# 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

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***Perspectives on Science and Christian Faith***




**MANUSCRIPT GUIDELINES**

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# Exemplary Books

The recent surge of interest in science and religion has yielded a rich harvest of books. The reviews in this issue attest to the quality and diversity of these offerings. Here are some examples. John Brooke and Geoffrey Cantor's *Reconstructing Nature: The Engagement of Science and Religion* (1998, The 1995–96 Gifford Lectures) uses *engagement* to show how new ways of understanding the science of the past can suggest fresh approaches to the current situation. Eschewing any *master narrative* the authors offer a wide-ranging set of historical characters to illustrate the "interesting, unpredictable and extraordinarily diverse ways" that engagement occurs.

K. E. Greene-McCreight's *Ad Litteram: How Augustine, Calvin and Barth Read the Plain Sense of Genesis 1–3* (1999) illustrates the differences in which the ways these theological giants handled exegetical and hermeneutical issues undergirding scriptural passages critical to understanding science-scripture relations. Plain sense is not always plain except (perhaps) to the beholder.

*Darwinism Comes to America* (1998) is Ronald L. Numbers' latest work on evolution in North America. The focus is mainly on the period between the 1860s and the 1920s although some attention is given to the creation science and intelligent design movement. Numbers opens new ground in addressing the attitudes of the Seventh-day Adventist and Holiness Movements and in exposing some of the myths of the past.

Edward J. Larson and Darrell W. Amundsen's *A Different Death: Euthanasia & The Christian Tradition* (1998) provides a sobering historical analysis of opinions and practices related to suicide as a prelude to considering various options open to terminally ill individuals. Today the issues are complicated by life-extending technology and associated medical costs. There is much of value here for the Christian.

With this issue, the role of editor passes to Roman Miller. I am sure that he will gain the same spirit of co-operation and encouragement from reviewers, authors, and ASA staff that I have been privileged to receive in this decade. Special thanks go to Lyn Berg for her cheerful support in the day-to-day production of *PSCF* and for seeing *God Did it, But How?* to press. ♣

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### In This Issue

ASA members serve in science/technology related ministries around the world as teachers, engineers, botanists, physicians, linguists, and computer programmers. Kenneth J. Dormer and George Kinoti's paper points up the challenge of service in developing countries. They discuss the problems of technology transfer to cultures basically concerned with day-to-day survival and offer the African Institute for Scientific Research and Development (AISRED) as a model for "assisting the hungry, oppressed, and unhealthy."

In our first communication, Dennis L. Feucht turns to the late Donald M. MacKay's argument that physical determinism does not negate freedom of the will in demonstrating that "it makes explicit a *logical* limitation on determinacy as it related to self-conscious beings." Jack A. McIntyre then appeals to *logic* to argue that evolution contains a flaw that invalidates anti-theistic implications drawn from the concept. Then, Paul H. Seely exegetically demonstrates that the Creation Science appeal to Ps. 104:6–9 to support the notion of a worldwide flood is contrary to the context of the passage. Finally, Glen Morton examines the mental capabilities of foresight and planning of the fossil hominids. He concludes that hominids had the capacity to understand God's command not to eat of the fruit of the Tree of Knowledge of Good and Evil at least 1.5 million years ago.

Thomas D. Pearson's essay review of Edward O. Wilson's *Consilience: The Unity of Knowledge* leads our book reviews. We close with three letters.

# *In Memoriam*

# Irving A. Cowperthwaite (1904–1999): One of the Five Founding Fathers of ASA

Irving A. Cowperthwaite
(1904-1999)

**F. Alton Everest***
**Sole survivor of the five founders**

It is with sorrow and with great respect that we note that Irving Cowperthwaite is dead but it is with joy that he is now with the Lord he loved and served. Irving was one of the five who met in 1941 and organized the American Scientific Affiliation. While the attention of the nation was on war and preparation for war, this tiny band, each in some branch of science, had aspirations of helping the local church to understand the new language of science and especially to help young people meet the spiritual challenges to their faith that science seemed to be making.

Some of the first five fell by the wayside very soon. Irving was one who faithfully took up his responsibility and became an important early member of the ASA. He served as Secretary/Treasurer for the years 1942 and 1943 and was on the Executive Council which directed all ASA affairs for those very formative years. He was faithful in contributing to and attending all the early conventions.

*ASA Fellow*

Irving received the BS degree from Massachusetts Institute of Technology (MIT) in chemistry in 1926. About that time, Prof. D. A. MacInnes left MIT for Rockefeller Institute of Medical Research and he took Cowperthwaite with him. For the next four years, Irving was a research chemist at Rockefeller Institute in New York City while pursuing a full graduate Ph.D. program at Columbia University.

In 1937 Irving left Columbia University to become Chief Engineer and Metallurgist at Thompson Wire Company in Boston. He retired from Thompson in 1969 with an impressive list of scientific papers to his credit.

Irving in 1931 married Fae Irene Poore, a graduate student at Teachers College whom he had met at Calvary Baptist Church of New York City. An interesting twist—Will H. Houghton was pastor of Calvary at that time. It was in Dr. Houghton's Board Room at Moody Bible Institute that ASA "first saw the light of day." ♣

# News & Views

## "Where does the spiritual world fit into our description of the physical world?"

*by Robert L. Miller**
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I have a question that has been floating around in the back of my mind for a long time. I see the question hinted at frequently on the ASA listserv but no one comes right out and asks it. The question is: "Where does the spiritual world fit into our description of the physical world via relativity, quantum and evolutionary theory?" First let me define what I mean by spiritual world. I mean what the Apostle Paul describes in Eph. 6:12: "... our struggle is not against flesh and blood [the physical world], but against the rulers, against the authorities, against the powers of this dark world and against the spiritual forces of evil in the heavenly realms (the spirit world)." The Bible is replete with stories of demons and angels and encounters with God that have a physical effect in this world. The last two thousand years of church history contain hundreds of examples. (Cf. R. Douglas Geivett and Gary R. Habermas, *In Defense of Miracles: A Comprehensive Case for God's Action in History* (Downers Grove: InterVarsity Press, 1997) reviewed in *PSCF* 50:2 (1998): 149; and Don Richardson, *Eternity in Their Hearts* (Regal Books, 1981).

To take one example, consider Paul's encounter with Jesus on the road to Damascus in Acts 9. A spiritual casual agent generated light and sound and caused blindness, all physical effects in this world. I assume we cannot explain this physical event with our present laws. We could explain the light and sound, and perhaps the blindness, but not their source. That tells me that our present physical laws are incomplete, precisely because they cannot offer an explanation of the physical effect of the spiritual agent.

Robert Pennock states: "... supernatural explanations should never enter into scientific theorizing," (*PSCF* 50:3 [1998]: 206); and in excoriating Phillip Johnson for this sin, he issues this challenge to him: "Are divine interventions occurring today in particular cases? If so, which ones, and how do we check? If not, how do we know?" (p. 207). I can appreciate the utility for methodological naturalism as a practical guide for doing day-to-day science, but how does that exclude spirit? Just because our lack of imagination limits our ability to test for spirit does not mean that spirit does not exist. John Barrow comments in his book, *Theories of Everything*, (UOP [1991], 207):

> What are the things that cannot be included in the physicist's conception of "everything"? There appear to be such things, but they are more often then not excluded from the discussion on the grounds that they are not "scientific" – a response not unlike that of the infamous Master of Balliol of whom it was said that "what he doesn't know isn't knowledge."

John has written a couple of books detailing the limits to knowing via science. His most recent book is, *Impossibility: The Limits of Science and the Science of Limits* (UOP, 1998), which he closes by saying:

> Our knowledge about the Universe has an edge. Ultimately, we may even find that the fractal edge of our knowledge of the Universe defines its character more precisely than its contents: that what cannot be known is more revealing that what can.

I can remember George Murphy, on the ASA listserv, expressing discomfort with miracles. In one communication, he said that he could accept the miracle of the resurrection but not much else. More recently the exchange between Howard Van Til and Bill Dembski re-triggered the question in my mind. Howard's description of how God acts is titled a "fully-gifted creation" which includes a "robust formational economy." I take this to mean that God could have endowed his creation with the ability to create the complexity that we see without the need for periodic interventions, if he chose not to, i.e., using natural processes. Bill, on the other hand, taking a more empirical approach, says that the complexity we see requires a Designer, and, in particular, that "specified complexity" (Behe's irreducible complexity) excludes creation through strictly natural processes. Bill, however, opinions that "fully-gifted creation" may be compatible with "intelligent design," depending how you define natural processes.

My impression is that in an effort to avoid the God-of-the-gaps syndrome both authors have produced definitions of their view point, whether fully-gifted creation or intelligent design, that border on the strictly mechanical, so much so that Howard has been asked frequently how fully-gifted creation differs from deism.

*ASA Member

Is it impossible to meld the effects of the spiritual world with the physical world to produce a Theory of Everything that would be a truly complete description of the universe, or would it be considered sacrilegious to try? Or, to put it another way, is it possible to completely describe the universe without including spirit in the description? Does this throw us back to the God-of-the-gaps? Perhaps. It seems to me that part of the ASA charter is to probe for understanding where science ends and other ways of knowing kick in. But if we exclude spirit a priori how will we learn? ♣

## We Won

*John A. McIntyre**
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"Godless" evolution is dead! After seven score years of relentless Christian pressure, an authoritative scientific voice, The National Academy of Sciences, has withdrawn the claim that "evolution is an unsupervised, impersonal process."[1] Critics of Christianity can no longer assert that evolution denies the possibility of a personal God Supervising the process of evolution.

The nature of the scientific pressure on the National Academy is described in another article in this issue of *PSCF*.[2] There it is shown that the previous description of biological evolution contains a logical fallacy. By withdrawing the claim that "evolution is an unsupervised, impersonal process," the National Academy has eliminated this fallacy.

The logical fallacy used by evolutionists is the argument that there is no purpose behind evolution. This argument is a fallacy because the data of evolution are materialistic; the data are obtained with material measuring instruments. On the other hand, purpose and an agent of purpose (God) are outside the materialistic world. Thus, evidence from the materialistic world of evolution cannot logically be used to conclude that there is no God outside this materialistic world exercising purpose. It is as though Hamlet concluded that there was no Shakespeare because he could not find Shakespeare within the confines of the play.

This logical fallacy has appeared in official evolutionary literature as recently as the 1996 *Statement on Teaching Evolution* by the National Association of Biology Teachers.[3] The key phrase in their statement is:

> The diversity of life on earth is the outcome of evolution: an unsupervised, impersonal, unpredictable and natural process of temporal descent with genetic modification that is affected by natural selection, chance, historical contingencies and changing environments.

Here, the logical fallacy appears in the claim that evolution is unsupervised and impersonal. Since personal supervision lies outside the material world of evolution, evidence from materialistic evolution cannot logically be used to conclude anything about supervision from outside the materialistic world.

The above statement from the National Association of Biology Teachers is reproduced in Appendix C of the 1998 National Academy of Sciences publication referred to above, *Teaching About Evolution and the Nature of Science*. However, in Appendix C the statement has been modified by deleting the two crossed out words shown below:

> The diversity of life on earth is the outcome of evolution: an ~~unsupervised~~, ~~impersonal~~, unpredictable and natural process of temporal descent with genetic modification that is affected by natural selection, chance, historical contingencies and changing environments.

The National Academy version of the statement in Appendix C thus removes the logical fallacy previously used in the statement of the Biology Teachers.

In conclusion, the content of biological evolution is no longer officially claimed to be impersonal and unsupervised. Thus, the God of the Bible is no longer officially challenged by biological evolution. As a consequence, when opposing textbooks that continue to claim that evolution is impersonal and unsupervised,[4] Christians need only point to the National Academy of Sciences' definition of evolution that does not include this claim.[5] The removal of such textbooks from the curriculum should naturally follow. The Christian belief in a personal God who supervises the processes of creation will, then, no longer be challenged by evolution. ♣

*ASA Fellow*

## Notes

[1] J. A. McIntyre, "Evolution's Fatal Flaw," *Perspectives on Science and Christian Faith* 51 (September 1999): 162–9. This paper was presented at the 1998 Conference of Christians in Science and the American Scientific Affiliation, August 2–5.

[2] *Teaching About Evolution and the Nature of Science* (Washington, DC: National Academy Press, 1998).

[3]"Statement on Teaching Evolution," *The American Biology Teacher* 58:1 (1996).
[4]J. A. McIntyre, *Evolution's Fatal Flaw.*
[5]*Teaching About Evolution and the Nature of Science.*

## Neanderthal/Human Hybrid

*By Glenn R. Morton**
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On November 28, 1998, a chance discovery uncovered the 24,500-year-old skeleton of a child at Abrigo do Lagar Velho, Portugal. The four-year-old had been buried with a pierced shell and was covered with red ochre. The ochre was confined to the region of the body, suggesting that the body had been wrapped prior to burial.[1] When the child was examined several odd features were discovered. The child had a mixture of Neanderthal and anatomically modern human traits. Eric Trinkaus, an authority on Neanderthals, was called to examine the child. According to the report, the child's skull, mandible, and pubic proportions are those of a modern human. The ratio of femur length/tibia length and certain muscle attachments clearly display Neanderthal characteristics. The authors of the report confidently state that this child is a Neanderthal/modern human hybrid.

In an accompanying commentary, Tattersall and Schwartz claim that this is not evidence of hybridization and that the child is merely a stocky anatomically modern human. However, there are several genetic problems with such a concept. First, Neanderthals lived in glaciated Europe and adapted to the extreme cold by evolving short legs in which the crural index (ratio of tibia length divided by the femur length) was lower than most Neanderthals. Neanderthals had crural indices averaging around .79. Anatomically modern humans were hypothesized to have come out of Africa and invaded Europe and thus, were the Cro-Magnon peoples. They brought with them their heat-adapted body shapes that had crural indices much higher than those of the Neanderthals. Anatomically modern Europeans, even those from 3020,000 years ago, have an average crural index of .84.[2] The Abrigo do Lagar Velho child had a crural index of .78. Since no anatomically modern European human remains from 33,000 to 22,000 years have crural indices lower than .82, one must wonder where the child got the genetics for such Neanderthal-proportioned legs if, as Tattersall and Schwartz suggest, he was just a stocky modern human.[3] There are no known examples.

Secondly, in e-mail conversation with Trinkaus, he mentioned that the pectoralis major muscle insertion is diagnostic of Neanderthal ancestry, even in the juvenile state.[4] The Abrigo do Lagar Velho child has the Neanderthal-style pectoralis major muscle insertion yet none of the anatomically modern humans have that morphology. Once again, if this child is not a hybrid, the question must be raised as to where the child obtained the genes for this trait since modern humans did not possess it. The simplest explanation is that it is a hybrid.

Since the initial report and commentary, Trinkaus and Zilhao have bitterly attacked Tattersall and Schwartz charging them with misrepresentation of the views of others and numerous anatomical errors.[5] This is not the first time in the anthropological literature that such errors have been charged against Tattersall and Schwartz.[6]

The implications for Christian apologetics are clear. If this child is a hybrid, it means that humans were capable of interbreeding with Neanderthals and thus Neanderthals were us. This implies that they too were spiritual beings, as a possible Neanderthal religious altar suggests.[7] And if they were spiritual beings, it means that commonly accepted apologetical schemes need drastic revision. ♣

*ASA Member

### Notes

[1]Cidalia Duarte, et al., "Human skeleton from the Abrigo do Lagar Velho (Portugal) and modern human emergence in Iberia," *Proceedings of the National Academy of Sciences* Vol. 96, Issue 13 (June 22, 1999): 7604–9.
[2]David W. Frayer, "Evolution at the European Edge: Neanderthal and Upper Paleolithic Relationships," *Prehistoire Europeenne*, 2: 9–69, Figure 9, p. 68 and p. 33. For a discussion of this, see: http://www.calvin.edu/archive/asa/199906/0225.html
[3]Ian Tattersall and Jeffrey H. Schwartz, "Commentary Hominids and hybrids: The place of Neanderthals in human Evolution," *Proceedings of the National Academy of Sciences* Vol. 96, Issue 13 (June 22, 1999): 7117–9.
[4]Personal Communication, e-mail, July 6, 1999, 5:35 p.m.
[5]http://www.ipa.min-cultura.pt/docs/eventos/lapedo/lvfaq_corr.html
[6]Robert G. Franciscus, "Neanderthal Nasal Structures and Upper Respiratory Tract Specialization," *Proceedings of the National Academy of Sciences* Vol. 96, Issue 13 (June 22, 1999): 1805–9.
[7]Mark Berkowitz, "Neanderthal News," *Archaeology* (Sept./Oct. 1996): 22; and Robert G. Bednarick, "Neanderthal News," *The Artefact* 19 (1996): 104.

# Science and Development in Developing Countries

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*As we enter the next millennium, many countries in the Developing World (the South) continue to endure hardships: economical, medical, political, and spiritual. Economic and scientific development issues are hardly considered by the populace when they are hungry, oppressed, or concerned about just plain survival. Science, in western thinking, is the answer to all ills. Yet, in the South, science has its drawbacks of high cost, delayed applications, small success rate, low understanding or popularity, and limited utility. Nevertheless, how do Christians in science address the biblical admonition of "loving our neighbors as ourselves"? If developing countries in the South can benefit from scientific and technological development, what is the Christian's role? Should one impose western ways and thinking into that culture or seek humanitarian ways of benefitting such people? Should the Christian in science equate "science and technology transfer" as a "cup of water" to be given in Jesus' name? Or, as in western thinking, does everything have to be a "win-win" situation? Such are the confronting questions the African Institute for Scientific Research and Development (AISRED) is challenging scientists with as Africa struggles to emerge from the poorest of the poor into self-sustaining nations where discovery and invention can be used to assist the hungry, oppressed, and unhealthy. The scientific* modus operandi *of developed countries has had little impact on Africa. Why? The Christian mission has had little demonstrable socioeconomic impact on Africa. Why? What is our spiritual and scientific responsibility toward undeveloped countries? How can we accept this responsibility?*

## What Is Science For?

For many scientists, science is a sacred cow. However, we need to ask, "What is science for?" Let us remind ourselves, first, that modern science is the basis of the social and economic prosperity enjoyed by developed countries. Although the public is sometimes uneasy about science because it frequently raises disturbing moral questions or deep concerns about food, safety, human and animal health, or the future of the earth, western (North America and Europe) governments spend hundreds of billions of dollars annually on scientific research and development. They do so because science and technology are essential to their national economies. This fact is perhaps too obvious to need pointing out to scientists. What may be less obvious is the fact that developing countries also require modern science and technology if they are to develop their own economies in order to meet the food, health, communication, education, and other basic needs of their people.

*ASA Fellow
**ASA Member

Secondly, as every scientist knows, science is of great intellectual value. Having an understanding of the world is good in itself. Moreover, for Christians and other believers in God, science reveals the unfathomable wisdom and power of the Creator. The rudimentary state of science in the Developing World (the "South") denies the people God's great gifts of science and discovery.

We believe that Christians in science, whatever their discipline, have an obligation to share the benefits of science with those who need it most, namely the peoples of the South. David Livingstone's famous call to western Christians to take Christianity, commerce and civilization to Africa is still valid, provided we understand "civilization" to include western science and technology and recognize that partnership must replace paternalism.

Active concern for the poor and disadvantaged is not only for those who happen to be interested in social ethics. It is the responsibility of every son and daughter of the One who reveals himself in Scripture as the God who loves the poor, provides for them, and requires justice for them. In his earthly ministry, the Lord Jesus exemplified God's concern for the poor as "He went around doing good and healing" (Acts 10:38). Although we are saved by grace through faith, he links our eternal destiny to what we do or fail to do for the poor and disadvantaged (Matt. 25:31–46). This is probably because what we do, or fail to do, for the poor and disadvantaged is a measure of our love for, and identification with, the Son of Man and his concerns. God requires of his children both holiness and care for the poor and disadvantaged. James puts it this way: "Religion that God our Father accepts as pure is this: to look after orphans and widows in their distress and to keep oneself from being polluted by the world" (James 1:27). Note the order in which James puts God's two-fold requirement: holiness and care for the needy.

In this paper, we will first draw attention to the problem of poverty in the South. Secondly, we will review the status of science in developing countries. Finally, we will suggest what Christian scientists can do to spread the benefits of science to developing countries as well as to reduce the intellectual and spiritual "side-effects" of humanistic science.

## The Problem of Poverty

### Meaning of Poverty

Two thousand years ago Jesus Christ, using the parable of the rich man and poor Lazarus, taught that poverty is not only a problem of income but also of hunger, disease, destruction of human dignity, and injustice.[1] In addition, poverty is a question of obedience. In neglecting his duty to Lazarus, the rich man disobeyed the clear teaching of Moses and the Prophets. Recently experts have recognized that poverty is a multifaceted problem that includes inadequate income, food, healthcare, and education. A report by the United Nations Development Programme (UNDP) says:

> Human poverty is more than income poverty – it is the denial of choices and opportunities for living a tolerable life ... although poverty has been dramatically reduced in many parts of the world, a quarter of the world's people remain in severe poverty. In a global economy of $25 trillion, this is a scandal, reflecting shameful inequalities and inexcusable failures of national and international policy.[2]

Many will agree with a Colombian educator who says, "Poverty is criminal because it does not allow people to be people."[3]

### Devastation of Poverty

Abject poverty is widespread and growing in the South. A recent report of the World Bank states: "Poverty reduction is the most urgent task facing humanity today." It points out that although in the last twenty-five years developing countries have improved living standards, "more than 1.3 billion

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people in the Developing World still struggle to survive on less than a dollar a day, and the number continues to increase"[4] (Table 1).

Three other indicators—infant mortality, life expectancy, and adult illiteracy—also show that poverty and underdevelopment are widespread in developing countries (Table 2). Poverty, however, is also a problem in developed countries, which in 1993 had 100 million poor and 37 million jobless people. Poverty is increasing in almost every region of the world. In the last decade, it has increased very fast in Eastern Europe and in the Commonwealth of Independent States. Now poverty affects one-third of the population, with 120 million people below the poverty line of $4 per day. By the year 2000, half the people in Africa south of the Sahara will be living below the $1-per-day poverty line.[5] Probably well over 50% of the rural population do so already.

As UNDP notes:

> children are especially vulnerable—hit by malnutrition and illness just when their brains and bodies are forming. Some 160 million children are moderately or severely malnourished. Women are disproportionately poor—and too often disempowered and burdened by the strains of productive work, the birth and care of children and other household and community responsibilities ... The aged, a growing group in all regions, often live their twilight years in poverty and neglect.[6]

## Causes of Poverty in Developing Countries

If, as Christians in science, we are to contribute to the development of poor countries, we must understand the fundamental causes of poverty and underdevelopment. The causes of poverty in the South are as many as they are complex. Often it is difficult to distinguish cause from effect. As an example, backwardness in science and technology are both cause and effect of underdevelopment. Six factors are fundamental causes of poverty in developing countries and they must be addressed if these countries are to overcome poverty and underdevelopment. These are: (1) bad governance; (2) an unfair international economic system; (3) rapid population growth; (4) backwardness in science and technology; (5) low educational levels; and (6) environmental degradation.

Bad governance is unquestionably the most important single cause of socioeconomic wretchedness in most developing countries. Autocratic, corrupt, and incompetent governments have mismanaged the economy, plundered public resources, and retarded development. In many countries, autocratic rule has required huge military expenditures. In addition, it has caused political instability, displacement of large numbers of people, loss of capital, loss of investor confidence, and demoralized populations who are only concerned with survival.

Corrupt government leaders collaborate with foreign corporations and other interests to siphon off hundreds of billions of dollars from poor countries to rich countries each year. The so-called "technical co-operation" projects are a common way in which poor countries are exploited. Financed by foreign loans and tied with strings attached, such projects provide the huge salaries and other expenses of mandatory foreign experts. These costs may take as much as 75% of the project funds, including bribes for government officials and politicians.[7] Whether the projects succeed or fail—and they often fail—the country must repay the loan plus interest. Consequently, development does not occur and developing countries are saddled with crippling foreign debts.

In 1995, foreign debts amounted to about $226.5 billion for Africa, $404.5 billion for East Asia and the Pacific, $156.8 billion for South Asia, $216 billion for the Middle East and North Africa, and $636.6 billion for Latin America and the Caribbean.[8] The enormity of these debts becomes clear when one considers them as a percentage of the debtor's gross national product (GNP). The percentages were: Africa, 81.3;

*George Kinoti was educated at Makerere University College, Uganda, where he studied zoology and chemistry and at the London School of Hygiene and Tropical Medicine, University of London obtaining a Ph.D. in 1966. He taught at Makerere University in 1967–68 before moving to the University of Nairobi, Kenya. He served as Chairman of the Department of Zoology (1975–86) and Dean of the Faculty of Science (1980–83). He has extensive research experience in schistosomiasis and with research students has also worked on trypanosomiasis, malaria, leishmaniasis and hydatid disease. He has been a member of several national and international boards.*

East Asia and the Pacific, 32.9; South Asia, 30.5; the Middle East and North Africa, 37.3; and Latin America and the Caribbean, 41.0. The debts have grown dramatically over the last two decades and now exceed or are close to the total export earnings of these regions. For Africa, external debt in 1995 amounted to 241.7% of the exports of goods and service; for East Asia and the Pacific, 98.3%; for South Asia, 218.7%; for the Middle East and North Africa, 133.4%; and for Latin America and the Caribbean, 212%.

*Not many realize that foreign "aid" often benefits the "donor" countries much more than the "recipient" nations.*

Who is responsible for bad government in developing countries? While national leaders must take the largest share of the blame, the North (developed countries tending to be in the northern latitudes) has played an important role in the misrule of many developing countries. For political, strategic, or economic reasons, northern nations have played a key role in creating and then perpetuating oppressive and corrupt governments that have impoverished these same countries. A classic example was the regime of Mobutu Sese Seko in Zaire (now the Democratic Republic of Congo), a country with enormous natural resources, but currently one of the poorest and least developed in the world. It is well known that Mobutu's oppressive and exploitative rule that spanned thirty years depended on the support of the United States, Belgium, and France. Government officials and politicians have been partners with northern corporations and governments in large-scale corruption, or "Grand Corruption" as one author calls it.[9] To win government contracts northern companies paid bribes to national officials and politicians, some of whom reportedly demanded as much as 20% of the project funds. It is well known that northern governments, except the USA, either condone or encourage such bribery by allowing tax deductions for money used corruptly. An encouraging step was taken by the Organization for Economic Cooperation and Development (OECD) members and five other countries when they signed an agreement to outlaw bribery of foreign officials. Implementation of the agreement has not yet occurred.

The international economic system operates on the basis of unequal exchange between the North and the South (developing countries tending to be in the southern latitudes). Based on the theory of comparative cost advantage, this system was created by European powers to obtain raw materials in exchange for manufactured goods. The North continues to determine both the contents and the terms of the exchanges.

Trade barriers and control of capital goods, technology, and finance enable the North to control the international economic system in its favor. The result is net transfers of resources from the poor South to the rich North. An example was the net transfer to the West of $163 billion in debt-related payments in the period 1984–88.[10] The annual net transfers amount to hundreds of billions of dollars. The Human Development Report states:

> Global market restrictions and unequal partnership cost the developing countries about $500 billion—20% of the GNP ... If this $500 billion were available to developing countries and well used it could have a major impact on the reduction of poverty.[11]

It should be pointed out that ruling elites in developing countries are major beneficiaries of the unjust international transfers and readily collaborate with foreign interests in exploiting their countries. Not many realize that foreign "aid" often benefits the "donor" countries much more than the "recipient" nations. An example is the United Kingdom's official aid policy of making a 40% profit through trade.[12] Hancock in his book, *Lords of Poverty*, explains how international aid is used to exploit poor countries.[13]

The third major problem is rapid population growth. In many developing countries, the populations have grown rapidly since the end of World War II. This is especially true of Africa, the Middle East, and Latin America. This results in declines in the per capita GNP, Gross Domestic Product (GDP) and food production, increasing unemployment, and disintegration of social services. Moreover, rapidly growing demands make it difficult for the governments to devote sufficient resources to development and maintenance of developments already achieved. According to World Bank, between 1980 and 1990, the average annual population growth rate in Africa was 3.0% whereas the GDP growth rate was 1.7%. In 1990–1995, growth rates for the population and GDP were 2.6% and 1.4%, respectively. Interestingly, the rapid population increase over the last fifty years seems to have resulted from improved health, education, and living conditions in the South that reduced infant and childhood mortality rates and increased fertility.

