PERSPECTIVES on Science and Christian Faith

JOURNAL OF THE AMERICAN SCIENTIFIC AFFILIATION

In this issue . . .

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

VOLUME 48, NUMBER 2

JUNE 1996

Perspectives on Science and Christian Faith

MEMBER EVANGELICAL PRESS ASSOCIATION

MANUSCRIPT GUIDELINES

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PERSPECTIVES ON SCIENCE AND CHRISTIAN FAITH
(ISSN 0892-2675) is published quarterly for $30 per year by the American Scientific Affiliation, 55 Market Street, Ipswich, MA 01938-0668. Phone (508)356-5656. Fax (508)356-4375.
e-mail: asa@newl.com
http://www.calvin.edu/~grayt/mailasa/
Second class postage paid at Ipswich, MA and at additional mailing offices. POSTMASTER: Send address changes to: *Perspectives on Science and Christian Faith*, The American Scientific Affiliation, P.O. Box 668, Ipswich, MA 01938-0668.

Are Evangelical Scientists Practical Atheists?

A recent exchange on the HOPOS-L reflector saw one participant asserting that [science] "is a very humble, pragmatic method for taking observable events and constructing general statements to explain them ... the explanation is pragmatic truth ... not ultimate truth. It's weakness is that it is very narrow ... it cannot give ultimate explanations as to why we are here and why anything ... other ways of knowing art, music, literature, myth, religion can have a piece of the pie in explaining reality."

His opponent argued, "If civilization survived another 5,000-10,000 years, than there would be a fairly good [scientific] account of how an individual is 'effected' by art, music, literature, myth and religion." For him and many other intellectuals in the twentieth century, science has become a religion defined as the one and only source of truth concerning all of reality and man's questions.

ASA scientists may find some comfort with the first position. However, it is less easy to respond to those from within the Christian community who ask how the science that *we* engage is any different from that of our secular counterparts. It is one thing to be the subject of the derision of a non-believer, yet quite another when the charge of practical atheism is leveled by those of like faith. Do we function as naturalistic materialists in our daily work and Christians on Sunday?

Is there any discernable effect of our Christian world view on our vocation? Should we seek to promote what some have dubbed "theistic science?" Prominent scientists in the past have knowingly (and sometimes unknowingly) been influenced by their religious views. Today that seems less likely with the establishment of more universal norms in the scientific sub-disciplines.

I would ask our scientist readers to ponder anew the question of how their Christian faith plays a role in their scientific work. Some may wish to submit an essay on their thinking. In forthcoming issues of *PSCF*, we will feature a representative selection of your responses. Please limit your essay to 700 – 1000 words.

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In This Issue

That the grassroots of conservative Christianity is not entirely comfortable with the environmental movement can be gleaned from the remarks of televangelists and radio preachers who find an easy foe, and by laypeople, whose workplace activity and life style may be threatened by environmental law. Edwin A. Olson offers a more nuanced critique in his "A Response to Richard Wright's 'Tearing Down of the Green.'" If the soaring rhetoric of Christian environmentalists is to reach the church, it needs to take into account the causes for dissent.

In our second paper, George L. Murphy considers some of the potential ways that Christianity and the Bible may influence the science of physics. His thinking may provide background for the "essay" mentioned in the editorial. David L. Wilcox then examines anew "the bones" in his "Adam, Where are you? Changing Paradigms in Paleoanthropology." He concludes that the "image of God" in humans may have appeared in Africa as early as 150,000 years ago.

Next, Arie Leegwater offers a biographical sketch of Reijer Hooykaas, a leading Christian historian of science who influenced the thinking of the ASA and our UK counterpart, Christians in Science. David F. Siemens Jr. provides a critique of the way that evangelical scientists view evolution in his "Stepping Back to Look at Neo-Darwinism." Our concluding offering is a description of a novel science course taught by Karl Giberson and Kathy Frederich to liberal arts students at a Christian liberal arts college.

Letters to the editor and a strong section of book reviews conclude this issue.

A Response to Richard Wright's "Tearing Down the Green"

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Richard Wright's article, "Tearing Down the Green," (Perspectives on Science and Christian Faith, *June 1995) defines and debunks a group he calls the "evangelical backlash" — personified mainly by E. Calvin Beisner. More than a critique, however, Wright's paper also serves as a vehicle for communicating his overall outlook on environmental matters. In this paper, I take issue with Wright in a number of areas. I see regulatory excess, a slighting of scientific input for political gain, biased sources of environmental information, indoctrination masquerading as environmental education and Christian doctrine held hostage to an environmental agenda. Yes, there are environmental problems. But a crisis? No.*

In his paper, "Tearing Down the Green: Environmental Backlash in the Evangelical Sub-culture,"[1] Richard Wright infers that there exists a "backlash movement" (p. 80) within evangelicalism which he labels "Christian anti-environmentalism" (p. 89). The attack of these anti-environmentalists on the environmental movement, says Wright, is "primarily a political attack from the right in the name of Christianity" (p. 80). In his view these anti-environmentalists "make use of poor scientific work and discount the mainstream scientific consensus on the environment" (p. 80). To Wright, their scientific arguments are "patently indefensible ... when scrutinized carefully" (p. 90).

On what evidential grounds does Wright propose the existence of an evangelical backlash? He says that "without any doubt the two most prominent critics of environmentalism from within the Evangelical fold are E. Calvin Beisner and Larry Burkett" (p. 83). Burkett's specialty is advising Christians on financial management, and so Wright has no trouble exposing his lack of environmental expertise. Beisner, on the other hand, has done his homework regarding both environmental controversies and relevant biblical material. In fact, Wright acknowledges that "the presumed biblical support for [the emerging Christian anti-environmentalism] is currently found in Beisner's work" (p. 88). So when Wright describes the strategy of the environmental backlash as "calling into question most of the scientific claims of the environmentalists about resources, pollution, and population" (pp. 80-81), he really has in mind the writings of Calvin Beisner.[2] Thus, Wright's effort "to understand the environmental backlash within evangelical Christianity" (p. 89) seems reduced to finding out what makes Beisner tick. One wonders whether there is anything beyond a clash of two competent Christian brothers with contrasting ideological outlooks on environmental issues. Further insight into that clash was provided in a recent exchange between the two men in the pages of *PSCF*.[3]

If there is doubt about the reality of Wright's "evangelical backlash" as a movement, there is no question that he is provoked by certain secularists who furnish ammunition for Beisner to "put a Christian spin on" (p. 83). Calling them prominent anti-environmentalists, Wright lists Julian Simon, Herman Kahn, Fred Singer, and Dixy Lee Ray as Beisner's "scientific" sources. Notice the quotation marks enclosing *scientific*. They are the equivalent

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of *pseudo* — not a civil way to treat prominent people, even those with whom one differs.

Except for the first section, my critique of Wright's paper considers some of the same facets of environmental controversy which he addresses — political, scientific, informational, educational, and religious. To start, however, I call for a change in how debate is conducted.

Setting the Terms of the Debate

Winning a debate is made easier if you can either saddle your opponent's position with a label having bad connotations or adopt for your own ideas a term with winsome overtones. For example, members of the Institute for Creation Research and the multitudes in their sphere of influence have locked up the word *creationist* by their incessant use of that term to describe believers in fiat creation, a young earth, and flood geology. In so doing, they have pre-empted its use by Christian people who oppose their ideas yet hold to Divine creation. The latter are left with the label *evolutionist* simply because they are anti-"creationist."

The same kind of tactic is now being used in controversies over environmental issues. While Wright did not originate the practice, he makes full use of it. To him, environmentalists are "people with a strong interest in protecting the natural world and encouraging greater human concern for the world" (p. 80). They act "out of a deep love of nature and often out of sincere humanitarian concern" (p. 90). On the other hand, anti-environmentalists "deliberately downplay and deny unmistakable evidence that all is not right with the earth" (p. 90). This stark dichotomy is unfair and self-serving, creating a strong temptation to win points by applying the label *anti-environmentalist* without engaging the opposition's ideas.

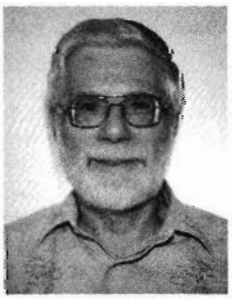
In my experience, anti-environmentalists are not a very large group. At least, I do not find many people who are either unconcerned about their surroundings or knowingly trash the planet. Consequently, when I oppose some of the ideas of those who call themselves environmentalists, I do not become thereby an anti-environmentalist. Indeed, if called that, I would be offended. I know from firsthand experience what bad air pollution is like, having grown up in Pittsburgh during the 1930s. I remember both the Donora tragedy of 1948 and the earlier rejuvenation of Pittsburgh when natural gas came flowing our way from Texas to replace soft coal in home-heating.

Thus, I place myself among a vast throng for whom environmentalist is a proper description. We are people who like clean air, good water, and healthful food; we appreciate a diverse biota, beautiful scenery, and the time and mobility to enjoy them. At the same time, some of us realize that perfection is not an option, that cost-benefit analyses are a part of the equation, and that trade-offs are sometimes necessary. We want to be full participants in the discussions without being dismissed as anti-environmentalist or backlash.

Politics and Environment

Wright's analysis of the political dimension of environmental concern is generally on the mark. He could easily have merged his world view analysis with politics, labeling the opposing viewpoints *liberal* and *conservative*. Thomas Sowell's categories of constrained and unconstrained visions also come close to describing the opposing views which Wright sketches out.

In bringing politics to bear on environmental issues, I differ from Wright mainly in two ways. First, I believe he sees too sharp a boundary between the political and the scientific. One could hope that when a full scientific analysis of an environmental problem is completed the proper course of remediation would be obvious to all concerned. Experience shows this is not so.



Dr. Edwin A. Olson is emeritus professor of geology at Whitworth College where he served on the faculty from 1960-1991. Since retiring, he has taught annually an introductory geology class, either physical or environmental geology. Olson has been an ASA member for about 40 years. In the 80s, he served a five-year term on the ASA Executive Council, which included a year as president. He has presented papers at four ASA annual meetings, one at Seattle on the topic, "Environmental PC — It Ain't Necessarily So." With two degrees in chemical engineering and a Ph.D. in geochemistry from Columbia University, Olson has the background to be an informed contributor to current environmental discussions.

Consider the issue of a diminishing ozone layer in the stratosphere, a problem Wright dealt with. Most likely due to CFCs diffusing into the ozone region from below, the depressed ozone levels might result in a higher ground-level flux of UV(B) radiation and thus a rise in skin cancer rates. In response to this possibility, an international meeting was held in Montreal in 1987. Out of the deliberations, there came the so-called Montreal Protocol. This agreement with subsequent actions led to the decision to stop worldwide production of CFCs at the end of 1995 and require a switch to new refrigerants of uncertain effectiveness and safety.

I believe [Wright] sees too sharp a boundary between the political and the scientific.

What went on at Montreal is the subject of a book by Karen T. Litfin entitled *Ozone Discourses*. She described her initiation into reality as follows:

> Superficially, this landmark ozone regime appears to have been the result of a rigorous process of risk analysis and adroit diplomacy with sophisticated atmospheric models serving as the scientific basis of the negotiations ... Like others, I was beguiled by a faith in the ability of science to make politics more rational and cooperative ... As I interviewed the participants and read the source documents from the international negotiating process, however, I began to suspect that more complicated dynamics than epistemic cooperation were involved. It became increasingly evident that "knowledge" was not deeply implicated in questions of framing and interpretation and that these were related to perceived interests. Although the range of uncertainty was narrow, atmospheric science did not provide a body of objective and value-free facts from which international cooperation emerged. Rather, knowledge was framed in light of specific interests and preexisting discourses so that questions of value were rendered as questions of fact, with exogenous factors shaping the political salience of various modes of interpreting that knowledge. In particular the discourse of precautionary action, not itself mandated by atmospheric science, moved from a subordinate to a dominant position.[4]

Litfin later describes the two main groups making up the U.S. delegation to the Montreal negotiations. Of course, there were the scientists. But ultimately of greater importance were people she calls "a group of ecologically minded knowledge brokers," mostly employed by the EPA. It was they who were "instrumental both in translating the available knowledge into terms understandable to decision-makers and in pushing forward specific policy proposals. This group ... was more inclined than were the scientists to employ knowledge on behalf of far-reaching policy recommendations."[5] In fact, says Litfin, almost no scientists "advocated the virtual ban on CFCs that was promoted by the U.S. delegation."[6]

What happened in Montreal in relation to ozone provides us with a prototypical scenario for handling alleged or real environmental problems once they reach the hands of political knowledge brokers, people with a "we-must-save-the-earth" mentality. With such a mind-set, extreme political options will always be the most favored ones. It is clear, then, to use Litfin's words, that "while [scientific] knowledge [is] indispensable, it [is] always open to interpretation, and it [is] never apolitical" (*was* changed to *is*).[7]

My second difference with Wright has to do with the government's regulatory role in environmental matters. Without calling for a laissez-faire approach, I believe that regulations have gotten out of hand. John Stossel, investigative reporter for the 20/20 television program, expresses my judgment. Admitting that he has spent much of his career exposing a problem and calling for a government agency to correct it, Stossel now says:

> I'm embarrassed to admit that it took me two decades of reporting to see that governmental action has side effects like dependency. I now realize that the government controls which consumer reporters rave about do more harm than good ... and that unregulated free markets solve problems much better than government ... [Lawmakers] should adopt the Stossel Rule, which is that every time they pass a law they have to repeal two old ones ... making the regulatory monster just a little bit smaller.[8]

As Stossel calls for less governmental regulation, vice-president Al Gore calls for more — much more. Wright sees Gore as a very concerned man "who speaks the language of environmentalism [and] understands the scientific literature" (p. 82). From my perspective, however, he comes across as frightening. Consider this passage from his book, *Earth in the Balance*:

> It is essential that we refuse to wait for the obvious signs of impending catastrophe, that we begin immediately to catalyze a consensus for this new organizing principle. Adopting a central organizing principle ... means embarking on an all-out effort to use every policy and program, every law and institution, every treaty and alliance, every tactic and strategy, every plan and course of action — to use,

> in short, every means to halt the destruction of the environment and to preserve and nurture our ecological system. Minor shifts in policy, marginal adjustments in ongoing programs, moderate improvements in laws and regulations, rhetoric offered in lieu of genuine change — these are all forms of appeasement, designed to satisfy the public's desire to believe that sacrifice, struggle and a wrenching transformation of society will not be necessary.[9]

Of course, says Gore, "this wrenching transformation of society [will be] agreed to voluntarily." That judgment, in my view, is a sure sign that Gore is ignorant of both history and human nature.

When Science Has Trouble Being Heard

The litany of environmental problems seems to grow larger almost daily. At least it does in the minds of some who have already concluded that environmentally the world is on the road to destruction. Unfortunately, that general conclusion is infecting more and more people, almost certainly because of constant doom-and-gloom bombardment. If those influenced happen to be in education or the media, the rippling effect becomes an avalanche of opinion. What has developed as a result is a societal milieu in which everybody *knows* that there's an environmental crisis. To question that generalization or any of its component judgments is to receive looks of incredulity.

Since politicians respond more to opinion then to sober analysis, the societal costs resulting from certain political decisions about the environment can be very significant. Alar, asbestos, dioxin, low-frequency electric fields, certain pesticides, and radon — all have been called serious environmental threats based on scientific arguments. Unfortunately, all have generated unnecessary anxiety, and some have led to laws that mandate great expenditures of money for little or no gain.

The acid rain story is an example of science put to the service of an environmental problem and rebuffed when the findings contradicted what everyone *knew* to be true. Sulfur dioxide released at coal-fired power plants and base-metal smelters has long been recognized as a contributor to the acidity of rain. Seeking a quantitative evaluation of the acid rain problem, Congress in the late 1970s authorized a ten-year research effort that spanned the 1980s. Called the National Acid Precipitation Assessment Program (NAPAP), it was ultimately to employ three thousand scientists and spend in excess of half a billion dollars.

