Street, city, county, state, and ZIP+4): 55 Market Street, Ipswich, Essex County, MA 01938-0668 — Contact Person: Frances Polischuk, Telephone: 978-356-5656

8. Complete Mailing Address of Headquarters or General Business Office of Publisher (Not printer): American Scientific Affiliation, P.O. Box 668, Ipswich, MA 01938-0668

9. Full Names and Complete Mailing Addresses of Publisher, Editor, and Managing Editor (Do not leave blank)

Publisher (Name and complete mailing address): American Scientific Affiliation, P.O. Box 668, Ipswich, MA 01938-0668

Editor (Name and complete mailing address): Dr. John W. Haas, Jr., American Scientific Affiliation - P.O.Box 668, Ipswich, MA 01938-0668

Managing Editor (Name and complete mailing address): Lyn Berg, American Scientific Affiliation - P.O.Box 668, IPswich, MA 01938-0668

10. Owner (Do not leave blank. If the publication is owned by a corporation, give the name and address of the corporation immediately followed by the names and addresses of all stockholders owning or holding 1 percent or more of the total amount of stock. If not owned by a corporation, give the names and addresses of the individual owners. If owned by a partnership or other unincorporated firm, give its name and address as well as those of each individual owner. If the publication is published by a nonprofit organization, give its name and address.)

Full Name	Complete Mailing Address
American Scientific Affiliation	P.O. Box 668, Ipswich, MA 01938-0668

11. Known Bondholders, Mortgagees, and Other Security Holders Owning or Holding 1 Percent or More of Total Amount of Bonds, Mortgages, or Other Securities. If none, check box → ☒ None

Full Name	Complete Mailing Address
"None"	

12. Tax Status (For completion by nonprofit organizations authorized to mail at nonprofit rates) (Check one)
The purpose, function, and nonprofit status of this organization and the exempt status for federal income tax purposes:
☒ Has Not Changed During Preceding 12 Months
☐ Has Changed During Preceding 12 Months (Publisher must submit explanation of change with this statement)

PS Form 3526, October 1999 (See Instructions on Reverse)

13. Publication Title: "Perspectives on Science and Christian Faith"	14. Issue Date for Circulation Data Below: June 1999, Volume 51, Number 2	
15. Extent and Nature of Circulation	Average No. Copies Each Issue During Preceding 12 Months	No. Copies of Single Issue Published Nearest to Filing Date
a. Total Number of Copies (Net press run)	2590	2534
b. Paid and/or Requested Circulation (1) Paid/Requested Outside-County Mail Subscriptions Stated on Form 3541. (Include advertiser's proof and exchange copies)	2189	2149
(2) Paid In-County Subscriptions Stated on Form 3541 (Include advertiser's proof and exchange copies)	29	23
(3) Sales Through Dealers and Carriers, Street Vendors, Counter Sales, and Other Non-USPS Paid Distribution	0	0
(4) Other Classes Mailed Through the USPS	0	0
c. Total Paid and/or Requested Circulation (Sum of 15b. (1), (2),(3),and (4))	2218	2172
d. Free Distribution by Mail (Samples, complimentary, and other free) (1) Outside-County as Stated on Form 3541	235	248
(2) In-County as Stated on Form 3541	13	17
(3) Other Classes Mailed Through the USPS	0	0
e. Free Distribution Outside the Mail (Carriers or other means)	0	0
f. Total Free Distribution (Sum of 15d. and 15e.)	248	265
g. Total Distribution (Sum of 15c. and 15f)	2466	2437
h. Copies not Distributed	124	97
i. Total (Sum of 15g. and h.)	2590	2534
j. Percent Paid and/or Requested Circulation (15c. divided by 15g. times 100)	89.94%	89.13%

16. Publication of Statement of Ownership
☐ Publication required. Will be printed in the December 1999 issue of this publication. ☐ Publication not required.

17. Signature and Title of Editor, Publisher, Business Manager, or Owner: Frances C. Polischuk, Financial - Circulation Manager — Date: October 20,1999

I certify that all information furnished on this form is true and complete. I understand that anyone who furnishes false or misleading information on this form or who omits material or information requested on the form may be subject to criminal sanctions (including fines and imprisonment) and/or civil sanctions (including civil penalties).