Consensus seems to be building that the way to reduce population growth to manageable levels is to lower birth rates by improving the quality of life of the people. This requires better healthcare, universal primary education (particularly for girls), improved incomes, and provision of social security. Human development will not only reduce population growth, but it will also equip people for productive roles in community and national development. Many now recognize that this approach is more effective than the more direct population control methods attempted by the North in poor countries. It is also the optimal ethical approach to a complex personal, family, and community matter. Aggressive promotion of contraceptives often hurts the moral values and cultural sensitivities of people and leaves them wondering about the motives of contraceptive promoters.

*... the way to reduce population growth to manageable levels is to lower birth rates by improving the quality of life of the people.*

Fourthly, low levels of education are a major hindrance to development. In many developing countries, adult illiteracy is widespread, primary school enrollments are low, only a small percentage of the age group attend secondary school, and only a tiny percentage receive tertiary education. Also, education standards are generally low. Naturally, low levels of education are inextricably related to backwardness in science and technology. In the modern world, education, science, and technology are absolutely essential both to socioeconomic development and to the provision of basic services, such as healthcare, telecommunications, and transport. No nation can develop or adequately provide such services without sufficient capacity for science and technology.

Finally, environmental and natural resource degradations are widespread in developing countries. Poverty is the main cause of these degradations, although ignorance and greed are also important factors. Demand for fuel wood (by far the most important source of energy) and building materials, overgrazing, and cultivation in marginal lands have caused extensive damage. Rapid growth of urban populations lead to crowding, poor sanitation, pollution of water supplies, and disease. Poverty and environmental degradation form an ever-widening vicious circle.

## The State of Science in Developing Countries

Although science and technology are essential to socioeconomic development, they hardly appear in discussions of development in developing countries. Certainly many northern Christians do not seem to realize that if the South is to overcome poverty and dependence on the North, they must acquire adequate capacity for science and technology. The development of science and technology in the South hardly features in the development agendas of the World Bank, the International Monetary Fund, and northern governmental agencies. So long as science and technology remain undeveloped in developing countries, those countries will remain underdeveloped.

For decades there have been discussions about helping poor countries develop capacities for science and technology, but little concrete action has been taken. Instead, leading northern nations have built up their own research and development (R&D) capacities in such important areas as tropical agriculture and tropical medicine (which they continue to control). Thus, they continue selling goods and services to poor countries.

A review of the status of world science reveals enormous inequalities between the developed and underdeveloped countries. A useful indicator of the status of science and technology in a country is the expenditure on R&D. Table 3 shows R&D expenditures in developed and developing regions. As the Director-General of UNESCO notes:

> Despite the almost universal acceptance that scientific knowledge and capacity are pre-requisites for socioeconomic development, it is clear that for many countries, governmental investment is not adequate to build or maintain a healthy, productive research community capable of contributing to national progress.[14]

A similar picture emerges when we consider the number of national scientists and engineers engaged in R&D, another useful indicator of the state of science and technology in an economy. According to the 1996 World Science Report, in 1992 the USA had 949,300 scientists and engineers engaged in R&D, that is 3.7 R&D scientists and engineers per 1000 of the population while Africa had 0.4 (Table 4).

Finally, let us consider technological production as measured by the number of patents issued. As Table 5 shows, developing countries produce virtually no intellectual property. This is also true of Cen-

tral and Eastern Europe and the Commonwealth of Independent States.

Although developing countries have made considerable progress in the training of scientists and engineers over the last three or four decades, their numbers are still very small. The levels of science education are very low due to inadequate facilities, paucity of properly trained science teachers, and lack of equipment, books, and other resources essential to an effective science education.

It is sometimes argued that the South does not need to develop their own technologies because they can import what they require. Forty years ago, many industries, based on the theory of import substitution, were set up in the South as a shortcut to modernization. It is now generally agreed that the experiment was a failure. Most developing countries lack the capacity to select, use, or adapt imported technologies. Secondly, most of the world's technology is owned by developed countries for whom profit is the motivation, and developing countries cannot afford to purchase goods in the amounts they need in order to develop and offer essential services.

## What Christians in Science Can Do

Christians who, in obedience to our Lord, desire to offer the "cup of water" (cup of science) to other Christians in the South can do any number of things. We would like to suggest three items for action: (1) interact with scientists; (2) oppose misuse of science and technology; and (3) promote science education.

**Purposefully interact with scientists in developing countries.** Interactions can take the form of letters or e-mail communications that stimulate, encourage, or provide new scientific insights so as to engage others in dialogue, questioning, or creative thinking. Such stimulation, like sending a state-of-the-art publication, gives encouragement to a scientist or teacher. Communications can lead to joint authorship, project collaborations, grant funding, and spiritual relationships that are both present and eternal.

The American Scientific Affiliation (ASA) and the African Institute for Scientific Research and Development (AISRED) interactions have demonstrated science and technology exchange. ASA and AISRED first began to communicate and later collaborate, knowing that applied science can impact on the spiritual, physical, and economic health of Africa. Collaborative experiments, publications, funded grants, and scientific and spiritual friendships have resulted. As this relationship continues to mature, it is becoming a model for Christians in science who seek to form partnerships and combine talents for the good of humankind.

Consider the western Christian in science who is immersed in the greatest technological explosion the world has ever known. Why aren't more of us who embrace the Judeo-Christian ethic demonstrating unconditional giving of science, technology, and teaching to those in scientific poverty? Even the ASA-AISRED model is weakly viable, partially because the same pressures exist on Christians as on non-Christians in science: publish or perish and get grants to bring in indirect funds to departments. To those ends, collaborations with the South and sharing of research budgets is often frowned upon by western, bottom-line administrators, peer review committees, and departmental chairpersons. Promotion and tenure often are dependent upon the amount of money brought into one's department from grant indirect costs, rather than the excellence of teaching, research, and service to one's profession. Consequently, scientist-educators may spend three months of a year writing local grant applications simply for job security. Thus, the joy of investigation diminishes. Attitudes become tainted by ownership "rights" and privacy of ideas rather than extension and sharing with others. Yet when we do have the privilege of God-given discovery, enthusiasm abounds and we can proclaim as did Samuel F. B. Morse when he discovered telegraphy/telephonics: "What hath God wrought!" Such proclamations could be shared as that "cup of science."

There are shortcomings in well-intentioned humanitarianism, even that performed in the name of Christ. Sometimes Christians in the West seek to influence another culture with an "our-way-is-best" or "instant-fix" mentality when, in fact, cultural change can do more harm than good. Additionally, creeping forces of secular humanism can influence humanitarian efforts, inadvertently harming the South. Productive North-South exchanges between Christians in science can be confounded by our own misperceptions of Christ's teachings or by hindrances from our universities, governments, and companies. For example, a contemporary threat to open exchange of scientific ideas and technology is the pursuit of intellectual property for financial gain, as seen in the recent explosion of molecular/genetic patents. Secular viewpoints of the U.S. and European Union on intellectual property, technology transfer, and scientific exchange with developing countries are also colored by politics, business

and trade attitudes and regulations, political ideologies, and religious convictions of their people. So, the West's attitude in intellectual transfers to the South varies greatly, from the purest form of giving—Christ's teaching of agape love that expects nothing in return, to the worst form of "giving"—expecting a greater return for the original "investment." Sometimes Christians today are more concerned about our "rights" than in doing what is right. This latter attitude can adversely affect our willingness to share that "cup of science."

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Another reason we generally tend to give less of ourselves (and less through the church) to directly counteract poverty is because we often have relegated bureaucrats to take care of giving for us. Consider the secular "entitlement" programs in the U.S., formerly known as "welfare" for poor and hungry people. German economist Wilhelm Ropke wrote:

> To expand the welfare state is not only easy ... it is for all of us the most ordinary temptation to gain ... a reputation for generosity and kindness. The welfare state is the favorite playground of a cheap sort of moralism that only thoughtlessness shields from exposure. Cheap moralism is anything but moral.[15]

Even the church sometimes allows programs or bureaucrats to handle all the poverty-related unpleasant tasks for us. But the size of a nation's budget is by no means an indicator of Christian compassion. To imagine that such shallow and self-gratifying efforts can eliminate poverty is shameless hubris, not charity and grace. Christians in science are in a position to avoid this temptation and have the unique opportunity to show that real prosperity is created from within, not *by* governments but *with* governments. Prosperity needs to be both created and redistributed. Sharing of scientific information contributes to both processes. In sharing science with poorer colleagues, we should take personal responsibility and not merely abdicate that biblical admonition to others.

A final reason science in the North is not a greater partner with science in the South is we have acquiesced to postmodern philosophies that devalue human life and set unreasonable limits to scientific inquiry. For example, extremists in the animal "rights" movement with over $100 million annual donations in the U.S. have dampened enthusiasm and even shut down some labs.[16] Animal "rightists" harassed one prominent English researcher by sending fake bombs to Professor Colin Blakemore, a leading advocate for humane animal research. He was also assaulted on stage as he delivered a memorial lecture at London's Conway Hall and has previously had his windows smashed, his three children threatened with kidnaping, a bomb packed with needles sent to his home, and paint remover poured over his car. Many northern scientists have acquiesced to animal "rightist" demands. What message does our caving in to such philosophies convey to scientists in the South? How supportive are we on the sanctity of *human* life? Is science a friend or foe in this instance?

**Oppose and prevent misuse of science and technology.** Our second recommendation is to become intolerant of any form of bad science or abuse of science, in any country. As scientists avowing the Judeo-Christian ethic, when our profession lacks integrity, our silence is inexcusable. A conundrum in the U.S. is that while we are enjoying economic and scientific prosperity, our government seems to be concomitantly abandoning the ideals and ethics of the founding fathers, whose precepts made our country successful in the first place.[17] The benefits Americans are experiencing appear to be phase delayed from decisions made decades ago. Sadly, such abandonment of Christian precepts also is having an impact on developing countries influenced by the West, and science has been implicated.

An example of misused medical science and technology involves the definition of human life as demonstrated by the continued U.S. governmental endorsement of the *Roe vs Wade* decision that legalized abortion and President Clinton's repeated support of the heinous partial birth abortion procedure. Partial birth abortion is a third trimester abortion where the baby's head is too large to enter the birth canal so the abortionist penetrates the skull and evacuates the (living) brain. The skull collapses and the (now) dead baby is subsequently delivered. Such grossly un-Christian attitudes toward human life are even reflected in U.S. international trade relations, human rights policies, and financial aid to developing coun-

tries, where food and assistance are tied to controlling live births. Kaufman wrote:

> In February 1998, reports of a U.S.-funded campaign of forced sterilization in Peru found their way to the U.S. House International Operations and Human Rights subcommittee and the *New York Times*. [Peruvian] doctors are given sterilization quotas and rewards for sterilizing larger numbers of (mostly poor) women, and who are required to undergo tubal ligation as a condition of receiving food. David Morrison, Director of the Population Research Institute, stated that "the sterilization campaign is an outgrowth of the larger USAID [population control] program. They use the same personnel. U.S. involvement is obvious even to a casual observer, with the USAID logo displayed on billboards promoting the government's family planning program and on food bins at clinics run by PRISMA, a Peruvian non-governmental agency charged with eliciting sterilization in return for food.[18]

"There is no doubt USAID has tried to distance itself from the sterilization program, but the primary reason is because this is such an obvious violation of human rights," said Laurel MacLeod, legislative and public policy director for Concerned Women of America. Such procedures are in violation of a United Nations agreement that specifically forbids population-control quotas.[19]

At a 1997 press conference of the Population Research Institute, Kenyan obstetrician/gynecologist Dr. Stephen Karanja noted that thousands of his people die of malaria, which can be treated for a few pennies, while U.S.-funded health facilities are stocked to the roof with millions of dollars worth of pills, IUDS, Norplant and Depo-Provera. He said:

> A mother brought a child to me with pneumonia, but I had no penicillin to give the child. What I have in the stores are huge cases of contraceptives ... Mothers come to me and I am helpless. I do not believe that Americans want their taxes used to hurt other people."[20]

In Plato's Republic, citizens were divided in this way: a few were made of gold, a slightly larger number of silver, and the vast majority of lead. The last had the souls of slaves and so were properly enslaved. Only persons of gold were truly to be to be treated as ends in themselves. For Christians, however, our God, who made every child in his image, has given worth and dignity to each of them, however weak or vulnerable. Jesus taught us in Matthew 25 that what we do for the least of people, we do for him. What we do *not* do for the least, we do *not* do for him. God identifies himself with the most humble and the most vulnerable.

**Promote science education in developing countries.** The future of science in the South rests in its students of the present. Our third suggestion is to promote science education through open communication, sharing of curricula, textbooks, equipment, computer-aided learning, and other techniques.

Christian educators in science have a fundamental advantage in the teaching and mentoring of tomorrow's scientists: *the proper handling of truth.* Communication of truth, a tenet of Christianity, is pivotal for scientific exchange to take place. It is the pursuit of truths (e.g. in physics, biology, or medicine) that is the basic job description for the scientist. Furthermore, communication of scientific discoveries (natural truths) is based upon *trust*, a character quality of the Christian. Scientists must trust each other in what is being professed or published otherwise the scientific process cannot function. Knowing *supernatural* truth also has set Christians free from some of the encumbrances of science: mistrust, jealousy, dishonesty, and pride.

***Christian educators in science have a fundamental advantage in the teaching and mentoring of tomorrow's scientists:* the proper handling of truth.**

Another advantage of teaching future scientists in the context of Christianity is the belief in absolute moral truths like "lying is always wrong" and "with freedom I have responsibility." In contradistinction to Christianity, secular humanism professes there are no absolute moral truths. Philosopher Francis Schaeffer wrote: "If there is no moral absolute by which to judge the state [or culture] then the state [culture] is absolute." And, of course, the latter is not true.

As students are taught science, life principles, such as truth telling, mutual accountability, and freedom with responsibility, can be taught simultaneously. However, we must ask the question: "Can freedom with responsibility in science be effective in cultures that are devoid of personal and political freedom?" The answer is, "No." A. Hayek, 1978 Nobel Laureate, author, and one of this century's greatest defenders of free markets and the free society wrote: "Societies prosper only when individuals are free to pool their limited knowledge and to make their own decisions."[21]

Finally, Christian educators truly enjoy learning because the deeper we go into complex biological and physical relationships we get to see a bit more of God (Prov. 1:5). The love of learning, the excitement of discovery, and the willingness for delayed gratification are all character qualities of good scientists and, like faith, these are not simply taught but also are "caught."

In summary, it is the combination of personal freedom, unconditional love of our neighbors, faith in one's God-given abilities, and an applied scientific knowledge base that can lead to prosperity in developing countries. Government ideologies can help or hinder.

> Early U.S. triumphs in technological innovation sprung from the moral codes and disciplines of religious commitment and faith and not a culture of secular rationalism.[22]

> If resources alone were the key to wealth, the richest country in the world would be Russia because of its abundant supplies of oil, gas, platinum, gold, silver, aluminum, copper, timber, water and fertile soil.[23]

Other forms of totalitarian collectivism, like communism, presuppose that a human is solely a creature of society, and that heaven on earth may be achieved through more and better central planning. In this vision, there is no room for the free, responsible individual with a God-given soul. Ideal socialism truly seeks to help poor people. Unfortunately, neo-socialism can be based on a false premise of human nature, and can stifle the conditions of opportunity, creativity, and initiative that make it possible for societies to prosper.[24] Triumphs in science and technology can occur within developing countries if exploitation from without and corruption from within do not economically hinder these triumphs. Christians in science in the North can foster development in the South by sharing that "cup of water" of science and education, expecting nothing in return.

> The guiding principle in any attempt to create a world of free [peoples] must be this: a policy of freedom for the individual is the only truly progressive policy. Economic development through science and technology is dependent upon this freedom and character qualities like diligence, industriousness, prudence, reliability, fidelity, and conscientiousness. It is not material resources but all of these Godly virtues exhibited through science and business working together that constitute what we call the technology market place, that which leads to prosperous economies.[25] ♣

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Table 1. **People living on less than $1 a day in the developing world, 1993.**

| Region | Number (millions) | Percent population |
|---|---|---|
| South Asia | 514.7 | 43.1 |
| East Asia and the Pacific | 445.8 | 26.0 |
| Sub-Saharan Africa | 218.6 | 39.1 |
| Latin America and the Caribbean | 109.6 | 23.5 |
| Middle East and North Africa | 10.7 | 4.1 |
| Total | 1,229.4 | 31.8 |

[1] Excluding Peoples Republic of China, which reduced the number of poor from 109.2 million (23.2% of the population) in 1987 to 73.5 million (13.7%) in 1993.

Source: World Bank, 1996

Table 2. **Infant mortality rate, life expectancy at birth, and illiteracy in adult populations in developing world and high income countries, 1995.**

| Region | Infant Mortality (per 1,000 live births) | Life Expectancy (years) | Adult Illiteracy (%) |
|---|---|---|---|
| South Asia | 75 | 61 | 51 |
| East Asia and the Pacific | 40 | 68 | 17 |
| Sub-Saharan Africa | 92 | 52 | 45 |
| Latin American and the Caribbean | 37 | 69 | 13 |
| Middle East and North Africa | 54 | 66 | 39 |
| High Income Countries | 7 | 77 | under 5 |

Source: World Bank, 1997

Table 3. **Research and Development expenditures in developed and developing countries, 1994.**

| | R&D Expenditures ($ billions) | R&D Expenditures/GDP (%) |
|---|---|---|
| Western Europe | 131.5 | 1.8 |
| Central & Eastern Europe | 4.4 | 0.8 |
| North America | 178.1 | 2.5 |
| Commonwealth of Independent States | 11.8 | 1.0 |
| Latin America | 9.2 | 0.3 |
| Arab States | 1.9 | 0.2 |
| Sub-Saharan Africa | 2.3 | 0.3 |
| Japan and NICs[1] | 87.3 | 2.3 |
| Southeast Asia | 4.4 | 0.3 |
| China[2] | 23.3 | 0.5 |
| India and Central Asia | 10.1 | 0.6 |
| Oceania | 6.0 | 1.4 |
| World | 470.4 | 1.4 |

[1] Newly-industrialized countries: Taiwan, Republic of Korea and Singapore

[2] Including Hong Kong

Source: UNESCO, 1998

Table 4. **Scientists and engineers in Research and Development, 1992.**

| | Number (Thousands) | Number/1000 of Population |
|---|---|---|
| European Union | 740.9 | 2.0 |
| Central & Eastern Europe | 285.5 | 2.2 |
| Israel | 20.1 | 3.8 |
| USA | 949.3 | 3.7 |
| Latin America | 158.5 | 0.3 |
| North Africa | 81.6 | 0.4 |
| Middle & Near East | 117.4 | 0.3 |
| Sub-Saharan Africa | 176.8 | 0.4 |
| Japan | 511.4 | 4.1 |
| NICs | 136.7 | 1.5 |
| Peoples Republic of China | 391.1 | 0.3 |
| India | 106.0 | 0.1 |
| Australia & New Zealand | 48.5 | 2.3 |

Source: UNESCO, 1996

Table 5. **Technological output measured in patents granted in Europe and USA, 1995.**

| | European Patents (%) | US Patents (%) |
|---|---|---|
| Western Europe | 47.4 | 19.9 |
| Central & Eastern Europe | 0.4 | 0.1 |
| Commonwealth of Independant States | 0.4 | 0.1 |
| North America | 33.4 | 51.5 |
| Latin America | 0.2 | 0.2 |
| Arab States | Under 0.05 | Under 0.05 |
| Sub-Saharan Africa | 0.2 | 0.1 |
| Japan and NICs | 16.6 | 27.3 |
| China | 0.1 | 0.2 |
| India and Central Asia | Under 0.05 | Under 0.05 |
| Oceania | 1.3 | 0.6 |
| World | 100.0 | 100.0 |

Source: UNESCO, 1998

# Communications

# Determinism and the Semidecidability of a Free Choice

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Donald M. MacKay was a Scottish physicist, brain researcher, and contributor to the understanding of the relationship between science and Christian faith. He championed an argument that physical determinism does not negate freedom of the will. Just as Heisenberg's uncertainty principle reveals a basic *physical* limitation on the determinacy of the physical world, MacKay's argument has value in that it makes explicit a basic *logical* limitation on determinacy as it relates to self-conscious beings, or *agents.*

## MacKay's Argument from Free Will

MacKay argues[1] that even if we, as free-choosing agents, are subject to physically determinate prediction, free choice is nevertheless *logically* indeterminate. As usually presented, the argument makes a minimal assumption about the relationship between brain (or *cognitive mechanism*) and mind: brain and mental activities are correlates. Physical activity in the brain is related (somehow) to conscious events. He avoids assignment of causality; all that is necessary is a correspondence. From this single physical assumption, the rest of his argument is purely logical.

The argument then proceeds in an unusual way in that it involves self-referencing logic. Our minds are culturally conditioned to propositional logic. We think *in* it without thinking about it. MacKay's use of self-referencing logic[2] (such as that found in Gödel's Incompleteness Theorem) can take some getting used to. A simple example of the logical indeterminacy that arises due to self-reference is the truth of the statement: "This statement is false." If true, then it is false; but if false, then it must be true. It is not possible to conclude its truth value, which is logically *indeterminate.*

MacKay argues that for an agent, $A$, about whom a physically determinate prediction, $P_1$, is made, that $P_1$ is logically indeterminate for A. Once $A$ is offered $P_1$, $A$ is affected by $P_1$ and is no longer the (unaffected) agent described by $P_1$. Thus, $P_1$ cannot be determinate for $A$ because it fails to account for its effect on $A$. To be determinate, all effects must be accounted for.

To remedy this, a second kind of prediction, $P_2$, can be offered which takes into account the effect $P_1$ otherwise would have on $A$. But if $P_2$ does not affect $A$ when it is offered to $A$, then $A$ is not the agent assumed in $P_2$. That is, $P_2$ assumes that $A$ will be affected by it when offered, but if $A$ is not affected, then this $A$ is not the $A$ of $P_2$.

In MacKay's form of the argument, the effect is belief, the essential quality of an agent. Therefore, no prediction can exist that the agent would be both correct to believe ($P_1$) and incorrect to disbelieve ($P_2$). Which of the two predictions is true, MacKay argues, is up to the agent. MacKay thus concludes that a physically determinate prediction for the predictor (a noninteracting observer) is not inevitable for the agent to whom it is offered. In this sense, the agent is free to choose the actual outcome, though it could have been predicted deterministically by an observer who does not interact with $A$.

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MacKay's argument might appear to assume deterministic predictions and conclude free will for the agent. Instead it argues *from* free will by allowing the agent, who is assumed free to choose, to respond to the predictions. It is up to the agent to believe a prediction or not, and such an act of free will determines the truth-value of the prediction. The physical outcome depends on the choice of the agent.

## An Argument from Determinism Instead

MacKay's argument can be turned around and argued from deterministic predictions instead. Then $P$ predicts what $A$ will believe about $P$. If $A$ is physically determinate, then a truly deterministic $P$ accounts for its effect on $A$ before it is offered. $P_1$ is not complete because it fails to take its own effect on $A$ into account. And $P_2$ is not comprehensive in accounting for its effect on the agent; it only assumes the agent will believe it. But a *determinate* prediction will be comprehensive in its account of its own effect.

A fully deterministic prediction also has two cases. For case 1, $P_3$ predicts that $A$ will believe it. In this case, when presented to $A$, because $P_3$ *is* deterministic, $A$ believes it. $P_3$ is consistent in predicting $A$'s response and $A$'s belief in $P_3$ is true.

For case 2, $P_4$ predicts that $A$ will not believe $P_4$ when it is offered to $A$. $P_4$ is offered, and, because $P_4$ is deterministic, $A$ does not believe it. $A$'s belief about $P_4$ is false, but in not believing $P_4$, $A$ believes $P_4$, for that is the negation of $P_4$. For case 2, the truth-value of $P_4$ is indeterminate.

The vacuity of a prediction that only asserts whether or not the agent will believe it can be given more content by adding a conjunctive statement to it that is true: $P$ AND {true statement}. The truth-value of the compound statement still depends on $P$, though the prediction contains an additional claim. This addition, however, is not critical to the argument here.

This result is common in the logic of truth and proof. Automated theorem provers can prove true statements in finite time, given a finite database of true statements. But even for finite databases, false statements take an infinite time to disprove.[3] This *semidecidability* is also evident in the above argument *from* deterministic prediction. $P_3$ is true, but $P_4$, is logically indeterminate, and no assumption was made that $A$ had free will. Even if the ability of the agent to choose breaks down, these behaviors are also predicted. This case is irrelevant to MacKay's argument because he assumes that $A$ chooses to believe or disbelieve.

Such free-will defense rests, as does MacKay's argument, on Gödelian limitations of logic. Our understanding of physical events rests on a logic of causality that precludes self-reference. But in such cases, even deterministic predictions have limitations that allow for agency. One could then argue for the *semidecidability* of a free choice.

## Heisenberg Uncertainty and Logical Indeterminacy

Though the self-referencing aspect of the argument from determinism is similar to the arguments from quantum mechanics, MacKay rejected quantum indeterminacy as a way of accounting for free will because quantum effects are too small in scale to directly affect any known neural mechanisms, and consequently show their effect only statistically.

Heisenberg's uncertainty principle anticipates self-reference in that the measurer interacts with what is being measured, affecting the physical quantities of position or speed. In the above arguments, $P$ affects the state of mind of $A$. While this correlates with brain states of $A$, the effect is not *necessarily* accountable in terms of Heisenberg uncertainty. Others have argued that Heisenberg uncertainty fluctuations are adequate to explain the independent existence of mind.[4]

Propositional logic, the classical logic of Aristotle, is fully decidable because its universe of possible propositions is finite, and all of them can be tested for truth in finite time. The logic underlying modern physics is, at the least, first-order predicate logic, which contains universal quantifiers ("for all $x$"), where $x$ can be a variable over an unbounded range of terms. For example, a negative universal is unprovable (in finite time). Predicate logic is consequently semidecidable. In the development of physical concepts such as causality or determinism, the limitations of this logic also apply to the physical concepts it supports.

## Closure

MacKay recognized that we think and behave as though we are free; and he argued that physical determinism does not deny this basic fact of our personal experience. The kind of physical determinism that MacKay's argument allows is limited to what can be predicted about $A$ without interacting with $A$. If a more comprehensive determinism is as-

sumed instead, the result is similar in that even fully deterministic predictions are semidecidable. From this, we can conclude that either the logic we employ in our understanding of determinism is inadequate to describe the world in (at least) the case of self-conscious agents, or the world is itself limited in ways that we recognize through the logical indeterminacies in our understanding of it. In neither case can we conclude that our understanding of physical determinism invalidates our experience as free agents. ♣

## Notes

[1] For example, see *The Clockwork Image,* (London: Inter-Varsity Press), ISBN 0-87784-557-3.

[2] See Raymond Smullyan's book, *Forever Undecided: A Puzzle Guide to Gödel,* (New York: Alfred A. Knopf, Inc. 1987) for an entertaining introduction to higher-order, and increasingly self-aware, systems of logic. Another light introduction is in Douglas R. Hofstadter's *Gödel, Escher, Bach: An Eternal Golden Braid* (New York: Basic Books, Inc.).