J. Laurence Kulp, NAPAP's research director for several years and chief editor for the 1987 interim report, summarized the NAPAP effort as follows:

> At the beginning of the [NAPAP] program, acid rain was suspected to have negative effects on surface waters, crops, forests, building materials, visibility and human health. Fortunately, the research has shown that the damage from current and historical levels of acid rain has ranged from negligible (for example, on crops) to modest (for example, on some lakes and streams). It is also clear that at current levels of acid rain deposition there will be no significant increase in these measured effects over the next half century. The causes and the distribution of acid rain over the United States through the seasons are now fairly well-defined, and rapid technological advances to control the emissions of the precursors of acid rain are occurring.[10]

When the interim report of 1987 came out, EPA officials and many environmentalists scoffed at the results because they failed to match what was expected. Kulp resigned shortly afterward and was succeeded by Dr. James Mahoney, who steered the program to completion and oversaw the final report of 5,000 pages. Like Kulp, Mahoney stood firm against the pressure from certain people in the environmental community to distort the interpretation of masses of data and make them say that acid rain was a disaster. Failing to get the report changed, these environmentalists and their political allies pushed through the Clean-Air Act of 1990 before the final NAPAP report was issued. Senator John Glenn chided his colleagues in the Senate when he said: "We spend over 500 million dollars on the most definitive study of acid precipitation that has ever been done in the history of the world, and then we do not want to listen to what [the experts] say."[11] According to Kulp, "The cost to society of the acid rain portion of the Clean-Air Act of 1990 will total at least forty billion dollars, but the benefits will be hardly perceptible."[12]

The acid rain story is an example of science put to the service of an environmental problem and rebuffed when the findings contradicted what everyone* knew *to be true.

The moral of the story is: Don't carry out expensive scientific evaluations if they will have no influence in shaping final policy.

Getting the Facts — Whom Can You Trust?

Wright traces environmental disagreements to their informational source. He writes: "The uninformed public — indeed, most of us — is dependent on whatever media source they encounter and can easily be misled into believing exaggerations and untruths" (p. 87). He is right. Then he asks how people can avoid being misled. His answer: "Look carefully into both sides of an issue and get in touch with the basic scientific work underlying the issue" (p. 87). Although generally valid, this approach neglects two facts: first, data often speak ambiguously, and second, bias is a part of every individual, even the most prestigious scientists. Environmental issues in particular seem fraught with both ambiguity and bias.

As a realist, Wright understands that the vast majority of people will not have access to the appropriate refereed literature, nor the interest to read it, nor the specialized understanding to evaluate it. So his recommendation is that people "search for media with no obvious ties to a political agenda." Fine! But then he recommends *Time*, *Newsweek*, *Discover*, *Scientific American*, and the *Nature Conservancy Magazine*. I subscribe to all but *Newsweek*, and it is not at all obvious to me that these publications (except *Scientific American*) lack a political agenda. Perhaps Wright is unaware that he himself has an agenda, one which matches that of the publications he recommends. To him their reporting probably reflects the perspective that he thinks all right-thinking people ought to have. On the other hand, I read environmental articles by *Time's* Eugene Linden and almost without exception detect a bias, one that is definitely not my own. Apparently, bias — or lack of same — is in the eye of the beholder.

One is not required to read between the lines in the case of Charles Alexander of *Time* magazine. During a global warming conference several years ago, he said: "As the science editor of *Time*, I would freely admit that on [the global warming] issue we have crossed the boundary from news reporting to advocacy."[13] Alexander's admission is only the tip of the iceberg. Everette E. Dennis, Executive Director of The Freedom Forum Media Studies Center, says that "U.S. newspapers and television (news magazines have been interpretive vehicles for years) have begun to leave behind their search for impartiality, however flawed that quest might have been."[14] Even *Time* magazine's Anastasia Toufexis wrote: "Much of today's political and social agenda is built around flagrantly flimsy figures ... Too often exaggerated figures are used to mislead, raise money or advance an agenda ... Environmental organizations tend to present the most alarming scenarios to pump up the threat of global warming."[15] She could easily have pointed an accusatory finger at her own organization.

Common sense tells us that advocates for a position can be careless with the truth — generally the more zealous, the more careless.

Another area where Wright and I differ is in his faith that certain environmental organizations simply go where the science leads them. Of the EPA, Wright says the group "makes a strong effort to base their regulatory rules on scientific research" (p. 87). Why, then, did the EPA oppose NAPAP results on acid rain? Why did the EPA require gasoline producers to use a minimum of 30% ethanol in their wintertime additives when cheaper and equally effective oxygenated compounds were available? (The Supreme Court has recently ruled that the EPA overstepped its authority.) When EPA administrator William K. Reilly asked a panel of experts to evaluate the science at EPA, he got back a fifty-page report that included these findings:

> The agency often fails to consider appropriate scientific information early or often enough in its decision making; fails to enlist routinely the best scientists — especially those at universities — to provide it with data; and fails to evaluate the impact of its regulations, thereby losing an opportunity to learn from past decisions.[16]

Wright also sees the environmental non-governmental organizations (NGOs) in a light different from mine. The specific NGOs he mentions are the Sierra Club, the Audubon Society, the Wilderness Society, the League of Conservation Voters, Greenpeace, Zero Population Growth, The Union of Concerned Scientists, the World Resources Institute, and the World Watch Institute. He says they all "hire scientifically trained staff ... and call on the findings of scientists for support" (p. 87). But my reading of literature from these NGOs leads me to conclude that science sometimes becomes a handmaiden for a political agenda. This is *not* to say that each group listed above is out to deceive through scientific deck-stacking. But common sense tells us that advocates for a position can be careless with the truth — gen-

erally the more zealous, the more careless. The constant internal prod for discernment is an absolute necessity for those who claim to be seeking the truth — myself included.

Environmental Education

To the extent that adults are educated about environmental matters, what they know is generally from print and TV journalism. Since journalists are overwhelmingly liberal in their political outlook, this bias comes through to the public when environmental issues are discussed. Under the heading "Environmentalist World View," Wright articulates well what the media present as environmental orthodoxy. While he offers a third way — what he calls the "Christian world view" — I sense that on the specific issues addressed in his summary of the "environmentalist world view" he is in substantial agreement. So insofar as the media curriculum in adult environmental education is mastered by the public, Wright is probably pleased. In 1994, a Louis Harris poll showed that it has been mastered. Asked to name "the greatest threat to human life," more chose "destruction of environment" than any other perceived danger.[17] Earlier, a 1989 poll by CBS News and the New York Times found 80 percent of the respondents agreed with this statement: "Protecting the environment is so important that requirements and standards cannot be too tight and continuing environmental improvements must be made regardless of the cost."[18]

Wright may be pleased as well with what is happening in the public schools — both primary and secondary. The crisis mentality is firmly in place. Thomas Harvey Holt investigated some of what happens under the rubric of environmental "education" and described his findings in an essay entitled: "Growing up green: are schools turning out eco-activists?"[19] What Holt found in curricula and in textbooks was a heavy dose of politics to the detriment of scientific background. Industry and the free-market economy were often denigrated and governmental solutions promoted. Students were even instructed in environmental activism. For example, second-graders in a New York City public school founded Kids-STOP (Save the Ozone Project) in order to "save the planet from the deadly effects of ozone depletion caused by continuing release of chlorofluorocarbons into the atmosphere."[20] Upon hearing this, Jack Padolino, president of the Pocono Environmental Education Center said: "Now what does a second-grader know about chlorofluorocarbons?" The answer, of course, is: "Not much." Such youngsters are reading a script, not expressing a judgment.

Holt went on to say that "many of those who shape the environmental education curriculum believe that their purpose is not to weigh conflicting facts, values and theories but to instill a sense of crisis."[21] Ed Clark of the Wildlife Center of Virginia is quoted as having said, "Understanding that the world is going to hell in a handbasket is half of environmental education."[22] I suggest that the other half is to create pliant, frightened students who later will endorse drastic solutions to overblown problems.

To the extent that adults are educated about environmental matters, what they know is generally from print and TV journalism.

Peggy Noonan, former Reagan speechwriter, provides an illustration of the environmental indoctrination that reaches down to the lowest levels of our educational system. She describes the day when

> my son came home from school ... and ran up the stairs with his backpack in his hand and announced with grave concern, like a perfect little Soviet child, that the air is so dirty now that it makes buildings fall down. It erodes them, he told me, and makes them crumble ... My son is afraid of capitalist polluters who are making the air unsafe to breathe and making buildings fall down ... He said, "We had a movie in class, a Green movie"... When [our society goes] into one of these seizures of fashion, we turn a good thing, protecting the environment, into a bad thing, environmental paranoia. We do not educate our children. We traumatize them.[23]

If the bleak picture presented to Noonan's son were accurate and the world really were on a fast road to destruction, one might argue that in the name of truth the chips must be allowed to fall where they may. There is, however, a contingent of unknown size, including me, who say it isn't so. Yes, there are environmental problems, and, yes, they need to be addressed. But an essential part of the story is the significant accomplishment in environmental remediation. The crisis approach is neither necessary to handle the situations we face nor helpful to our society's psychic well-being.

A Christian Approach to the Environment

With all sorts of religious spins being put on environmental matters, it was inevitable that eventu-

ally a manifesto by evangelical Christians would come out. That day occurred in late 1994 when Ron Sider as chief author, using scientific input from ecologist Calvin DeWitt, composed the 1600-word position paper entitled "Evangelical Declaration on the Care of Creation."[24] Other than one sentence listing seven "degradations of creation," the document links humans to their material environment with a number of verbs. One set is in the past tense and bemoans what has happened to planet earth; humans are said to have degraded, polluted, distorted, destroyed, devalued, used, forgotten to take care of, and failed in their stewardship of the environment. A second set of verbs urges certain wise actions — cherish, care for, protect, heal, sustain, preserve, nurture, respect, and extend Christ's healing to the environment (generally called *creation*). Helped by vagueness, this Evangelical Declaration has drawn almost universal approval from a host of well-known evangelical leaders, among them Richard Wright.[25] Almost the only negative note was sounded by E. Calvin Beisner in *World* magazine.[26] Focusing on the seven degradations of creation — the contribution of Calvin DeWitt — Beisner presented another side of the story. A subsequent issue of *World* carried an exchange between Sider and Beisner.[27]

Is Beisner a fool rushing in where angels fear to tread? After all, the list of eminent endorsers of the Declaration constitutes a formidable deterrent for an evangelical like Beisner to speak out. My opinion is that Beisner's intent was "pinpoint bombing" — aiming at specific environmental issues on which he has some expertise. Certainly no one in his right mind would oppose all the good verbs listed in the Declaration. But the problem with words such as *cherish* and *nurture* is that they must be defined by specific concrete acts, both individual and corporate. It is my judgment that Beisner, through his critique of the Declaration is really saying, "Let the rubber meet the road; let us wrestle with what it means specifically to be a good steward of God's world." I echo that view and hope that discussions where this occurs find their way into future issues of *PSCF*.

Although giving most attention to differences in outlook between himself and the "evangelical backlash," Wright understands as well that there are "fringe" groups entering environmental discussions with non-Christian religious convictions. He discusses them in a section headed "Gaia, New Age, Eco-feminism and Deep Ecology." I share his concerns and applaud his position. At the same time, I fear that there are deviations from orthodoxy closer to mainstream Christianity than Wright and I would like.

Orthodox Christians risk straying from the fundamentals of the faith, when their embrace of "mainstream environmentalism" leads them to conclude that human activities have brought the earth to the brink of disaster. For immature Christians, often young, it may be only a short step from an earth presumed to be in mortal danger to the conclusion that "saving the earth" must take priority over saving souls. In struggling to be witnesses for Christ, they may be tempted to take an easier path — namely, to jump on the popular environmental bandwagon as a substitute for the more difficult witness to a transcendent reality.

Orthodox Christians risk straying from the fundamentals of the faith when their embrace of "mainstream environmentalism" leads them to conclude that human activities have brought the earth to the brink of disaster.

What might be called mid-course theological adjustments make the environmental option increasingly attractive. These elevate environmental activism beyond its proper place in a full-orbed Christian world view. They are rationalizations which often take the form of downgrading the supremacy of the transcendent realm with its emphasis on reconciliation with God and eternal life in his presence. Or they may elevate material reality to almost a unity with the spiritual domain and so encourage utopian hopes for planet Earth, subtly suggesting that environmental cleanliness is next to godliness.

Even more subtle is the implication that the condition of the earth in the last days somehow influences the quality of the supernatural realm that will one day become "all in all." It is as if God has set up a covenant with the human race on a *quid pro quo* basis. How his people treat their planetary abode will ostensibly influence him as he prepares his heavenly house for their future occupancy. On that view, earth-keeping takes on the motivation of self-interest — not a bad reason but usually not the one trumpeted by Christian environmentalists.

There are, however, occasions on which theological orthodoxy is totally shunted aside to make way for an environmental agenda. This is the case with Philip Hefner, Lutheran theologian and editor

of *Zygon*, a journal relating science and Christian faith. Hefner has gone far beyond the looseness of speech that sometimes accompanies exuberance. Instead, he has discarded a Christian world view for an entirely new metaphysical outlook. Here is how he described it:

> In order to best serve our self-understandings, we must recognize (1) our intrinsic kinship with the rest of nature; (2) that our purpose as humans is to serve nature; (3) that we are preparers for nature's future; (4) that our highest calling as humans is to discern the dimensions of ultimacy in nature and to conceptualize them. In this we follow God's own pattern of investing in nature as the greatest project.[28]

With Hefner, there is no way one can legitimately suggest that beneath ambiguous language there really lies an orthodox world view. Hefner writes clearly and what he writes is not historical Christianity. Instead, it is a radical exaltation of current concerns about environmental problems and a clear demonstration that designing religious systems around an environmental core is not the exclusive province of the avant-garde groups which Wright describes in his paper.

Conclusion

Richard Wright is to be commended for his comprehensive overview of environmental controversy. I hope that his paper, Beisner's response, and my critique stimulate further discussion of this important subject. From my standpoint, that discussion should emphasize papers which focus on a single environmental issue and are multidimensional — including scientific, economic, political and theological dimensions. It would also help to lower the emotional pitch. *

Notes

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[3]Letter by E. Calvin Beisner and response by Richard T. Wright, *Perspectives on Science and the Christian Faith*, Dec. 1995, 285-288.
[4]Karen T. Litfin, *Ozone Discourses*, (New York: Columbia University, 1994), 5, 6.
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[6]Ibid, 81.
[7]Ibid, 81.
[8]Ileane Rudolph, "Consumer Reporter John Stossel: TV's Truth Sleuth," *TV Guide*, 28 January 1995, 43, 44, 46, 48.
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[10]J. Laurence Kulp, "Acid Rain: Causes, Effects and Control," *Regulation (The Cato Review of Business and Government)*, Winter 1990, 41.
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[13]L. Brent Bozell and Brent H. Baker: *And That's the Way it Isn't*, (Alexandria, VA: Media Research Center, 1990), 109.
[14]Everette E. Dennis, "The Re-Europeanization of the U.S. Media," *Communique 9* (The Freedom Forum Media Studies Center, an affiliate of Columbia University), no. 2, (Oct. 1994): 2.
[15] Anastasia Toufexis,"Damned Lies and Statistics," *Time*, 26 April 1993.
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[17] Constance Holden,"Science: What the Public Thinks," *Science* 264, 13 May 1994, 902.
[18]P. J. O'Rourke, *All the Trouble in the World*, (New York: The Atlantic Monthly Press, 1994), 143.
[19]Thomas Harvey Holt, "Growing Up Green: Are Schools Turning Out Eco-Activists?" *Reason*, Oct. 1991, 38-40.
[20]Ibid, 40.
[21]Ibid, 39.
[22]Ibid, 39.
[23]Peggy Noonan, *Life, Liberty and the Pursuit of Happiness*, (New York: Random House, 1994), 51-53.
[24]"Evangelical Declaration on the Care of Creation," *Prism*, Dec./Jan. 1994 (This Declaration was reprinted in *Perspectives on Science and Christian Faith*, June 1995, 110-111).
[25]Randy Frame, "150 Sign 'Care of Creation,'" *Christianity Today*, 4 April 1994, 76.
[26]E. Calvin Beisner, "Are God's Resources Finite?" *World*, 27 Nov. 1993, 10-13.
[27]Ron Sider, "Another View," *World*, 8 Jan. 1994, 22.
[28]Philip Hefner, "Nature: God's Great Project," *Zygon* 27, no. 3 (Sept. 1992): 327.