Instructions to Publishers

1. Complete and file one copy of this form with your postmaster annually on or before October 1. Keep a copy of the completed form for your records.
2. In cases where the stockholder or security holder is a trustee, include in items 10 and 11 the name of the person or corporation for whom the trustee is acting. Also include the names and addresses of individuals who are stockholders who own or hold 1 percent or more of the total amount of bonds, mortgages, or other securities of the publishing corporation. In item 11, if none, check the box. Use blank sheets if more space is required.
3. Be sure to furnish all circulation information called for in item 15. Free circulation must be shown in items 15d, e, and f.
4. Item 15h., Copies not Distributed, must include (1) newsstand copies originally stated on Form 3541, and returned to the publisher, (2) estimated returns from news agents, and (3), copies for office use, leftovers, spoiled, and all other copies not distributed.
5. If the publication had Periodicals authorization as a general or requester publication, this Statement of Ownership, Management, and Circulation must be published; it must be printed in any issue in October or, if the publication is not published during October, the first issue printed after October.
6. In item 16, indicate the date of the issue in which this Statement of Ownership will be published.
7. Item 17 must be signed.

Failure to file or publish a statement of ownership may lead to suspension of Periodicals authorization.

PS Form 3526, October 1999 (Reverse)

HOW DO I JOIN THE ASA?

Anyone interested in the objectives of the Affiliation may have a part in the ASA.

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

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

Full-time students may join as Student Members (science majors) with voting privileges or as Student Associates (non-science majors) with no voting privileges. Spouses, who also wish to join, qualify for a redued rate. Full-time overseas missionaries are entitled to complimentary Associate membership in the ASA.

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

Membership Categories and Rates

Category	Rate
Full Member	$55
Friend of the ASA	$55
Associate Member	$55
Student Member	$20
Student Associate	$20
Spouse	$10

Subscriptions to our journal, *Perspectives on Science & Christian Faith,* are available at $30/year (individuals), $45/year (institutions) and $20/year (students). The journal comes automatically with your membership.

MEMBERSHIP/FRIEND OF ASA APPLICATION/SUBSCRIPTION FORM

(Subscribers complete items 1 & 2 only)

American Scientific Affiliation, P.O. Box 668, Ipswich, MA 01938-0668

1. Name (please print) _____ Date _____

2. Home address _____

_____ Zip _____

Office address _____

_____ Zip _____

Please leave blank any numbers you do not wish published.

Home phone _____ Office phone _____

Fax _____ e-mail _____

I would prefer ASA mailings sent to: ❑ home ❑ office

3. Sex _____

4. If married, spouse's name _____

5. Academic Preparation

Institution	Degree	Year	Major

Major field of study _____

Area of concentration within the field (2 word limit) _____

Briefly describe what your present or expected vocation is _____

_____

_____

_____

Please complete back of this form ☞

AS A MEMBER YOU RECEIVE:

Publications. As a member, you receive ASA's quarterly journal, *Perspectives on Science & Christian Faith*, and bimonthly Newsletter. The journal has become the outstanding forum for discussion of key issues at the interface of science and Christian thought. It also contains news of current trends in science and reviews of important books on science/faith issues. The Newsletter brings you news of the scientific work and Christian witness of ASA members, reports of ASA activities, and other items of current interest. It also carries notices of ASA members seeking employment and of positions open to Christians trained in science.

Books. ASA titles such as *Teaching Science in a Climate of Controversy* and the *Membership Directory* are sent to all new members when available. Other books and resources are sometimes available for purchase through the home office. We now offer the books, *God Did It, But How?* by Robert B. Fischer that suggests we separate Who? and Why? from What? and How? and *Being A Christian in Science* by Walter R. Hearn that looks at what scientists do and addresses the hard questions Christians face as scientists. We also offer the leaflet, *God and the Big Bang* by Michael Poole.

Fellowship. The spiritual and intellectual stimulation of ASA meetings is a distinctive feature of ASA membership highly valued by those who participate. An annual meeting, which usually includes three days of symposia, papers, field trips, and worship together, is held each year (since 1946) in late July or early August. For the convenience of members, the location moves across the country on a regular cycle. Local and regional meetings are held throughout the country each year. Members keep in contact with each other through the Newsletter, Internet, and at ASA get-togethers at national scientific meetings.

Church Affiliation _____

How did you learn about the ASA? _____

If you are an active overseas missionary, please give the name and address of your mission board or organization to qualify for complimentary membership.

Name _____

Street _____

City _____ State_____ Zip _____

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 ASA 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 Apostle's 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 Member, Associate Member, Student member status)

I have enclosed (Please check one):

____$55, Full Member ____ $55, Friend of the ASA ____ $55, Associate Member

____ $20, Student Member ____ $20, Student Associate ____ $10, Spouse

Credit Card #: _____ (MasterCard or VISA only)

Expiration Date: _____ Signature: _____

Please mail to: American Scientific Affiliation, P.O. Box 668, Ipswich, MA 01938-0668

Opportunities for Service. The ASA sponsors and encourages individual and group efforts to serve both the Christian community and the scientific community. Major efforts are made to clear up misunderstandings of one group by the other, but speaking and writing are not the only forms of ASA ministry. We seek opportunities to witness as a body of people with a grasp of biblical truth wherever that witness is needed.