[3] *Logic for Computer Science* by Steve Reeve and Michael Clarke (Reading, MA: Addison-Wesley, 1990), pp. 83–8 introduces the idea of semidecidability.

[4] *In The Emperor's New Mind* (New York: Penguin Books, 1989), Roger Penrose argues for quantum effects as the basis for free will.

*Correction!*

## New address for special offer to *PSCF* readers:

On pages 127–8 of the June 1999 issue, readers were offered a special price for the book, *Galileo: His Science and His Significance for the Future of Man* by Albert Di Canzio.

Unfortunately, the mailing address was incorrect. You may still purchase the book at the special price of $29.50, if you mail a check or money order to:

**ADASI Publishing Co.**
**Dept. PSCF**
**6 Dover Point Rd. Ste. B**
**Dover, NH 03320**

# Evolution's Fatal Flaw

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## Character of the Flaw

A fatal flaw lies at the heart of the theory of biological evolution. The flaw is a logical fallacy, i.e. a logical argument that appears to be conclusive.[1] It is fatal because a *logical* error in any system of knowledge destroys the logical coherence of the system. In this respect, a *logical* error is like an *arithmetical* error such as 2 + 2 = 5. If such an arithmetical error is incorporated into a calculation, conclusions of the calculation cannot be trusted. Correspondingly, with a logical fallacy incorporated into the theory of evolution, conclusions drawn from it cannot be trusted. If conclusions from the theory of evolution cannot be trusted, then the theory of evolution is worthless—indeed, a fatal flaw.

## Identification of the Flaw

So, where is this fatal flaw, this logical fallacy, in evolution? The fallacy appears in the evolutionists' understanding of evolution itself. This understanding is expressed, for example, in the popular description of evolution by George Gaylord Simpson:

> The meaning of evolution is that man is the result of a purposeless and materialistic process that did not have him in mind.[2]

Here, the logical fallacy reveals itself immediately. Evolution is said to be a purposeless and materialistic process. Indisputably, evolution is a materialistic process since materialistic instruments (electrical measurements, microscopes, chemical tests) are used to investigate evolution. But these materialistic measurements can tell us nothing about the purpose behind evolution, since "purpose" lies outside the materialistic world. Furthermore, by introducing "purpose," Simpson necessarily introduces an agent exercising purpose. Thus, Simpson draws the conclusion that there is no agent (God) exercising purpose outside the materialistic universe from information gained inside the materialistic universe. It is as though Hamlet concluded that there were no Shakespeare because he could not find Shakespeare within the confines of the play.

Of course, such an obvious logical fallacy has long been known to philosophers. Aristotle (circa 350 BC) identified this particular logical fallacy in the following Latin and English terms:

> *A dicto secundum quid ad dictum simpliciter*
> "From a statement under a condition to a statement simply, or without that condition"[3]

In modern terms, Aristotle says that if a conclusion is reached from a premise under a restrictive condition, then it is fallacious to reach the same conclusion when the condition on the premise is removed. Yet this is just what Simpson does in his description of evolution. He begins with the premise of a materialistic universe and reaches the conclusion of the absence of purpose in this universe. (He can describe evolution in the materialistic universe without using the concept of purpose.) However, Simpson then removes the restriction of a materialistic universe and proceeds to reach the conclusion of the absence of purpose outside the materialistic universe. He, thus, uses the fallacious argument of Aristotle.

## Description of the Flaw

What kind of mistake is made by committing this fallacy? This question can be answered with precision by casting the fallacy into an argument form

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that can be analyzed by the use of symbolic logic. (Symbolic logic is a systematic way to deal with logical statements just as arithmetic is a systematic way to deal with numbers.) We begin with Simpson's description of evolution:

> The meaning of evolution is that man is the result of a purposeless and materialistic process that did not have him in mind.

We then cast Simpson's description into an argument with a premise and a conclusion:

> Since evolution proceeds through a materialistic process, there is no God to provide a purpose for the process.

This argument can be analyzed through the use of symbolic logic and is found to be an invalid argument (see Appendix A). The use of Aristotle's fallacy *a dicto secundum quid ad dictum simpliciter* leads, then, to an invalid argument. Since the characteristic of an invalid argument is that its conclusion may be false, the conclusion that evolution is purposeless is worthless.

**The flaw in the description of evolution is the incorporation of an invalid argument into the description.**

## The Christian Response to the Flaw

Since a logically invalid argument must be used in order to proceed from the materialistic content of evolution to the conclusion that there is no Maker of heaven and earth who has a purpose for his creation, Christians, then, should recognize that no conclusions about purpose or design in the universe can be based on a materialistic description of the universe. Beliefs, such as those in the Apostles' Creed: "I believe in God the Father Almighty, Maker of heaven and earth," are thus secure from the conclusions of any argument based on the materialistic content of evolution.

No longer do Christians need to be concerned about the content of materialistic evolution, since conclusions about religious beliefs can be drawn from this content only through the use of a logically invalid argument. Consequently, when Christian students are told today by their George Gaylord Simpson-parroting teachers that "the meaning of evolution is that man is the result of a purposeless and materialistic process that did not have him in mind," the students should simply respond, "*a dicto secundum quid ad dictum simpliciter*." If the teachers hear these words often enough, maybe they will stop using this logical fallacy.

## The Consensus of Evolutionists and the Flaw

Simpson is not the only evolutionist to use the logical fallacy, *a dicto secundum quid ad dictum simpliciter*. For example, Jacques Monod, French Nobel Laureate; Douglas Futuyma, college textbook writer; and Richard Dawkins, author of *The Blind Watchmaker*, also use the fallacy in their descriptions of evolution:

> The ancient covenant is in pieces; man knows at last that he is alone in the universe's unfeeling immensity, out of which he emerged only by chance.[4]

> Some shrink from the conclusion that the human species was not designed, has no purpose, and is the product of mere mechanical mechanisms – but this seems to be the message of evolution.[5]

> The evidence of evolution reveals a universe without design.[6]

The logical fallacy of these arguments becomes apparent when they are rephrased as premises (under the condition) and conclusions (without the condition). Writing the word **since** before the premise and **there is** before the conclusion, the three arguments become:

> **Since** man has emerged through random processes (by chance), **there is** no God (man is alone).

> **Since** man evolved through a mechanical process, **there is** no God (designer) to give purpose to the process.

> **Since** evolution proceeds through a materialistic process, **there is** no God (designer) behind the process.

In every case, a conclusion is drawn about God (or a designer) based on a premise concerning materialistic processes. However, the absence of the designer within the materialistic universe (under the condition) cannot logically lead to a conclusion that there is no designer outside the materialistic universe (without the condition).

A consensus, then, appears to have developed among the leaders of evolution to use the logical fallacy *a dicto secundum quid ad dictum simpliciter* in their description of evolution.

**This description of evolution, incorporating the logical flaw, should thus be considered to be authoritative.**

## A Curious Phenomenon

We have witnessed the appearance of a curious phenomenon during our discussion of the logical fallacy used by the evolutionists. The phenomenon is the spectacle of the leaders of a scientific discipline repeatedly using a logical fallacy with its associated invalid argument. And, this use is always associated with the concept of purpose. In contrast, when discussing the weather, which is certainly as random as evolution in its processes, meteorologists do not feel compelled to say that the weather has no purpose. Neither do historians of the Roman Empire say that "the history of Rome is the result of a purposeless and secular process that did not have the Romans in mind." Yet, in speaking of the prerecorded history of humanity, George Gaylord Simpson says that "the evolution of man is the result of a purposeless and materialistic process that did not have him in mind." Why this fixation on purpose?

The explanation for this opposition to purpose is supplied by the evolutionists themselves. In a well-known remark, Richard Dawkins has said that evolution has made the world safe for atheists.[7] There is a compulsion, then, for such evolutionists to use evolution to attack God. And when they do this they run into the buzz saw described by St Paul:

> Where is the wise man? Where is the scholar? Where is the philosopher of this age? Has not God made foolish the wisdom of the world? (1 Corin. 1:20).

This foolishness of the world when challenging God has been exhibited repeatedly throughout history. At the beginning of the Enlightenment, when the intelligentsia in France were beginning to abandon their religious beliefs, the great physicist Blaise Pascal observed this foolishness and wrote:

> In truth, it is the glory of religion to have for enemies men so unreasonable; and their opposition to it is so little dangerous that it serves on the contrary to establish its truths.[8]

A millennium before Christ, the psalmist exulted:

> Why do the nations rage and the peoples plot in vain?
> The one enthroned in the heavens laughs; the Lord scoffs at them (Ps. 2:1,4).

Even Sophocles, without the revelation of the Bible, had a sense of the danger of opposing the supernatural when he wrote:

> Whom Zeus would destroy, he first makes mad.[9]

And finally today, we have a public demonstration of the foolishness that comes over people when they oppose God – as we observe evolutionists repeatedly using a logically invalid argument to attack the God of purpose and design.

How the mighty have fallen! Since the Scopes trial in 1927, the public has been told that the imperial science of evolution has triumphed over the Bible. Today, however, this imperial science must incorporate a logically invalid argument to attack the Bible and its purposeful God. The time has come for the public to recognize that this emperor of science has no clothes. ♣

## Notes

[1] See e.g., H. W. B. Joseph, *An Introduction to Logic* (Oxford: 1916), 566.
[2] G. G. Simpson, *The Meaning of Evolution* (New York, New American Library Mentor Book, 1953), 179.
[3] See e.g., Joseph, 589.
[4] Jacques Monod, *Chance and Necessity* (New York: Random House, 1972), 180.
[5] D. J. Futuyma, *Science on Trial: The Case for Evolution* (Pantheon, 1983), 12–3.
[6] Richard Dawkins, *The Blind Watchmaker: Why the Evidence of Evolution Reveals a Universe without Design* (New York: Norton, 1986), from the title of the book.
[7] Ibid., 6.
[8] Blaise Pascal, *Pensees* (New York: Modern Library, 1941), No. 194.
[9] Sophocles, *Antigone*.

# Appendix A

# Symbolic Logic Representation of Aristotle's fallacy:

***a dicto secundum quid ad dictum simpliciter***

"From a statement under a condition to a statement *simply*, or without that condition"

In modern terms, Aristotle says that if a conclusion is reached from a premise under a restrictive condition, then it is fallacious to reach the same conclusion when the condition on the premise is removed. To analyze this fallacy using symbolic logic, we represent the premises and conclusions of the arguments with symbols: p, q, and r. Thus,

p = premise under the restrictive condition
q = conclusion under the restrictive condition
r = premise without the restrictive condition

Now, by definition, p implies q for a premise p and a conclusion q. Thus, under the restrictive condition,

p implies q (Restrictive condition)

Aristotle's fallacy then states that the same conclusion q is reached when the restriction on the premise is removed,

r implies q (Restriction removed)

Aristotle's fallacy further asserts that the truth of the restrictive statement implies the truth of the statement with the restriction removed. Thus,

(p implies q) implies ® implies q)

In less stilted language, we can write, if p implies q, then r implies q. Summarizing,

Symbolic Logic Expression for *a dicto secundum quid ad dictum simpliciter* is
*if p implies q, then r implies q*

With the argument form *a dicto secundum quid ad dictum simpliciter* expressed in symbolic logic terms, we can now apply the procedures of symbolic logic in Appendix B to test the validity of this argument form. Referring to Appendix B, we see that this argument form appears in Expression 10. But Expression 10 is demonstrated in Appendix B, by symbolic logic analysis, to be an *invalid* argument form. Thus, we have

*if p implies q, then r implies q* (invalid argument form)
*a dicto secundum quid ad dictum simpliciter* (invalid argument form)

# Appendix B

# Symbolic Logic

## I. Statements

A statement is a verbal formulation affirming or denying that something is the case. If we are interested in the *form* of a logic operation, and not specific statements, we use lower case variables: p, q, etc. to represent the statement.[1]

## II. Connectives

A statement connective is a word, phrase, or symbol that, when attached to one or more statements, creates a new statement.[2]

**NEGATION [ - ].** If p is true, then -p is false. The **truth table** exhibits the truth or falsity of p and -p as the truth T and falsity F of p is changed over all combinations.

| | p | -p |
|---|---|---|
| (1) | T | F |
| (2) | F | T |

[T1]

An important consequence of the **negation** operation is that if a statement is not false, it is true (line 2). This is the Principle of the Excluded Third, i.e.,

$$p = -(-p) \tag{2}$$

**EQUAL [ = ].** The statement **p EQUALS q** is written as

$$p = q \tag{3}$$

Letting p and q range over all possibilities of truth and falsity, the truth table is

| | p | q | p = q |
|---|---|---|---|
| (1) | T | T | T |
| (2) | T | F | F |
| (3) | F | T | F |
| (4) | F | F | T |

[T3]

**OR [ V ].** The V is used to replace the word OR. Thus, the statement **p OR q OR both** is written as

$$p \vee q \tag{4}$$

The truth table is

| | p | q | p V q |
|---|---|---|---|
| (1) | T | T | T |
| (2) | T | F | T |
| (3) | F | T | T |
| (4) | F | F | F |

[T4]

**AND [ • ].** The dot is used to replace the word, AND. Thus, the statement **p AND q** is written as

$$p \bullet q \tag{5}$$

The **truth table** exhibits the truth or falsity of p • q as the truth T and falsity F of p and q are changed over all combinations.

| | p | q | p • q | |
|---|---|---|---|---|
| (1) | T | T | T | |
| (2) | T | F | F | [T5] |
| (3) | F | T | F | |
| (4) | F | F | F | |

The truth table shows the AND character of p • q. If both p and q are true, then p • q is true. If p and q are not both true then p • q is false.

**IMPLICATION [ → ].** The statement

$$p \rightarrow q \tag{6}$$

is read: if p, then q; or it can be read: p implies q. The truth table is:

| | p | q | p → q | |
|---|---|---|---|---|
| (1) | T | T | T | |
| (2) | T | F | F | [T6] |
| (3) | F | T | T | |
| (4) | F | F | T | |

The first two lines of the truth table are transparent. In the first line, if p is true, and q is true, then p implies q and p → q is true. In the second line, if p is true and q is false, then p does not imply q and p → q is false. In the third and fourth lines, however, p is false. But, the implication restricts q only when p is true. Thus, when p is false, it is not false for q to be either true or false. Thus, since the implication is not false, the implication is true (Eq. 2) and we have the third and fourth lines of the truth table.

## III. Tautologies

A tautology is a compound statement that is "necessarily true," i.e. it is true under all possible combinations of truth values for its component statements.[3] An example of a tautology is p V -p where, for example, p = "it is raining" so that p V -p = "it is raining or it is not raining." Clearly, this compound statement is always true as can be demonstrated by a truth table:

| | p | -p | p V -p [T4] | |
|---|---|---|---|---|
| (1) | T | F | T | |
| (2) | F | T | T | [T7] |

## IV. Logical Argument Forms

In an argument, some statement or statements (the premise or premises) provides evidence for the truth of some other statement (the conclusion).[4]

**Valid argument forms.** Validity concerns only the form of an argument, not its content. A valid argument is such that the conclusion necessarily follows from (is logically implied by) the premises. To say that an argument is valid is to say that if the premises are true, then the conclusion must also be true. Such an argument is said to **instantiate** (that is, be an instance of) a valid argument form.[5]

**Testing for the validity of an argument form.** From the definition of a valid argument above, the validity of an argument form can be demonstrated by showing that the conclusion necessarily follows from the premise(s). Using the implication logic symbol, →, a valid argument form is defined by the Validity Condition:

*Premise of the argument form* → *Conclusion of the argument form* is a tautology. (7)

The demonstration of the validity of an argument is achieved, then, by using truth tables to show that, for all possible true or false component statements in the argument, the Validity Condition (7) is true.[6]

## V. Testing for the validity of several useful argument forms.

We now test for the validity of several useful argument forms:

### (1) If p implies q, and p is the case, then q is the case (*Modus Ponens*).

The premise P is: $P = [p \rightarrow q] \cdot p$

while the Conclusion C is: $C = q$

We now use a truth table to test whether the Validity Condition (7) above is always true for this Premise and Conclusion, i.e. whether $P \rightarrow C$.

| | C | | | P | $P \rightarrow C$ | |
|---|---|---|---|---|---|---|
| | p | q | $p \rightarrow q$ [T6] | $[p \rightarrow q] \cdot p$ [T5] | [T6] | |
| (1) | T | T | T | T | T | |
| (2) | T | F | F | F | T | [T8] |
| (3) | F | T | T | F | T | |
| (4) | F | F | T | F | T | |

The last column in the truth table shows that $P \rightarrow C$ is always true. Thus, the argument form is valid:

*If p implies q, and p is the case, then q is the case (valid)* (8)

### (2) If p implies q, and q is the case, then p is the case.

The Premise P is: $P = [p \rightarrow q] \cdot q$

while the Conclusion C is: $C = p$

The argument will again be tested for its validity with a truth table to show whether it is always true that $P \rightarrow C$.

| | C | | | P | $P \rightarrow C$ | |
|---|---|---|---|---|---|---|
| | p | q | $p \rightarrow q$ [T6] | $[p \rightarrow q] \cdot q$ [T5] | [T6] | |
| (1) | T | T | T | T | T | |
| (2) | T | F | F | F | T | [T9] |
| (3) | F | T | T | T | F | |
| (4) | F | F | T | F | T | |

The truth table shows that P → C is not always true. In particular, the argument is invalid when p is false and q is true (line 3). Thus,

*If p implies q, and q is the case, then p is the case* *(invalid)* (9)

Note the asymmetry in the **implication** operation. If the premise p is the case, then the conclusion q is also the case (Eq. 8). However, if the conclusion q is the case, then the premise p is undefined (Eq. 9). This situation is easily understood by means of an example. Consider the specific argument, corresponding to the logical argument in Eq. 8:

*If it is raining, then I will stay at home. But, it is raining. Therefore, I will stay at home.*

Here, p = "it is raining," q = "I will stay at home," and p is the case. Clearly, the argument is valid. Now, consider the same specific argument, corresponding to the logical argument in Eq. 9:

*If it is raining, then I will stay at home. But, I am staying at home. Therefore, it is raining.*

Again, p = "it is raining" and q = "I will stay at home." But this time q is the case. Clearly, the argument is invalid. My staying at home has nothing to do with whether it is raining or not.

**(3) If p → q, then r → q.**

Here, the Premise P is: P = p → q

while the Conclusion C is: C = r → q

We now test the argument form for its validity with a truth table to determine whether it is always true that P → C.

| | p | q | r | P<br>p → q [T6] | C<br>r → q [T6] | P → C<br>[T6] | |
|---|---|---|---|---|---|---|---|
| (1) | T | T | T | T | T | T | |
| (2) | T | F | T | F | F | T | [T10] |
| (3) | F | T | T | T | T | T | |
| (4) | F | F | T | T | F | F | |
| (5) | T | T | F | T | T | T | |
| (6) | T | F | F | F | T | T | |
| (7) | F | T | F | T | T | T | |
| (8) | F | F | F | T | T | T | |

The truth table shows that P → C is not always true. Therefore, the argument form is invalid.

*If p implies q, then r implies q* *(invalid)* (10)

## References

[1] See W. H. Halverson, *A Concise Logic* (New York, Random House, 1984), 4, 155-7.
[2] Ibid., 157-65.
[3] Ibid., 175.
[4] Ibid., 5.
[5] Ibid., 110.
[6] Ibid., 185.

# Creation Science Takes Psalm 104:6–9 Out of Context

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Creation science theory interprets Noah's flood as a global event. One of the many facts which falsifies that interpretation is that there is not enough water on all the earth (including the negligible amount in the atmosphere) to cover "all the high mountains" (Gen. 7:19) on the globe. To cover all the high mountains on the globe would take eight times more water than now exists on earth and in the atmosphere.[1]

One might suppose that creation science theorists would simply have God create more water for the Flood and then just as miraculously have it disappear after the Flood. They rightfully reject this solution, however, because in the Bible the water of the Flood comes only from natural sources (rain and the waters from above and below [Gen. 7:4, 11, 12]); and after the Flood it does not disappear instantly and supernaturally but rather subsides very slowly over months via the natural processes of evaporation and running off (Gen. 8:1–3).

By accepting the biblical account in Gen. 8:1–3, however, and thus restricting the water of Noah's flood to that which presently exists on earth—preeminently in the oceans, creation science theorists are saddled with the problem of there not being enough water to cover "all the high mountains" (Gen. 7:19) on the globe. For even if all the ocean beds were raised to present sea level and all of the world's ocean water was thus thrust up and over the land, it would only reach a depth of c. two miles, c. 12,000 feet.[2] That would leave Mt. Ararat, which is c. 17,000 feet high, only about two-thirds covered; Mt. Everest, which is c. 29,000 feet high, only about one-third covered; and numerous other mountains on earth likewise only partially covered. All of the mountains of the globe would not even begin to have fifteen cubits of water above their tops as specified by Gen. 7:20. Also, there is no good reason to suppose that all of the earth's ocean beds were raised to present sea level during Noah's flood.

This lack of sufficient water to cover all the mountains of the earth, as Gen. 7:20 requires (when "earth" is interpreted globally), falsifies the theory that Gen. 6–8 is speaking of a *global* flood. But, creation science theorists, not realizing they are unconsciously reading modern science's concept of a global earth into Gen. 6–8,[3] mistakenly identify their eisegetical interpretation with God's revelation.

So, although they acknowledge there is not enough water on earth to cover all the mountains of the globe as they exist today,[4] creation science theorists attempt to save their misinterpretation by reducing the height of the mountains at the time of Noah's flood to 12,000 feet or less. John Whitcomb believes they were probably only 6,000–7,000 feet high (a height apparently chosen because some creation scientists believe that all of the water in the oceans would only cover the earth to a depth of about 7,500 feet). The mountains, according to the dominant creation science theory, only grew to their present heights during the latter part of Noah's flood.[5]

This solution is rationally plausible, but there is no scientific evidence which even suggests that all of the mountains of earth were less than 12,000 feet high at the time of Noah's flood. Geologists, including the majority of professing Christian geologists, believe the mountains at the time of Noah's flood (say 2,500–7,000 BC) were essentially the same

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height they are today.[6] Not even the scientists in the Creation Research Society are able to provide scientific evidence of any kind to show that mountains at today's heights did not exist at the time of Noah's flood, but rose to their present heights only at the end of the Flood.

In fact, the creation science belief that the mountains only rose to their present heights and the ocean beds fell to their present depths during Noah's flood is so contrary to the laws of physics that even scientists within the Creation Research Society admit there is no way this could have happened unless God suspended some of the most basic constants in physics. For example, as one of them pointed out, for the mountains of today to have been formed during Noah's flood, God would have had to have made the earth's crustal plates move one million times faster than they move today and the rocks cool as least ten thousand times faster than the laws of physics allow for.[7]

Another very capable creation scientist, seeing how scientifically improbable it is that the mountains rose to their present heights and the ocean beds fell to their present depths during Noah's flood, concluded that it would be easier from a scientific point of view to believe that the earth and its inhabitants were half as big as they are now; and thus the mountains at their present heights could have been flooded with the water available—with the earth and its inhabitants growing to their present size since the time of Noah's flood![8]

Another creation scientist, seeing how extraordinarily improbable it is that the mountains of earth rose to their present heights during Noah's flood, is writing a paper on "the unlikelihood of orogeny [mountain building] occurring during the Flood."[9] One or two other creation scientists who participated in the "Minisymposium on Orogeny," which was published in the *Creation Research Society Quarterly* in 1987, offered speculations as to how the mountains doubled and even tripled in size during Noah's flood; but, their speculations skirted the most serious scientific problems; and, none of the offered speculations is regarded even by their fellow creation scientists as particularly believable.

So, the creation scientists of the Creation Research Society nowhere offer scientific proof for saying that all the mountains of Noah's day were less than 12,000 feet high and only rose to their present heights during Noah's flood. This belief, therefore, rests solely upon the fact that it is logically necessary in order to save the interpretation of Gen. 6–8 as a global flood. The argument for the rising of the mountains in the latter part of the Flood is thus circular and hence logically invalid.

Whitcomb and other creation science theorists, therefore, seeing that they have neither a scientific nor a logically valid basis for saying that the mountains of earth were only 12,000 feet or less high before Noah's flood, turn to Scripture for support. They attempt to save their theory by appealing to Ps. 104:6–9 as teaching that the mountains rose to their present heights and the ocean basins fell to their present depths during Noah's flood.[10] The question is, "Does Psalm 104 really teach this?"

## Is Psalm 104:6–9 about Creation or Noah's Flood?

*You covered it with the deep as with a garment;*
*The waters stood above the mountains.*
*At your rebuke they fled;*
*At the voice of your thunder they hastened away.*
*They went up over the mountains; They went down into the valleys,*
*To the place which you founded for them.*
*You have set a boundary that they may not pass over,*
*That they may not return to cover the earth.*

Psalm 104:6–9 (NKJ)

Of the twenty-eight commentaries on Ps. 104:6–9 (ranging from the sixteenth century to the present) which I consulted, *all* of them regarded Ps. 104:6–9 as referring to the third day of creation. Some of them explicitly denied that these verses referred to Noah's flood. Three commentators, however, said that in addition to the reference to the third day of creation there is also a secondary reference to Noah's flood. No commentator saw Ps. 104:6–9 as referring solely to Noah's flood—as creation science theorists do. The basic reason commentators see Ps. 104:6–9 as a reference to the third day of creation is that v. 2a of the Psalm is an implicit reference to the first day of creation, vv. 2b and 3a are references to the second day of creation, and v. 5 which is tied literarily to vv. 6–9 is a reference to the third day of creation. So, context favors the idea that vv. 6–9 are a reference to creation, not to the Flood.

The use of the word *tehom* ("the deep") in v. 6 connects better with Gen. 1 than with the Flood account according to the commentators; but, one must grant that the phrase "above the mountains" reminds one of Gen. 7:19. Yet, neither of these wordings settles the issue because the Flood account also mentions the *tehom* (Gen. 7:11); and, the phrase "above the mountains" lacks the word "high" which is used in Gen. 7:19, leaving it so general a

phrase that it is just as applicable to Gen. 1 as to the Flood account. There is nothing in Gen. 1 which excludes the earth from having mountains today as high as they were before the earth was separated from the waters (Gen. 1:9). Also, other biblical passages associate the creation of the earth with the creation of the mountains (Prov. 8:25, 26; Ps. 90:2). Psalm 104:9 is the verse which creation science theorists really count on to connect Ps. 104:6–9 to the Flood account. As Whitcomb and Morris put it:

> that this passage [Ps. 104:6–9] refers to the Flood rather than to the initial Creation is evident from the last verse, which refers to God's promise that the world-covering flood would never again be visited upon the earth (Gen. 9:11).[11]

If one lifts vv. 6–9 out of the context of the preceding verses, one might agree that v. 9b, "the waters will not return to cover the earth," fits the promise of Gen. 9:11 better than Gen. 1:9. But, is interpreting v. 9b apart from its context a good enough reason to reject the historic interpretation of the church?

In addition to the fact that verses 2–5 place verses 6–9 in a context of creation, the action of Ps. 104:9, "setting a boundary," also fits the context of the first three days of Genesis. On day one in Genesis, light is separated from darkness: God puts a boundary between them. On day two, the waters above are separated from the waters below: God puts a boundary between them. On day three, the waters below are gathered into one place and separated from the dry land: God puts a boundary between them (which is the sand of the seashore according to Jer 5:22). Psalm 104:6–9 with its "setting a boundary" thus fits very nicely into the creation context and seems to be clearly referring to God's actions on day three.