Possible Influences of Biblical Beliefs upon Physics

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In this paper, we consider some ways in which religious beliefs might be understood to influence the science of physics and/or the interpretation of its results. Six possibilities, which are not mutually exclusive, are considered. We are especially concerned here with the religion of Christianity and its Bible and with the science of physics.

Our title limits us to a certain part of the science-religion interface. We focus on "biblical beliefs," those based upon the Hebrew (and Aramaic) and Greek Scriptures, not with religion in general, and with physics, not with science in general, although we will note the broader context at times. It is equally important to note that we concentrate on physics, and not primarily on the philosophy of physics, though that boundary is not always sharp and we will sometimes cross it. Furthermore, the statement of the topic is asymmetric: we are interested in the way in which biblical beliefs may influence or limit physics, and not the influence of physics on biblical interpretation. Thus, for example, a naturalism which insists that all biblical accounts must be brought into conformity with current scientific understanding is outside our realm of interest at present.

Given these limitations, there are several ways to categorize views of the relationship between biblical beliefs and physics. We may note, for comparison, Barbour's four "ways of relating science and religion" (conflict, independence, dialogue, and integration, each with subcategories), or the five types of views on the specific question of the relationship between Big Bang cosmology and the doctrine of creation which Drees sets out.[1] Our survey of possible influences calls not for a comprehensive classification of ways in which two disciplines as a whole are related, but for a more informal listing of types of views for which people have argued.

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Some have seen the Bible as providing insights for physics in various degrees. The spectrum of such beliefs includes the idea that physics must conform to a "biblical physics" as well as the milder idea that the Bible contains hidden scientific information which helps to validate its authority. A view more in the mainline of the current science-theology dialogue is that some fundamental biblical views about the world have, at least historically, been influential in the development of physics.

Others would argue for the independence of biblical beliefs and physics. Scripture and science may be understood simply to be talking about two disjoint aspects of reality. On the other hand, Scripture and science might have a significant overlap, but science could be given independence — within its own realm of competence — by theology.

Finally, one may see the importance of biblical beliefs to lie in the realms of philosophy and ethics. Thus, biblical beliefs would be important for the meaning and use of physics.

We have, then, the following possibilities:

1. Investigation of the world must conform to a "scriptural science."
2. Scripture contains hidden scientific information.
3. The religious contribution to the cultural atmosphere can help scientific development.

This is a revision of a paper presented at the Pascal Centre International Conference on Science and Belief, August 1992.

4. Religion and science are disjoint.
5. Religion affirms the independence of science.
6. Religion provides deeper significance and value to scientific results obtained without religion.

Because biblical beliefs could conceivably influence physics in several ways, we do not have to make one choice among those views. It is possible, for example, that the Bible contains references to modern scientific concepts *and* that biblical ideas are needed for ethically responsible decisions about the technological applications of physics.

It will become clear that my own sympathies lie most strongly with the fifth and sixth of these views. We will note, however, some things which can be said in support of each, and all of them have some inadequacies that we need to be aware of.

Biblical Physics?

First, we consider the view that physics must conform to a supposed scriptural view of the physical world. This idea was widely held in the Middle Ages when the Aristotelian-Ptolemaic system was thought to be the world view of the Bible. When the deficiencies of Aristotelian physics began to surface, this idea ran into serious problems.

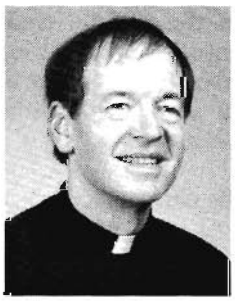
The positive aspect of the "biblical physics" view is its attempt to maintain a high view of biblical authority. We will note in our discussion of historical influences that biblical belief in the goodness of creation does seem to have played a role in the development of physics. Problems arise, however, if one tries to argue that models of the world used by biblical writers to present their message are authoritative *as* models of the world for today's physics. An obvious example is the attempt to find physical "waters above the firmament" because such waters were part of a world model of the culture in which Genesis 1 was written.

Attempts at "biblical" biology or geology under such rubrics as "creation science" are well-known today. There are related attempts in physics, Barnes' *Physics of the Future* being an example.[2] The Bible is not cited as an authority in this book, but it is significant that the book is published by the Institute for Creation Research. Its basic thesis is that the "physics of the future" is the physics of around 1890. Relativity and quantum theory, black holes, and the expansion of the universe are rejected in favor of the common-sense world and Baconian science which "creation scientists" think are required by the Bible.

It is not possible here to analyze Barnes' book in detail. Suffice it to say that he seems unaware of almost all developments in quantum theory or relativity since the 1920s, that he repeats statements with no proof, and that his model of the hydrogen atom — which is to remedy defects in Bohr's theory (as if Schrödinger never lived) — does not give the Rydberg formula. "Refutations" of modern physics and "Back to Newton"[3] appeals are not uncommon, and most physicists ignore or joke about them. The fact that this book is part of a modern religious program should give some pause to those involved in the science-theology dialogue.

Science Hidden in the Bible?

Another approach does not attempt to constrain science by biblical authority, but tries to find ideas of modern science in Scripture. The intent of such claims today seems to be more to show that the Bible is true and relevant because it contains scientific concepts than to exercise religious control over scientific work. Ramm devoted a chapter to criticism of the idea of "Anticipation of Science in Scripture," with reference especially to Rimmer and Sanden.[4] This approach to science-religion questions is not restricted to Christians. As Wood points out, some Muslims have argued that the Qur'an "contains references which can only be fully understood by modern science."[5]



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Since our concern here is with the influence of biblical beliefs on physics, we will simply note that the supposed references to atomic theory, electricity, airplanes, etc. in the Bible have all been *ex post facto* "discoveries." Once a scientific discovery or technological development has been made, it is relatively simple to find a verse of the Bible which can be given a figurative reference to it. It is not surprising that this procedure can also be practiced with the Qur'an. If the primary intention of texts is not given priority, one can read modern science into any ancient writing by interpreting its language as figuratively as necessary. It would be a different matter if one could find new aspects of physics in the Bible *before* scientists had discovered them, but that does not seem to happen. Thus, the supposed scientific references do not contribute anything to the development of physics.

This kind of eisegesis is not taken very seriously by most modern biblical scholars, for the most part rightly so. But the healthy intention behind the practice should not be ignored. Attempts to find hidden references to modern science in Scripture stem from belief that Scripture is not only authoritative but that it deals (at least in part) with the same world which is described by modern science.

The theologians of the early Church searched the Old Testament for hidden references to Christ, and often brought them forth by means of allegorical interpretation. Some of their results seem today no less artificial than attempts to find modern science in the Bible. There is a significant difference, however. The claim of the New Testament that "all the scriptures" bear witness to Christ (e.g., Lk. 24:25-27; 44-47) provides a basis for christological interpretation of the Old Testament, but the Bible does not give such a basis for a scientific interpretation.

Religion a Factor in Scientific Development?

It has been argued that the Judeo-Christian component of western culture was a major factor in the development of modern science.[6] To the extent that this is true, biblical ideas played an important part in the birth of physics. However, their significance for physics at its present point of development still remains open for discussion.

Without entering into detailed discussion of historical questions,[7] we can say that the following thesis seems plausible: the cultural atmosphere informed by the biblical tradition was important in the rise of modern science. There were promising beginnings in other cultures, but science never "took off" in them in the way it did in western Europe in the sixteenth and seventeenth centuries. For example, the biblical teaching that God has created a world which is "good but not God" may have been a significant factor in the rise of modern science. The assertion of Genesis 1 that creation is good means, among other things, that the world is knowable and *worth* knowing. But the world is different from God (e.g., Rom. 1:25) and, therefore, it is not a sacrilege to analyze it to discover its workings. Greek emphasis on rationality influenced the ways in which the goodness of the world was understood, but that emphasis helped to fuel the scientific revolution only when it was set in the context of biblical thought about creation.

Beliefs that the world can be understood by observation and rational thought, and that the object of that study deserves such attention, continue to be important for science today.

Beliefs that the world can be understood by observation and rational thought, and that the object of that study deserves such attention, continue to be important for science today. It could not endure long as a coherent enterprise without those beliefs.

We cannot conclude that science can be done only in a culture influenced by biblical faith. Scientific work was done before the scientific revolution and outside the Judeo-Christian tradition. We still teach Archimedes' Principle and make use of careful observations by ancient Chinese astronomers. There apparently were not the conditions needed for sustained scientific programs in other cultures, but scientific results were obtained by them.

Also, science has continued even when many scientists are not believers in the biblical tradition. Marxism, Buddhism, or agnosticism are at least as likely as Christianity or Judaism to be the core beliefs of scientists today, without obvious detriment to the quality of science *qua* science.

This is not surprising. The early successes of science could be appealed to as proof that it *can* understand the world, and such success continues today. In addition, science-based technologies provide a reason for many people to pursue the scientific

enterprise, apart from any theological arguments about the goodness of the world. These are merely pragmatic arguments for the validity and value of science and give the scientific enterprise no firm grounding. However, that does not invalidate the work which is done or show that science will eventually feel the lack of any basis in a theological doctrine of creation.

Religion and Science Disjoint?

The belief that science and religion really have nothing to do with one another is common. It is, of course, natural that scientists who have no interest in religion or a definite antipathy to it should wish to keep it from having any influence on science. Of more interest is the fact that some theologians have wanted to keep Christianity and science quite separate. That may stem simply from the belief that theologians and scientists should stick to their respective areas of competence, and that science can operate most honestly if questions of religious belief are not introduced into it. Theology came into some disrepute through its dealings with Galileo and Darwin, and it would be good to avoid such mistakes in the future. One way of doing that is to maintain that proper science and proper theology deal with completely different realms, that of observable facts and that of beliefs and values, and therefore *cannot* conflict. Barth's rejection of natural theology, and neo-orthodoxy in general, seem to support such a separation.

It is simply a fact that science today generally operates without any reference to God or God's interaction with the world. This is not by any means because all scientists are atheists. Many are Christians or believing members of other faiths. A person may feel called to be a physicist as his or her Christian vocation, yet that physicist will not appeal to divine activity as an explanation of something which has been observed in the laboratory. Physics *qua* physics is done — to use the phrase popularized by Bonhoeffer — *etsi deus non daretur*.[8]

But we cannot ignore the fact that the Bible does talk about the physical world, and not simply an inner realm of religious experience. To argue for a complete disjunction between biblical beliefs and physics has the practical consequence of making Christianity seem irrelevant because of its surrender of any claim to deal with what most people regard as "the real world." The theoretical foundations of this position are also weak. Torrance has pointed out that Barth's argument is actually directed against the idea of an *independent* natural theology which claims to discover truths about God and God's relationship with the world without God's own self-revelation.[9] It is something quite different to use science to learn about God within the context of specifically Christian theology. In that case, our understanding is subject to God's self-revelation from the start, and *a priori* theological objections to interaction between science and theology should disappear.

Emancipation of Science by Religion?

We have seen difficulties with the view that biblical beliefs and physics are simply unrelated. A more nuanced approach argues that they are related, but that one implication of a biblically based theology is an appropriate independence of science. We have already noted Torrance's argument which points in this direction. It is also fitting here to note that Pascal distanced himself both from the idea that God's activity could easily be discerned in the world *and* from the idea that it could not be discerned at all.

> What meets our eyes denotes neither a total absence nor a manifest presence of the divine, but the presence of a God who conceals Himself [cf. Isa. 45:15]. Everything bears this stamp.[10]

The idea that the world can be understood "though God were not given" is sometimes seen as an unpleasant fact forced upon Christian theology. It is certainly true that theology has often struggled against it, interposing various gods of the gaps. But there is a theological approach which seems to *require* the independence of science, the theology of the cross which stems from Luther.[11] I have argued for such a view of the relationship between theology and science.[12] One of its implications is that theology, on its own grounds, recognizes that science can be done without any reference to God. There is interaction between theology and science, but of a type more subtle than the interactions pictured by naive natural theologies.

Theologia crucis insists that God is not first to be found by our observation of natural phenomena and our reason (*Theologia gloriae*) but through God's self-revelation in situations of suffering and loss, in the apparent *absence* of God. God is active in everything which happens in the world but, as Pascal suggested, God hides himself behind natural processes, using them simultaneously as his "masks" and as his instruments of ongoing creation.[13]

(Of course, I do not suggest that a modern view of the place of physics is to be found in Luther's

writings. The point is that the theology of the cross provides a natural way, within the Christian context, to consider the possibility of a natural science which needs no explicit theological content.)

It is because these created instruments of creation work so well and (on the physical level) completely, because their operation displays the goodness of God's creative work, that God does not need to intervene directly in the world (though perhaps an exceptional set of miraculous events of measure zero needs to be allowed for). From the theological standpoint, this is *why* the universe can be understood *etsi deus non daretur*. In this view, natural science, and physics in particular, is granted its independence because of the goodness of God's creation. Indeed, science is *forced* to be independent. Even if it wanted special information from Scripture about the laws of physics, it would not get it.

The theology of the cross provides a natural way ... to consider the possibility of a natural science which needs no explicit theological content.

In this view, the relationships between physics and biblical faith will be seen differently by the Christian and the unbeliever, and both of them, as long as they do not overstate their case, will be correct. (Maybe the principal weakness of this whole approach lies in the temptation to exaggerate.) A physicist who is an atheist may say that no belief in God is needed for his or her work of understanding the processes which take place in the physical world. The physicist *qua* physicist need never refer to any explicit religious belief. This case is overstated, however, if the atheist asserts that science has shown that there simply is no reality behind or beyond what natural science deals with.

The Christian, however, believes that the existence of the world and the fact that it can be understood by scientific means are expressions of divine grace. God's activity takes place through secondary causes so suited to their task that phenomena can be explained in terms of them. While the world remains God's creation, dependent upon God, it has been given its own integrity. The doctrine of the contingent rationality of the universe which Torrance[14] has emphasized means that God has freely created a rational world, so that human observation and thought can grasp its character "from within."

Both the existence of the universe and the possibility of scientific understanding are seen by the believer to be based in the gracious activity of the God to whom the Bible bears witness. In this sense, physics has a religious underpinning. But the Christian should not overstate the case by arguing that a person must acknowledge, or even be aware of, this religious underpinning in order to be a competent physicist.

It has, of course, been argued that the order which science discerns in the world provides evidence for God. Many scientists, however, for one reason or another, are not convinced by such arguments. The point here is that they do not have to be convinced in order to do good science.

Meaning and Value from Religion?

Whatever theological attitude one may take to the matter, it does seem clear that modern physics has achieved a considerable depth of understanding of the world without having to make any explicit appeal to ideas of divine action. Wider and wider ranges of phenomena are being correlated, more and more control of the energies of nature is gained, and there seems to be no need to say anything about God in all of this. But what if the physicist steps outside the bounds of pure physics and asks about the meaning or purpose of all the marvelous order which science has disclosed? What if the engineer begins to ask about the ethical use of his or her technologies? Can we find any satisfactory answers to these questions if we continue to think and act as if God were not given?