Affiliations and Commissions. Each member is asked to choose a primary and secondary affiliation or commission from the list below. Affiliations are autonomous but usually meet in conjunction with the ASA Annual Meeting. Commissions help plan annual meetings, report to the membership through the Newsletter, and have a chair with four to five other members as a steering committee. Each of the commissions is asked to relate its discipline toward science.

a. Affiliations

Affiliation of Christian Biologists
Affiliation of Christian Engineers and Scientists in Technology
Affiliation of Christian Geologists

b. Commissions

Bioethics
Communications
Creation
Global Resources and Environment
History and Philosophy of Science
Physical Sciences
Social Sciences
Science Education

The ASA is a member of The Evangelical Council for Financial Accountability.

WHAT EXACTLY IS THE AMERICAN SCIENTIFIC AFFILIATION?

The American Scientific Affiliation (ASA) is a fellowship of men and women of science and disciplines that can relate to science who share a common fidelity to the Word of God and a commitment to integrity in the practice of science. ASA was founded in 1941 and has grown significantly since that time. The stated purposes of the ASA are "to investigate any area relating Christian faith and science" and "to make known the results of such investigations for comment and criticism by the Christian community and by the scientific community."

Science has brought about enormous changes in our world. Christians have often reacted as though science threatened the very foundations of Christian faith. ASA's unique mission is to integrate, communicate, and facilitate properly researched science and biblical theology in service to the Church and the scientific community. ASA members have confidence that such integration is not only possible but necessary to an adequate understanding of God and his creation. Our total allegiance is to our Creator. We acknowledge our debt to him for the whole natural order and for the development of science as a way of knowing that order in detail. We also acknowledge our debt to him for the Scriptures, which give us "the wisdom that leads to salvation through faith in Jesus Christ." We believe that honest and open study of God's dual revelation, in nature and in the Bible, must eventually lead to understanding of its inherent harmony.

The ASA is also committed to the equally important task of providing advice and direction to the Church and society in how best to use the results of science and technology while preserving the integrity of God's creation. It is the only American evangelical organization where scientists, social scientists, philosophers, and theologians can interact together and help shape Christian views of science. The vision of the ASA is to have science and theology interacting and affecting one another in a positive light.

American Scientific Affiliation
P.O. Box 668 • 55 Market Street
Ipswich, MA 01938-0668

phone: (978) 356-5656
fax: (978) 356-4375
e-mail: asa@asa3.org
website: http://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.

Local Sections

Local sections of the ASA and the CSCA have been organized to hold meetings and provide an interchange of ideas at the regional level. Membership application forms, publications, and other information may be obtained by writing to: American Scientific Affiliation, P.O. Box 668, Ipswich, MA 01938-0668 or by contacting the ASA web site at: http://www.asa3.org or Canadian Scientific & Christian Affiliation, P.O. Box 40086, 75 King St. S., Waterloo, ON, Canada N2J 4V1 or by contacting the CSCA web site at: http://www.csca.ca

Chicago–Wheaton	DC–Baltimore	Guelph, ON	Los Angeles	New York–New Jersey
Rocky Mountain	San Diego	San Francisco Bay	Southwest (AZ)	Toronto, ON

INDICES to back issues of *Perspectives on Science and Christian Faith* are published as follows:

Vol. 1–15	(1949–1963)	*Journal ASA*	15	126–132	(1963)
Vol. 16–19	(1964–1967)	*Journal ASA*	19	126–128	(1967)
Vol. 20–22	(1968–1970)	*Journal ASA*	22	157–160	(1970)
Vol. 23–25	(1971–1973)	*Journal ASA*	25	173–176	(1973)
Vol. 26–28	(1974–1976)	*Journal ASA*	28	189–192	(1976)
Vol. 29–32	(1977–1980)	*Journal ASA*	32	250–255	(1980)
Vol. 33–35	(1981–1983)	*Journal ASA*	35	252–255	(1983)
Vol. 36–38	(1984–1986)	*Journal ASA*	38	284–288	(1986)
Vol. 39–41	(1987–1989)	*PSCF*	42	65–72	(1990)
Vol. 42–44	(1990–1992)	*PSCF*	44	282–288	(1992)
Vol. 45–47	(1993–1995)	*PSCF*	47	290–296	(1995)
Vol. 48–50	(1996–1998)	*PSCF*	50	305–312	(1998)

A keyword-based on-line **subject index** is available on the ASA web site at: http://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 *Perspectives* are available in microfilm form at a nominal cost. For information write: University Microfilm Inc., 300 North Zeeb Rd., Ann Arbor, MI 48106.

"Upholding the Universe by His Word of Power" Hebrews 1:3

Volume 51, Number 4 **December 1999**