Finally, it is quite clear from the way the waters are described in Ps. 104:7 that the reference is not to the removal of the Flood's waters from the earth. That is, in Ps. 104:7 the waters are described as rebuked by God in such a way that they "fled" ... "hastened away," in the sense of being in a hurry or alarm. The picture is one of waters rapidly running off, just as would have occurred in Gen. 1:9, 10 as the newly created earth emerged from below as a submarine rising to the surface. In contrast, Gen. 8:3 describes the removal of the waters of Noah's flood as subsiding very, very slowly, taking some seven and one-half months to get to the place where it was dry enough for Noah to get off the ark.[12] The picture of waters fleeing in panic given in Ps. 104:7 is just the opposite of the interminably slow lowering of the waters by draining and evaporation given in Gen. 8:3. We can see then that Ps. 104:6–9 fits the context of Gen. 1 much better than the context of Gen. 8.

Despite the fact that the context of Ps. 104:9 is that of creation rather than the Flood, Whitcomb and Barker each try to save it as a reference to the Flood by citing Isa. 54:9 as "a significant parallel passage." Isaiah 54:9 reads: "To me this is like the days of Noah, when I swore that the waters of Noah would never again cover the earth."

If you remove Ps. 104:9 from its context, it can look partially parallel to Isa. 54:9 in that both verses refer to water not again covering the earth. But, even removed from its context, Ps. 104:9 is significantly different from Isa. 54:9. In Isa. 54:9, God made a covenant with living beings and swore to them that the waters of Noah would never again flood the earth. In Ps. 104:9, on the other hand, there is no covenant with living beings and no oath. God simply "sets a boundary" for the inanimate waters. Isaiah 54:9 is not a true parallel to Ps. 104:9.

If one were looking for genuine parallels to Ps. 104:9, they are easily found in Prov 8:29 and Job 38:4–11. Both passages speak not only of God setting a boundary for the sea, just as Ps. 104:9 does, but also of God laying the foundation of the earth, just as Ps. 104:5 does. They are accordingly much closer parallels than Isa. 54:9; and since their context is creation, they confirm that Ps. 104:9 is a reference to creation.

This leaves the question: "What does Ps. 104:9b mean when it says the waters 'will not return to cover the earth'?" How can this be a reference to creation as the context demands when the waters did in fact return and cover the earth at the time of the Flood? The answer to this question is that v. 9b is a rhetorical statement made for the purpose of emphasizing God's power and sustaining control over nature as he keeps the sea from engulfing the land. (Cf. Jer 5:22 where the point of mentioning God's setting a boundary for the sea is to obtain respect for God.) The rhetorical statement is like the statement in Ezek. 21:5 [Hebrew 10] where in the threat against Jerusalem and the land of Judah. God says: "I the Lord have drawn my sword from its scabbard; it will not return (*shub*, same word as in Ps. 104:9b) again." This statement is even stronger than the one in Ps. 104:9b because it adds the word *'od* ("again"), thus making the "not" a virtual "never." Yet Ezek. 21:5 is just rhetorical, emphasizing God's determination to judge and to slay. It is not to be taken literally because just seven chapters later Ezekiel is prophesying the return of Israel to live in the land *in peace*

(Ezek. 28:25, 26), just the opposite of the Lord never returning his sword to his scabbard.[13]

Similarly, Ps. 104:5 says: "The earth will never be moved." If you interpret that literally as an absolute promise, you contradict Rev. 20:11. Further, since the straightforward meaning of Ps. 104:6–9 is a reference to creation, if you insist on taking the words, "they will not return to cover the earth," literally, you would have to conclude that the waters of Noah's flood must not have completely covered the earth and therefore the Flood was local.

## Does Psalm 104:8 Say that Mountains Rose?

Since the subject of verses 7, 8b and 9 is "the waters" and verses 10–13 all revolve around water, one must say that contextually the subject of v. 8a is probably "the waters." Most exegetes have understood it that way; and, the minority who understood the text to say, "the mountains rose," understood it with reference to creation—with no thought that the mountains at creation would not be as high as they are today.

Barker, unable to see that the waters are being poetically described (apparently as an army in rout[14]) rejected "water" as the subject because, he said, water going up mountains "violates the natural order of things."[15] He interpreted v. 8a as meaning that the mountains rose to their present heights in "the latter part of the flood year." The tendential nature of this interpretation is evident not only in its ascription of the verse to the Flood when virtually every other exegete in history has ascribed it to Creation; but also in Barker's self-contradiction. For he interprets the verse as describing mountains rising so fast they certainly "violate the natural order of things." The fact that his interpretation is given with an explicit reference to creation science theory strongly suggests that it is flood theory rather than the biblical context which is determining his exegesis.

## Conclusion

Nearly all exegetes throughout church history have understood Ps. 104:6–9 as referring to the third day of creation. The preceding verses, the action of "setting a boundary," the rapid retreat of the waters, and the parallel verses in Prov. 8:29 and Job 38:4–11 all testify that Ps. 104:6–9 is about Creation not the Flood. The fact that the Flood waters are described in Gen. 8:1–14 as running off very, very slowly is just the opposite of the description given in Ps. 104:7; so, we can be sure Ps. 104:6–9 is not a reference to the Flood.

Creation science theorists are departing from their own standards of following a straight forward interpretation of Scripture when they offer an interpretation of Ps. 104:6–9 which is contrary to its context and which virtually no one but themselves has ever seen there. It seems apparent the only reason they do this is because they desperately need a cover for the fact they have arbitrarily introduced a gigantic miracle *ad hoc* to save their theory from being falsified.[16] ♣

## Notes

[1] Bernard Ramm, *The Christian View of Science and Scripture* (Grand Rapids: Eerdmans, 1954), 244; Wayne Ault, "Flood" in *The Zondervan Pictorial Encyclopedia of the Bible*; M. C. Tenney and S. Barabas, eds. (Grand Rapids: Zondervan, 1975), 555, 556.

[2] John Whitcomb, *The World That Perished* (Grand Rapids: Baker, 1988) 42, 44, 56. Other creation scientists say just 1.7 miles of water (Glenn Morton, *Creation Research Society Quarterly* 24 (9/1987): 54, Frederick Filby and Byron Nelson both say 1.5 miles (*The Flood Reconsidered*, [Grand Rapids: Zondervan, 1970], 7; *The Deluge Story in Stone*, [Minneapolis: Augsburg, 1931], 23). The basic math is simple: the ocean averages c. 2.4 miles in depth and covers c. two-thirds of the earth; if it has to cover the remaining third, the depth will fall one-third to c. 1.6 miles.

[3] The concept of the "earth" in Gen 6–8 goes back ultimately to Gen 1; but, in spite of the fact that a global earth is frequently read into Gen 1 by modern readers, this interpretation is not the historico-grammatical meaning. See my paper, "The Geographical Meaning of 'earth' and 'seas' in Gen 1:10," *Westminster Theological Journal* 59 (1997): 231–55.

[4] Whitcomb, *The World*, 42, 44; Donald, DeYoung, *Weather and the Bible* (Grand Rapids: Baker, 1992), 115.

[5] John C. Whitcomb and Henry M. Morris, *The Genesis Flood*, (Philadelphia: Presbyterian and Reformed, 1961), 77; Whitcomb, *The World*, 42.

[6] Ault, "Flood," 552; Cf. Donald Boardman, "Did Noah's Flood Cover the Entire World? No" in *The Genesis Debate*; Ronald Youngblood, ed., (New York: Thomas Nelson, 1986), 210–2: 217–8.

[7] John Baumgardner, "The Imperative of Non-Stationary Natural Law in Relation to Noah's Flood," *Creation Research Society Quarterly* 27 (12/1987): 99; Cf. Davis Young, *Creation and the Flood* (Grand Rapids: Baker, 1977), 177–85.

[8] Glenn Morton, "Mountain Synthesis on an Expanding Earth," *Creation Research Society Quarterly* 24 (Sept. 1987): 125. Although Glenn Morton no longer subscribes to creation science, he was sincerely trying to justify creation science when he wrote this paper.

[9] Bernard Northrup, "Mountains, Meteorites and Plate Tectonics," *Creation Research Society Quarterly* 24 (12/1987): 125.

[10] Whitcomb and Morris, *The Genesis Flood*, 121–2, 267; Whitcomb, *The World*, 37–42; David Barker, "The Waters

of the Earth: An Exegetical Study of Psalm 104:1-9," *Grace Theological Journal* 7.1 (1986): 57-80; Mace Barker, "Evidence of a World Wide Flood from a Study of Dinosaurs," in *Proceedings of the Second International Conference on Creationism* (Pittsburgh, PA: Creation Science Fellowship, 1990), 15.

[11]Whitcomb and Morris, *The Genesis Flood*, 122; Barker says the same thing in "The Waters of the Earth," 78-9.

[12]Whitcomb and Morris, *The Genesis Flood*, 8. It should also be noted that the slow draining of the Flood waters implies that uniformitarian natural law is already in effect; hence the idea of mountains rising during this period far more rapidly than natural law allows is contrary to the tenor of the biblical account.

[13]Similarly, Prov. 30:30 speaks of the lion as "mighty before the beasts and does not retreat (*shub*) before any;" but, in fact, a lion will retreat before an elephant or a crocodile. The statement is rhetorical to glorify the lion as Ps. 104:9 is rhetorical to glorify God.

[14]Richard Clifford, "A Note on Psalm 104:5-9," *Journal of Biblical Literature* 100 (1981): 89.

[15]Barker, "The Waters of the Earth," 78.

[16]Whitcomb sees Ps. 104:6-9 as solving "one of the great problems connected with a universal flood." (Whitcomb, *The World*, 39).

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## Right of Way

*(Lk 18:9-14)*

Satisfied chose narrow way
moving well along high path
purviewing wanton from afar
cavorting, dancing in their plight
on broadway beckoning wrack ruin —
want no part of weakness street
not my concern what choice *they* make
just concentrate on number one
be super-good, try really hard
called holy-as-they-come, this road
What puzzles me about it though
is strangers smiling filing back
don't stop, inquire, just pass by
yet wonder why they can't go on —
doubtless I'll stick, never flag
*my* piety's not second rate
targetting the pearly gates
convinced *this* is the way to go
Self-reliance, that's the key
to progress sanctimoniously
of use these others in reverse
who blazed same trail ahead of me —
yet sad to see most fail to cope
once lost their stamina and hope
with goal they set unmet, reformed
resorting to a dead-end path
For *mine* is how to reach the Lord
to find Him in the bitter end
don't meet Him on the road, of course
since He's the *goal* of sanctity
far better not to bother Him —
unburden Jesus, free His hands
who's busy seeking out lost sheep
He'll credit extra those like me
who reach Him bravely on their own
run interference for the Lord
never really needing help
Who score, endure on self-power
should surely gain well-earned reward

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# Planning Ahead: Requirement for Moral Accountability

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One of the most fascinating apologetical issues concerns the place of fossil hominids in Christian theology. The command given to Adam by God, not to eat the fruit, presupposes a certain ability to understand and prepare for the future. The prohibition required an ability to see the connection between future consequences and current actions. Adam needed to be able to plan *not* to eat the fruit as a step in obtaining God's gift of life and in avoiding the alternative, death. This ability is a prerequisite for accountability before God. Adam also had to possess an ability to keep the prohibition in mind for a long period of time, remembering it before, during, and after his more mundane tasks. Keeping a long-term goal in mind while other activities are carried out requires that Adam be able to engage in a long sequence of steps leading to a particular outcome. If, like a child, he was unable to remember or maintain this long sequence of steps, then it would be difficult to hold him accountable.

Humans can remember very long sequences of steps toward a given goal; chimpanzees cannot. The longest sequence of steps engaged in by chimpanzees in the wild may be that seen in termite fishing. The sequence consists of only five steps: (1) pick a twig, (2) remove the leaves, (3) stick the twig in the termite nest, (4) remove the stick, and (5) lick the termites off the stick.

Anthropological evidence can shed light on the ability of hominids to engage in multi-step actions and actions requiring long memory. Thus, by implication, it can illuminate the time at which humankind was theoretically capable of moral accountability. Whether hominids were accountable is another question.

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Given the generally accepted understanding that Adam and Eve must be the progenitors of the entire human race and the general understanding that they had to live relatively recently (less than 100,000 years), there is a strong pressure on Christian apologists to seek solutions which disconnect anatomically modern humans from the preceding hominids. This is accomplished either via a separate creation for anatomically modern humans[1] or the insertion of the spiritual element into a pre-existing hominid, either anatomically modern[2] or an animal-like hominid. However, anthropological data clearly indicate that ancient hominids were mentally capable of planning for the future and holding important tasks in long-term memory for the past two million years. Thus, if one of the above theological positions is true, it means that the ability to understand and plan for the future are not unique to theologically-defined humankind. This communication will not discuss the archeological evidence for spirituality in fossil humans as that was covered elsewhere.[3] Rather, it will examine the mental capabilities of foresight and planning, which are prerequisites for obeying God's commands.

## Fire

One of the hallmarks of humans is their use of fire. No other animal uses or controls fire. The maintenance of fire requires an ability to plan ahead and an ability to remember a complex sequence of actions. Fire may even require language.[4] Animals simply do not possess these abilities.

Fire has two uses within primitive human cultures: to cook foods and to deter predators. Many of the plants eaten by technologically-primitive hu-

mans are toxic in the uncooked state. Yams, a food staple for many peoples, contain toxins used to immobilize monkeys, poison fish and birds, and kill head lice. Macrozamia, a cycad, must be carefully prepared to remove both a nerve toxin and an extremely powerful cancer-causing agent.[5] Yet, if cooked, the toxins are destroyed and a hearty meal can be eaten. If the fire is for the purpose of deterring predators, it must be placed at the proper location and continually stoked.

To use fire for cooking, fire users must know the sequence of steps involved in food preparation, which may be many, e.g., finding the plant and processing the material (pounding, soaking, kneading, etc.). Before the food can be cooked, however, a fire must be built. To do this, a fire builder must perform a unique sequence of steps. Prior to the invention of ceramics, there were two likely means of cooking. Vegetables could be impaled on a stick and roasted marshmallow-style. Alternatively rocks could be heated, placed in a previously prepared pit after which, the food would be placed on the rocks and covered with soil. All of these procedures must be maintained in memory while the fire users mentally calculate how long the previously collected wood will last before it is burned up, remember where the excellent sources of wood are and which woods burn best (green or dry), depart at the proper time for gathering the wood, and return before the fire goes out. They also must understand that the wood must be put on the fire and that correct distances between large logs must be maintained for optimal burning.

If fire users did not know how to make fire, they had to know and remember another sequence of steps for the maintenance of the fire. This often involved careful treatment of embers, such as wrapping them in green leaves and carrying them in special containers.

The number of sequential steps above is more than a chimpanzee can accomplish; and among animals, he is one of the best at remembering sequential steps.[6] Clearly, the use and maintenance of fire require essentially modern planning abilities. These planning abilities would also suffice for enabling the fire users to understand moral commands.

Twenty years ago, it was believed that humankind's use and control of fire began around 500,000 years ago. But starting in the 1980s, discoveries at Chesowanja, Kenya, at Swartkrans, South Africa, and other sites revealed the use of fire much earlier. Gowlett lists several of these ancient sites.[7]

| Site | Date |
|---|---|
| Vertesszollos, Hungary | 166,000–250,000 |
| Terra Amata, France | 300,000–375,000 |
| Olorgesailie, Kenya | 375,000–460,000 |
| l'Escale, France | 450,000–550,000 |
| Zhoukoudian, China | 450,000–550,000 |
| Gadeb, Ethiopia | 1,125,000–1,200,000 |
| Yuanmou, China | 1,210,000–1,300,000 |
| Karari Escarpment, Kenya | 1,375,000–1,460,000 |
| Chesowanja, Kenya | 1,375,000–1,460,000 |
| Swartkrans, South Africa | 1,600,000 |

At Chesowanja, Kenya, there is evidence, though controversial, of the control of fire in the form of a hearth, an arrangement of stones surrounding the fire which resembles those found at much later sites.[8] The clay was burnt and the mineralogical changes in the clay indicate a normal campfire temperature of 400–600° C.[9] While it is not out of the range of possibilities that the burnt material was due to a wild fire, such fires are of short duration and are unlikely to have baked the clay in the fashion seen at Chesowanja.[10]

The Swartkrans's site, however, is widely accepted as evidence of fire use. Why is this important? Because as Gowlett says:

> If the use of fire goes back to the Lower Pleistocene (over 1 million years), as seems likely, it can be argued that our ancestors had already achieved a basically human character: but this view will be hotly debated for some time to come.[11]

> Why then is there hostility to the idea of early fire among some archaeologists? One view is that fire use represents a considerable mental advance over stone tool manufacture, and that it must therefore be expected at a later stage. Holders of this opinion are unwilling to postulate the use of fire at any time earlier than is actually proven. But it seems likely that early human beings who were skilled in stone tool manufacture and use would have a similar familiarity with wood (although it is never preserved).[12]

While the wood itself is never preserved, evidence of woodworking goes back at least as far as the earliest evidence of fire. Lawrence Keeley studied the microscopic wear on stone tools from the 1.5 MYR site of Koobi Fora and concluded that the tools were used to cut wood.[13] What exactly was being

done with the wood is unknown, but fire certainly cannot be out of the question.

## Huts

Another typically human use for the wood cut by hominids one and a half million years ago illustrates their greater ability to plan than animals. They seem to have been making huts similar in form to those made by many modern hunter-gatherers. The activity of hut making requires a long sequence of steps which animals could not mimic. Hut builders must go through the multitudinous steps of making the hand-ax, whose simplest form requires at least twenty-five carefully placed blows.[14] With a mental set of plans, hut builders chop down the appropriate saplings with the previously made stone tool. Then they must gather the appropriate material for covering the frame of the hut. This type of activity is different from nest construction seen in animals in two ways: (1) humankind is not running on instinct and (2) animals do not use modified tools in their nest construction.[15]

While the earliest dated evidence of huts is controversial and most likely will remain so, the evidence is accumulating that hut-making was a common activity at this time. The earliest one was discovered by Mary Leakey at the DK site in Olduvai Gorge, dated 1.8 MYR ago.[16] She found a circular pattern of stones, twelve feet in diameter resembling what is left from modern nomadic huts. At Melka Konture, Ethiopia, the living level was strewn with tools except for a cleared area eight feet in diameter. In this region, the surface was slightly raised above the rest of the area. Once again a few stone piles remained to suggest the presence of poles.[17] Gowlett states:

> Ethiopia has a major share of early sites for, in addition to Hadar, there are other important sequences at Melka Konture, and Gadeb. Melka Konture has a number of different levels ranging from Developed Oldowan through to Late Acheulean. On one site, aged about 1.5 million years, there are indications of a cleared area, probably lying within a wind-break, and the excavator, Jean Chavaillon, suspects that fire was in use.[18]

At other, younger sites, there is proof of the construction of habitations. At Bilzingsleben, Germany, the remains of three huts were found along with paved social areas.[19] At the Neanderthal site of Grotte-du-Lazaret, a line of post holes marked the boundaries of a tent or habitation and *Homo erectus* and/or *Homo heidelbergensis*[20] were also making post holes for their habitations.[21] An abbreviated list of hut sites is shown below.

| Hominid/Site | Age BP |
|---|---|
| **Neanderthals** | |
| Arcy-sur-Cure | 40,000[22] |
| La Baume Peyrards | 80,000[23] |
| Grotte-du-Lazaret | 150,000[24] |
| ***H. Erectus/H. Heidelbergensis*** | |
| Terra Amata | 350–400,000[25] |
| Bilzingsleben, German 3 huts | 300–400,000[26] |
| ***H. erectus*** | |
| Melka Konture | 1,500,000[27] |
| Olduvai, DK1 | 1,800,000[28] |

## Transport of Stone Tools

Probably the best evidence for future planning by hominids in the time period between one and two million years is that evidenced by the distance certain tools were carried. The distance that an object is carried for use elsewhere is a measure of the temporal planning range. Today humans transport oil for weeks on end across the oceans for use elsewhere. We plan projects that take decades to complete, like the aqueduct being tunneled under New York City or the construction of a cathedral. Primitive societies do not engage in planning on this scale. Most of their planning is of a more limited temporal range, yet this is not due to an innate difference in planning abilities. It is due to the lack of opportunity to display their already existing talent.

Animals, like chimpanzees, do not plan activities more than 20–30 minutes in advance. Chimpanzees use stone pounders to open up coula and panda nuts. The maximum distance a chimpanzee has been observed carrying a stone for this purpose is about half a kilometer. Given that it takes no more than twenty minutes to walk this distance, this represents the proven length of time that chimpanzees are capable of advanced planning. Humans on the other hand can plan days ahead. Dean Falk writes:

> Of course, humans are the supreme planners. A chimpanzee can hold on-line the location of previously stored food and go for it when permitted to do so. However, Savage-Rumbaugh tells us that unlike humans, chimpanzees have difficulty attending to more than one task at a time, do not plan much ahead, and seem to have no concept of death (perhaps the ultimate in planning ahead).[29]

Over the past 1.5 million years, humankind appears to have been able to plan actions days in ad-

vance. Two hundred thousand years ago, someone in England manufactured a stone hand ax in such a way that the finished product displayed a beautifully preserved fossil on the center of the hand-ax as if it were a blazon. We know one other thing about this hand ax. The nearest source for rocks with that particular fossil was 193 km away.[30] The owner carefully managed the carrying of this object over that distance which, assuming a straight-line and a rapid walking rate of thirty km per day, gives evidence of advanced planning for at least six days. Each morning the owner had to remember to pick the object up and carry it. This is a much greater planning ability than that possessed by chimps; and these six days represent the *minimum* planning time of which the owner was capable.

Other evidence of the foresight abilities of ancient hominids comes from the 1.2 MYR old archeological site of Gadeb, Ethiopia.[31] *Homo erectus* carried a rare obsidian hand-ax at least 100 km from its nearest source to the plains of Gadeb. Once again, assuming a forced march, this implies a temporal planning range of at least four days. Why would they carry heavy rocks 100 kilometers?[32] Obsidian can be fashioned into a very sharp tool whereas the local Gadeb stones create poorer cutting edges. Given this, one can reasonably postulate a reason for *erectus* to engage in this hard work.

One final evidence of planning ahead among ancient hominids comes from the Neanderthal site at Shanidar Cave, Iraq. Some modern cultures tie the heads of infants to boards in order to shape the skull to some preconceived vision of beauty. The fashioning of the skull by head-binding is a process that takes several years of effort. Native American societies flattened the heads of free people but not their slaves. Both boards and sandbags were used to shape the crania.[33] One cannot immediately see the benefits (in perceived beauty). Neanderthals at Shanidar (50,000 years ago) engaged in head-binding and thus proved that they could plan several years ahead.[34] Tattersall notes:

> There's also other possible evidence of "modern" behavior from Shanidar. A couple of crania from the site may have been artificially deformed by binding the head when the individuals were young, a practice otherwise unknown except among modern people.[35]

## Conclusion

The demonstrable planning depth of the fossil hominids is clearly within the range of modern humans and not within the range of the chimpanzee or other nonsentient beings. Clearly hominids, as long ago as 1.5 million years ago, had the capability to have understood God's command not to eat of the fruit of the Tree of Knowledge of Good and Evil. To consider the members of the genus *Homo* as little more than bipedal animals, as some apologists have suggested, seriously underestimates their observed capabilities.[36] ♣

## Notes

[1] John Wiester, *The Genesis Connection* (Nashville: Thomas Nelson, 1983), 188; David Wilcox, "Adam, Where Are You? Changing Paradigms in Paleoanthropology" *Perspectives in Science and Christian Faith* 48:2 (1996): 88–95, 94; E. K. V. Pearce, *Who was Adam* (Walkerville, SA: S.A.L.T. Project, 1987), 4; Evan Shute, *Flaws in the Theory of Evolution* (Nutley, NJ: Craig Press, 1961), 227.

[2] Dick Fischer, *The Origin Solution* (Lima: Fairway Press, 1996), 193.

[3] Glenn R. Morton, "Dating Adam," *Perspectives in Science and Christian Faith* 51 (June 1999): 87–97; Morton, *Adam, Apes and Anthropology* (Dallas: DMD Press, 1997).

[4] Terrence Deacon *The Symbolic Species* (New York: W. W. Norton, 1997), 368-9; Derek Bickerton, *Language & Species* (Chicago: University of Chicago Press, 1990), 140–1; Victor Barnouw, *An Introduction to Anthropology: Physical Anthropology and Archaeology* Vol. 1 (Homewood, IL: The Dorsey Press, 1982), 147.

[5] Jonathan Kingdon, *Self-made Man* (New York: John Wiley, 1993), 156–7; Josephine Flood, *The Archaeology of Dreamtime* (New Haven: Yale University Press, 1989), 211. The toxins prepared from yams are not always from domesticated species. There are over six hundred species of yam, only a few have been domesticated.

[6] Monkeys and apes appear to be able to remember only six items at once. See Audrey E. Cramer and C. R. Gallistel, "Vervet Monkeys as Traveling Salesmen," *Nature* 387 (May 29, 1997): 464; Dean Falk, *Braindance* (New York: Henry Holt, 1992), 64–5; Steven Mithen, *The Prehistory of the Mind* (New York: Thames and Hudson, 1996), 78–9; A porpoise appears to be unable to remember a five-word command. See Michael C. Corballis, *The Lopsided Ape* (New York: Oxford University Press, 1991), 148.

[7] John A. J. Gowlett, *Ascent to Civilization* (New York: McGraw-Hill, Inc., 1993), 56. A recent work has cast doubt on fire at Zhoukoudian. They were unable to examine the originally excavated material since it has been lost and depended upon peripheral parts of the cave. See Steve Weiner, et al., "Evidence for the Use of Fire at Zhoukoudian, China," *Science* 281 (1998): 251–3.

[8] Glynn Isaac, "Early Hominids and Fire at Chesowanja, Kenya," *Nature* 296 (1982): 870.

[9] Gowlett, *Ascent to Civilization*, 47. See also, John Scarry, http://www.unc.edu/courses/anth100/acheulia.htm Revised: February 28, 1998.

[10] J. A. J. Gowlett, et al., "Early Archaeological Sites, Hominid Remains and Traces of Fire from Chesowanja, Kenya," *Nature* 294 (1981): 125–9.

[11] Gowlett, *Ascent to Civilization*, 57.

[12] Ibid.

[13] Kathy D. Schick and Nicholas Toth, *Making Silent Stones Speak* (New York: Simon and Schuster, 1993), 160.

[14]Bernard G. Campbell and James D. Loy, *Humankind Emerging* (New York: HarperCollins, 1996), 432.
[15]Schick and Toth, *Making Silent Stones Speak*, 53–4.
[16]Richard Leakey, "Recent Fossil finds From East Africa," in J. R. Durant, ed., *Human Origins* (Oxford: Clarendon Press, 1989), 60–1.
[17]Gowlett, *Ascent to Civilization*, 58; see also, C. R. Gibbs writes in "Black Inventors: from Africa to America Two Million Years of Invention and Innovation," http://www.erols.com/tdpedu/blkintx.htm.
[18]Gowlett, *Ascent to Civilization*, 58.
[19]D. Mania, U. Mania, and E. Vlcek, "Latest Finds of Skull Remains of *Homo erectus* from Bilzingsleben (Thruingia)," *Naturwissenschaften* 81 (1994): 123–7.
[20]Some have criticized my use of *Homo heidelbergensis* as being outdated. This taxonomical nomenclature is making a comeback among some anthropologists. See Ian Tattersall, *Becoming Human* (New York: Harcourt Brace & Co., 1998), 145–50.
[21]Brian Hayden, "The Cultural Capacities of Neandertals," *Journal of Human Evolution* 24 (1993): 113–46, 132; Bernard Campbell, *Human Evolution* (Chicago: Aldine Publishing Co., 1974), 385.
[22]Andre Leroi Gourhan, *The Hunters of Prehistory*, transl. Claire Jacobson (New York: Atheneum, 1989), 33.
[23]Leslie Freeman, "The Development of Human Culture," in Andrew Sherratt, ed., *Cambridge Encyclopedia of Archaeology* (New York: Cambridge University Press, 1980), 84–5.
[24]Paul C. Mellars, *The Neanderthal Legacy* (Princeton: University Press, 1996), 281.
[25]Richard E. Leakey, *The Making of Mankind* (New York: E. P. Dutton, 1981), 124.
[26]Mania, et al., "Latest Finds of Skull Remains," 124.
[27]Gowlett, *Ascent to Civilization*, 58.
[28]Leakey, "Recent Fossil finds From East Africa," 60–1.
[29]Dean Falk, *Braindance* (New York: Henry Holt, 1992), 64–5.
[30]K. P. Oakley, "Emergence of Higher Thought 3.0–0.2 Ma B.P," *Phil Trans. Roy. Soc. Lond B* 292: 205–11.
[31]Gowlett, *Ascent to Civilization*, 56.
[32]J. Desmond Clark and Hiro Kurashina, "An Analysis of Earlier Stone Age Bifaces from Gadeb (Locality 8E), Northern Bale Highlands, Ethiopia," *South African Archaeology Bulletin* 34 (1979): 93–109, 94–5.
[33]*Encyclopedia Britannica* Vol. IV (1982): 971.
[34]Ian Tattersall, *The Human Odyssey* (New York: Prentice-Hall, 1993), 130.
[35]Ibid.
[36]Hugh Ross, *The Fingerprint of God* (Orange, CA: Promise Publishing, 1991), 160; David L. Wilcox, "Adam, Where are You? Changing Paradigms in Paleoanthropology," *Perspectives on Science and Christian Faith* 48 (June 1996): 88–96.