A straightforward answer to the question of meaning has been given by Weinberg. After describing how scientific cosmology can tell us about the first minutes of the universe and connect them with phenomena today, he asks what this all means. From a purely scientific standpoint, he must honestly reply that it has no ultimate meaning. "The more the universe seems comprehensible," he says, "the more it also seems pointless."[15]

What of ethics? Oppenheimer could say of the military use of nuclear fission:

> In some crude sense, which no vulgarity, no humour, no overstatement can quite extinguish, the physicists have known sin, and this is a knowledge which they cannot lose.[16]

But he did not get the category "sin" from physics.

Christian theology does not try to tell physicists how to do physics — other than that it should be done honestly. However, it does place all natural science in the context of meaning and value set forth in Scripture, the revelation in the history of Israel which culminates in the crucified and risen Christ. This is the other side of the theology of the cross. God who is active but hidden in the wonders of nature is revealed in the hiddenness of the cross. And because *he* is risen and "ascended far above all the heavens, so that he might fill all things" (Eph. 4:10), the crucified is seen by faith to be the creator, the guide for all right action, and the goal of the universe. He is the one through whom and for whom all things were made (Col. 1:16), and to the pattern of whose *kenosis* we are to be conformed (Phil. 2:3-11). The purpose of the universe can be spoken of not only in terms of putative scientific "anthropic principles," but in terms of the Incarnation as a "theanthropic principle," and the theology of the cross is to provide the context for our decisions about ethical uses of technology.[17]

One biblical theme which is very helpful for dealing with such matters is *wisdom*. The biblical writers were not concerned to teach "natural science" in the modern sense, but the wisdom tradition of Israel is the closest thing in Scripture to a scientific approach to the world. It calls for a disciplined and realistic approach to nature as well as to social and personal relationships, and insists that genuine wisdom begins with "the fear of the LORD" (Pr. 9:10 and Ps. 111:10 — cf. also Pr. 1:7, 15:33 and Job 28:28). This tradition is given christological significance in the New Testament (e.g., I Cor. 1:18-31). Unlike much of Western thought since the Enlightenment, it makes no sharp separation between facts and values: the wise person not only knows things but behaves in ethical ways. From the standpoint of biblical faith, this tradition seems to be a natural context for science.[18] Without telling physicists the details of how the physical world and its subsystems work, it speaks to them of deeper meanings behind those workings, and provides ethical guidance for the use (and non-use) of science-based technologies.

The wisdom tradition would not deny that a person can do competent work in physics without faith in God, anymore than it would deny the possibility of good cooking or carpentry by unbelievers. But such a physicist would not deserve the title "wise" in the deepest biblical sense. Sirach 38:14-39:11 is of interest in this connection.

Physics itself cannot generate an ethic for the use of physics-based technology, but we cannot move immediately from that difficulty to a need for an ethic based upon the Bible. Scripture gives "You shall not kill" as a guideline for the use of nuclear energy, but so do many other religious and philosophical traditions. The second table of the law is not unique to the Judeo-Christian tradition. One may, of course, question the depth of understanding of such laws in other traditions, but that is another matter. Christianity shares with many other belief systems some general ideas about what is needed for the good ordering of society. Thus, it would be an overstatement to say that science needs a *uniquely* biblical ethic. *

Notes

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[3]Note, e.g., the book with this title by G. de Bothezat, *Back to Newton* (G. E. Stechert, New York, 1936).

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[5]K.A. Wood, "The Scientific Exegesis of the Qu'ran: A Case Study in Relating Science and Scripture," *Perspectives on Science and Christian Faith* 45 (1993): 93-94.

[6]See, e.g., J. L. Heilbron, *Elements of Early Modern Physics* (University of California, Berkeley CA, 1982), R. Hooykaas, *Religion and the Rise of Modern Science* (Scottish Academic, Edinburgh, 1973), and S. L. Jaki, *The Road of Science and the Ways to God* (University of Chicago, Chicago, 1978). C. Kaiser, *Creation and the History of Science* (Eerdmans, Grand Rapids MI, 1991), provides a good overall look at the interactions between the Christian understanding of creation and the development of science.

[7]For a modern discussion see, e.g., J. H. Brooke, *Science and Religion* (Cambridge University Press, Cambridge, 1991).

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[9]T. F. Torrance, *Transformation and Convergence in the Frame of Knowledge* (Eerdmans, Grand Rapids MI, 1984), 263-283, and *Reality and Scientific Theology* (Scottish Academic, Edinburgh, 1985).

[10]B. Pascal, *The Pensees* (Penguin, Baltimore, 1961), 222.

[11]See, e.g., W. von Loewenich, *Luther's Theology of the Cross* (Augsburg, Minneapolis, 1976).

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[13]M. Luther, *Luther's Works*, vol. 14, (Fortress, Philadelphia, 1957), 114.

[14]T. F. Torrance, *Divine and Contingent Order* (Oxford, New York, 1981), especially chapter 2.

[15]S. Weinberg, *The First Three Minutes* (Bantam, New York, 1979), 144.

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[17]G. L. Murphy, "The Incarnation as a Theanthropic Principle," *Word & World* XIII, (1993): 256 and "Chiasmic Cosmology as the Context for Bioethics," *Perspectives on Science and Christian Faith* 42 (1990): 94.

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Adam, Where Are You? Changing Paradigms in Paleoanthropology

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Current physical evidence in paleoanthropology favors the sudden appearance of anatomically modern humans about 150,000 years ago in Africa. Cultural evidence indicates parallel changes in artifacts and behavior. This suggests that the "image of God" was established in these humans at that time.

Paleoanthropology, the study of human fossils, is in a state of crisis.[1] In some senses, that crisis began long ago with the impact of the human-centered world view of the Enlightenment, and is only secondarily a product of scientific advance. The common mythology about science held both by the public and by many people in science is that facts (data) alone force us to modify our understanding of reality. What facts *mean*, however, depends on the patterns within which they are perceived. Some very perceptive comments on this subject have been made by Stephen J. Gould:

> First, facts do not come to us as objective items seen in the same unambiguous way by all reasonable people. Theory, habit, prejudice and culture all influence the facts we choose to observe and the way in which we perceive them. Second, the construction of theories is not a "second story" operation in science, an activity to be pursued after constructing a factual ground floor. Theory informs any good scientific work from the very beginning; for we ask questions in its light, and science is inquiry, not mindless collection. Moreover, the sources of theory are manifold; new ideas arise more often by the creative juxtaposition of concepts from other disciplines ... than from the gathering of new information within an accepted framework.[2]

Nowhere has this been more apparent than in paleoanthropology. As Landau documents, there is a pervasive tendency for storytellers' motifs to appear in theories of human origins.[3] The central role played in this debate by intensely defended paradigms has also been charted in Lewin's book, *Bones of Contention*.[4] Still, for forty years or more, there has been a generally accepted view of the origin of anatomically modern humans (AMHs), the polygenic hypothesis that we are products of gradual parallel evolution in several archaic hominid populations.[5] Now this consensus is being challenged by a resurgence of the monogenic view, the idea that AMHs originated fairly recently in a single location.[6] How significant is this challenge, and what does it mean for a Christian understanding of man?

Possibly the strongest advocate of the "traditional" view, Dr. Milford Wolpoff describes his view for the popular audience in the following words, which are quoted in Putman:

> Look, everyone knows that all humans alive today have a common origin. And everybody agrees that in some fundamental way that origin was in Africa. No doubt about this. Our closest relatives are chimpanzees ... I'm one of many who conclude that modern humans originated in areas all over the world — after *Homo erectus* had populated that world and provided the basis for further evolution. And that basically, modern Africans originated in Africa, modern Chinese in eastern Asia, modern Europeans in Europe. And this happens to some extent because these populations were interconnected by a flow of genes.[7]

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The primary evidence adduced in support has been the alleged local continuity of specific "racial" characteristics from *Homo erectus* populations to the modern populations of the same areas.[8]

Traditional anthropologists might be upset to find their discipline invaded by geneticists and physicists, who (with little training in anatomy) seem to think they can offer better theories without ever looking at a fossilized bone. But, traditionalists are no happier with certain physical anthropologists, who draw different conclusions from the fossil data. The challenges which the traditionalists are facing include: (1) a reinterpretation of the morphology of "archaic" *Homo sapiens*, (2) new dating methods for evaluating finds of early *Homo*, (3) reevaluations of the cultural evidence in Europe and Africa, and (4) results from comparisons of molecular sequence which bear on the biogeography and date of AMH origins. This paper evaluates the challenges of the first three areas, which may be viewed as extensions of existing techniques.

Reading the Bones

How well does the evidence support a gradual appearance of AMH? This question hinges on the nature of those hominid forms termed "archaic *Homo sapiens*," hominids with up to modern sized brains, but with archaic skeletal characteristics. If evidence of ancestry for modern forms (us) exists, it is here that it is most likely to be found, and thus the pressure from the investigators' world views is likely to be high. This is an area of controversy. Apparently there was a tendency for a simultaneous increase in both robustness and brain size in several areas around 200,000 to 300,000 years ago.[9] The question is whether these large brained fossils (including the Neanderthals with modern average brain sizes) are different enough from *H. erectus* to be classified in the same species with AMH, as "archaic *H. sapiens*," or whether general anatomy rather than brain size should be used for making taxonomic distinctions.

Earlier archaic fossils classified as *Homo erectus* appeared in Africa more than 1.7 million years ago, e.g., the boy from the Nariokotome River.[10] Then they spread to Europe and the Far East almost immediately.[11] The later forms classified as "archaic *Homo sapiens*" include populations such as the European Neanderthals, which have been cast as a separate robust species by several investigators.[12] The European Neanderthals had a distinct and a characteristic morphology which differentiated more than 100,000 years ago. Presumably, they descended from less specialized archaic forms which entered Europe 800,000 years ago.[13] Trinkaus characterizes them as having about the same life style as other archaic forms, life spans of 30 to 40 years,[14] showing more trauma (injury during life) than fossil populations of more modern aspect, of much higher endurance and strength (much thicker bones and larger muscle attachments), questionable phonetic ability, and more rapid growth and maturation of the brain, teeth, and extremities.[15] Neanderthals were contemporaries of AMH for about 65,000 years and were replaced in Europe by the AMH Cro-Magnon people about 35-40,000 years ago.[16]

In Foley's opinion, most of the differences between archaic *H. sapiens* and *H. erectus* are *allometric* changes (scaling) related to increased robustness.[17] Compared to AMH, archaic hominids were more robust, had a relatively flat basi-cranium and thicker skull bones, had larger facial skeletons and larger teeth, lacked the mental (chin) eminence and showed smaller, lower, and more elongated cranial vaults with more buttressing and torus formation. Though the archaic morphology may be very static, the brain size of the Nariokotome specimen (and the half million year old Zhoukoudian specimen) are about 65% of modern levels, whereas Neanderthal brain sizes were slightly greater than those of modern peoples.[18] Whether this represents a continuous trend, or stasis and punctuated speciation, is hotly debated, but Foley would identify all the "archaic *Homo sapiens*" forms as subspecies of *H. erectus*.[19]

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On the other hand, Foley suggests that skeletal differences between modern and archaic *H. sapiens* indicate a different *adaptive* complex. With the appearance of anatomically modern forms, he points out that the trend to robustness is reversed. We now see what has been termed neoteny, the retention of "juvenile" skeletal characteristics in the adult as well as cranial reorganization. Foley identifies the shift away from robustness to a more complex cultural base which possibly includes language. Thus, he stresses the idea that the uniqueness of AMHs is a qualitative difference which separates them from all earlier hominids.[20]

Traces of Time

The appearance of AMH seems to have occurred during a specific time period which has been a "black hole" as far as physical dating methods are concerned. C_{14} dating is inaccurate before 30,000 BC and most others inaccurate after 400,000 BC. Thus, time estimates have been based on analysis of anatomical and cultural evidence — which clearly has a circular element. Recent thermoluminescence (TL) and electron spin resonance (ESR) measurements, based on the ability of flint and tooth enamel to collect and retain electrons until heated, close that gap. Also, the tendency of amino acids in ancient proteins to racemization (randomly change from l to d form), and enhanced methods for C_{14} analysis, help to zero in on specific dates.[21]

A strong challenge to the polygenic view comes from recent new dates for the earliest anatomically modern *Homo sapiens*, dates of around 100,000 years ago. The most interesting of the finds have been the fossils of the Qafzeh and Es Skhul caves in Israel. These anatomically modern hominids had been thought to have lived about 50,000 years ago, and to represent a "Proto-Cro-magnon" (AMH) population evolving from earlier Neanderthals (archaic hominids) in the region.[22] This evaluation was based on anatomical considerations and on what was considered an advanced form of the typical middle palaeolithic technology (the Mousterian culture). Recent TL and ESR measurements and the associated small mammal fossils indicate instead that these individuals died around 92-115,000 years ago.[23] On the other hand, TL dates the presumed "ancestral" Neanderthal remains at Kebara at 60,000 years ago. Thus, AMHs long preceded their supposed Neanderthal "ancestors" in the Levant.

This conclusion has been hotly debated. For instance, Chase and Dibble would identify both sets of fossils as a single polymorphic population evolving in that area.[24] But Rak has shown that the Kebara and Qafzeh pelvises are sharply different, with that of Qafzeh indistinguishable from modern peoples and that of Kebara identical to European Neanderthal populations. Rak suggests that those differences relate to posture and locomotion, and are of the same order of magnitude as the differences in the skulls. He therefore concludes that they must represent two distinct species because such anatomical differences could not have remained distinct for 40,000 years in a single polymorphic population.[25] The same conclusions have been drawn about the overlap in Europe of Neanderthal and Cro-Magnon peoples.[26] AMHs of about the same era (perhaps slightly younger) have also been found at Border Cave and the Klasies River in South Africa and Omo-Kibish in Ethiopia. These finds have been thought to be as much as 120,000 years old (by the supporters of the new paradigm), suggesting an "African genesis." Grun et al., however, have reported ESR dates of 70-90,000 years ago for the finds in the Border Cave in South Africa (Zambia), a little more recent than Qafzeh.[27]

Created in the Image of God

The data seems to suggest that the big brained hominids of archaic morphology were displaced by AMH rather than developing into them, but did those archaic forms deserve to be called "men"? For the Christian, to be called "man" means to be made in the image of God (Gen. 1:26). However, *that* theological concept has been debated throughout Church history. We cannot solve this debate in this paper, but perhaps we can chart some options.

According to Anderson, the characteristics generally discussed include reason, righteousness, relationship, and rule. He views each characteristic as a facet of a complete scriptural description of God's design for humanity, with the additional complication that the image has been defaced by the fall.[28]

The first facet is reason, the concept that as a "rational soul" man mirrors the thought of God — that he can understand God and the world which he has made. Thus, man can communicate with, fellowship with, and worship his Maker. This view has been especially important to theology (such as that of Aquinas) which has been influenced by the Greek concept of eternal reason. It is held today by such men as Carl F. H. Henry and Gordon Clark. "The image must be reason or intellect. Christ is the image of God because he is God's Logos or Wisdom. This Logos enlightens every man that comes into the world. Man must be rational to have fellowship with God."[29]

The second facet is righteousness (especially favored by the reformers Calvin and Luther), the idea that man is to mirror the holy character of God in thought and in life. Unlike the rest of creation, man can choose to obey — or to disobey — being fully conscious of his own selfhood. Hence, the teaching of the Fall in Eden would imply a defacement of the image, though not its complete destruction. The fallen man still *knows* righteousness and can still reason. However, he freely rejects the right, refuses to perceive the evidence of God, and abuses his reason to support his rebellion. "For although they knew God, they neither glorified him as God nor gave thanks to him, but their thinking became futile (reason, understanding) and their foolish hearts were darkened (perception, will)" (Rom. 1:21).

It is not appropriate to base [whether an ancient hominid was in God's image] primarily on* physical *anthropology, for the image is not physical.