# Essay Review

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*Edward O. Wilson,* Consilience: The Unity of Knowledge *(New York: Alfred A. Knopf, 1998), 298 pages, plus notes and index.*

If there is anything Edward O. Wilson is not shy of, it is self-awareness. He launches his discussion in *Consilience: The Unity of Knowledge* with a chapter on "The Ionian Enchantment," a paean to the ancient and remarkable investigations of the natural world undertaken by Thales, Anaximander, and others in the sixth century BC. What is remarkable about those pioneers was their insight about the unity of reality. Everything that exists, they concluded, was reducible to a single substance, and so there must also be a single mode of genuine knowledge: one primordial natural substance to be known, and one primordial system for understanding the world to go with it.

This is what Wilson calls "consilience," a term used to describe the unity of the sciences, grounded in a fundamental belief that "the world is orderly and can be explained by a small number of natural laws" (p. 4). Wilson readily acknowledges his awareness that he stands in a long line of natural philosophers who pledge allegiance to a radically reductionist model of inquiry and explanation, a genealogy that stretches back through the modern Enlightenment, through a pair of Bacons and the medieval Enlightenment, and ultimately to the Ionian enchanters themselves. It is a tradition that dies hard.

Indeed, I was reminded of a more recent manifestation of this reductionist heritage as I read *Consilience.* In 1963, Hans Reichenbach, a pillar of the logical positivist community, authored *The Rise of Scientific Philosophy,* a rigorous manifesto detailing a "rise" that would not be followed by a "fall." Reichenbach was convinced that the scientific methodology of positivism would ultimately lead to the truth about the natural world. And the final truth about that truth was the realization that all reality and all knowledge are fully unified.

Although stripped of the positivist penchant for linguistic and logical analysis, *Consilience* bears a striking—and eerie—resemblance to *The Rise of Scientific Philosophy.* Reichenbach does not hesitate to reach into the realms of social theory and ethics as natural (and logical) extensions of scientific knowledge. Neither does Wilson. Every generation, it seems, is prone to produce a scientific synthesizer, a descendant of the Ionians, a speculator with a basket into which all the eggs may be put.

Wilson is famously known as the author of texts on sociobiology and on ants. He is a dedicated evolutionist, and *Consilience* is, by any standard, an ambitious and brilliant work, an attempt to deepen the philosophical foundations of evolutionary theory. Folks like Philip Johnson might well regard this as naturalism run amok, but that is not its most interesting liability.

Wilson's ideology of speculative naturalism has received most of the attention from reviewers thus far, an understandable development in the current climate of re-appraisal of naturalistic claims in science. But the question of "the unity of knowledge" is at least as imposing, and is the more troubling philosophically. By first claiming, in the spirit of the

*ASA Member

Ionians, that all knowledge is reducible to a single domain, Wilson is able to structure his book in a progression that takes in physics, chemistry, and biology; then the social sciences, followed by the arts and humanities; and finally embraces ethics and religion. Whatever can be known about any of these fields carries implications for all the others. This is so because investigation in all these domains is governed by the same methodology. At this point, Wilson relies on his speculative naturalism as the means for defining the basis and thrust of this common methodology.

This methodology is not always easy to formulate, as evidenced by Wilson's frequent recurrence to metaphor and myth in describing it. He portrays consilience by recounting the fable of *Ariadne's Thread* (p. 66), the story of Theseus groping through the Cretan labyrinth, able to find his way out of the maze by unraveling a ball of thread given him by the goddess Ariadne.

> The labyrinth ... is a fitting mythic image of the uncharted material world in which humanity was born and which it forever struggles to understand. Consilience among the branches of learning is the Ariadne's thread needed to traverse it. Theseus is humanity, the Minotaur our own dangerous irrationality. Near the entrance of the labyrinth of empirical knowledge is physics, comprising one gallery, then a few branching galleries that all searchers undertaking the journey must follow. In the deep interior is a nebula of pathways through the social sciences, humanities, art, and religion. If the thread of connecting causal explanations has been well laid, it is nonetheless possible to follow any pathway quickly in reverse, back through the behavioral sciences to biology, chemistry, and finally physics (p. 67).

A prime example of Wilson's approach can be found in his invocation of *epigenetic rules* (p. 150 ff.). What are these things? The phrase is borrowed from the philosophical term "epiphenomenal," which refers to mental or spiritual entities which are dependent on prior material substances for their existence. For instance, in the current parlance employed by some in cognitive science, consciousness is an "epiphenomenon" of brain activity. So, it seems, epigenetic rules are those natural regularities directing the dynamics of genetic activity. We cannot see these rules, of course, but we can see the effects of the rules at work, as they produce the regular patterns expressed by genetic functioning.

As such, these epigenetic rules are the result of our inferences about what *must* be case, if we are to account for the regularities we notice. Not surprisingly, all the usual complaints now promptly emerge. There is no way to test for these epigenetic rules; they cannot be verified or falsified; they are simply presumed, as antecedent conditions for making sense of the world around us. Nonetheless, the governance of epigenetic rules is wide and firm. Their sovereignty ranges, according to Wilson, from the lowest level of molecular operation in organisms to highest levels of cultural achievement, moral reflection and religious sentiment. Since the epigenetic rules explain so much in the natural sciences, and since all that we can know about everything is essentially unified, these epigenetic rules must provide the explanatory agency by which everything can be understood.

Like Reichenbach before him, "everything," for Wilson, includes ethics and religion. Reichenbach would have relegated ethics to some sort of emotivist scheme. Wilson reduces it to the brain in action, favoring "a purely material origin of ethics" (p. 241). He chides most ethicists as "transcendentalists at heart" (p. 240); poor fellas, they don't have their feet firmly planted in the neural networks, where they belong. Wilson does admit that he inclines toward deism, a stance that he suspects may ultimately be validated or not by the material evidence, in good consilient fashion.

So far, so bad; at least for those pledged to some form of theism. Doesn't Wilson get it? His reliance on the apparatus of things like epigenetic rules are a faith-claim, no different in epistemic character from the theist's claims in favor of, say, intelligent design or progressive creation. Why prefer epigenetic rules over divine providence? It's all a matter of faith. When it comes to the broad assumptions underlying the scientific enterprise, you pays your money and you takes your choice.

Except for one thing. Wilson and his robust evolutionary faith, and the theist with her commitment to God's creative sovereignty, share a large patch of common ground. Their arguments are over whether natural processes are due to an intelligent, purposeful creator, or to a vast and lengthy cycle of self-governing embryonic development; naturalism vs. supernaturalism. But both agree that all our knowledge of the natural world is congruent, and susceptible to a tidy integration. All truth is God's truth; or conversely, all truth is nature's truth. For all the squabbling over entrenched naturalistic presuppositions in science—and it *is* important squabbling—there is a broad agreement from theists and non-theists alike on the unified character of our knowledge of reality. Any theist, in fact, could have

written a book entitled, *Consilience: The Unity of Knowledge.*

But why? Why assume that all human knowledge of the natural, social and phenomenal worlds must be unified? What would our accounts of the world be like if we did not reflexively begin our inquiries with the assumption that everything flows from a single fount?

We have an example of what those accounts might look like. That example comes from Aristotle. His own method was straightforwardly empirical, but allowed room for metaphysical foundations for explaining nature. He was rigorous in inspecting the physical evidence, but relaxed enough to entertain the existence and activity in the cosmos of God (and gods). And he certainly did not think that all human knowledge was unified because it originated in some common source. Biology had its own point of departure for scientific inquiry. So too with the physical sciences, and logic, and metaphysics, and ethics, and politics, and poetry. Each of those fields has its own object of scrutiny, and there is no reason at all to presuppose that the manner of investigating those objects must proceed on the further assumption that, in the end, they are all connected. If our scientific inquiries move us along trajectories for which we can locate no obvious point of convergence, in what way does that jeopardize the inquiries themselves?

Indeed, why should the theist conclude that *all* things emanate from God's creative activity, and are unified thereby? After all, philosophers have for a long time been worrying over the problem of evil, and theists have been at pains to distance God from the existence of evil in the world. God made the world good; it is human beings who wreak the havoc. In providing an explanation of evil, then, do we trace it back to God? Or does our inquiry into evil focus on the human propensity for allowing evil to flourish? Is our knowledge of God ultimately unified with our knowledge of evil? Is our knowledge of evil ultimately unified—meaning that it conforms to the same methodological template—with our knowledge of economics, or our knowledge of baking bread, or our knowledge of playing bridge, or our knowledge of how to catch a fly ball to deep center field? Why suppose that all these diverse ways of knowing are ultimately tethered in one spot?

Well, Wilson just *does* suppose so, as do a great many Christians. The Christian's commitment to the unity of knowledge is no different from Wilson's; the difference lies in Wilson's speculative naturalism and the Christian's belief in God's creative sovereignty, as specific mechanisms for systematically integrating the knowledge. Wilson exhibits in *Consilience* his self-awareness that he has succumbed to the recurring rage for methodological reductionism. Are those Christians who wish to argue against Wilson's naturalism also aware of their own surrender to reductionism, so new and yet so ancient?

It is not only Wilson and his friends who have been enchanted by the Ionians. Many theists are also in thrall to Thales. ♣

# Book Reviews

**THE ATOM IN THE HISTORY OF HUMAN THOUGHT** by Bernard Pullman. New York: Oxford University Press, 1998. 403 pages, index. Hardcover; $30.00.

This book is an outstanding historical survey of the interaction among atomic theory, philosophy, and religion. It is collected into four main time periods beginning in ancient Greece (Part I), and progressing through the first fifteen centuries AD (Part II), the Renaissance and the Enlightenment (Part III), to the nineteenth and twentieth centuries. Pullman was a Professor of Quantum Chemistry at the Sorbonne and writes "not as religion" but as an atomic theorist with a strong interest in philosophy. Unfortunately he died in 1996 and was not able to witness the publication of this English edition translated by Axel Reisinger, an industrial physicist.

Each time period is preceded by an excellent summary of the key protagonists and their contributions, succinctly orienting the reader before delving into the intricacies of atomic theory and philosophy. The early part of the book focuses on the properties of atoms, particularly atomic motion, the necessity for an atomic void, and whether the soul is composed of atoms. Part I concludes by contrasting the atomism of ancient Greece with similar propositions independently arrived at by Hindu philosophers.

Part II, the shortest section in the book, introduces the role of the Christian church in the development of atomism. Atomism directly impinged on the nature of the Eucharist, stimulating close monitoring by the Roman Church. Early Islamic scholars grappled with similar ramifications of atomic theory and developed an omnipotent view where atoms exist only because God continually recreates each atom for each moment in time. The corollary is to eliminate miracles and other supernatural occurrences since all creation is reliant on God's continual re-creation—perhaps the ultimate expression of Heb. 1:3, "sustaining all things by his powerful word."

In the Renaissance and Enlightenment (Part III), Pullman shows how the revival of atomism was largely rekindled through the efforts of Christian scholars. "From a historical perspective it could be said that [Christian scientists] added God to atoms, although [they] probably would have preferred to be seen as having returned atoms to God" (p. 122). The contributions of Christian atomists are followed by those of Christian anti-atomists in a historical progression that highlights the main philosophical contributions to modern atomic theory.

Modern atomic theory (Part IV) is both the longest section in the book and, unavoidably, contains the most discussion of the experiments on which the theory rests. Even so, the author maintains an even emphasis between philosophy and atomism, showing that those philosophers who failed to re-evaluate their ideas in light of the rapid advances in atomic theory often left themselves open to ridicule. "It is better not to know anything than to cling to preconceived ideas based on theories that are confirmed only at the cost of ignoring anything that does not fit" – quoted from Claude Bernard (p. 222). This section is particularly well written, spanning the birth of modern chemistry to the latest advances in quantum chemistry in an extremely descriptive and yet non-technical style.

"The central topic of this book is to retrace how philosophical and religious thought concerning the atomic structure of the world evolved during the course of the centuries" (p. 194). The author admirably achieves this aim, and in the process, raises some profound questions, such as "why despite their long political existence and enduring spiritual influence, the deeply religious Hebrews, unlike the Greek pagans, contributed virtually nothing of significance to the birth or development of science?" (p. 6). Similar probing questions to many modern physicists teases out how these influential scientists viewed the metaphysical ramifications of their work. This is an excellent book for those interested in the intersection of religion and atomic theory.

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**REASONING WITH THE INFINITE: From the Closed World to the Mathematical Universe** by Michel Blay. Chicago: The University of Chicago Press, 1998. 216 pages, index. Hardcover; $30.00.

The project of Galileo and Descartes to understand nature through the means of Euclidean geometry was replaced by one of grasping nature through

quantitative laws that form a deductive system. (The first work that fully incorporated this ideal was LaGrange's *Analytical mechanics* [1788]). Why such a shift in the scientific paradigm? This is a question that Blay tries to answer in this book by pointing primarily to the problem of dealing with infinity. Euclidean geometry considered a true reflection of the world, but it did not grapple with infinities satisfactorily, particularly with the infinitely small. The solution was to use a tool that allows science to tackle the problem of infinity. This led to the emergence of calculus, which was primarily treated as a technique, not as a reflection of the structure of nature. Leibniz, one of its co-discoverers, sometimes denied the existence of infinitesimals in nature (although he was not always consistent in this matter). The emphasis was placed on how to encompass nature's laws in the framework of the newly developed tool, the calculus, not on finding counterparts in nature of the concepts used in this framework. This approach was found unsatisfactory by Fontenelle, who in his *Elements of geometry of the infinite* (1727) undertook the project of rediscovering infinity in nature and not treating it as a mere mathematical tool.

The author traces these developments in the science of motion focusing on the works of Galileo (chaps. 1–3), Huygens (chaps. 1–2), Newton (chap. 2), Hobbes, (chap. 3) Leibniz, Varignon (chaps. 3–4), and Fontenelle (epilogue). He ends with a quote from Polish mathematician and philosopher Józef Hoene-Wroński, which also seems to state the author's position: "It is only through the infinite that the science of mathematics is possible" (p. 162).

This is primarily a resource book. Of its 216 pages, about eighty pages are quotations (sometimes two pages long), about eighty pages are Blay's summaries of what is not quoted, of what was quoted, and of what is about to be quoted with little discussion of the quoted material; and the remaining pages are footnotes, a bibliography, and an index. The author lets the actors of the developments in dynamics recount their struggles with infinity in their own words. The book, however, often gives little guidance in understanding certain things taken for granted by the quoted authors. Here are some examples.

1. When quoting Leibniz, Blay retains his notation but does not explain the meaning of the horizontal bar in such terms as $\overline{dxv}$, (p. 109); (it is a *vinculum* that plays the role of our parentheses).

2. The author mainly reproduces original drawings which sometimes use the vertical line for abscissas, sometimes the horizontal line. This may be rather confusing when discussing a particular problem when both these conventions are used at the same time. For example, Varignon proves Rolle wrong, showing a proper plot of a function, but because of mixing the conventions, the comparison is not immediately apparent (pp. 116–7).

3. It is not obvious how Varignon's definition of velocity is related to the preceding discussion or to the diagram he uses (in which he also uses abscissas drawn *both* horizontally and vertically [p. 123]).

4. The author does not comment on Fontenelle's assumption of the existence of the largest finite square (p. 142) which by itself would render invalid Fontenelle's reasoning concerning the existence of the so-called indeterminate finites in the example Blay quotes at length.

Although the book is wanting as a treatise in the history of science, it is very useful nonetheless. To a large extent, it relies on materials that are very hard to access: minutes of sessions of the Royal Academy of Sciences, manuscripts, and old books. In these sources lies much of the value of the book.

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**AD LITTERAM: How Augustine, Calvin, and Barth Read the Plain Sense of Genesis 1–3** by K. E. Greene-McCreight. New York: Peter Lang, 1999. 274 pages, index. Hardcover; $52.95.

Members of the ASA are all too aware of the differences that "Bible-believing" Christians hold concerning the "meaning" of biblical texts related to creation and the sometimes insufferability that evangelical Christians hold toward one another when discussing relationships between scientific and "biblical" views of origins. The history of the discussion has witnessed its share of accusations that one person or another has clearly strayed from both the "plain sense" of Scripture and fidelity to biblical (read "historical") understandings by the Christian Church about the meaning of the Bible and Genesis in particular. Green-McCreight, a professor within the Religious Studies Department of Connecticut College, has added a splendid new dimension to this discussion with this book, a revision of her dissertation at Yale. True to the tradition of

the "Yale School" of narrative theology, the book considers in great detail the ways in which Augustine, Calvin, and Barth read the "plain sense" of Scripture of the first three chapters of Genesis.

The book opens with a careful discussion of what we mean when we invoke "the plain sense" of Scripture for our particular purposes. It becomes quickly apparent to the reader that most of us have not considered this action thoughtfully enough, since many key issues and themes, problems and possibilities present themselves under her exegetical and philosophical scrutiny. The bulk of the book is then devoted to careful readings of Augustine's *De Genesis ad Litteram*, Book 12, Calvin's *Commentary on the First Book of Moses*, and Barth's *Church Dogmatics*, Vol. 3.1. Key issues she considers for each author include: (1) how they understood the task of reading the verbal sense of specific verses and passages within Genesis; (2) the degree to which each writer investigates the narrative structure employed, the intent, and the historical referents of the "original author(s)"; (3) intrabiblical "prooftexting" in which each writer engages as a reader removed by time and space from the original writer(s); and (4) how the interpreter's assumptions about the "sacredness" of the text and its meaning influence their interpretation of the "plain sense." Clearly these issues not only relate to Genesis 1-3 but also to our individual doctrine of Scripture. Our perspective on the "plain sense" of Scripture and the meanings we attach to that phrase dramatically influence exegesis, hermeneutics, theology—and might we say—our understandings of the relationship between science and Scripture.

While the intent of the author was to explore the doctrine of Scripture, using these three theologians and their musings about Genesis 1-3 as the test case, she has inadvertently made a major contribution to contemporary evangelical debate about the meaning of Genesis 1-3. Readers can find themselves as more or less represented by the viewpoints of Augustine, Calvin, or Barth regarding the meanings of the primordial narrative of Genesis. The exegetical and hermeneutical issues that must be understood and explored to arrive at a "plain sense" of Scripture and the inevitable assumptions that underlay their "proper" use should lead all of us to consider anew those things that unite us rather than highlighting and majoring on those things that divide us. I cannot recommend this book too highly despite its steep price.

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**SCIENCE & RELIGION: An Introduction** by Alister E. McGrath. Oxford: Blackwell Publishers Ltd., 1999. 250 pages, index. Paperback; $29.95.

The focus of this book is the main themes and issues in the study of science and religion. There are chapters on "Historical Landmarks" (covering Galileo, Newton, Darwin), "Religion: Ally or Enemy of Science?" "Religion and the Philosophy of Science," "Science and the Philosophy of Religion," "Creation and the Sciences," "Natural Theology: Finding God in Nature," "Models and Analogies in Science and Religion" (examining the use of models in science, and of analogy and metaphor in religion), "Issues in Science and Religion" (cosmology, evolution, psychology), and "Case Studies in Science and Religion" (Ian G. Barbour, Charles A. Coulson, Wolfhart Pannenberg, Arthur Peacocke, John Polkinghorne, Pierre Teilhard de Chardin, and Thomas F. Torrance).

This book can easily serve as a course textbook. The writing is clear and accessible to those without specialized backgrounds. Topics are presented in a fair and balanced manner. Chapters include frequent displays of summary material and reading lists for further study. There is also a nine-page bibliography. This book is also a very readable summary that could be attractive to *PSCF* readers. I highly recommended it.

*Reviewed by David T. Barnard, Professor of Computer Science and President, University of Regina, Regina, SK S4S 0A2.*

**BELIEF IN GOD IN AN AGE OF SCIENCE** by John Polkinghorne. New Haven, CT: Yale University Press, 1998. 133 pages. Hardcover; $18.00.

Polkinghorne, former president of Queens' College, Cambridge University, is a Fellow of the Royal Society. Sixteen years ago, he resigned from his chair in Mathematical Physics at Cambridge to study for the Anglican priesthood. Since then, he has published ten books relating science to religion, beginning with the book, *The Way the World Is*.

The first four chapters of this book are from the Terry Lectures delivered at Yale University in October 1996. In the first chapter, Polkinghorne uses his physics background to argue that the correspondence of a mathematical model with the universe is unusual if the universe is simply a fortunate by-product of atheistic evolution. The rational beauty of the cosmos is a reflection of God who makes human beings in his image to understand his creation.

Polkinghorne says that the Anthropic Principle, the fine-tuning of physical laws, again calls for recognizing the theistic conclusion as an intellectually satisfying explanation of the universe. Polkinghorne's natural theology is different from that of Anselm and Aquinas, in that it is not based on proof but on insight. It also differs from William Paley's view in not emphasizing one particular occurrence, but on the general characteristics of the physical world. It is no longer a natural theology, but a theology of nature. Theology provides assistance for our understanding of the universe.

Polkinghorne then explains that God-given human freedom has a necessary cost. He charts a middle course between determinism and relativism. He thinks that our moral intuitions, aesthetic pleasures, and religious inclinations point to the mind of God. Polkinghorne concludes that hope makes life complete by denying the finality of death.

The second chapter explores the similarity between science and religion in their ways of finding truth. He uses the examples of quantum theory and Christology to show that both theories went through periods of revision, confusion, synthesis, further wrestling of problems, and extension. He concludes that both science and theology have a quest for truth as its central task.

The third chapter discusses how God acts in the physical world. Polkinghorne takes the view of a top-down causality (input of information), which is different from the bottom-up view of Process theology. However, he takes the view that God has both temporal and eternal poles and is thus involved in time, just as we are. God's omniscience is self-limited to allow for an open and evolving world. God is not the Composer of the whole cosmic score, but the Great Improviser of unsurpassed ingenuity.

In the fourth chapter, Polkinghorne emphasizes the importance of a continuing dialogue between science, especially biology, and religion. However, he thinks the conversation is most lacking in contributions from systematic theologians. In contrast to the "bottom-up thinking" of Barbour, Peacocke, and Polluck, other theologians appear to take the top-down approach. Polkinghorne thinks Big Bang cosmology, the dawn of human consciousness, the meaning of eschatology, and the moral problems posed by the growth of science are areas for intensive discussion. He also thinks both science and theology are being marginalized by the postmodern world; and he involves himself as a missionary for science, as well as for religion.

In the post-Terry Lecture chapter, Polkinghorne explains his critical realism view of science and religion. In both areas, knowledge should be a true description of reality and should be pursued critically and creatively. The variety of scientific methods may help authenticate the variety of authentic spiritual experiences. By faith, scientists and theologians trust that truth can be found through understanding and experience.

In the last mathematical postscript, Polkinghorne further explores mathematic realism. He shows that mathematics is more than logic and human construction. He believes that there is a realm of mental experience containing the truths of mathematics. Mathematics provides a powerful encouragement to refute physical reductionism and to support the dual nature of reality.

This treatise contains Polkinghorne's ultimate thinking about the relationship between science and religion. He explains in great detail why it is possible to believe in God in an age of science. He shows that this is not only possible, but also preferable. He tries to make the dialogue between science and religion a two-way street, but I think his theology is influenced too much by quantum theory.

Darwinism is not an inescapable consequence of the theory of evolution; "Openness of God" theology is also not a necessary conclusion of the quantum theory. Some readers may see Polkinghorne's concept of God as deviating too much from classical theology. Otherwise, this is a well-written and well-argued book from the hand of a preeminent scientist-theologian.

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**A HISTORY OF THE WARFARE OF SCIENCE WITH THEOLOGY IN CHRISTENDOM** by Andrew D. White. Buffalo, NY: Prometheus Books, 1993. 889 pages. Paperback; $19:95.

This collection of essays by the former president of Cornell University was published in 1896 and hailed as brilliant by many academics and policy makers. Its central argument was that religious beliefs and sentiments should not control features of institutions or research programs that are striving to be scientific. The book was produced in an era when universities still prescribed daily or weekly chapel attendance for all students, restricted or allowed no

student course electives, and stressed a curriculum steeped in the classics with only moderate or little attention to modern science. Reading it now in this handy one-volume reprint that preserves the pagination of the original two volumes reinforces the cultural gulf between then and now. It reminds the reader of just how far we have advanced in our understandings of the relationships among religion, science, technology, and theology.

Some arguments advanced by White still have large kernels of truth within them, despite being written over one hundred years ago. Others have been completely discredited by more recent research by Gingerich, Polkinghorne, Peacocke, Hooykaas, Butterfield, Livingstone, Mitcham, Richardson, Numbers, Brooke, Russell, Peters, Ellul, et al. Students should read this book that in its time was greatly influential and still is widely cited with sweeping approval by people who want to maintain a strict wall of separation between religion and science. Many of its lessons about the dangers lurking in exegetical excesses, hermeneutical hyperboles, theological tenets, and religious recidivism are important for every generation. Excesses of scientism and mistaking current "scientific" knowledge for truth are also easily seen in its pages.

Teachers and scholars will appreciate this reprint which makes a wonderful cultural artifact in the debate about science and religion easily accessible. It can be nicely supplemented with any or all of the following recent texts: *Spiritual Evolution: Scientists Discuss their Beliefs* (J. M. Templeton and K. S. Giniger, eds.), *Mere Creation: Science, Faith & Intelligent Design* (W. A. Dembski, ed.), *Religion and Science: History, Method, Dialogue* (W. M. Richardson and W. J. Wildman, eds.), *Science & Theology: The New Consonance* (T. Peters, ed.), *Reconstructing Nature: The Engagement of Science and Religion* (J. Brooke and G. Canter), *Christianity and the Images of Science* (G. C. Henry) and *God and Contemporary Science* (P. Clayton).

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**CHILDREN OF PROMETHEUS** by Christopher Wills. New York: Perseus Books, 1998. 310 pages, index. Hardcover; $25.00.

Wills, professor of biology at the San Diego University of California, is the author of five previous books covering several different topics including genetics and anthropology. In this new offering, Wills lays out the case for the modern acceleration of the rate of human evolution. Modern society, Wills claims, is creating new selective pressures which are altering many aspects of our physical being. These are new pressures which humankind has never faced in history.