A third facet of the image of God is relationship, the idea that humans mirror God (who is a trinity, three persons in one being) in the way they form relationships — with God, with husband or wife, between humans (human society), and finally, with the rest of the creation. "So God created man in his own image, in the image of God he created him; male and female he created them" (Gen. 1:27). Thus, Barth would suggest that the image lies in the human capacity for relationship, for we reason or rationalize, show righteousness or selfishness, in community.[30] The image of God is not fully expressed in a solitary life. "The preservation of humanness has often been interpreted as the preservation of understanding and will, but actually it manifests itself in a much deeper and more important way in the various sorts of relations between man and fellow man."[31]

A fourth facet is rule, the idea that man images God by the office which he was given at his inception, the dominion over the earth. Thus, his intellectual and physical abilities equip him for that office. "You made him a little lower than God and crowned him with glory and honor. You made him ruler over the works of your hands; you put everything under his feet" (Psalm 8:4,5). The concept of rule views the human species as mirroring the kingly activity of God, as it obeys its creational commission; to govern under God and to further realize his purposes in the creation. In human cultural activity and development, the human community was to reflect the activity, intentions, and character of God to act in a pattern of governance which would increase the goodness of the creation — to tend and extend the garden of God (subdue the earth) and to build the City of God (the community of Shalom).

My intent in the above discussion was not to resolve this ancient discussion, but simply to sketch out its dimensions, to provide check points for evaluating anthropological data. How are we to evaluate whether an ancient hominid was in God's image or not? Clearly it is not appropriate to base this primarily on *physical* anthropology, for the image is not physical. What sort of fossil evidence can exist for reason, righteousness, relationship, and rule? These are, in a sense, behavioral questions; and all we have to look at are the remains of tools, burial practices, rates of cultural change, indications of their way of life, etc. Of course, as we look at such remains, we tell stories. In recent years, those stories have been changing.

The Cultured Neanderthal?

There is a considerable debate about cultural conclusions. According to Trinkaus, archaic types of *Homo* all maintained about the same mode of life throughout their tenure — scavengers and small game hunters doing a great deal of endurance running, a style of life comparable to that of the modern chimp.[32] But, others have considered them virtually identical to AMHs in cultural capacity.[33] What is the evidence?

As measured by tool making, the archaic cultural pattern certainly seems different. The only "cultural" evidence we have of *Homo erectus* is the Acheulian bifacial "handaxe" industry which appeared suddenly and remained more or less unchanged by time and location for a million years. Is this culture? It depends on definition. If culture means *learning* to make a specific sort of tool from another individual, then chimps have culture.[34] The question is: were the archaic hominids and hominoids more like chimps in their tool making, or more like modern humans? The shape of the triangular "axes" seems to have been determined by the material used, and the evidence is that they were made when needed and then discarded (the edges seldom show wear marks) — rather as chimps make and discard tools such as termite mound probes.[35] Morin et al. suggested that 1.57 million years were required to produce the "cultural" differences between two subspecies of chimpanzee.[36] There is no evidence of

symbolic art (cognitive significance?) or of burial (religious significance?) at *H. erectus* sites.

What about the larger brained "archaic *H. sapiens*"? The most complete cultural evidence is that of the Neanderthals. Their characteristic "tool kit," — termed the Mousterian culture — used flakes, scrapers, and wedge-shaped hand axes produced by the Levallois technique (a prepared core off which predictable flakes could be struck). It appeared around 100,000 years ago and remained uniform across Europe, unchanged for 65,000 years. In contrast, the Aurignacian evidence of the AMH Cro-Magnon people shows rapid continuous change.[37]

The extended period of Neanderthal cultural stasis is not true of *any* AMH population, including modern "stone age" groups such as the native people of Australia. It is far closer to the stasis seen in *H. erectus* than to the continuous change of the Cro-Magnon culture. As Mellars puts it,

> It is tempting to see the sharply increased morphological "complexity" and "structure" of Upper Paleolithic tool forms as one further manifestation of this "symbolic explosion" in the Upper Paleolithic, paralleling — and no doubt closely associated with — the simultaneous development of language and art.[38]

In less than half the tenure of the Neanderthals, AMHs were walking on the moon! Compare that to one of the most diagnostic anatomical features of the Neanderthals; mid-facial prognathism (along with increased nuchal musculature) was apparently an adaptation to facilitate the use of the anterior teeth as a vise.[39] If so, the physical structure of the Neanderthal changed under the selective pressure of their culture, which means that their *morphological genome* was more labile than their *culture.*

The evidence for artistic or religious expression among the Neanderthals is almost nonexistent.

The evidence for artistic or religious expression among the Neanderthals is almost nonexistent. There is debate over whether (and for what reasons) they may have occasionally buried their dead,[40] over whether they used ocher as paint, and over their hunting methods — for instance, did they use cliff fall techniques to hunt large game? However, there is no evidence of art, no ornaments, no symbolism, no indication of graving tools or sewing, and no clear indication of permanent settlements or trade of raw materials.[41] Mellers states:

> Lastly, many if not most Upper Paleolithic tool forms display a significant degree of 'imposed form' during the process of shaping tools, which is largely if not entirely lacking in at least the majority of Lower and Middle Paleolithic tools.[42]

Culture at Qafzeh

Was there a difference in the culture of the very early AMH at Qafzeh and Es Skhul? Burials, for one thing, had grave goods associated with them. Also, although the Qafzeh people used a "Mousterian" tool kit (Levallois technique), it is considered relatively "advanced," similar to those found at subsequent African sites and reminiscent of the Upper Palaeolithic.

> The early Levantine Mousterian (phase 1) is characterized by elongated Levallois points, a preponderance of "Upper Palaeolithic" tool types like burins and endscrapers, and a blade technology. This phase has been dated to ca. 90-80 kyr B.P. at Tabun, Layer D ...[43]

This use by a modern, rather than an archaic, population is possibly the *earliest* appearance of the Mousterian technique. Also, the archaic populations which lived at Tabun (layer C) for the next 40,000 years used a "typical" Mousterian style. At more northern Levantine sites (in Lebanon and Syria) and on across Europe, such typical "Tabun C" assemblies date from 90,000 years ago. Again, note that layers D and C differ more in the intended *use* of the tools rather than in tool manufacturing technique. This implies that greater *cognitive* control was exercised in their manufacture ... the tools in level D show higher levels of intent or design.[44]

Further, at the K'sar Akil rock shelter (Lebanon) and Boker Tachtit in the Negev, technologies of the later "Tabun B" type begin with "advanced" forms like "Tabun D." They are transformed in stages, by a series of major changes in technique, into the Aurignacian culture characteristic of the Cro-Magnon.[45] Since these sites are 47,000 to 50,000 years old, and since the Aurignacian culture may have reached Spain as early as 40,000 years ago, those 5,000 years represent a technological "explosion" at the rate of change typical of AMH "stone" cultures of 15,000 to 35,000 years ago.[46] Meanwhile, the contemporaneous Neanderthals enjoyed a 65,000-year period of cultural stasis![47]

In fact, one could speculate that the Neanderthal use of Mousterian techniques was imitation rather than invention, for it could have been *invented* by the Qafzeh people, and passed on (in part) to their Neanderthal neighbors (and thence on into Europe) to be used without change. Consider this in light of Mellars' evaluation of the Chatelperronian industries of Roc de Combe. Modern man and Neanderthal alternated in residence at this location for a few hundred years around 34,000 years ago. Mellars suggests that after modern humans arrived with their Aurignacian tool-making techniques, the local Neanderthals picked up some of the Aurignacian techniques and modified their Mousterian "tool kit," producing the Chatelperronian industries. (These levels are also the only Neanderthal remains showing a few bone and antler artifacts). To Mellars, this suggests an acculturation phenomenon, which implies Neanderthals were capable imitators (like AMH) but not creative inventors (unlike AMH).[48] This might also be compared with the acculturation of Kanzi, the pygmy chimp that makes stone tools.[49] Of course, the anthropological community has not completely accepted Mellars' conclusions![50]

Despite their rather human appearance, it seems unlikely that the group of fossils called "archaic Homo sapiens" meet the criteria which the Scriptures set for humanness.

To summarize, recent evaluations of the European cultural evidence have suggested that two very different species of hominid existed, and that one displaced the other. The Neanderthals apparently did not show the niche diversity of AMH (dominion over the earth?), but simply an extension of the archaic *Homo* niche.[51] Despite their large brains, they showed cultural stasis — no indications of representational art or record keeping, and no sign that language was part of their "adaptive complex" — things which the Cro-Magnon sites following them showed from the start.[52] It is hard to believe that their reasoning capacity was of the same order as man as we know him today (including modern hunting and gathering societies). The only indications of "religious" thought are a few possible burial sites, the significance of which are much debated.[53] I conclude that despite their rather human appearance, it seems unlikely that the group of fossils called "archaic *Homo sapiens*" meet the criteria which the Scriptures set for humanness. Like apes, they were simply creatures which resembled humans in some ways, but not in others.

Early African Culture

The above description is a contrast between Neanderthal and Cro-Magnon around 35,000 years ago in Europe. Still, if AMH appeared about 100,000 years ago, why is there a 65,000-year gap in the development of human culture? Perhaps because we have looked in the wrong place. After the Qafzeh people, there is no further evidence of AMH in Europe or Asia until about 50,000 years ago in the Levant and in Australia.[54] In Africa, it is a different story. Around the 70-100,000 year range, there are finds which range from Omo-Kibish in Ethiopia to the Klasies River in South Africa. The monogenic view typically holds that modern man arose at one of these locations and spread across the savannahs of eastern Africa.[55] What cultural evidence is associated with these early African finds?

One significant difference (from the European Mousterian) in the African cultural record is its high level of variability in place and time, which implies a dynamic, changing culture. Further, at scattered sites throughout eastern and southern Africa, "middle stone age" assemblages "reveal a number of features which in a European context would be more at home in an Upper than in a Middle Palaeolithic context ..."[56] For instance, recent finds by Yellen in Zaire indicate that the people of the Upper Semliki River were making tools, such as barbed bone harpoons and fish hooks, more than 90,000 years ago in a pattern which "reminded him of harpoon hooks made in Europe some 14,000 years ago."[57] These tools indicate that they thought of bone as a "plastic media which could be used for very many different things."[58] Also impressive are the "Howieson Poort" industries characterized by "microlithic forms" (tiny blades) designed as replaceable components of complex hafted tools, a feature characteristic of tools found in Europe about 15,000 years ago.[59] These finds have been ESR dated at 45-75,000 years old.[60] Both finds are especially significant since the manufacture of such tools requires a high level of prior conceptualization and the control of precise form.

Deacon has also reported "anachronistic" behavior among early Africans. He argues that they used fire to maintain and exploit "geophyte" patches of slow growing root crops, a form of "agriculture" supplemented by hunting and shellfish collection. Deacon concluded that anatomically modern people at Klasies were "using artifacts as symbols to cope

with stress,"[61] i.e., that they were behaviorally modern. In Zambia, Border Cave contains evidence of a 90,000-year-old (mesolithic), red hematite (ocher) mine which apparently had continuous usage for tens of thousands of years.[62] Over 60,000 worn mining tools have been found, including "picks," "cleavers," "hammers," "wedges," and "chisels," associated with modern skeletons.[63] The only known use of ocher is as a decorative and ceremonial material, usually in burials and religious rites. One cannot observe its use 90,000 years ago, but it seems reasonable to view the early modern peoples of Africa, like the later Cro-Magnon people, as fully human in every sense.

But, where did first AMH appear? The new paradigm opts for Africa, some place between South Africa and Ethiopia, or possibly the Levant, at the northern end of the continuous east African savannahs. Further, the material industry at Qafzeh (in Israel) was less advanced than the African finds, and the ESR dates at Qafzeh at somewhat earlier than the African dates. Indeed, the 50-60,000 year date for Australia is almost as old as that at Klasies River.[64] When we remember that man was "placed" in the garden planted eastward in Eden, we seem free to consider an African genesis.

In Conclusion

Where among the various hominids will we find the "adaptive barrier" between typical ape and typical human? Which forms shall we consider man (called to image God)? Which shall we consider beast (not so called)? Creation-wise, at the point (if it is a point, as I believe it to be) of human emergence, how did God act? Based on the evidence cited, we have tentatively suggested a few answers. Biologically, as Foley suggested, AMH show a distinctive adaptive anatomical complex, as well as a diverse ecological niche, both of which point to a high ability to control the environment. Based on this, I judge the anatomically modern *Homo sapiens* of Africa and the Levant (which appeared about 100,000 years ago) as a unified species, differentiated from the archaic groups of "*H. sapiens*" which preceded and paralleled him.[65] Theologically, what evidence we have concerning cognitive ability, symbolic behavior, religious activities, burials, and evident dominion over the earth (diversifying life styles) would indicate that modern man (AMH) has clearly shown the image of God wherever he has been found. What then of archaic *Homo* sps.? I would suggest that investing archaic *Homo* sp. with these qualities reflects, not a clear pattern in the data, but a commitment to the idea of the gradual appearance of human qualities. Both cultural and physical evidence suggest an abrupt establishment of the image about 100,000 years ago.

What evidence do we have for *how* God acted as he created us in his own image? The reader may have already decided what is implied by the evidence presented above. But, such material evidence does not force us to accept any particular conclusion. The appearance of AMH is abrupt, but so are the appearances of most species.[66] The problematic "archaic" specimens can be viewed as transitional, but their significance is the hottest conflict in Paleoanthropology. Passionate disagreement is certain. Nowhere in science are world view assumptions more likely to influence which patterns are seen in the data. But perhaps we can try to narrow the options.

For instance, if the evidence suggests that the image of God appeared *within* genus *Homo*, the idea that God made man from other *Homo* species seems more likely. However, if the evidence of the image appears when genus *Homo* first appears, it would suggest a fossil and cultural barrier between *Homo* and the Australopithecines, increasing the plausibility of the idea that God did *not* use existing hominoids in such creation.

For the Christian, Yahweh is the Governor of history, and that must also include all* evolutionary *history. There is no autonomous "natural" background against which to pick out divine action.

As Christians, we must accept the fact that God created man in his image, and that this creative act is an eternal fiat command, a part of his eternal decree for all of reality. This decree is the word of his power which calls the whole temporal order into obedient existence at every point. Therefore, of necessity, if humanity arose by material processes, those processes were ordained to bring our species forth before the foundations of the world. In that case, the eternal creation ordinance for man must have shaped the causal chains of the universe back to its very beginning. Gould speaks of our existence and fundamental nature as contingent on "happenstance piled on happenstance."[67] Well enough for an atheist, but for the Christian, "The lot is cast into the lap, but its every decision is from the Lord" (Prov. 16:33). Wilson views man as simply the result of evolutionary processes.[68] Again, material proc-

esses may indeed be involved. *But* for the Christian, Yahweh is the Governor of history, and that must also include all *evolutionary* history. There is no autonomous "natural" background against which to pick out divine action. God is never *constrained* by the material processes which he includes in that which he ordains and reveals. Rather, he always constrains *them*. On the other hand, although he does not *need* to include material processes to unroll his created order, he is always absolutely *free* to do so. Equally, he is absolutely *free* to act without them.

In our speculations, we must be limited by God's self-revelations — both by Scripture and in his created (natural) world. As we seek to be guided by these two sources of truth, let us humbly acknowledge that our interpretations of *both* sources of knowledge are world view guided and fallible. We will always need to be guided — and corrected — by the Spirit of Truth, in science or in theology. And when we get home ... won't we have a good laugh at ourselves?! *

Notes

[1]C. B. Stringer and P. Andrews, "Genetic and Fossil Evidence for the Origin of Modern Humans," *Science*, 239 (1988): 1263-1268.

[2]S. J. Gould, "Is a New and General Theory of Evolution Emerging?" *Paleobiology*, 6.1 (1980): 119-130.

[3]M. Landau, "Human Evolution as Narrative," *American Scientist*, 72 (1984): 262-268.