Wills presents his case in three parts which has the effect of making it difficult for his reader to follow his overall argument. The first part examines the processes of natural selection occurring in human populations today. His case studies are fascinating. Tibetans and Andeans are being selected for life at the edge of space. People have lived in Tibet about five times longer than the Andeans have lived in the Andes and thus are better adapted. Infant birth weight in Tibet is the same as for people living at a lower altitude. However, for Chinese living in Tibet or the less well-adapted Andeans, infant birth weight at these altitudes is significantly less and mortality higher. Africans are being selected for resistance to malaria, which is a recent affliction on the continent, probably arising with agriculture. British civil servants appear to be undergoing selection for acceptance of their place in the political hierarchy. Lower level civil servants seem to die young.

The second part of the book covers the selection that changed apes into humans. While the parts on anthropology are well written with unique insight, it seems to be disconnected from Wills' thesis about humans' continuing evolution. In a chapter entitled "Why are we such evolutionary speed demons?" Wills does not prove that our evolution has occurred at a faster pace than other animals. He does, however, present an excellent history of our evolution. One of the unique tidbits that comes from this book concerns Wills's thoughts about mitochondrial (mt) Eve. He presents a fascinating hypothesis for the lack of diversity in human mtDNA. The mitochondria are the power sources for the cell and the mtDNA codes for these energy producing organelles. It is a lack of mtDNA diversity which leads to the idea of a recent mitochondrial Eve. Chimpanzees and gorillas show about three times more divergence in the mtDNA than do humans. There is less divergence between the Neanderthal mtDNA and ours than there is among the chimpanzees. What Wills suggests (p. 193) is that selection

acts to limit any reduction in the power generation abilities of the mtDNA. The difference between us and the apes lies in the brain. Our brains have an "insatiable" appetite for energy, with 60% of a young child's energy diverted to the brain. Given this, Wills says that selection weeded out any mtDNA that did not produce the highest efficiency mitochondria. The implications of this for the Christian apologist lies in the origin of humans. Wills's thesis would push Eve further back into the past. The lack of mtDNA diversity would thus be due to the selective needs of our brains rather than the recent origin of humans.

The third part concerns the future evolution of humans. Wills describes the change in physical skills required of a primitive human to those required by a participant in extreme sports contests, snowboarding, or even music. The selective pressures generated by modern activities are of a completely different nature than those faced by our ancestors. They require new adaptations. We have also "intellectualized" the world, for better or worse, and it will have consequences for our evolution. Wills likens this to our domestication of other animals. We, like them, have become docile. He likens us to lab rats who, when placed in a large water-filled tank with a submerged platform, will find the platform and docilely wait for the scientist to haul them out of the water. A wild rat, on the other hand, when faced with the same test, will use the platform as a springboard to jump out of the tank and run away.

The book is easy to read, entertaining and contains much valuable information. The biggest drawback is its lack of focus on the central theme. Too many rabbit trails lead the reader to stray from the author's hypothesis. But even with this technical fault, reading the book was an enjoyable experience.

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**DARWINISM COMES TO AMERICA** by Ronald L. Numbers. Cambridge, MA: Harvard University Press, 1998. 216 pages; index. Paperback; $18.95.

Numbers is William Coleman and Hilldale Professor of the History of Science and Medicine, University of Madison-Wisconsin. He is the President Elect of both the History of Science Society and the American Society of Church History. Numbers has written and edited a number of books dealing with the evolution vs. creation controversy.

The Introduction deals with early reactions to Darwinism in America, different interpretations concerning the days of Genesis and the beginning of the American Scientific Affiliation (ASA). Also, the writings of creationist Henry M. Morris and his founding of the Creation Research Society (CRS) are discussed. Several pages are devoted to the "Intelligent Design" (ID) theory of which Phillip Johnson is one of its better-known proponents. However, "the intelligent-design crowd took a beating from all sides: scientific creationists, theistic evolutionists, and, of course, naturalistic evolutionists" (p. 19).

Chapters 1 and 2 describe the different reactions to Darwinism by the scientific community in America. Definitions of terms such as Darwinism, anti-Darwinism, evolution, and creationism are considered. The influence of scientists, such as Louis Agassiz, Asa Gray, James Dana, and John William Dawson (the last three evangelicals), on the development of Darwinism in America is examined.

Chapter 3 examines attitudes that prevailed between the 1860s and the late 1920s primarily within church-related institutions. This sets the stage for chapter 4, which deals with the Scopes Trial that began on July 10, 1925, in Dayton, Tennessee. Concerning the trial: "Despite a shelf of scholarly studies on Fundamentalism, anti-evolutionism, and Bryanism, the Scopes trial remains a grotesquely misunderstood event ..." (p. 76). (Numbers indicates in the endnotes than an important work by Edward J. Larson, *Summer for the Gods: The Scopes Trial and America's Continuing Debate over Science and Religion* [New York: Basic Books, 1997], was published after this chapter was written. Larson's effort won the Pulitzer Prize in History.)

An important misunderstanding concerning the Scopes trial is the perception that William Jennings Bryan—who was pitted against the famous lawyer and agnostic Clarence Darrow—believed in a "young" earth, created in six, twenty-four-hour days. Numbers reproduces transcript from the trial and concludes: "It is clear from this testimony that Bryan not only rejected the notion of a 6,000-year-old Earth but freely interpreted the days of Genesis as vast periods of time" (p. 80).

Another fallacy Numbers corrects is the notion that Fundamentalists of Bryan's day—because of their commitment to literalism vis-à-vis Scripture—were unable to distinguish between different literary genres in the biblical text. (Contemporary evangelicals still are forced to grapple with this misunderstanding: to interpret the Bible literarily is to understand it as a piece of *literature*, with con-

comitant rules of grammar, speech, syntax, and context.) Numbers concludes the chapter: "What the trial has come to represent is far more important historically than what the trial accomplished" (p. 91).

In chapter 5, Numbers addresses Seventh-day Adventist attitudes toward evolutionary biology and geology. The Seventh-day Adventists were formed when the nineteenth century debate over evolution began. The Adventists defended the "young earth" view and were extremely suspicious of evolution, labeling it "atheistic." When George McCready Price embraced the Adventist faith, the group acquired its first "scientist." Price championed what he called the "new catastrophism" and "flood geology." This view held that there was no natural order to the fossil-bearing rocks, all of which are the result of Noah's flood.

With the appearance of his most systematic book, *The New Geology*, Price's views became more widely known. Although the book pleased many fundamentalists, it did not improve his standing with practicing scientists. This chapter details the history of reactions between Adventists and other Christians who did not feel a belief in a young earth and creation in six literal days should be the major test for orthodoxy.

Chapter 6 investigates the reception that evolution had in the American Holiness Movement. These were denominations that emerged primarily from followers of John Wesley and many were identified by belief in a special baptism by the Holy Ghost, and the ability to speak in tongues and to perform physical healings.

Although those in the Holiness Movement, for the most part, shared a distrust of Darwinism with their non-Wesleyan brethren, "... unlike their Fundamentalist brothers and sisters from the Calvinist tradition, who stereotypically staked all on the inerrancy of Scripture, conservative Wesleyans such as those found in the Holiness Movement, tended to place experience above exegesis" (p. 112). For Wesleyans, "deed" is more important than "creed."

The volume ends with an appendix, "Naturalists in the National Academy of Science, 1863–1900." The use of "Naturalists" is confusing in that the term generally describes a philosophical position (scientific materialism, scientism) which is at odds with classic orthodox Christianity. In fact, some scientists mentioned, such as James Dana (1813–1895) and Asa Gray (1820–1888), were evangelical believers.

Several corrections are in order: The term, "Fundamentalism," is used throughout the book rather loosely—at least in the current understanding of the word. All of my Missouri Synod Lutheran sources rejected Numbers' statement that their group defended Ptolemaic astronomy "well into the twentieth century ..." (p. 7). Lastly, it would have been helpful to mention the 1981 Arkansas Creation-Evolution trial (McLean vs. Arkansas), also called Scopes II. This event set the stage for the later developing "intelligent design" movement.

The book has copious endnotes and makes a real contribution towards understanding the origins debate in America. Misinterpretations are corrected on all sides. Recommended.

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**TIME: A Traveler's Guide** by Clifford A. Pickover. New York: Oxford University Press, 1998. 285 pages, bibliography, index. Hardcover; $25.00.

Describing this book is hard, since it is not just a science fiction book, nor is it just a science book, nor is it just a romance, though it is all three. The first page of each chapter has a line of music in the center and around it quotes from scientists and others. The relationship between the music and the quotations escapes me. It may be because I lack a thorough knowledge of music. Each chapter refers at least once to Chopin's music and its influence on people. I enjoyed reading the book, though I doubt that science will ever develop as far as Pickover envisions.

Pickover describes how a lecturer gradually falls in love with a student attending his lectures in the year 2063. An extraterrestrial also attends the lectures. Using a "time-machine," the couple visits Austria in 1829 to attend a concert given by Chopin. In the science part of this chapter, Pickover refers to Tipler's description (*Physical Review*, D9, 1974).

Most readers of this journal will know the science described in the last parts of the chapters. It might be an easy introduction to some of the science involved in Pickover's imagination, but, unfortunately, there are errors in the printing of the formulas. For example, the top formula on page 16 should not have the "c" under the square root sign; both square root signs are in the wrong place on page 199; on page 142, eighth line from the top, the "u" in "uc" should be Greek letter "mu" as on page

141; and on page 157, the formula is above the line and it should be on the line. Errors like that break the flow of one's reading. Also, human pride and even an anti-Christian attitude shine through in a sentence like: "Time travel would allow us to become omniscient, omnipresent, and omnipotent—qualities humans have normally attributed to God. In a sense, time travel would allow us all to become God" (pp. 245-6).

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**RECONSTRUCTING NATURE: The Engagement of Science and Religion** by John Brooke and Geoffrey Canter. Edinburgh, Scotland: T&T Clark Ltd., 1998. 367 pages, indices of names and subjects. Hardcover; $49.95.

As historians of science, Brooke and Canter have analyzed science-religion relationships in the light of recent developments in the history of science. They presented their scholarship during the 1995-96 series of Gifford Lectures at the University of Glasgow. *Reconstructing Nature* is a compilation of extended and revised versions of their Gifford lectures arranged into ten chapters that are classified under four sections. The primary aim of the authors is "to show how new ways of understanding past science can be used to suggest fresh approaches to the science religion domain" (p. xi). Considering that science is about "constructing" a perspective of nature, the authors explore how this scientific construction of nature interrelates with religious perspectives particularly those within Christianity. The authors call these interrelations the "engagement" of science and religion. They claim that "the richness and ambiguity of the word *engagement* helps to capture the many different ways in which the relationship between the two has been presented" (p. 7).

The authors identify four different forms of engagement of science and religion. The first form involves a fusion or union of science and religion as exemplified in the life and work of Newton. For Newton, the mathematical analysis of nature had transcendental implications in that mathematically precise motion of planets in their orbits implied to him a deity very skilled in mechanics and geometry. Thus, as in the case of Newton, science supports faith in God and vice versa.

The second form of engagement is that of adversaries as if in a battle against each other. The authors use, as an example, the adversarial interactions between supporters of the Darwinian theory of biological evolution and those who oppose the theory on religious grounds. They cite the 1860 discourse on the topic between Bishop Samuel Wilberforce and Darwinian biologist T. H. Huxley as a classic illustration of the adversarial engagement of science and religion.

The third form of engagement involves an interlocking of science and religion in much the same way as parts in a machine interlock or engage with each other. Connection between the engaged parts is such that movement in one part produces movement in the other. The authors cite the interleaving of Aristotelian philosophy and Christian theology as an example of this form of engagement. They correctly claim: "Interlocking was sometimes so strong that threats to the authority of Aristotle would be read as threats to the Catholic Church" (p. 8).

The final form of engagement proposed by the authors involves the idea of "winning over," as an adherent or helper. This form of engagement of science and religion includes instances of scientific knowledge used as a resource by religious apologists as well as the converse situation of scientific thinkers needing to gain the approval of religious authorities.

By identifying these four forms of engagement of science and religion, the authors set the stage for exploring the history of this engagement in all its richness through the use of different styles and methods of historical scholarship. They critique popular accounts of science-religion interactions as inadequate in that they "constrain discussion by imposing master-narrative on historical data" (p. 8). Rather, the authors claim, new insights are possible by applying a variety of styles and methods of historical scholarship, which is precisely what they do to various pieces of historical data in different chapters of the book. By pointing to the diversity of philosophies and approaches of a few prominent scientists such as William Thomson, Francis Bacon, and Robert Boyle, the authors make the point that science and theology have interrelated in many "interesting, unpredictable and extraordinarily diverse ways" (p. 16), which cannot all be explored when master-narratives are imposed.

The authors define a "master-narrative" as a "definitive historical account of how science and religion have been (and are) interrelated" (p. xi). Then they proceed to identify and apply various approaches to specific historical data representing science-religion interactions and demonstrate several

new insights that the master-narrative approach does not bring out. The authors use the following five approaches to the analysis of historical data.

1. *Contextual Approach*: Analyzing components of the context in which science has been pursued, including the religious parameters, socio-economic factors, political factors, and geographic coordinates.

2. *Functional Approach*: Here the historian asks what *function* the theology may be playing within the science and vice versa. This is particularly useful in analyzing the literature of natural theology in which the interpenetration of ideas about nature and about God "was often so complete that one and the same book could be read as a work of scientific popularization or contemporary theology" (p. 26).

3. *Linguistic Approach*: The language in which claims about the relationships between science and religion are expressed is analyzed in this approach. It helps clarify the rhetorical functions of the text, thereby enriching the contextual and functional analyses.

4. *Biographical Approach*: The focus here is on the life of the individual involved. An analysis of the biography may bring to the surface science-religion issues as they were played out in the inner life of the individual.

5. *Practical Approach*: Here the analysis focuses on the practice of science and religion and on comparisons between the two. Social studies of science are crucial in this approach to understand the engagement of science and religion.

In different chapters of the book, the authors apply these approaches to key historical instances, such as the Galileo affair, to demonstrate the rich and diverse aspects of the engagement of science and religion. There are several illustrations in different chapters and bibliographic notes at the end of each chapter. The uniqueness of this book lies in the fact that the authors demonstrate their methods and the value of applying several different approaches to analyzing historical data. It will make an excellent text for upper-level undergraduate and graduate courses dealing with science-religion interactions and an excellent reference book for history of science courses.

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**THE FACE THAT DEMONSTRATES THE FARCE OF EVOLUTION** by Hank Hanegraaff. Nashville, TN: Word Publishing, 1998. 240 pages, index, appendices. Hardcover; $16.99.

Hanegraaff is the host of the popular Christian radio broadcast, "The Bible Answer Man," and president of the Christian Research Institute. In his latest book, *The Face that Demonstrates the Farce of Evolution*, he attempts to demonstrate that evolutionary theory is a "farce" (p. 6).

This book, written for Christians new to the origins debate, is a standard critique of evolutionary theory in both its social and scientific ramifications. Hanegraaff uses acronyms (F-A-C-E/F-A-R-C-E) to highlight his main points (**F**ossil follies; **A**pe-men fiction, fraud, and fantasy; **C**hance; **E**mpirical science; and **R**ecapitulation). Appendices, references, and notes, only several of which directly relate to the thesis, take up a considerable amount of space.

In six chapters, Hanegraaff briefly spells out the controversies and consequences of the theory of evolution. First, he argues that evolution undermines the foundations of the Christian faith put forth in Genesis, allowing an excuse for sexual permissiveness, sexism, and even racism (pp. 19, 22–24). Next, he argues that fossils (animal and hominid) fail to yield the evolutionary transitional forms needed to confirm macroevolution and explores the issue of chance as a creative agent. Third, Hanegraaff argues that philosophical naturalism, which undergirds evolutionism, presupposes that something came from nothing. This concept violates the first law of thermodynamics which states that energy cannot be created or destroyed but can only convert from one form to another (p. 83). He also rehashes the familiar arguments about the second law of thermodynamics as being inconsistent with evolution (p. 85). To his credit, Hanegraaff notes that information entropy is the issue here. He rightly notes that simple raw energy from the sun does not produce complexity and information (p. 87). The final chapter on recapitulation theory spends most of its length exposing the false link between ontogeny and phylogeny and on the social ramifications that recapitulation theory has added to abortion and racism (pp. 93–102). The rest of the book is made up of appendices that deal with various topics addressed briefly in earlier chapters, such as abortion, the reliability of the Bible, and evidence for the resurrection of Jesus (pp. 123–59).

I found this book confusing on several points. First, it sets out to be a critique of evolution but fails to clearly define or specify the correct use of the terms "evolution," "Darwinism," "evolutionism,"

or "naturalism." Its treatment of evolution wavers, vacillating between evolution as a philosophy (atheistic materialism; Darwinism) and evolution as a theory of the origin of species. While one can certainly argue persuasively that atheistic materialism leads to sexism, racism, and the rejection of objective moral values, Hanegraaff fails in this regard because he does not provide the reader with an explicit definition of evolutionism as a full-blown atheistic materialism. The reader is left to guess what evolution means in all of its subtle connotations. In fact, this is the major defect in the introductory chapter, since the book is intended for Christians new to the discussion. Second, it is disturbing that the reader is left with the impression that much of hominid fossil studies are fraudulent and based upon the subjective imaginations of paleo-anthropologists (p. 180). While one must be cautious of frauds purported to be early human ancestors in the past, we should not dismiss all hominid fossils as snake oil. Third, the argument that energy conservation contradicts the notion of something coming from nothing, is an egregious misunderstanding. The first law is simply a relation that holds for energy in a thermodynamic system. It has absolutely nothing to say about the origin of the energy in question or even the origin of the thermodynamic system under study. Thus, Hanegraaff should have taken his own advice on not making "death moves" (e.g., giving bad arguments) in his first law argument.

Overall, the presentation of information and discussion is fair but unimpressive. Hanegraaff employs a creative use of acronyms to highlight his main points, which is good for Christians looking for a simple representation of evolution. However, compared to other introductory books critiquing evolutionary theory, this book just does not give the thoughtful analysis and information that Christians should be aware of when thinking seriously about evolution. Instead, Christians seeking critiques of evolution as philosophy or biology would be better served consulting works by Phillip Johnson and others of the intelligent design movement.

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**SKEPTICS AND TRUE BELIEVERS: The Exhilarating Connection between Science and Religion** by Chet Raymo. New York: Walker and Company, 1998. 288 pages, notes, index. Hardcover; $23.00.

Raymo, professor of physics and astronomy at Stonehill College in Massachusetts, has written several books on astronomy and the relationship between science and religion. His column, "Science Musings," in which he reflects on the human side of science, appears weekly in the *Boston Globe*. One theme, which has emerged from readers' letters, is that we are a culture that is divided at its heart. According to Raymo: "We warmly embrace the technological and medical fruits of science, but often hold religious beliefs that stand in flat-out contradiction to the scientific way of knowing" (p. 7). Those who hold these contradictory religious beliefs are "true believers" while the author, in contrast, admits to being a "thoroughgoing skeptic." These two intellectual postures are clearly described in the book's introduction and are then contrasted throughout the remainder of the book.

How are skeptics different from true believers? According to Raymo, skeptics are children of the Scientific Revolution and the Enlightenment who accept the evolving nature of truth. They are willing to live with a measure of uncertainty, are tolerant of cultural and religious diversity, and are usually socially optimistic. Their world is colored in shades of gray. True believers, on the other hand, are comforted by dogma, repulsed by diversity, and are less confident that humans can "sort things out for themselves." Their world is black and white. Whereas true believers retain in adulthood an absolute faith in some forms of "empirically unverifiable make-believe," skeptics keep a wary eye even on firmly established facts. In Raymo's opinion, genuine science can only flourish among skeptics. Pseudoscience, exemplified by astrology, parapsychology, New Age superstition, and religious fundamentalism, lies within the realm of the true believer.

After reading these distinctions between skeptics and true believers, most readers of this journal would be willing to align themselves with the skeptics. A further distinction is made, however, which makes this allegiance extremely difficult, if not impossible. To become a true skeptic, one must completely renounce the possibility of the supernatural. Raymo first denounces the miracles of his Catholic upbringing which include the authenticity of the Shroud of Turin, the spinning sun at Fatima, and the tradition of having throats blessed with crossed candles on Candlemas Day in order to prevent choking on chicken bones. But he goes on to deny the scientifically unexplainable teachings of Scripture: the existence of angels, the efficacy of intercessory prayer, the resurrection of the dead, and the possibility of everlasting life. What is left is a form of religion that is derived solely from the discoveries of science.

What does science teach us about the nature of God and the nature of man? According to Raymo,

God is nothing more than the name for an impersonal force which permeates the whole of creation. This is the "God of the spiraling powers" who resides in nature "beyond all metaphors, beyond all scriptures, beyond all final theories. It is the ground and source of our sense of wonderment, of power, of powerlessness, of light, of dark, of meaning, of bafflement" (p. 214). Human beings are nothing more than complex biochemical machines, mere mortals who are "contingent, ephemeral-animated stardust cast up on a random shore, a brief incandescence" (p. 245). We are encouraged to "surrender the ancient dream of immortality" so that we can begin to build a new theology, one that is "ecumenical, ecological and non-idolatrous" (p. 246).

What is this "new theology" which Raymo proposes? It appears to be the creation spirituality of Meister Eckhart, Thomas Berry, and Pierre Teilhard de Chardin. The surest way to know God is through creation, and the truest knowledge of creation is that provided by contemporary science. According to Raymo: "The dubious miracles of the scriptures and of the saints are an uncertain basis upon which to base a faith; the greater miracle of creation is with us twenty-four hours a day, revealed by science on every side, deepening and consolidating our sense of awe" (p. 133). The totality of religious experience is therefore relegated to the sense of wonder, adoration, and celebration we feel when confronted with the mysteries and complexities of the natural world. Several examples of these greater miracles are described: the astonishing replication process of DNA, the incredible migratory senses of the Red Knot, the unimaginable vastness of the universe, breathtaking observations of the comet Hyakutake, and the author's own "I - Thou" encounter with a solitary great blue heron.

Near the end of the book, the author states that "science cannot nor should not be a religion, but it can be the basis for the religious experience: astonishment, experiential union, adoration, praise" (p. 253). This statement suggests that there is only one type of religious experience that is possible—an experience derived from an awe-inspiring encounter with the mysteries of creation. Raymo is correct when he argues that this type of religious experience has often been downplayed within the Christian tradition. It is also true that this type of religious experience can lead to "exhilarating connections" between science and religion. But the implication that this is the archetypal religious experience, or possibly the only truly valid type of experience, is difficult to accept. When forced to choose between Raymo's brand of skepticism and the other option of "true belief," most people (as the author has documented) will readily choose this second option. If the intent of the author is to win converts to skepticism, his complete denial of the supernatural along with his rejection of other types of religious experiences are enough to ensure that there will not be many takers.

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

**MERE CREATION: Science, Faith and Intelligent Design** by William A. Dembski, ed. Downers Grove, IL: InterVarsity Press, 1998. 475 pages, index. Paperback; $24.99.

*Mere Creation* contains the proceedings of the 1996 "Mere Creation" conference at Biola University. The papers cover a wide range, from physics to biology to philosophy to ethics, and are organized into five categories: "Unseating Naturalism," "Design Theory," "Biological Design," "Philosophy & Design," and "Design in the Universe." While much of my review contains adverse criticism, I recommend this book to every member of the ASA because of its low price and wide range of arguments.

I set out, in reading *Mere Creation*, to require the arguments to convince me. My marginal notations are almost uniformly hostile—but there are large stretches of the book in which I did not feel the need to supply marginalia! This does not mean that I had no problems with the arguments presented (though often I did not), but rather that I often felt myself unqualified to judge the arguments in their full detail. For example, I know little of developmental biology (Jonathon Wells) or of the differences between finite state automata and push down storage automata (David Berlinski).

*Mere Creation* makes a good case for creation and design as First Causes, but not for throwing out evolutionary explanations for the development of life or the universe. Articles were often hostile to theistic evolution; the most sympathetic was Del Ratzsch' "Design, Chance and Theistic Evolution," an excellent analysis of the aspects of "intelligent design" which are necessarily parts of any theistic (or pantheistic) evolutionary picture—such as the fact that natural phenomena are mathematically tractable. As Ratzsch points out, Darwinism in its full rigor is reserved for philosophical naturalists.

The quality of the articles varied widely, from one which was beneath the level I find on my parish's tract rack to several which I found well-written

and convincing. Some were quite modest in their claims (papers by Siegfried and Sigrid Scherer on the use of "basic types" in biology were very careful to point out that "types" can fit into an evolutionary framework), while others were triumphal (Michael Behe, Hugh Ross) or downright contemptuous of Darwinism (Berlinski).

Several papers fail to convince. Walter L. Bradley's "Nature: Designed or Designoid?" seems an example of Richard Dawkins' "argument from incredulity." (Is Darwinism an argument from credulity?) Nancy Pearcey's "'You Guys Lost': Is Design a Closed Issue?" uses the history of science to commit the genetic fallacy, charging that Darwin and his followers arbitrarily closed off non-naturalistic explanations as "unscientific."

I found Hugh Ross particularly disappointing, because I am convinced that the anthropic cosmological principle is good evidence for theism. Most of Ross' one-hundred-plus, anthropic coincidences ("The Big Bang Model Refined by Fire") are specious. He commits the error of including many dubious items rather than expanding on the significance of a few, compelling instances.[1] Furthermore, Ross pads the list! For example, he lists the values of the electromagnetic force constant and the speed of light as separate coincidences; Maxwell's equations show that the latter is directly dependent on the former.

*Mere Creation* makes its most compelling argument in asserting that we must play fair. Archeologists debating over bits of stone use design arguments to decide whether the bits are human tools or not. Other sciences should be free to use the same types of arguments to decide whether other aspects of the world around us are designed. Dembski's article, "Redesigning Science," sets out clear criteria which may be used by design theorists.

1. If highly probable, the event should be attributed to law.

2. If the event has intermediate probability, it should be assigned to chance by default (though it may in fact be designed). If the event is highly improbable but fills no specified need or function, it may still be attributed to chance.

3. Only if an event is both highly improbable and carefully specified can it be attributed to design.

The best, most modest and most compelling statement of design theory is that we can and should determine whether certain bits of the world are or are not designed, regardless of whether we conclude that nearby bits could have developed by evolutionary processes. Design and some sort of evolution must coexist. Only the extremists on each side insist otherwise.

[1]For example, Ross claims that:

- the color of the Sun is exactly what it needs to be for photosynthesis. A quick inquiry into photosynthetic biochemistry would tell him that there are more than one extant photocenters that use wavelengths of light. The corollary is that any star that radiates in the visible region could support photosynthesis.
- a minor difference in the Earth's temperature range would result in no life. Paleoclimatology shows that the Earth has, in fact, had widely varying temperatures in its history, and life somehow managed to make it anyhow. Besides, biochemistry appears to be possible up to 200°C.
- the quantity of oxygen in the atmosphere is an anthropic coincidence. Free atmospheric oxygen is a *product* of living things, its particular concentration is maintained by biofeedback, and it would disappear quickly if life were snuffed out.

*Reviewed by Daniel J. Berger, Associate Professor of Chemistry, Bluffton College, Bluffton, OH 45817-1196.*

**GOD'S ECSTASY: The Creation of a Self-Creating World** by Beatrice Bruteau. New York: Crossroads Publishing Company, 1997. 179 pages, index, footnotes. Paperback; $19.95.

Bruteau, with degrees in mathematics and philosophy, writes "a book on science for Christians ... for already religious people who are acquainted with the basic doctrines of the Trinity and the Incarnation, and especially for contemplatives" (p. 9). Her goal is to show her readers, presumably not scientists, that science is a vital part of religious life.

The author, in her world view and understanding of Christianity, stands in the tradition of the late Teilhard de Chardin. This view is probably understood by few ASA members and adhered to by even fewer. It is highly interesting and hard going at times to view faith through a mindset so foreign, primarily because many words have alien meanings. The following excerpts illustrate the difficulties. "There may not be an external Designer... but neither is the world devoid of divinity ... the world can be regarded as an incarnate expression of the Trinity ..." (p. 9) and "... the manifestation and revelation of the invisible God, is the Cosmos ..." (p. 11). She equates "cosmogenesis" with "Christogenesis," the growth of Christ. "This Christ has been 'growing in stature and wisdom' (Luke 2:52) ... these last

dozen or so billion years and is nowhere near finished yet" (p. 12). She views the Trinity, the Incarnation, and *Theotokos* (Greek for "God-bearer") as metaphors. Trinity is used as both community and life-cycle; it is a plural word, not necessarily three. Incarnation is the union of the finite and the infinite, a model of the cosmos. *Theotokos* is the union of matter and spirit. "The cosmos is the great *Theotokos*, made by God as capable of giving birth to God, bringing the creative act full circle" (p. 21).

Bruteau is firm on one point which most ASA members will reject: "... the Infinite does not `intervene' in the finite" (p. 55). Miracles are totally within the laws of nature. God does not intervene in the world supernaturally.

With such a peculiar (to conventional Christians) view, is this book of any value at all? I think it is. Reading it impresses on me how varied are the views which come from humanity's search for meaning. I can reject the author's world view – yet I can learn from her. Her discussions on human consciousness, for instance, are interesting.

> It is not true to say we don't know what consciousness is. It is only true to say that we cannot find a fully satisfying way of saying what it is in terms of something else. This seems to me to be the mark of an independent dimension. Just as we all know what time is ... (p. 159).

I recommended the book as a "read" for ASA members interested in a different view of the religion-science interface.

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

**THE MEANING OF IT ALL: Thoughts of a Citizen Scientist** by Richard P. Feynman. Reading, MA: Addison-Wesley Books, 1998. 122 pages. Paperback.

Feynman was a great theoretical physicist, a lecturer with a pervasive sense of humor, and one who could often communicate his ideas clearly to a wide audience. This book contains three, nontechnical John Danz Lectures that Feynman gave at the University of Washington in 1963.

In his first lecture entitled "The Uncertainty of Science," Feynman attends to the question "What is science?" He discusses three important aspects of science: (1) the methodology of study, (2) the content of knowledge arising from the study, and (3) the things we can do with that knowledge (technology). Feynman also points out that the freedom to deal with doubt and uncertainty is very important to the scientific enterprise, and he returns to this subject in the second lecture.

The second lecture is entitled "The Uncertainty of Values." Feynman discusses such questions as why science and moral questions are independent (scientific study can tell you what will happen when/if ... but not whether it *should* happen), and he gives attention to what he describes as the two great heritages of Western civilization: the scientific spirit of adventure and Christian ethics. He also discusses the way in which the government of the Soviet Union treats scientists and independent thinkers. He maintains that humankind must have the freedom to grapple with questions on the truth of scientific principles, or the aesthetic value of artistic creations, or the validity of economic or philosophical doctrines, without governmental control of ideas.

> I hope for freedom for future generations – freedom to doubt, to develop, to continue the adventure of finding out new ways of doing things, of solving problems. Why do we grapple with problems? We are only in the beginning [of time for the human race]. We have plenty of time to solve the problems. The only way we will make a mistake is that in the impetuous youth of humanity we will decide we know the answer. That is it. No one else can think of anything else. And we will jam. We will confine man to the limited imagination of today's human beings.

In the third lecture titled "This Unscientific Age," Feynman covers an enormous amount of territory very rapidly. For example, he points out the problems we have with a variety of issues because we don't know how to deal with uncertainty, and in the process he debunks the claims of mind readers and astrologers. He discusses the way he approaches reports of unusual circumstances, and then moves on to discuss the ways in which ordinary people are being insulted by the news media, and then on to other concerns.

All of the lectures are presented in an informal, conversational style. Feynman's thoughts are clearly presented and often illustrate and they are engaging, to say the least. Some thinkers will wish Feynman could have been more thorough on the above themes. The probability is that no one knew better than Feynman that each topic deserved a book-length treatise. That was not his purpose. "I want to address myself directly to the impact of science on man's ideas in other fields," and this in a popular form. Therefore, none of these lectures are tightly woven arguments presented rigorously and in detail, rather they are, as the subtitle puts it, *thoughts*. Yet many of them are thoughts worthy of

consideration, for Feynman has tried very hard to communicate about important matters of science and the way scientific understanding impacts other areas of human knowledge and endeavor. The lectures are presented in the popular form in which they were originally given; thus, this book is very accessible to a wide variety of readers.

*Reviewed by Mark Koonz, P.O. Box 347, Opheim, MT 59250.*

**THE GENESIS QUESTION** by Hugh Ross. Colorado Springs, CO: Navpress, 1998. 235 pages, appendices, notes, indices. Hardback; $20.00.

Ross, founder of Reasons To Believe, is an astronomer turned high-profile Christian apologist. His work is well-known to the readers of *Perspectives on Science and Christian Faith*, with several of his books having been reviewed in these pages. In his most recent book, *The Genesis Question*, Ross attempts to harmonize the theology and science of Genesis 1-11. His reason for singling out these chapters for analysis is simple: "... most intellectual barriers (or excuses for dismissing Christianity) come from misconceptions about Genesis 1-11." The themes of the book are among Ross's favorites; they have appeared in several forms throughout his very diverse ministry. His primary task is not so much to summarize or evaluate the various attempts at harmonization but to present his own model. Of course, he does take the time to criticize some competing theories along the way.

The first major idea, and perhaps the most important one, we encounter in the book has appeared previously in *Creation and Time* and *The Creator and the Cosmos*. Ross stresses the importance of recognizing the correct frame of reference and initial conditions in a narrative. Ross begins with his interpretation of the implied frame of reference in the early verses of Genesis 1 within the framework of modern astrophysics and geophysics: "The events of the six Genesis creation days are described from the point of view of the surface of the ocean, underneath the cloud layer..." He argues that this interpretation, combined with a careful reading of the original Hebrew, removes many apparent difficulties in the early verses, in particular, the creation of plants prior to the creation of the sun. Throughout *The Genesis Question*, Ross assumes an ancient creation date. He does not spend much time defending it, since he has addressed it in some detail elsewhere.

There are a couple of short, yet very informative, chapters on history: one on Higher Criticism and the other on Creation Science. Ross's position falls somewhere between these two extremes. He uncovers an interesting ironic inconsistency within the Creation Science framework that I have not heard elsewhere: the several thousand species present on the ark must have evolved into the millions of species extant today in just a few thousand years!

It is difficult to say which part of the book is the most controversial, but the Flood certainly ranks high on the list. The local/global flood debate is more heated than the young/old age debate, which has been pretty much settled except for a few young-earth holdouts. Ross's proposal of a local flood interpretation is not new, but he does give some plausible theological defenses of it. He addresses another difficult issue, the origins of nations and races. His discussion, while mostly speculative, may serve the useful purpose of stimulating much needed debate on this topic. Other controversial topics touched on include the long life spans of the patriarchs and the Nephilim.

Several very useful appendices are included: one has the text of Genesis 1 with all the key words translated to the original Hebrew with their definitions; another associates specific scientific discoveries with specific sections of Genesis. Many of the associations are speculative, but that is the nature of this subject. The notes, as usual, are extensive. The works cited are quite diverse, ranging from the skeptical magazine, *Free Inquiry*, to the young-earth classic, *The Genesis Flood*. Curiously, there are no articles cited from *Perspectives on Science and Christian Faith (PSCF)*.

Ross will no doubt be criticized on specific points by some *PSCF* readers (he has already received criticism in a couple of recent articles). His approach is subject to the danger of changing scientific theories, and his exegesis of the text, while apparently reasonable, does not result in a unique interpretation. However, he would be the first to admit that his ideas should be considered as proposals, not as the only possible solutions. I strongly recommend *The Genesis Question* to anyone with a respect for science and the text of Genesis.

*Reviewed by Guillermo Gonzalez, Post-Doctoral Research Astronomer, University of Washington, Seattle, WA 98195.*

**Correction to Special Offer published in the June issue. See p. 160.**

**THE STARS ARE NOT ENOUGH: Scientists—Their Passions and Professions** by Joseph C. Hermanowicz. Chicago: The University of Chicago Press, 1998. 210 pages, appendices, references, index. Hardcover; $45.00. Paperback; $15.00.

In this book, Hermanowicz, a sociologist living in Chicago, studies the careers of sixty contemporary physicists of different ages and at universities with varied research reputations. He seeks to understand how the careers look "from within" by basing the study on an in-depth interview with each of the scientists. He asked the participants about their initial career aspirations as graduate students, their careers up to the time of the interview, and their hopes/goals for the remainder of their careers. The primary intention of the study is to see how careers are affected by the type of university setting in which they take place. A secondary issue is to see how career patterns are affected by the time period (and thus the job market conditions) in which they began.

Physicists are chosen in part as the object of study because physics is a field in which there are "heroes," such as Einstein, who are well known in society-at-large. Therefore, these heroes might be seen as inspirations for young physicists in a way parallel to Michael Jordan's influence on young athletes (Hermanowicz's analogy, not mine). The book could theoretically have studied academics in a different field and asked virtually the same questions. Thus, it is not a book in which one discovers what makes a physicist different from a biologist, but rather what makes a physicist at a prestigious university different from a physicist at a lower-ranked school. Contrary to the tone of the publisher's description, it is very much a book of sociology, rather than a book designed to inspire future scientists. Thus, a physical scientist whose department was going through a major review process might find it of interest, but it is not a good book to pass on to a student who is considering a career in the physical sciences.

The introduction discusses the sociological background for this book and describes the ways in which this study differs from those that preceded it. This introduction provides enough of a framework to allow a non-sociologist like this reviewer to understand the rest of the book, but not enough to judge whether it breaks new ground in its field.

I am somewhat hesitant about Hermanowicz's suggestion that his conclusions apply fairly widely across academic fields, since my graduate school experience in mathematics at a school similar to his "elite" institutions had a very different flavor from the descriptions given in this book. My classmates were a much more diverse group, in terms of self-images and initial career plans, than his descriptions allow. I don't know whether this reflects a genuine difference between mathematicians and physicists or anomalies in Hermanowicz's sample and/or mine. However, it does suggest caution in applying Hermanowicz's ideas across fields.

In summary, this is an interesting sociological study of careers in physics, but not the sort of "life as a scientist" book one might expect from the title and publisher's description.

*Reviewed by Kathleen E. Lewis, Assistant Professor of Mathematics, SUNY Oswego, Oswego, NY 13126.*

**THE GENETIC REVOLUTION AND HUMAN RIGHTS: The Oxford Amnesty Lectures 1998** by Justine Burley, ed. New York: Oxford University Press, 1999. 215 pages. Paperback; $14.95.

Some discoveries are so radical that scholars in many areas of study feel the necessity to re-examine their assumptions. The discovery of DNA and the ability to handle and change DNA is an instance of such a discovery. Now that scientists have cloned a sheep we ask: What if a man is cloned? Is cloning of human beings acceptable? Should we "improve" our race by DNA manipulation? What about "healing" DNA in embryos in the early stages of pregnancy? Should information obtained by checking the DNA of a person be protected information, not available to insurance companies or employers? In this book, fourteen writers discuss some of these questions.

The book consists of seven chapters. Each chapter has a main writer and a respondent. The chapter headings give an idea of the contents: "Cloning People," "The Age of Biological Control: Who Should Have Access to Genetic Information," "Clones, Genes, and Human Rights," "Eugenics and Human Rights," "Silver Spoons and Golden Genes: Talent Differentials and Distributive Justice," "A Perspective from Africa on Human Rights," and "Genetic Engineering." Most of the writers are teachers at universities, but in different disciplines and countries: Medicine (Sol Benatar); Politics (Jonathan Burley); Molecular Biology (Alan Colman); Law (Ruth Deech, Bartha Maria Knoppers); Zoology (Richard Dawkins, Richard Gardner); Ethics (Jonathan Glover, Roger Crisp, Alan Ryan); Bioethics (John Harris); Philosophy (Hilary Putnam, Roger Crisp, Jonathan Wolff); Political Philosophy (Hillel

Steiner); and Mathematical Logic (Hilary Putnam). Ian Wilmut, the writer of chapter two, studied embryo development in sheep which led to the birth of the sheep, "Dolly."

Following any important discovery, the question about human rights is likely to surface. However, one person's rights may infringe on another person's rights. In her essay, Knoppers points out that mechanistic responses not based on normative principles may eventually harm society. She points to ecological disasters, and believes that humility, caution, and foresight based on knowledge are ethical prerequisites for intervention.

That is more than what Putnam says on the first page of chapter one: we should not "violate the great Kantian maxim against treating another person solely as a means." Putnam's statement is ironical in a time when labor is just one of the means of production, according to economic theory. Human rights are too often viewed as a means to achieve a goal which may have detrimental results for many people. Rights and duties belong together. Not mentioning duties may be dangerous.

The writers live in different countries, thus they present different perspectives. For example, Benatar from Africa writes when discussing the monitoring of human rights:

> The United States is notable for two aspects of its programme. First, it selectively monitors and reports on human rights in other countries but fails to monitor/report human rights abuses within its own borders. In so doing there is a denial and masking of the extent to which the freedoms of its own citizens to control their lives have been eroded by powerful economic forces.

Roger Crisp points out that patenting a particular set of human genes may create a genetic underclass. Are the rights of people born in that new underclass violated? Another example is that a patented genetically-engineered crop may lead to greater poverty in the developing world.

Some people think that we should allow everything that is possible in reproductive techniques. For example, John Harris writes:

> In so far as decisions to reproduce in particular ways or even using particular technologies constitute decisions concerning central issues of value, then, arguably the freedom to make them is guaranteed by the constitution of any democratic society, unless the state has a compelling reason for denying them that control.

That could mean that rich people could buy embryos of a particular healthy, beautiful, or intelligent type, and thus create a superclass. Because people in this superclass would have fewer sicknesses, their insurance premiums would be lower than the premiums of others. The premiums of those not in the superclass will go up. Some probably cannot afford that. Others do not want to go that way. Also, if these records are required to get a job, it would get in the way of some people obtaining jobs.

One characteristic of modern universities is extreme specialization which has the advantage of getting to know more about certain subjects in a shorter time, but has the distinct disadvantage that many scientists do not think through the problems their discoveries may cause in other areas. That is especially true for discoveries which may have ethical, legal, or religious consequences. I believe that as Christians we ought to be concerned about the kind of questions discussed in this book. While we may not agree with everything in this book, it does open our eyes to the potential harm which may result from scientific work.

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

**GENETIC TESTING & SCREENING: Critical Engagement at the Intersection of Faith and Science** by Roger A. Willer, ed. Minneapolis: Kirk House, 1998. 210 pages, index. Paperback; $10.00.

The title may bring two questions to your mind: Do we need another book about genetics testing and religion? Why a book on genetic testing and screening, as opposed to, say, cloning? The authorship may evoke a categorization—yet another, poorly-integrated, edited volume. My answers are yes; and, as the editor indicates, testing and screening, not cloning, are where most people are going to be impacted by the application of genetic technology. (Such relatively common impacts include the possibility of losing insurance coverage, pre-natal testing and what to do with it, and whether or not to be tested for a hereditary disease found in other family members.) My comment on the multi-authorship is that this book is better integrated than most books written by several authors. There is evidence of awareness of each others' chapters. The editor is a pastor and theological student.

This book has an attribute not apparent from the citation at the beginning of this review: it was au-

thorized by the Division for Church in Society of the Evangelical Lutheran Church in America. It is not an official church statement on the topics, however. (I doubt if any denomination have official positions on genetic testing and screening.) All of the authors are members of Lutheran churches, presumably ELCA churches. There are places in the book where official ELCA doctrine is referred to. The ELCA does not seem to be vastly different from other Protestant bodies. It does allow for abortion in some cases, which some groups would not do. The book quotes Martin Luther's views in appropriate places, whereas books done by other denominations would quote other founders.

The book is well written. I did not find a single typo. It has appropriate sidebars and illustrations in some chapters. There is a five-page glossary, an adequate index, and several pages of notes. I shall comment on each of the nine chapters that are divided into the following sections: "Understanding Genetic Testing and Screening," "Engaging Worldviews and Proposing Alternatives," and "Confronting Professional Challenges," with three, four, and two chapters, respectively.

Kevin Powell, a pediatrician, medical school professor, and member of a hospital committee, wrote the first chapter, a basic guide. Even professional geneticists could profit from reading this. Powell defines and explains basic genetics and the issues involved in testing and screening. His use of a recipe metaphor for explaining nucleic acid function is new to me and clearly explains the function.

Kirsten Finn Schwandt is a genetic counselor. She explains her profession and gives ten types of examples of cases in which persons might seek genetic counseling. She states: "Genetic counselors do not tell people what decisions to make. For example, if a patient declines testing or chooses to terminate a pregnancy, it is his or her choice alone. The genetic counselor's code of ethics mandates this approach" (p. 40). Schwandt includes nearly a page of issues that, she believes, the church needs to think about and perhaps speak to.

John Varian is chief financial officer of a biotechnology company. In addition to considering moral questions raised by genetic testing and screening, he considers the economic aspects.

Philip Hefner is a theology professor and the editor of *Zygon*. This can be taken as his thesis statement: "The adequacy of the church's proclamation and spiritual nurturing will be judged by whether they engage the worldview, whether they reflect helpfully on the actual practice of genetic testing and screening, and sustain the men, women, and children who participate in our congregations" (p. 73). Hefner analyzes the prevailing worldview, and the Christian response to it.

Elizabeth Bettenhausen is a social ethicist and teacher, apparently including some current elementary school work. It is difficult to summarize her chapter succinctly, but I will say that she presents a case for an informed and active social conscience.

Ted Peters has taught and written about this kind of issue before. His chapter title is "Love and Dignity: Against Children Becoming Commodities." The availability of testing, he believes, will make us much more likely to discard fetuses which do not measure up.

Hans Tiefel is a college religion teacher. His chapter is entitled "Individualism vs. Faith: Genetic Ethics in Contrasting Perspectives."

Robert Roger Lebel is a clinical geneticist. His chapter, "A Geneticist's Synthesis: Evolution, Faith and Decision Making," seems to depart from "Mere Christianity," or perhaps from good sense, more than any of the other chapters. For example, "Each individual goes through an evolutionary process..." (p. 151); "If God had intended for us to fly, She would have given us wings" (p. 160); "Evil operates in the chemical world by disintegrating complex molecules, rendering them to simpler molecules and ultimately to individual chemical atoms" (p. 164). Lebel indicates that the other authors did not agree with him on all points.

I have reviewed several books of this type, but have never read a chapter like Larry Holst's. He is a retired hospital chaplain who has addressed his writing to pastors, describing how, in what seem to this non-pastor to be very practical, yet theologically informed ways, to deal with persons facing the dilemmas posed by genetic testing. He considers questions like: Should I be tested? Should my fetus be tested? What do I do with the knowledge that results from such a test?

This book would make an excellent addition to any library, personal or institutional, that deals with genetics and its intersection with religion and ethics. The first and last chapters, at least, should be required reading for all pastors, or pastors in training.

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

**ORIGINS, ICONS AND ILLUSIONS: Exploring the Science and Psychology of Creation and Evolution** by Harold R. Booher. St, Louis, MO: Warren H. Green, Inc., 1998. xviii + 474 pages. Paperback.

This is a skeptical work that turns a jaundiced eye on the entire gamut of cosmological, geological, palaeontological, and evolutionary sciences. Booher derives his authority to invade the fields of earth sciences and evolution from his degrees in psychology, human factors, and engineering, and from his wide experience in using a systems approach in studying the interaction of people and their technology.

His approach in this book is to analyze geological and evolutionary theories and the findings of science in conjunction with the human factor. The problem is that there is ultimately no way to do pure systems analysis on psychological interaction with ideas and theories in the abstract; an understanding of the data and a judgment on the validity of palaeontological and cosmological reasoning is also required. This is where he occasionally gets in trouble. He touts his interdisciplinary approach and his high regard for the scientific method as qualifications for this project, describing himself as a skeptic who will accept only what is inescapable. Unfortunately, he does seem to find the conclusions of Creation Scientists' writings less escapable than those of the standard scientists.

His lack of expertise in the field is revealed in his apparently unquestioning acceptance of Creation Scientists' claims that evolutionists are saying the fossils are old because the rocks are old and the enclosing rocks are old because the fossils are old (p. 31). Another example is his implication that the great overthrust faults, with the great Lewis Overthurst as a prime example, are mere hypotheses in order to explain fossils being out of evolutionary sequence (p. 68).

He discusses Creation Science (p. 154) and criticizes the Big Bang (pp. 158 ff.). He glosses over new discoveries in whale fossils to claim that there is no fossil evidence that they ever had legs (pp. 71, 91). He frequently uncritically accepts Creation Science writings (e.g., p. 116). He acknowledges that two scientific contributions to the speed of light decay debate tends to "force greater objectivity into creationists' findings" (p. 387). He appears to take flood geology seriously (p. 391) and adopts sneering rhetoric on occasion (p. 154).

Booher attempts to put the work of a wide variety of specialists into a manageable scheme of six parts. He sets the stage with an extended discussion of the implications and results of the famous Scopes trial, followed by a critical history of Darwinism in its various forms. He further builds his base with an excellent discussion of semantics and logic and of human perceptions and illusions. "Foundations" is a systematic analysis of and commentary on the geologic column, phylogenetic trees, homology, molecular biology, animal behavior, the perception and measure of time, and cosmological beliefs. He considers the postulated driving force of evolution, beginning of life, problems of biological complexity, and laws of thermodynamics, along with alternates from Neo-Catastrophism, the "New biology" intelligent design, and various scientific problems.

Two final chapters give his position on the issues. Needs influence beliefs while beliefs can dictate needs; together they influence perceptions so that people perceive what they want to perceive. Both the highly religious and those adhering to scientific authority exhibit similar religious type behavior. The special creationist's position is admittedly an interweaving of religion and philosophy. While at best evolution is non-religious, it provides many of the needs to its believers that religion does to the religious and is like a religion to those deeply committed to it. He sees evolution as promoting Godlessness, disbelief in a literal Bible, and a relativism and selfishness. Since science cannot prove either system of belief based on origins, faith determines individual choice.

His chapters on the problem of semantics, in which people not only confuse or trick others but are also confused and tricked themselves, and his chapter on the way human perception suffers from illusion, (over)simplification, and other tricks of the mind, senses, and will are very good. In his application of the observations to the debate, he raises a number of issues that all scientists, educators, and in fact anyone who tries to be well informed need to very soberly and carefully consider. However, he is occasionally his own best example. For instance, his principle of diffusion, in which there is "blurring of distinction between the real and the imagined, between known fact and known speculation" (p. 37), might well speak to his uncritical acceptance of Creation Science writings.

When all is considered, however, Booher does provide an excellent critique and an opportunity for the reader to carefully rethink his own position on many long held "virtual certainties," especially when some of the techniques and principles of critical evaluation so admirably laid out early in this book are applied to the arguments found therein. Recommended to the knowledgeable scholar and

lay person as an at times irritating, occasionally disturbing (by design), but always a very thought-provoking book.

*Reviewed by Eugene O. Bowser, Reference Librarian, James A. Michener Library, The University of Northern Colorado, Greeley, CO 80639.*

**BETRAYAL OF SCIENCE AND REASON** by Paul R. Ehrlich and Anne H. Ehrlich. Washington, DC: Island Press, 1996. 216 pages. Paperback; $16.95.

Paul and Anne Ehrlich, famous conservation biologists at Stanford University, coined the term "brownlash" in this book to describe anti-environmental rhetoric, particularly that with weak scientific credence. Paul has written over seven hundred articles and a number of books, including the famous *Population Bomb*, and, recently, *The Stork and the Plow*, each dealing with agriculture, the environment, and population issues.

Although now three years old, this book is relevant for both scientists and lay readers. It has copious references, and it is written in a clear, understandable style. This book aims at unscientific anti-environmental writing in the press. In short, it defends the "scientific consensus" that there are serious global environmental problems worthy of scientific and political attention.

The authors begin by telling how they came to move from being traditional scientists to environmental activists and writers. They then move on to define "wise use," a movement popularized in recent years, ostensibly to continue to use earth's resources, but to use them "wisely." Here is where the book moves into its main mode: disputing various authors' statements and clarifying or explaining what the Ehrlichs believe to be the case. Their arguments start with a whole chapter clarifying some of the issues besides wisdom involved in the wise use movement. They contend that many "wise use" groups are driven by personal or corporate greed, and confuse the general populace because they place short-term goals over long-term ecological and social health.

The third chapter, titled "In Defense of Science," decries the attacks on science by everyone from religious fundamentalists to astrologists to corporate raiders. However, to their credit, the Ehrlichs manage to explain to the lay reader and remind the scientist of the basics of science, including "statistical analysis, controlled experimentation, computer modeling and peer review." Their explanation of how science deals with uncertainty and their reasonable extension to scientific views and advice regarding environmental degradation seem well presented.

Next, they present "The Good News ... in Perspective," a chapter about the many environmental improvements of the last fifty years, including improved water and air quality and legislation for reducing pollution. However, the chapter ends on a down note, pointing out efforts to weaken environmental laws while three major factors still pressure the environment: increasing population, consumption, and environmentally damaging technologies.

This leads to four chapters which refute claims by many "brownlash writers." These four chapters are on "Population and Food," "Non-living Resources," "Biological Diversity and the Environmental Species Act," and "The Atmosphere and Climate." In each chapter, they point out real trends masked or outright discounted by various recent authors. They note that population is continuing to increase, while food production is no longer keeping pace in many parts of the globe. They recognize that, although there may be sufficient natural resources for the present, the costs of extraction are rising, including environmental costs. They point out that biological diversity is threatened around the world, primarily as habitat is destroyed for human habitation and resource extraction (e.g., clear cut forestry). They suggest that the losses may be costly. Finally, they point out that there is mounting evidence that local, regional, and global atmospheric and climatic changes are taking place, while there has been little admission of these real concerns by brownlash writers.

After many attacks and counterarguments, the final chapter left me a bit depressed. Nevertheless, if one is interested in understanding the issues and possible future of the environmental movement, and likely, the possible futures for our country and world, this is a good place to pick up a flavor for some of the major players and some of the major themes affecting our lives. As we move into the twenty-first century, political, religious, scientific, economic, and environmental forces are interacting in fascinating and at times frightening ways.

This book will undoubtedly help to explain the situation and to remind us to use a critical eye when appraising scientific, environmental, or political statements. I was saddened that the Ehrlichs found so little to consider as positive, but was impressed

by their wide-ranging considerations of these issues so critical to our lives.

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**DIVIDED PLANET: The Ecology of Rich and Poor** by Tom Athanasiou. Athens, GA: The University of Georgia Press, 1998. 387 pages. Paperback, $16.95.

**ECOLOGICAL PSYCHOLOGY: Creating a More Earth-Friendly Human Nature** by George S. Howard. Notre Dame, IN: University of Notre Dame Press, 1997. 161 pages. Paperback.

was active in environmental and technology politics for more than two decades and wrote extensively on these subjects. Howard was chairman of a Department of Psychology. Athanasiou wants communal actions but believes that these will only come through violent revolutions. He has no confidence in Christianity producing ecological improvements. Howard shows what we personally can do to improve our ecologically wasteful lifestyles (pp. 55–6). A basic shortcoming of the books is that references to Christians who wrote about the same subjects are missing. For example, they did not mention Calvin De Witt, professor of Environmental Studies at the University of Wisconsin.

Ecologists warn us that this planet, as we know it, will not last for more than a few decades. Natural disasters will destroy great parts of the planet, and food will become scarce. Floods, storms, exhaustion of the soil, and other disasters will overtake us, unless we stop destroying the ecological balance. Both writers deal with these problems, but do not agree about their cause. Consequently, they do not agree on solutions. Howard believes that overpopulation is the single cause from which all other disasters follow. Therefore, Howard wants people to limit reproduction voluntarily (p. 117), though he does not tell us how to achieve this. Athanasiou denies that overpopulation is the basic cause of ecological disasters (pp. 77ff). He points to the "logic of almost unregulated global economic processes that are far more powerful than the laws of individual nations" (p. 173).