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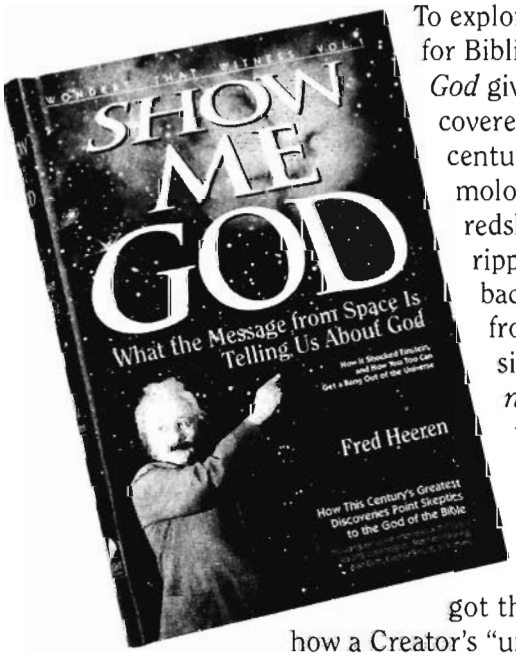

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In Memoriam

Reijer Hooykaas (1906-1994): A Modern Advocate for *Philosophia Libera*

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On January 4, 1994, one of the leading Christian historians of science in the world — and one of only two honorary members of the American Scientific Affiliation (ASA) — passed away. It was a passing not recognized to any great extent in the Anglo-Saxon world. Yet Professor Reijer Hooykaas exerted a great influence on many in the United Kingdom and North America through his writing and lecturing activities. He repeatedly spoke at conferences of Christians in Science, formerly known as The Research Scientists' Christian Fellowship (RSCF) in the UK, including the joint 1985 RSCF/ASA Conference at Oxford University. He also lectured with his close friend, Professor Donald MacKay at Regent College. There is a certain irony in this: namely, that his life and work, particularly his Christian witness, were often more recognized and appreciated by foreigners than by his own countrymen.[1] I would like to give the reader a brief sketch of Hooykaas's life and some of his more important contributions to the history of science.[2]

History of science was not a large enterprise in the Netherlands in the 1930s. There were a number of *privatdocenten*, Eduard J. Dijksterhuis the author of *The Mechanization of the World Picture* (1950/1961) comes readily to mind.[3] However, in 1945 the Free (Vrije) University of Amsterdam had the foresight to appoint Hooykaas to the first chair in the history of science in the Netherlands. All students in the natural sciences and mathematics were required to take his course in the history of science. Students could also select history of science as a *bijvak* (minor). According to my count, Hooykaas had four *promovendi*, one of whom, Harry A. M. Snelders, became director of the Institute for the History of Science at the University of Utrecht. Hooykaas himself later moved to Utrecht as professor in 1967 until his retirement in 1976. From 1948-1960, Hooykaas taught mineralogy to chemistry students at the Free University and was instrumental in establishing its mineralogy collection.[4]

Hooykaas was trained as a chemist, taught chemistry at two secondary schools from 1930-1946, and in 1933 defended a dissertation entitled *Het Begrip Element in zijn historisch-wijsgeerige Ontwikkeling* (The Concept Element in its Historical-Philosophical Development) at the University of Utrecht. In 1934 at a Free University scientific gathering, he gave a clear indication of his interests and concerns in a lecture entitled *Natuurwetenschap en Religie in het Licht der Historie* (Science and Religion in the Light of History). An article on Pascal in 1939 and a lengthy study of Robert Boyle, *Een Studie over Natuurwetenschap en Christendom*, soon followed.[5]

For many years, Hooykaas also played an active role in the Christian Society of Scientists and Physicians in the Netherlands. In 1948 he first lectured at the annual conference of the RSCF in London upon the invitation of Dr. Martyn Lloyd-Jones. As Hooykaas increasingly began to lecture and publish

*ASA Fellow

in English, his work became more widely recognized and respected. He served as Vice-President for Europe (1967-1976) and then as President of the International Committee on the History of Geological Sciences (1976-1984). In 1970 he presented the Erasmus Lectures at Harvard University and in 1975-1977 the Gifford Lectures at the University of St. Andrews.[6]

Hooykaas was a professor of the old school: well-read, proficient in languages, and "lord" of his domain.

Hooykaas was a professor of the old school: well-read, proficient in languages, and "lord" of his domain. He did not suffer fools gladly, whether they were under-prepared students coming for an oral examination or historians of science who used and abused his work without acknowledgment. His facility with languages was legendary. Dutch, English, French, German, Latin, Polish, and Portuguese were at his command, and he let university students know it — often to their embarrassment. Hooykaas frequently described himself as an old-fashioned Calvinist, not enamored by contemporary theological and philosophical movements in the Netherlands. For example, one finds a few references to theologians such as Abraham Kuyper and Herman Bavinck in his early work, but none to Gerrit Berkhouwer in his later writings; and none at all, that I could discover, to contemporary philosophers such as Herman Dooyeweerd or Dirk T. H. Vollenhoven.

Hooykaas was his own person. No shades of Kuyperian triumphalism for Hooykaas: "just" patient humble inquiry. No call for the "Christianizing" of disciplines or the "inner reformation of the sciences." Pure, good science is Christian science, as he told me once in a conversation after a lecture on Robert Boyle. The truth and a respect for the given reality which surrounds us and of which we are a part are what drives us on in our scientific work and serve as a check on our frail human pretensions and speculations. Humility and respect will win the day. Pride, particularly scholastic pride in a system of thought, has led to too many pratfalls and in turn stigmatized the gospel. Wanting to take and make his own way also had a down side. Hooykaas frequently did not engage the literature on a particular topic. One often gets the impression that he, and he alone, is the first interpreter of many of the documents and manuscripts he studied.

If there is one hero that shines through Hooykaas's work, it is Blaise Pascal. Hooykaas, like Pascal, abhorred anything that smacked of system building, whether it was the ecclesiastical dogma of theologians or the philosophical systems of the various philosophical schools. And so, he was often fond of quoting Pascal: "The heart has its reasons of which reason knows nothing." Frequently, the little people, the unschooled, served as examples of those who could fell a system with one little word or action. Henry the Navigator's Portuguese sailors, craftsmen, and artisans (like the silversmiths Hooykaas knew in his birthplace of Schoonhoven) were people that moved him. One illustration must suffice:

> The Portuguese are the people who first of all opened new vistas for Europe in a concrete manner. Not the Copernican world picture was the starting-point of the scientific revolution, but the hard fact, discovered by the intrepid Portuguese seafarers, that the habitable earth was much greater than ancient and medieval philosophy had deemed possible.[7]

I also vividly recall his reaction to Walter Thorson's lectures at the 1985 RSCF/ASA meeting exploring the significance of Michael Polanyi's thought for scientific practice. "Why make things so complicated in developing a science? Just do it." A Christian science? That is a chimera best left to rest. "If ... were to try to build a 'Christian' science, we should be acting like a man who hunts for his spectacles while they are on his nose. Modern science and technology to a great extent *are* fruits of Christianity."[8]

Reijer Hooykaas in a typical pose circa 1977.

Hooykaas could also deflate the vanity of those in authority. He took ministers and theologians to task in his article, "*Dominees en Evolutie*" (Ministers and Evolution), for not allowing believing scientists to speak to the issues surrounding evolution in a 1949 Reformed Ecumenical Synod report. Don't they believe in the priesthood of all believers? Aren't believing scientists able to judge and speak to these issues? Don't the theologians remember Calvin's principle of accommodation? Are they trying to repeat the mistake of creating a Mosaic science, i.e., basing a science on the Scriptures? The questions raised form a litany of concerns which Hooykaas continually raised in his publications.[9]

***The larger issue that Hooykaas struggled with was the issue of freedom, a free science or* philosophia libera.**

The larger issue that Hooykaas struggled with was the issue of freedom, a free science or *philosophia libera*. As he put it: "The spirit of the Reformation and the spirit of true science have much in common, it is the spirit of liberty through submission to a divine revelation ..."[10] It entails a freedom from systems theological and philosophical.

> [T]he *philosophia libera* is no elaborate system, not even an elaborate *Christian* system, which takes away from us the duty of thinking things out for ourselves. It is the freedom of the children of God, who have found the Philosopher's Stone: the Stone which the builders of philosophy rejected.[11]

But a freedom to do what? If, in fact, Hooykaas wishes to advance a free science unburdened and unhindered by philosophical and theological systems, then what is the positive relationship between religion as lived and acted on and the scientific enterprise? How does, or should, a Christian view of the world and science intersect? Could there not be a Christian philosophy that might encourage scientific development and provide categories, however tentative, that reflect ontological states of affairs? By restricting theology to Scripture, as Hooykaas tended to do, doesn't religion become in a sense emasculated or restricted to certain arenas? Is a Christian philosophy even possible? Hooykaas's answer seems to be, "No."[12] He prefers to be a stepchild of the Reformation on this point or at least extremely dubious about its possibility.

In a number of his more philosophical pieces, Hooykaas argued for a rational empiricism.[13] One almost sees Francis Bacon's images in this phrase: not the ant (the empiricist) nor the spider (the rationalist), but the bee (rational empiricist) collecting nectar with purpose and cunning. On reflection, his argument for rational empiricism often made his own position appear to carry a positivistic stain. His appeal to facts, quoting T. H. Huxley and Bacon at length, often appeared to be less than self-critical and his tracing of scientific concepts frequently lacked contextualization. No sustained inquiry into the social context of scientific claims (or truth) are to be found in Hooykaas. In his lengthy analysis of Teilhardism, one finds this typical quote:

> [T]he founders of modern science strove for a methodological separation of science and religion. With Kepler, (a devout christian), astronomy was made independent of Bible texts, but metaphysical notions still intervened in his method; with Pascal and Boyle, (both apologists of christianity), this separation has become complete. In their scientific work one does not find a word about religion, although their strictly rational-empirical method certainly formed an organic unity with their christian faith.[14]

Hooykaas, therefore, argued for a methodological, but not an ontological separation of religion and science. The troubling phrase "organic unity" was never explicated in any great detail. He once described this interrelationship between general revelation and scriptural revelation as one of independence: "Christian faith acknowledges two independent sources of revelation: Scripture and Nature."[15] But true to form, there never was a systematic analysis of this persistent question.

Hooykaas ... argued for a methodological, but not an ontological separation of religion and science.

On the other hand, the quiet confidence that good, realistic, and humble science is intrinsically Christian, that one can "cleanly" separate the methodological from the ontological, also harbors a danger. How does one stem the tide against what Hooykaas took to be a rising evolutionism? What philosophical weapons, besides his persistent appeal to be humble before the data, could one use if someone was convinced that the weight of the evidence indicated that an extensive evolutionary development had in

fact occurred? These issues, the increasing politicization of the university, and the "contextualization of science" movements of the day were difficult ones for him to come to grips with. I suspect he became increasingly isolated on these questions.

Historiography

Among the many contributions Hooykaas made to the history of science, I think three stand out as signposts of his diverse interests and breadth of knowledge: (1) the historiographic issues tackled in *Religion and the Rise of Modern Science*; (2) the seminal work done in the history of geology, *The Principle of Uniformity* and *Catastrophism in Geology*; and (3) his discovery of a missing work of Rheticus. The first contribution, in particular, with its suggestion of a close causal link between Christianity (specifically the Reformation) and early modern science was met with controversy and question. One only needs to turn to the pages of this journal to read the stinging book review by David Lindberg.[16] The most mature and balanced expression of Hooykaas's views on this matter can be found in a recent article entitled, "The Rise of Modern Science: When and Why?" Hooykaas argues:

> The rise of modern science has two major causes: firstly, the new natural history and the methodological epistemological changes connected with it; and secondly, the transition from an organistic to a mechanistic view of the world, a change closely connected with experimental philosophy and the contribution made to it by engineers, physicians, alchemists, cartographers, pilots and instrument makers.[17]

In this article, there are many references to much of his previous work, but again Hooykaas has no real engagement with historians who hold differing viewpoints.[18]

The seminal work done in the history of geology,* The Principle of Uniformity *and* Catastrophism in Geology, *was path-breaking.

The geology work was path-breaking. As Martin Rudwick, a leading historian of science and geology, and eventually Hooykaas's successor at the Free University, described it:

> When this work [on 'The Principle of Uniformity'] was published ... the study of the history of geology was still in a primitive state. Professor Hooykaas put it on a new basis, by emphasizing the reasonableness and scientific value of those who had criticized Lyell's geological arguments. Previously, these opponents had been virtually dismissed, because their scientific arguments had clearly been related to religious concerns. Characteristically, Professor Hooykaas's freedom from their anti-religious historical prejudice made it possible for him to re-assess the value of Lyell's work, and that of these other scientists, more objectively.[19]

In 1984 Hooykaas published a translation of a missing work, "Treatise on Holy Scripture and the Motion of the Earth," by G. J. Rheticus (1514-1576), an assistant of Copernicus. Hooykaas was able to recognize a quotation (long attributed to Rheticus but never properly identified) in a leaflet bound in a collection of seventeenth century texts.[20] In fact, Hooykaas always had a keen interest in how scientists and theologians reflected on the relationship of science and Scripture. In particular, his analysis of John Calvin's position of not reading Greek astronomy into the Scriptures, but rather arguing that the Bible is a book accessible to everyone and that therefore Moses "adapted his writing to common usage" was one he repeated many times.[21] In 1955 he had already identified Andrew Dickson White's error in attributing anti-Copernican quotations to Calvin.[22]

A Quiet Confidence

In many ways, the views of Hooykaas were those of a person confident of the liberating power of the gospel, born to a culture where the engagement of Protestant Christians in cultural pursuits was the air one breathed. Yet he was ever hesitant to be too confident in human constructions and institutions. He enjoyed pricking the balloons of other people's pretensions. He too much relished his role as a gadfly to ever provide a sustained system or argument.

> If we want to know what it means to cultivate science in a christian way we should not theorize too much about it, but we ought to state by induction how scientists, who lived consciously out of faith, not only in church but also in the laboratory, saw the relation between science and religion. The history of science demonstrates clearly that respect for empirical facts and methodical independence of theology and philosophy characterized the work of Pascal, Boyle, Newton, Duhem, Faraday, Roozeboom, etc. Consequently they bore fruit, which did not shrivel after a short time, like the speculations of the system-builders.[23]

He transmitted this confidence to others, particularly to English scientists with a rich sense of their own tradition. Hooykaas was ever active in alerting us to a "cloud of witnesses."[24] For that we will ever be in his debt.

Bibliography of Hooykaas's Publications

By way of conclusion, let me give a short (almost) chronological bibliography of Hooykaas's publications in English:

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"The Rise of Modern Science: When and Why?" *British Journal for the History of Science*, 20 (1987): 453-473. *

Notes

[1]No references to Hooykaas's work, for example, are found in a two-volume work dedicated to *Geloof en Natuurwetenschap* [Faith and Science] (s' Gravenhage: Boekencentrum, 1967) despite a lengthy discussion of the Foster thesis and several sections devoted to history of science replete with appeals to Butterfield, von Weizacker, Holton, etc. A recent book by H. Floris Cohen, a Dutch historian of science, entitled *The Scientific Revolution: A Historiographical Inquiry* (Chicago: University of Chicago Press, 1994) finally does justice to Hooykaas's contributions.

[2]These personal recollections are partially based on my attending Hooykaas's lectures for two years (1967-1969) at the Free University of Amsterdam. Also see the recent article by Oliver R.Barclay, "Obituary: Professor Reijer Hooykaas." *Science and Christian Belief* 6 (1994): 129-132.

[3]For a good overview of the practice of history of science in the Netherlands see the article by H. A. M. Snelders, "History of Science Today, 2. History of Science in the Netherlands." *British Journal for the History of Science* 20 (1987): 343-348.

[4]*Capita Selecta uit het werk van Professor Dr. R. Hooykaas* (Utrecht: Institute for the History of the Natural Sciences, 1976) has a relatively complete bibliography through 1976, and has good biographical information.