Athanasiou shows the great danger of accumulation of land by a minority of people (pp. 54–5) He sees a connection between land and poverty: "The South (the third world countries) could be freed from its burden of odious debt, and even escape the crushing poverty that is the immediate, if not ultimate, cause of so much devastation." Athanasiou is not alone in that request. Canadian churches started action "Jubilee 2000" to release third world countries from their crushing debts to the World Bank, International Monetary Fund, and others (see web site www.webnet\~jubilee). Unregulated economic processes (free trade) and accumulation of land may be combined under one heading: greed.

Free trade leads to many injustices. For example, the 1998 strike at General Motors was to keep jobs from going to Mexico. The rich and the strong often become more powerful while the general population suffers. Average wages worldwide are going down, because the very poor underbid the poor for jobs (Athanasiou, p. 143). Even in the USA, average wages are lower now than in 1964 (p. 180). Under "free trade," corporations become planetary in their operations, thus often escaping state control. The state declines in power (p. 48), and unrest is created, especially in poor nations. Athanasiou rejects the argument that population control prevents hunger and decreases pollution since some well developed counties have a high population density. In underdeveloped countries, birth control is too expensive, causing population-growth to be larger than in the West. National security plays a part in population control, too. *The Interim*, Canada's pro-life, pro-family newspaper of July 1998, mentions a secret 1974 U.S. executive-level document, declassified in 1989, which states U.S. security as a reason that thirteen named countries should control their population.

Advances in science result in "improved" lifestyles often generating more garbage in production and consumption. Howard gives examples of how we can personally create less garbage. Athanasiou shows how we, in rich countries, contribute to the poverty and misery in our own and in third world countries by the "improved" way we live. Politicians speak about the growth of the GNP, but seldom about the declining of average incomes. When rich countries ask poor countries to start new policies (e.g., birth control, pollution control, industrialization), they should include arrangements for the cost of their requests.

The injustices and disasters mentioned by Athanasiou and Howard must be taken seriously. Athanasiou documents facts in extensive notes. I recommend both books for study, though they are not written from a specific Christian point of view. Christians are guilty too, even when we disagree with Athanasiou's accusations (p. 100).

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

**EARTH FOR SALE** by Brian Tokar. Boston: South End Press, 1996. 224 pages.

*Earth For Sale* might be described as an ecological fundamentalist's diagnosis and prescription for healing the ecological movement. Tokar suggests that many of the environmental organizations have sold out to the corporate culture or lost sight of their real *raison d'être*, and he suggests a return to basics and more grassroots activism.

Tokar teaches at the Institute for Social Ecology and Goddard College. The Institute of Social Ecology "integrates the study of human and natural ecosystems, advances a critical, holistic worldview and suggests that creative human enterprise can construct an alternative future, reharmonizing people's relationship to the natural world ..." Tokar studied biophysics at Harvard, has been a peace and environmental activist since the 1970s, and has also written *The Green Alternative: Creating an Ecological Future*. He includes what appear to be personal accounts of various activist demonstrations as well as personal relationships with various individuals in the environmental movement. He makes no claims that his book is unbiased, but, with thirty-five pages of references and notes, it is well researched, and fairly clear in its description of its position.

Tokar begins by presenting an image of the "Official Environmental" movement. He claims that "deep ecology" was originally a grassroots movement, which was strongly anti-establishment and anti-corporate. In the years since, however, it has been largely co-opted by corporations and even many "environmental" organizations are strongly influenced or even controlled by corporate and other potentially anti-environmental organizations. He notes that the Sierra Club, Audubon Society, Wilderness Society and National Wildlife Federation each accept significant contributions from corporations. The Audubon society, for example, spent $38 million in 1988, with only $10 million from individual contributions. Corporate donors included General Electric, GTE, Amoco, Chevron, DuPont, and Morgan Guaranty Trust.

He claims the perplexity goes further: Twenty-three leaders of various environmental organizations, including the Wilderness Society, NRDC, the World Resources Institute, and the World Wildlife Fund, were associated with nineteen corporations cited in the National Wildlife Federation's recent survey of the five hundred worst industrial polluters, including Exxon, Monsanto, Union Carbide, and Weyerhaeuser. He concludes: "It is getting hard to figure out who is really protecting the planet and who is poisoning it."

The ensuing chapters are specific examples of how the environmental movement has been severely compromised, or, in some cases, even bought out by corporations. Chapter 2, "Trading Away the Earth," discusses tradable permits for pollution and "corporate environmentalism." Chapter three, "The Limits of Regulation," points out that many environmental organizations have now come to define successes in terms of legislative and litigative milestones. He notes: "We are losing sight of the real issues of health and abundance of natural ecosystems."

After presenting his diagnosis of the compromised environmental movement, Tokar begins the second half of the book, whose theme is "New Ecological Movements." Chapter six, "Environmental Justice," hits close to home for me as a Christian. A quote from Robert Bullard sums it up:

> The crux of the problem is that the mainstream environmental movement has not sufficiently addressed the fact that social inequality and imbalances or power are at the heart of environmental degradation, resource depletion, pollution and even overpopulation. The environmental crisis can simply not be solved effectively without social justice.

In chapter eight, a quote on the image of planet earth by Vandana Shiva summarizes much of the book: "The concept of the planet is invoked by the most rapacious and greedy institutions to destroy and kill the cultures which use a planetary consciousness to guide their daily actions." Tokar seems to find many modern prophets, some of whom are extremely eloquent, to support his views. Other chapters in the later part of the book include third world, forest, deep ecology, ecofeminist, peace, and other related movements.

Chapter ten summarizes the author's claims and hopes: "The heart and soul of the ecological movement does not lie with multi-million dollar organizations, politicians, or corporate America. It lies with millions of people all across the country and around the world." Tokar is calling for an ecological revival to "speak in a united voice for healing, cooperation and a peaceful, more compassionate future."

Despite moments of almost poetic prose, Tokar comes off in many places as downright abrasive. He pulls no punches, and, in fact, many environmental organizations or middle class citizens (and Christians) may be pushed beyond their comfort zone by this book. If taking a hard line is his aim, he has succeeded. If opening a dialogue was desired, he may have failed.

I have no evidence to suggest Mr. Tokar is a Christian, yet his words do offer a wake-up call, a prophecy of sorts for all: if we abdicate our responsibility for the environment, we may end up suffering for it. Our sins can be sins of commission, when we actively pollute or waste resources, and also sins of omission, when we fail to watch out for the rights of others, to steward the resources we have been given, or to speak out boldly when we see greed triumph over compassion, pride and power over humility, and stealth over honesty. If we abuse or allow abuses of people, resources, and other creatures, sooner or later, there will be consequences to our actions.

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**BELIEVING IN MAGIC: The Psychology of Superstition** by Stewart A. Vyse. New York: Oxford University Press, 1997. 220 pages.

If you had the assignment to produce a 220-page article for an encyclopedia, this is the document you might well produce. Chock full of facts, citations, reports of researchers in the field, it nonetheless falls short of recommendation, for it has no "soul." There is much of worth in the book, and it has, I believe, a valued place on library shelves. But, unless you have "psychology" in your job description, it is probably not a book you would retain for a private library.

The author addresses all the usual questions surrounding the issue: why superstitions are so common, how "rational" people come to put their faith in them, and how such behavior is established and maintained. However, every time Vyse draws close to an issue of real interest, e.g., what the difference might be between magic and religion, he pulls back, becomes passive, and talks about the views of others without making observations of his own. His own metaphysical assumptions are revealed, I think, by this passage: "Religious faith exists without need of proof, while science is built upon proof ... a number of ... religious groups hold beliefs that fall within our definition of superstition" (p. 21).

Chapter two, "The Superstitious Person," is perhaps the best. Keying on Nancy Reagan, neither condemning nor approving her particular behavior, he does a good job of explaining how superstitious behavior comes about—and continues—even in the lives of some highly intelligent, educated people.

The book concludes with this statement, which is as close as the author gets to expressing his own view: "When we recognize the power of human understanding, it is easy to choose science over magic, and the natural over the supernatural" (p. 220). Blurbs on the cover contain endorsements by James Randi and Martin Gardner. There is, apparently, no comparable work to this one from a Christian perspective. There should be.

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

**A DIFFERENT DEATH: Euthanasia and the Christian Tradition** by Edward J. Larson and Darrel W. Amundsen. Downers Grove, IL: InterVarsity 1998. 288 pages, notes, indices. Paperback.

This book is fundamentally a history of euthanasia in Christendom, starting with a review of opinions and practices related to suicide from early Christianity to today. Then it focuses on the various dimensions of suicide, assisted suicide, and euthanasia for patients who are terminally ill, chronically ill, or suffering from mental disorders, with choices varying from voluntary requests of the patients, to ending life at the discretion of the physician.

Larson is Professor of History and Law at the University of Georgia, and is Professor of Classics and Chair of the Department of Modern and Classical Languages at Western Washington University in Bellingham, Washington. They devote six chapters to a consideration of attitudes toward suicide and euthanasia beginning when Christianity arose, through early Christianity and the Middle Ages, and since the Middle Ages. Then they consider the Right-to-Die movement, transitions from this movement to a Right-to-be-Killed position, and current legal issues in physician-assisted suicide. Finally, they consider euthanasia practices today, and present their assessment of the desired course of action. The overall conclusion from their detailed and exhaustive historical and legal summary is that actively ending life is forbidden, but that deliberately choosing not to sustain life may not be.

Complex issues are involved. For a terminally ill person to cause his own death by drinking poison is forbidden; but for a terminally ill person to refuse to be attached to a life support system is not. For a physician to deliberately inject poison into a terminally ill person to end life is forbidden; but for a physician to increase the dosage of morphine to al-

leviate pain, even to the extent that the patient's life is shortened, is not.

A careful review of the issues and choices leads the authors to a definite distinction between "yearning for death and praying to die" and "taking one's own life." "The whole of the New Testament's and the church fathers' theology, morality and values militated against suicide, especially when it was done to avoid suffering."

The authors trace the development of the right-to-die movement to two major developments: (1) the growing ability to unnecessarily prolong the dying process through the use of technological techniques, and (2) the exploding health-costs associated with the new technologies. General Christian support has come for the personal and familial right to refuse medical treatment that merely prolongs the dying process. One development that grew from this need was the hospice concept, which provides a peaceful and pain-relieving environment for a terminally ill person's last days. Laws designed with such ends in mind include the concept of a living will and the designation of "durable power of attorney for health care." The 1990 Supreme Court Decision on the Cruzan case "confirmed everything that the right-to-die movement reasonably had sought with respect to the right to refuse medical treatment."

"There may come a point in the dying process when adequate pain medication depresses respiration to the point where the patient dies, but this is proper medical practice, not physician-assisted suicide or euthanasia." The acceptance of this right led naturally to efforts to extend it to include physician-assisted suicide and euthanasia. In this pair, the approval of physician-assisted suicide becomes the opening-wedge for the advocates of euthanasia. A necessary distinction must be drawn between the relief of unmanageable pain and the deliberate ending of the patient's life, not for objective pain but for subjective suffering and a false sense of control.

The authors next consider current legal issues in physician-assisted suicide, which have become the focal point of the euthanasia debate in America today. After a detailed consideration of these issues, the authors conclude the chapter by stating:

> Society will need to hear the compelling public-policy arguments against physician-assisted suicide, not just the biblical commands, or it will be seduced by the siren song of physician-assisted suicide, a song that sings of painless passings and dignified death without warning about the dark shoals of abuse, mistake, duress and undue influence that lie just beneath the surface calm of physician-assisted suicide.

In a consideration of euthanasia practices today, the authors argue that insufficient evidence may still be available, but what there is points toward the grim predictions of the opponents of euthanasia in which the practice is "fed by duress, abuse, mistakes, subtle coercion and changing societal norms." It is argued that no viable distinction is possible between physician-assisted suicide and euthanasia. Specific cases considered include Jack Kevorkian, and the history of euthanasia in the Netherlands, the only place in the world where euthanasia is currently openly practiced. Official records indicate a growing number of involuntary euthanasia cases performed primarily because of a lack of prospect for improvement rather than because of pain or suffering. The chapter concludes with five case histories in the Netherlands.

A final chapter stresses the Christian choice as caring, not killing. Key issues involve "pain management, patient control over life-sustaining treatment, and the recognition and treatment of depression." Hospice programs are recognized as one of the best and most general ways of meeting these needs.

This is a valuable book to be used as a resource in any responsible and informed Christian evaluation of the issues involved in facing the end of earthly life.

*Reviewed by Richard H. Bube, Emeritus Professor of Materials Science and Electrical Engineering, Stanford University, Stanford, CA 94305-2205.*

**THE TRIUNE GOD: A Historical and Systematic Study** by Colin E. Gunton. Grand Rapids, MI: Eerdmans Publishing Co., 1998. 246 pages, index. Paperback; $25.00.

The doctrine of creation is a topic that has been a key focus of systematic theologians from Augustine and Calvin (Book 1 of the *Institutes*) through Barth (Volume III.4 of *Church Dogmatics*) to contemporary theologians as diverse as Pannenberg (Volumes 1 and 2 of *Systematic Theology*), Henry (Volume 6 of *God, Revelation and Authority*), Thielicke (Volumes 1 and 2 of *The Evangelical Faith*), Bloesch (*God the Almighty: Power, Wisdom, Holiness, and Love*), and Erikson (*Christian Theology*). How the "doctrine" would have been understood in ancient Israel has

also been a focus of recent study (e.g., Simkins, *Creator & Creation: Nature in the Worldview of Ancient Israel*, Hendrickson, 1994).

Gunton, Professor of Christian Doctrine at King's College, University of London, has been addressing portions of this doctrine in various ways for a number of years (e.g., *Christ and Creation*, Eerdmans, 1992). His recent, edited volume, *The Doctrine of Creation* (T & T Clark, 1997), engaged a variety of contributors on issues as diverse as eternal creation, Genesis and the leaders of the Reformation, spatio-temporal dimensions of creation, divine and human creativity, and creation and eschatology. Gunton now extends this treatment into a monograph that considers the doctrine of creation in conversation with the history of the explication of the doctrine and modern science viewed in a theological frame.

A notable addition to the Edinburgh Studies in Constructive Theology series, the opening chapters discuss the origins of the doctrine in the Bible and early theology. He focuses on the relationship between the biblical view and Greek cosmology as exemplified by Plato, Aristotle, and later Greek thought. The writings of Justin Martyr, Irenaeus of Lyons, Origen of Alexandria, Athanasius, Basil of Caesarea, and Augustine of Hippo are all discussed, documenting a divide between early writers who focused on a theology of mediation and later writers who moved toward "creation out of nothing" as a chief focus within the doctrine of creation. Particular attention is paid to how early theologians made certain serious theological and exegetical mistakes that have led to highly problematic outcomes, not the least of which has been the historic divorce of theology from science.

The narrative moves on to consider the historical and intellectual dimensions of Thomas Aquinas (Aristotelian thought), John Duns Scotus, William of Ockham, and Immanuel Kant, which resulted in a new theology of nature. Somewhat in parallel, but largely divorced in conversation from the evolving theology of nature was a doctrine of creation discussion among Luther and Calvin through Barth to Pannenberg that focused principally on Trinitarian considerations and the role of creation in relation to redemption and evil.

After this historical grounding, Gunton then rapidly surveys modern science and its interactions with biblical and Christological considerations, focusing on creation and providence, the nature of being made "in the image and likeness of God," and eschatology and ethics. The book is facile in its historical theology approach to a key Christian doctrine and adept at bridging a variety of fields of human endeavor. Footnotes enable the reader to test the judgments of the author and the overall work clearly sets the stage for further work to be done by systematic theologians capable of engaging with the modern scientific enterprise. We shall await with eagerness Gunton's next major contribution to this formidable and important research agenda.

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**THE CHRIST MYTH** by Arthur Drews. Amherst, NY: Prometheus Books, 1998. 300 pages. Hardcover.

Originally published in Germany in 1910, this book was translated by C. Delisle Burns into English and republished in the United States later that year. This edition is a photocopy of that printing with a new cover. A jacket blurb is the only attempt to position it.

The argument Drews makes is that there is no basis for a historical Jesus. He describes the Jesus of Scripture as "scarcely more than the shadow of a shadow" and asserts it is "self-deceit to make the figure of this 'unique' and 'mighty' personality, to which a man may believe he must on historical grounds hold fast, the central point of religious consciousness" (p. 19).

Why has Prometheus Press issued this book? I can find no answer. Queries of several pastors and one philosophy professor uncovered only one who had ever heard of the author—then only as a minor writer of a bygone day. Ben Witherington's recent book, *The Jesus Quest*, makes no mention of him, nor does he cite it in his seven-page bibliography. Inquiries on several listservs, inhabited mostly by academics, drew a blank. I made direct inquiries to a CompuServe forum (Free Thought in Religion) where some of my atheist friends gather from time to time. Even there, I found no one who had heard of him or the book.

That leaves me in an embarrassing position. It is entirely possible that this work is of some importance, but that I have not found its target audience. I suspect, however, that its audience is unlikely to include many ASA members. Drews argues that a "Jesus cult" developed out of a combination of vari-

ous Jewish and pagan beliefs, that Paul was primarily responsible for its success, and that we can know nothing of Jesus himself, who may, or may not, have existed. He makes much of the fact, unquestioned by most Christian scholars, that many of Christ's words in the Gospels were not original, but had been said before by earlier historical figures. He makes much of the differences in the Gospels, writing: "Indeed, the differences and contradictions—and this not only to unimportant things, such as names, times and places, etc.—are so great that these literary documents of Christianity can hardly be surpassed in confusion" (p. 223).

A possible key to the author's thinking is: "They [the sources] are, we can add, of such a nature that a real historian ... cannot doubt that he has here to do with religious fiction, with myth in an historical form, which does not essentially differ from other myths and legends—such as perhaps the legend of Tell" (p. 229). Also: "... they [Christian theologians] might just nevertheless just for once consider how much that is of little worth, how much that is mistaken, spiritually insignificant and morally insufficient, even absolutely doubtful, there is in what Jesus preached" (p. 254).

Drews, it may be inferred, made the mistake of thinking one should base faith wholly on a belief in historical facts, rather than seeking a personal relationship with the Lord. He apparently went to his end without ever encountering the Risen Christ. That is sad. The book is not recommended; it has no merit.

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

# Letters

I am a scientist, an evangelical non-denominational Christian, and an old-Earth creationist. I recently decided to take up membership in the American Scientific Affiliation, thinking that I would find there a forum which would unify Christians with a serious scientific perspective, fostering enlightened dialogue on the many issues of science and faith which are relevant to our society. While I have in fact found some articles in *PSCF* interesting and thought-provoking, I am disappointed to find sharp lines of distinction being drawn over theological issues, destroying the unity with which we scientifically like-minded Christians should speak.

I was particularly disturbed to find, within the pages of *PSCF*, pejorative generalizations about premillennialists and literal inspiration of the Bible, such as the wholly false statement that "premillennialists ... are not concerned much with activities which would improve the world" (*PSCF* 50 [Dec. 1998]: 281). In like manner, while I do not mind reading a defense of the Presbyterian view of original sin, to label all opposing views as "subverting biblical teaching" is entirely inappropriate (*PSCF* 51 [June 1999]: 115).

It seems, from reading your publication, that the ASA is not in fact an organization for Christians of all traditions, in which we can put aside our denominational differences and work together to help Christians better understand science, and to help the world to better understand Christianity. Rather, it seems that the ASA is an organization for Christians of a particular tradition (namely, those with a strongly Reformed or Calvinist leaning), and that Christians of other stripes, such as myself, are not really welcome. I do not know if this statement reflects the makeup of the ASA membership, but it certainly reflects the tone of several articles in *PSCF*.

I would love to be part of an organization founded upon mutual respect that can freely discuss science and faith. I do not mind being told that others think my views are wrong, as that is an important part of free inquiry. However, if your organization were truly inter-denominational, I would not find your publication meanly disparaging views held by large segments of the Christian community, or saying that such views are not valid ones for a Christian to hold. I pray that God will bless the ministry of the ASA. But if, as it seems, "my kind of Christian" is not welcome in your organization, then perhaps I should discontinue my membership.

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## On Moberg

Three items in Moberg's thoughtful paper on the Great Commission (*PSCF* 51 [March 1999]: 8–16) seem to me to need comment. First, despite the way it is universally translated, Matt. 28:19 has only one imperative, "make disciples." What is translated "Go" is an aorist participle. While a Greek participle apparently can take on imperative force when coupled to an imperative, in most contexts the idiomatic translation is a clause, "As you travel." This is not so much a command to foreign missions as one to do something specific, to make disciples, wherever one goes. "Baptizing" and "teaching" (v. 20) are both present participles, indicating ongoing actions connected to the primary command. But the aorist participle, in contrast, does not indicate continuous or repeated goings, merely the fact. So this verse applies as much to the technician, the teacher, the scientist, the farmer, the carpenter, or the banker as to the minister, the evangelist, or the missionary.

Secondly, Moberg applies Matt. 7:1 correctly (p. 14), but does not give the full Greek sentence, which includes the second verse. What is forbidden is not evaluation, but the partiality of the classic "I'm tenacious; you're stubborn; he's pigheaded." God will not allow one to have two standards, a tough one for others and a slack one for oneself. But there must be a standard.

Finally, the point is implicit on page 16, but, I believe, should be made explicit and emphasized: every Christian should be directed of God to his or her occupation. How may this be accomplished? Paul was called by a dream (Acts 16:9f), by prophecy (13:1–4), by the need to deliver an offering (11:29f) and, apparently, by disagreement (15:36–41). Matthias, in contrast, was one of two selected by the church and chosen by lot (1:23-26).[1] The deacons were chosen by the multitude (6:3–6). That is, the Lord uses various means.

How does this work today? Though his means are never restricted, I believe that he usually takes his children step by step, using circumstances more often than revelations. For example, his direction has been recognized (usually later) in a "chance" meeting, blacklisting by an offended professor, doors opening as others closed, a special burden, a physical problem that frustrated an expectation, a letter that was not forwarded, among many others. Such matters have shaped at least a part of a career. Many have found themselves pursuing activities that they never anticipated, but are confident that they are fulfilling God's purpose. Indeed, they have found that Ps. 37:23 consistently holds.

### Note

[1] I recall being told that they had a church meeting and took a vote, in keeping with Baptist polity. However, I have found no evidence that *klēros* ever means "vote." There is another term for that, *psēphos* (Acts 26:10).

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## A Response to David Siemens' Prediction Sets

I read with interest the article by Siemens in *PSCF* proposing some prediction sets for evaluation of intelligent design theories.[1] I think he has made a beginning, primarily in examining theories based on DNA and the genetic information encoded therein. My intelligent design position was not specifically mentioned, but my views appear to be very similar to those of Michael Behe.[2] Behe does not use the words "genetic information" as I do, but he often uses the term "information" in much the same sense, and as a biochemist, it is clear that he is thinking of either DNA, RNA or proteins in his use of the term "information."

I now wish to critique Siemens' prediction statements.[3] I note: "... we should find no quiescent genes that are similar to active genes." Siemens' related prediction notes: " ... some structurally similar genes will have specific functions that do not parallel or overlap those found in related species." Also this "... prediction specifies that we should find sets of genes in various species in which one gene of a set preserves a function while other members of the set produce different effects." Although these items are listed as predictions by Siemens, they are really citations of some known experimental findings. Both Behe and I have emphasized that our view of design should be in accord with the scientific evidence. Both of us recognize the possibility of chance events (gene duplications, point mutations, gene crossovers, etc.), so quiescent genes, genes with parallel functions, or genes where different members of a set produce different effects, can be consistent with our concept of design theories. Hence both Behe's view and my own would be compatible with these latter two predictions of Siemens. Consequently, I disagree with Siemens' statement that each prediction would confirm only one of the two distinct intelligent design views noted earlier.

In regard to Siemens' suggested consequences, I do not consider "Efficiency" to have the significance that he suggests.[4] There are many other important considerations in regard to why living organisms are as they are. Siemens seems to be talking about the trapping and utilization of energy by a cell or organism. The assumption being, that if God were involved, these cells or organisms would operate at a maximum efficiency. I believe our knowledge is much too limited to even suggest how important a factor "Efficiency" is as a defining characteristic of the deity's impact on living organisms.

Siemens' second consequence, "On Descent," is probably of greater significance. I, and probably Behe, would accept a certain amount of ancestral descent, when the gene sequences clearly support this descent. In some instances, the role of the deity might be at the "governance" level as suggested by Van Till,[5] and not subject to experimental study. In other instances the role of the deity might be more clearly evident from an examination of the data. I have recently noted one instance where genes seem to have appeared suddenly in the geological record (e.g., the genes for antibody formation which appeared first in the jawed fishes about 350 million years ago[6]). I have also noted that certain changes in the mitochondrial genetic code are not consistent with ancestral descent by chance alone.[7] I believe looking for similar instances would be a valuable research endeavor. I would caution, however, that we need to be aware of the possibility of interspecies gene transfer as a source of unexplained nucleotide sequences in DNA.

In dealing with the third suggested consequence listed by Siemens, "Extinction vs. Overlap," I would note that as a biochemist/molecular biologist, I have tried to phrase my "Design Theory of Theistic Evolution" so that it will be in accord with the scientific evidence.[8] Others (e.g., theologians or philosophers) might prefer to begin with a theological or philosophical position and attempt to fit the DNA sequence data to their position. I believe my position (a moderate MI by Siemens classification?) would be in accord with each of the scientific findings described in Siemens' "Extinction vs. Overlap" section.

It has always been my position that if my theory is found not to be in accord with the scientific evidence, it should be modified accordingly.[9] In my most recent papers, I have shown how the theory could be adapted to more recent findings (e.g., concepts of modular gene segment transfer, and the mitochondrial genetic code).[10] I have also suggested several different levels of possible activity by a designer, some of which might be subject to experimental confirmation, and some which could never be tested.[11] In a letter (with Philip Anderson), we tried to show that our view of the deity's activity was not as radically different from the views of other scientists (Van Till, Peacocke, and Polkinghorne) as some have suggested.[12] I believe continued discussion of these different views, in a charitable manner, to be worthwhile.

## Notes

[1]D. F. Siemens, "Two Prediction Sets and Their Consequences for Applying Intelligent Design Theories," *PSCF* 51:2 (1999): 108–13.

[2]M. J. Behe, *Darwin's Black Box: The Biochemical Challenge to Evolution* (New York: The Free Press, 1996), chapters 9, 10, and 11. See also ——, "Experimental Support for Regarding Functional Classes of Proteins to be Highly Isolated from Each Other," in J. Buell and V. Hearn, eds., *Darwinism: Science or Philosophy?* (Richardson, TX: Foundation for Thought & Ethics, 1994),60–71.

[3]Siemens, "Two Prediction Sets and Their Consequences," 109.

[4]Ibid., 109.

[5]H. J. Van Till and P. E. Johnson, "God and Evolution: An Exchange," *First Things* (June/July 1993): 32–41, p. 38.

[6]G. C. Mills, "The Origin of Antibody Diversity," *PSCF*, In Press.

[7]G. C. Mills, "Similarities and Differences in Mitochondrial Genomes: Theistic Implications," *PSCF* 50:4 (1998): 286–91.

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

[9]Ibid., 121.

[10]G. C. Mills, "Possible Role of Protein Modules in a Theory of Theistic Evolution." *PSCF* 50:2 (1998): 136–9; ——, "Similarities and Differences in Mitochondrial Genomes: Theistic Interpretations," *PSCF* 50:4 (1998): 286–91.

[11]Ibid., 290.

[12]P. E. Anderson and G. C. Mills, "Functional Integrity and God's Interaction with his Creation," *PSCF* 48:4 (1996): 282–4.

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