[5]The Pascal article was translated into English and appeared in the *Free University Quarterly* of 1952. H. Floris Cohen has his own translation of this article published in 1990 as "Pascal: His Science and His Religion." *Tractrix: Yearbook for the History of Science, Medicine, Technology and Mathematics* 1 (1990) 115-139. The Boyle study of 126 pages, *Robert Boyle: Een Studie over Naturwetenschap en Christendom* (Loosduinen: Kleijwegt, 1942) has recently been translated by Harry Van Dyke of Redeemer College as *Robert Boyle: A Study in Science and Christian Faith* and will be published under the auspices of its Pascal Centre.

[6]Hooykaas was also a member of a number of European scientific societies and holds an honorary doctors degree from the University of Coimbra in Portugal.

[7]"The History of Portuguese Culture." *Free University Quarterly* 7 (1960): 211.

[8]*The Christian Approach in Teaching Science* (London: The Tyndale Press, 1960): 12. Emphasis in the original. In a later article, "A New Responsibility in a Scientific Age." *Free University Quarterly* 8 (1961): 95, he states: "Thus there is no necessity to christianize science: this has already happened. We may consider it a product of the human mind which has been enabled to find its right method and its highest purity by being christianized in the 17th century. In spite of the then following dechristianization of much of Western thought, the basis and method have remained the same."

[9]"*Dominees en Evolutie.*" [Ministers and Evolution], *Bezinning-Gereformeerd Maandblad tot Bewaring en Bevordering van het Christelijk Leven* 5 (1950): 74-88.

[10]*Philosophia Libera: Christian Faith and the Freedom of Science* (London: The Tyndale Press, 1957): 23

[11]Ibid, 24. Emphasis in the original.

[12]"*Is een christelijke philosophie mogelijk?*" [Is a Christian Philosophy Possible?] *Vox Theologica* 19 (1948): 48-53.

[13]See, for example, "*De Baconiaanse traditie in de natuurwetenschap,*" *Algemeen Nederlands Tijdschrift voor Wijsbegeerte en Psychologie* 53 (1961) 181-201, in which the Baconian tradition is characterized as "the proclamation of rational empiricism, namely experimental science founded on experience in contrast to rationalism and traditionalism," 181.

[14]"Teilhardism, Its Predecessors, Adherents, and Critics." *Free University Quarterly* 9 (1963): 59.

[15]"Science, Materialism, and Christianity." *Free University Quarterly* 1 (1950): 60.

[16]David Lindberg, review of *Religion and the Rise of Modern Science*, in *Journal of the American Scientific Affiliation* (December 1974): 176-178. Also see the subsequent exchange between D. M. MacKay and Lindberg: *JASA* (September 1975): 141 and (March 1976): 48.

[17]"The Rise of Modern Science: When and Why?" *British Journal for the History of Science* 20 (1987): 471.

[18]For a thorough and balanced presentation of the historiographical interpretations of the 'Scientific Revolution' see H. Floris Cohen's book (fn. # 1). For a recent analysis of the Foster thesis see Edward B. Davis, "Christianity and Early Modern Science: The Foster Thesis Reconsidered," a paper presented at a recent conference on "The Evangelical Engagement with Science," sponsored by the Institute for the Study of American Evangelicals, Wheaton College, Wheaton, IL (March 30-April 1, 1995).

[19]M. J. S. Rudwick, "The History of the Natural Sciences as Cultural History," Inaugural lecture at the Vrije Universiteit, Amsterdam, (23 May 1975): 13. Also see Rudwick's comments in "Historical Analogies in the Geological Work of Charles Lyell." in *Symposium: Hooykaas and the History of Science* (Utrecht: Utrecht State University, 1977): 89.

[20]*G.J. Rheticus': Treatise on Holy Scripture and the Motion of the Earth* (Amsterdam: North-Holland Publishing Co., 1984).

[21]*Religion and the Rise of Modern Science* (Grand Rapids: Eerdmans, 1972): 117-122, 154.

[22]"Thomas Digges' Puritanism." *Archives Internationale d'Histoire des Sciences* 8 (1955): 151.

[23]"Science, Materialism and Christianity." *Free University Quarterly* 1 (1950): 61-62.

[24]"Hendrik Willem Bakhuis Roozeboom (1854-1907): *Grondlegger der Phasenleer.*" *Geloof en Wetenschap* 53 (1955): 77.

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Communication

Stepping Back to Look at Neo-Darwinism

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There is a serious problem with the way evangelical scientists view evolution. For example, the "Call for Papers: 1994 Annual Meeting Symposium" asks "whether the scientific data justify extrapolating from microevolutionary changes produced by natural selection to the production of new body plans and structures."[1] The answer must be "No," for the question prejudges the problem.[2] The first difficulty is that natural selection does not produce microevolutionary changes. It does not, indeed cannot, drive mutations. It merely sorts among such mutations as they occur.[3]

The introductory question of the call is broader: "Is the neo-Darwinian mechanism of selection of random mutations adequate for the creation of major biological innovations?" The answer is still "No." The accumulation of mutations, translocations, transpositions, and inversions seems to produce "good" species within genera or families. The Hawaiian *Drosophila* come immediately to mind. Ecological niches occupied and behavioral changes in timing and mating signals prevent interbreeding in the wild.[4] Genetic modifications affect, and even control, all these. But no accumulation of mutations in the small genome of an entity like a dipteran can produce the large genome of a vertebrate. Also, any radical change in an essential gene will almost certainly reduce viability. It may well be lethal.

A First Look: Color

If we step back from a simple consideration of mutations, we may ask whether there is any way in which a vital gene can take on new functions without sacrificing the old.[5] The answer appears to be "Yes." A crude example occurs in color vision. Human beings, like many other mammals, have genes for color vision on different chromosomes. The visual pigment giving blue sensitivity is produced by a gene on an autosome. The two visual pigments giving green and red sensitivity are produced by genes on X, the sex chromosome.[6] This is why color-blindness is thought of as a sex-linked recessive. Both genes on X are very similar. The visual pigments for which they code are just different enough to shift their peak spectral absorption somewhat. This shifting produces very subtle differences in color vision.[7] The pigment giving blue sensitivity is also similar, as is rhodopsin, which gives the rods monochromatic sensitivity. Fish produce rhodopsin. Blue vision is widespread among mammals. American monkeys have a gene for red visual pigment on the sex chromosome. Chimpanzees add green visual pigment. The simplest biological explanation for these phenomena is that the original rhodopsin gene was duplicated and the replication mutated. This produced the continued ability to see plus the new ability to differentiate some colors in bright light. Later, a similar process produced the added ability to detect red, giving enhanced color discrimination. Finally, the new ability to see green produced full trichromatic vision.[8] At each stage, enhanced sensitivity would plausibly be selected for, whereas modification of the original genes without duplication would surely be deleterious, except perhaps for creatures like blind cave fish. There is another piece of evidence that bolsters this explanation: some human X-chromosomes carry more than one copy of the gene for green visual pigment.[9] Those with this unusual genotype have a normal phenotype.

One may also ask whether an organism can acquire new genes from outside the species. The answer appears to be "Yes." Germs are known to trans-

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fer resistance to antibiotics from one bacterial species to another. Some viruses transfer genetic material between plants. More recently, evidence has been found that transfer by arthropods can occur among insects. So viruses, bacteria and small arthropods are potential vectors.[10]

The Genetic Attic

Recent evidence shows that a duplicated gene may become quiescent rather than taking on new duties. Researchers found a gene that they estimate has not been active for about five million years in the mouse genome.[11] This gives additional support to the view that the large mammalian genome results from the accumulation of duplicate DNA. Some of this may be currently without function, "junk DNA." However, I keep reading of functions, especially control functions, discovered for some introns which had been written off as "junk."[12] The most surprising development to me is that a functional coding sequence may be embedded in an intron.[13] This brings to mind the long list of vestigial organs once given,[14] at least mainly the product of ignorance of the endocrine system. So it behooves us to say only that parts of the genome are currently without known function, rather than declaring them without function. Unfortunately, where careful scientists insert qualifications, popular and semi-popular reports often omit them.

Managing Structure: Homologies

Scientists long ago observed that embryos develop in an orderly fashion. More recently they have discovered that aspects of the progression are controlled by strings of genes called homeoboxes. The nature and distribution of these control sequences also bear on the possibility that reduplication and modification of genes may produce radically different body plans and structures. A relatively small number of homeobox genes were found to lie sequentially on a *Drosophila* chromosome. During embryogenesis, they were activated sequentially to control the development of segments on the cephalocaudal axis. Mutations of these genes produce leg-like structures in place of antennae, four wings in place of the normal two wings and halteres, or embryonic death.

Using probes derived from *Drosophila* genes, geneticists have discovered a much larger number of mammalian homeobox genes. They function like the dipteran genes, although the radically different body plans necessarily produce clearly different effects. A fruit fly, larva or adult, has clearly delimited segments whose sequential development can be tied directly to specific homeoboxes. A mammalian embryo has a much more complex pattern of development, requiring more than one sequence. Nevertheless, it appears that strings of such genes are activated sequentially to control the various stages of development. Further, the *Drosophila* sequence and the several mammalian sequences are clearly similar.[15]

A different type of control gene contains a sequence of thymine and adenine residues (abbreviated as T and A), whose duplication produces the name, TATA-boxes. These genes are even more broadly conserved.[16] Apoptosis is controlled by similar genes in *Drosophila* and *Xenopus*.[17] The list may be extended by those familiar with the literature, for 40% of the genes are homologous in *Drosophila* and *Homo*.[18]

Obviously, the total embryonic environment has much to do with the effect of any gene. There is no way that the gene controlling production of legs, wings, and halteres on the three segments that fuse to form the insect thorax can trigger similar organs in a chordate, let alone a mammal. Further, as scientists gain more understanding of the work of control genes, they find them acting in more complex ways, being reactivated a second time during development, or even apparently having a function in the adult organism.[19] Despite all these complexities of function, it has been shown that a mammalian gene can replace a defective dipteran gene, and even a yeast gene. Apparently, the structure of some vital genes has been conserved while duplicated genes have mutated, combined, or otherwise changed to take on different functions.

Bumps Under The Carpet

Besides gene duplication and mutation, there are additional possibilities for change. Polyploidy, hybridization, chromosome breakage and recombination, reassortment of introns and exons within and among genes, including transpositions and inversions, along with position effects, may combine to effect more radical changes than most of us expect. I have not encountered any indication that we have deciphered the factors that differentiate the relatively simple segmentation of annelids from the more complex patterns of arthropods, or the gene-activation pattern transforming the bilateral embryonic body into a radially organized starfish or sea urchin. Until all such matters have been deciphered and it can be shown that *no* genetic process can connect one pattern of development to another, we must not claim that evolutionary descent is impos-

sible. To suggest that evolution is not reasonable because simple mutation cannot produce the required changes, is to bear false witness.

Where Next

Do these considerations show that an updated neo-Darwinian mechanism has provided an adequate explanation for the development of radial, externally supported and internally supported animals from a single aboriginal form? No. Do they suggest experiments to transform "primitive" animals into "advanced" forms? No, for all are, *ex hypothesi*, the latest result of eons of modification and selection.[20] But they definitely narrow the gap between some diverse structures. Also, they suggest the kind of information which may narrow the gap even more. They clearly need to be faced by honest investigators.[21] *

Notes

[1]*ASA/CSCA Newsletter*, (March/April 1994): 3.

[2]I have assumed that the scientist is fully open to evidence that macroevolution may have occurred and is unwilling to bias the investigation. However, the question is purely rhetorical to some, for they are certain that macroevolution has not, or cannot, occur. Both 144-hour Creationists and those who believe that the geologic eras saw multiple creations that suffered only microevolutionary change fall here. The adherent to dogmatic evolutionism is oppositely biased. I thank the anonymous referee for calling my attention to this matter.

[3]This view may require modification. See David S. Thaler, "The Evolution of Genetic Intelligence," *Science* 264 (8 April 1994): 224f. The original report, John Cairns, Julie Overbaugh and Stephan Miller, "The Origin of Mutants," *Nature* 335 (8 September 1988): 142-145, produced numerous responses. See ibid. 336 (3 November 1988): 21f; (8 December): 525-528; 337 (12 January 1989): 119, 123f. Both Cairns' response (336: 528, notes 7-10) and Thaler, op. cit., add other studies.

Samuel L. Scheiner, in his review of Stephen C. Stearns, *The Evolution of Life Histories*, notes the broad range of matters which require consideration in the evaluation of scientific theories of descent. See *Science* 258 (11 December 1992): 1820-1822.

[4]Kenneth Y. Kaneshiro, "Speciation in the Hawaiian *Drosophila*," *BioScience* 38 (April 1988): 258-263 says that the number of species is both 509 and about 640-730 on p. 258. Roger Lewin, "Hawaiian Drosophila: Young Islands, Old Flies," *Science* 229 (13 September 1985): 1072-1074 says over 800 on p. 1072. Fred Hapgood, "Fruit Fly Fandango," *Science* 84 (September 1984): 68-74, notes behavioral isolation.

We may be seeing speciation in the split of a fruit fly, *Rhagoletis pomonella*, into populations adapted to apple and hawthorn, with their different schedules. See *Scientific American* (February 1989): 22, 24. The original reports are Jeffrey L. Feder, Charles A. Chilcote and Guy L. Bush, "Genetic Differentiation Between Sympatric Host Races of the Apple Maggot Fly *Rhagoletis pomonella*," *Nature* 336 (3 November 1988): 61-64; Bruce A. McPherson, D. Courdney Smith and Stewart H. Berlocher, "Genetic Differences Between host races of *Rhagoletis pomonella*, ibid. 64-66; D. Courtney Smith, "Heritable Divergence of *Rhagoletis pomonella* Host Races by Seasonal Asynchrony," ibid. 66f. This last adds dogwood to the hosts.

[5]See Russell F. Doolittle and Peer Bork, "Evolutionarily Mobile Modules in Proteins," *Scientific American* (October 1993): 50-56; Jürgen Brosius, "Retrosponsons — Seeds of Evolution," *Science* 251 (15 February 1991): 753; Stephen C. Stearns, ibid. 259 (5 March 1993): 1476.

[6]Both these genes map to Xq28. See "Genome Maps III," bound in *Science* 258 (2 October 1992): center; Douglas Vollrath, Jeremy Nathans and Ronald W. Davis, "Tandem Array of Human Visual Pigment Genes at Xq28," ibid. 240 (17 June 1988): 1669-1672.

The gene for blue sensitivity maps to chromosome 7. See Jeremy Nathans, "The Genes for Color Vision," *Scientific American* (February 1989): 42-49; Geoffrey Montgomery, "Color Perception: Seeing with the Brain," *Discover* (December 1988): 52-59, sidebar on 58.

[7]See Deborah Franklin, "Newswatch," *Science* 86 (July/August): 6; Vollrath, Nathans and Davis, op. cit.; Shannath L. Merbs and Jeremy Nathans, "Absorption Spectra of the Hybrid Pigments Responsible for Anomalous Color Vision," *Science* 258 (16 October 1992): 464-466.

[8]See Maureen Neitz, Jay Neitz and Gerald H. Jacobs, "Spectral Tuning of Pigments Underlying Red-Green Color Vision," *Science* 252 (17 May 1991): 971-974. South American monkeys have a single X-linked pigment apiece which is, in the species examined, from 96% to 98% identical to the human red pigment.

[9]See Franklin, op. cit.

[10]Margaret A. Houck *et al.*, "Possible Horizontal Transfer of *Drosophila* Genes by the Mite *Proctolaelaps regalis*," *Science* 253 (6 September 1991): 1125-1129.

[11]See "Reviving Old Mouse DNA," *Science* 264 (1 April 1994): 27. The original report is in *Proceedings of the National Academy of Sciences* for 15 February.

[12]See, for example, Marcia Barinaga, "Introns Pop up in New Places — What Does It Mean?" *Science* 250 (14 December 1990): 1512; John Abelson, "Recognition of tRNA Precursors: A Role for the Intron," ibid. 255 (13 March 1992): 1390; M. Irene Baldi *et al.*, "Participation of the Intron in the Reaction Catalyzed by the *Xenopus* tRNA Splicing Endonuclease," ibid. 1404-1408; Marlene Belfort, "An Expanding Universe of Introns," ibid. 262 (12 November 1993): 1009f.

[13]See Roger Lewin, "Reverse Transcriptase in Introns," *Science* 229 (13 September 1985): 1073.

[14]Robert Weiderscheim, *Der Bau das Menschen* (1895; 3rd ed., 1902), is commonly cited. I was unable to confirm the given number, about 180, in its translation, *The Structure of Man* (1895).

[15]See, for example, Jean L. Marx, "Homeobox Linked to Gene Control, *Science* 242 (18 November 1988): 1008f; John F. Fallon *et al.*, ibid. 264 (1 April 1994): 105-107; John Rennie, "Old Gene, New Trick: The Not-so-holy *Engrailed* Reveals the Path of Evolution," *Scientific American* (December 1989): 30f; Eddy M. De Robertis, Guillermo Oliver and Christopher V. E. Wright, "Homeobox Genes and the Vertebrate Body Plan," ibid. (July 1990): 46-52.

[16]See Michael Gregory Peterson *et al.*, "Functional Domains and Upstream Activation Properties of Cloned Human TATA Binding Protein," *Science* 248 (29 June 1990): 1625-30; C. Cheng Kao *et al.*,"Cloning of a Transcriptionally Active Human TATA Binding Factor," ibid 1646-50.

[17]See Clark Coffman, William Harris and Chris Kintner, "*Xotch*, the *Xenopus* Homolog of *Drosophila Notch*," *Science* 249 (21 September 1990): 1438-1441.

[18]See Ross H. Crozier, *Science* 245 (21 July 1989): 314.

[19]See John Benditt, "POU! Goes the Homeobox: Developmental DNA Sequences Are Found in Puzzling Places," *Scientific American* (February 1989): 20, 22.

[20]Population genetics adds further complexity by warning us that selection is not simple. Specialists in various fields will surely add to the list of relevant considerations.

[21]Stephen C. Meyer (Symposium, ASA Annual Meeting, August 9, 1993) implicitly made a point that all should remember: evolutionary descent does not preclude design. Alternatively phrased, a mechanism does not have to be mechanistic, naturalistic, and materialistic.

Science Course Description

Imposing Science on the Liberal Arts Student

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The discussion of scientific ideas at Christian colleges is complicated because of the controversial role that science plays in contemporary evangelical discourse and the widespread assumption of the historical conflict model of interaction. This article describes a general education history of science course taken by all undergraduates at Eastern Nazarene College, a liberal arts college in the Boston area. In this course, entitled "Epoch Making Events in Science," students are exposed to a variety of scientific ideas presented in their historical context. The historical format is helpful because it facilitates comparison of present and past conflicts and provides a much more natural context for the presentation of many important, although controversial, contemporary ideas such as evolution, genetics, and Big Bang cosmology. A survey of student attitudes at the beginning and end of the course indicates that the course has helped some students move beyond the simple conflict metaphor into a more mature integrated view of the interaction between science and religion.

One of the greatest pedagogical challenges facing the evangelical Christian college is the teaching of science. As the source of much confusion and even friction within the church, science is viewed with suspicion by many evangelicals. The problem is exacerbated by an accelerating national science illiteracy and certain prominent theological traditions (eg. Barthian neo-orthodoxy) that consider science irrelevant to the Christian faith.

Major Christian booksellers (InterVarsity, Eerdmans, Zondervan) carry very few titles in the field of science and religion. Those publishers that do have an interest in books in this area tend to be dominated by the scientific creationist perspective. Nevertheless, it is increasingly important that Christian colleges educate their students about science. The credibility of the gospel in the coming millennium demands that its message be found among the scientific leadership and the scientifically literate. The day is coming when a theology that is not in dialog with science will find itself with no one to talk to.

This article will describe a science course taught at Eastern Nazarene College designed to provide the Christian liberal arts student with some perspectives on science, its historical development and cultural influence, and its relationship to the Christian faith. The course is titled "Epoch Making Events in Science" and is a part of the General Education program that consists of eight integrated courses taken by all students and collectively labeled "Cultural Perspectives." In the order that they are taken by a typical student, the eight required courses are: "Biblical History and Literature," "Western Heri-

tage," "World Literature," "Arts & Music," "The Philosophical Quest," "Christian Tradition," "Epoch Making Events in Science," and "Living Issues." Each course is taught within a historical framework and is designed so that the students can see the interconnections among the different fields. The final course in the series, "Living Issues," is a capstone that attempts to "bring it all together" by focusing on issues that confront the contemporary Christian — bioethics, racism, homosexuality, civil disobedience, world hunger, pornography and art, etc. The students also take a variety of distribution options — lab science, math, language, social science, etc.

Mission Statement

Eastern Nazarene College (ENC) is one of eight colleges sponsored by the Church of the Nazarene, a Wesleyan denomination with about one million members in the United States. The relatively large number of sponsored colleges reflects the denomination's historically strong interest in education, an outgrowth of the social commitments of its founders.

The General Education program at ENC is designed to complement the individual student's major in meeting the educational mission of the college:

> ... to provide the resources for a liberal arts education and life-long learning in an environment which awakens and fosters truth, righteousness, justice, and holiness as they reflect the life which has been transformed by God's grace through Jesus Christ. We seek to serve the Church by equipping people for Christian leadership and service to humankind. ... The entire education program encourages each person to become a creative and redemptive force in the world through integration of the richness of the Christian tradition and the human quest for understanding.

Despite the college's denominational affiliation, about half of the undergraduates at ENC are not members of the sponsoring church, with Roman Catholic being the next largest constituency. And even those that are members of the Nazarene church bring a variety of theological perspectives, ranging from conservative to liberal. (See Fig. 1 for student population demographics.) In recent years, many members of the church — which is strongest in the Midwest — have begun to embrace biblical literalism, a source of great concern on the college campuses, particularly for those who teach science.

While there are a variety of perspectives found among the students, many of those who have been raised in the church have become a little distrustful of science. Many, if not most, of the few who have attended private Christian high schools are openly antagonistic toward contemporary science. This distrust, coupled with the general level of scientific illiteracy among the students of today, makes it quite difficult to provide the kinds of educational experiences with science that we would like our students to have. Often we find ourselves faced with students who, besides being abysmally ignorant of science, are openly hostile to much of it. (See Fig. 2 for assessment of scientific literacy.)

Course Description

"Epoch Making Events in Science," or "EMES" as it is affectionately known, is taken by students in their junior year. The course provides an opportunity for students to reflect on the important role that science has played in the formation of the modern world and in the formation of their personal world view. It is an important goal of the course to make the students more open to contemporary theories of origins (Big Bang, evolution) and to in-

Fig. 1. EMES Student Population Demographics

The following questions were distributed in a student questionnaire and percentages were calculated from 65 total responses.

1. Which of the following religious traditions has been the ***most*** influential in the development of your own personal religious ideas?

Nazarene	55%
Catholic	14%
Baptist	11%
Other Christian	18%
Traditions outside Christianity	2%

2. How long do you think you have been a Christian? (If you are not sure that you are a Christian, how long have you been actively interacting with Christian ideas?)

more than 10 years	67%
5 – 10 years	23%
1 – 5 years	4%
less than one year	2%
I am not a Christian	4%

3. What is your class standing?

sophomore	6%
junior	63%
senior	31%

tegrate those ideas into their religious views. Toward this end, the course provides a historical framework for the science/religion controversy, emphasizing the Galileo Affair as a useful point of contact. (See Fig. 3 for course outline.) Because EMES contains many different topics, we have found it useful to emphasize a few recurring themes. These are: (1) the birth of science in the pre-Socratics' interest in the basic stuff of the world and how the stuff changes, and how those two questions have retained their centrality throughout the history of science; (2) the profound interaction between science and the world view of each generation; (3) the religious implications of scientific ideas.

Fig. 2. Assessment of Student Scientific Literacy

The following questions were distributed in a student questionnaire on the first day of class. Percentages were calculated from 65 total responses. The topics in question 2 are arranged based on the number of students who responded that they had never heard of the idea.

1. How often do you read materials (newspapers, magazines) or watch TV shows (Nova, Discover) that deal with scientific issues?

once a week	22%
once a month	18%
5 or 6 times a year	20%
seldom	33%
never	7%

2. For the following ideas, state whether (a) you could explain this to another person, (b) you've heard of it but don't fully understand it, (c) you've never heard of it.

Percentage of students who responded

	could explain	don't fully understand	never heard of it
ozone layer	62	38	0
Big Bang	71	27	2
Darwin	56	42	2
ecosystem	45	47	8
Copernicus	26	63	11
in vitro fertilization	38	42	20
carbon cycle	16	58	26
Human Genome Project	13	51	36
cold fusion	4	60	36
quark	14	38	48
1st Law of Thermodynamics	14	35	51

The course begins with a general discussion of the nature of science. The hypothetico-deductive scientific method is discussed (see Fig. 4) and the students are invited to apply it to a staged incident. One year, for example, a faculty member sitting in the audience began to interrupt and make rude remarks while the lecturer was speaking. The disruptive behavior got excessive — "way out of hand" — and the class was dismissed for ten minutes while the faculty members ostensibly resolved their differences. When the class returned, they were instructed to try and figure out what was going on. Initial discussion helped the students distinguish between observation (Professor X interrupted Professor Y) and inference (X was rude to Y). The difficulty of separating observation and inference helps the students understand that all data are, to some degree, theory laden. The triangle scheme in Fig. 4 serves as the framework for much of the discussion. After the problem has been described as objectively as possible, the students are invited to develop testable hypotheses to try and figure out why X behaved so rudely to Y. (Hypothesis one — X, who is a physi-

Fig. 3. Brief Overview of the Course

Outline of "Epoch Making Events in Science" Course

1. A discussion of the nature of science
2. A survey of the origins and history of science emphasizing cosmology
3. A discussion of evolution and genetics
4. A historical survey of the development of the modern concept of matter, emphasizing the periodic table and quantum theory.
5. An examination of some of the issues surrounding religion and science:
   a. Biblical issues like interpretation of Genesis, fall of man, miracles;
   b. Ethical issues like bioethics, the atomic bomb, pure research in a world where people are starving;
   c. Philosophical issues like determinism, materialism.
6. A survey of some of the interactions between science and religion — Galileo, Aquinas' synthesis of Aristotle and Christianity, scientific creationism.
7. Several hands on activities designed to illuminate different aspects of the scientific enterprise — Black Box, Tinker Toy Time, Blockhead (discussed below).

cist, dislikes Y, a chemist. We can test this by inviting another chemist to engage X and see if X continues to be rude. Failing this, hypothesis two — X dislikes people who wear suits. We can test this by engaging X and another person in a suit, etc.). The essential testability of scientific ideas is repeatedly emphasized, initially in this exercise and throughout the course.

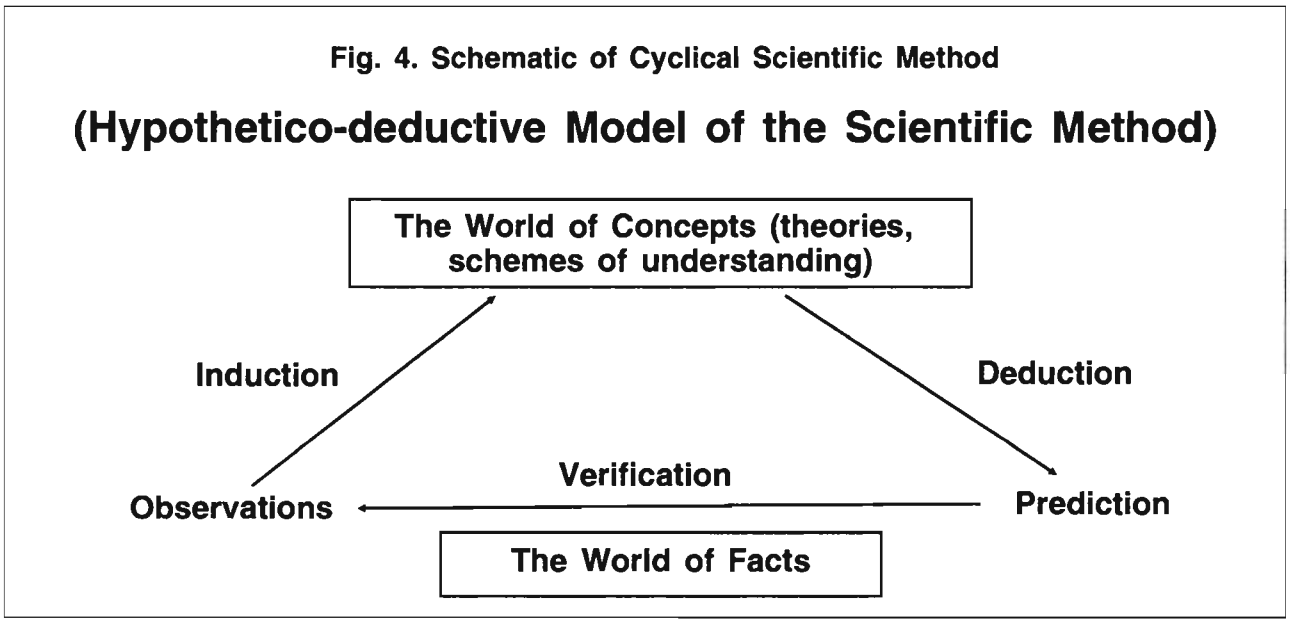
Once the general nature of science has been discussed and its important role in the modern western world made clear, the course proceeds to a series of historically-based lectures on the development of science, using cosmology as the focus. Topics include: (1) the origin of science in pre-Socratic Greece; (2) the Plato/Aristotle divergence; (3) the Aristotelian scheme; (4) the languishing of science during the early middle ages; (5) the rediscovery of Greek science and Aquinas' synthesis; (6) the scientific revolution, with emphasis on Galileo and the various interests that combined to create that colorful, but tragic, affair; (7) the Newtonian world view as the replacement for the now defunct Aristotelian view; (8) Einstein's special relativity as the disintegration of the Newtonian scheme; (9) General Relativity and the gradual ascendance of the Big Bang; (10) the union of particle physics and cosmology in "Theories of Everything."

The cosmology lectures are followed by a brief discussion of the remarkable fine tuning of the universe for life as we know it. We mention the viability of viewing cosmic evolution as the creative work of God (à la the Anthropic Principle), with cautions about entangling scientific and theological ideas.

The third major component of the course is a discussion of the origin of the modern concept of matter. This is done in a straightforward way describing the origins of chemistry in alchemy, the development of the periodic table, and the modern quantum theory of matter. Since this portion of the course is review for many science majors, considerable attention is given to the history of the ideas to maintain their interest in the material. At the end of the discussion of matter, the topic of reductionism or scientific materialism is used to help the students see the significant but subtle issues raised by these scientific developments.

Biological theories of evolution and genetics comprise the final major component of the course. Evolution is treated first historically, emphasizing that Darwin developed the theory of evolution by natural selection to explain some observations, not to discredit traditional religious views. Next we present the confused state of contemporary evolutionary theory, presenting some major challenges to the traditional understanding of the theory. The sequencing of the fossil record is presented as evidence for evolution; the gaps in the sequence are presented as problems. Throughout the discussion attention is focussed on the difference between observation and theory, between facts and explanation. We have elected not to focus on the "two models" approach to origins at this point (creation/evolution) because we do not feel that scientific creationism provides a legitimate scientific alternative to evolution. We do, however, make it clear that philosophical bias can play an important role in both evolution and creationist perspectives. Toward this end, we show

Fig. 4. Schematic of Cyclical Scientific Method



Phillip Johnson's video on the Blind Watchmaker and have the students read the essay that goes along with it. (We have some reservations about this because of Johnson's affinity for scientific creationism.)

Then we consider genetics. One lecture is devoted to its history beginning with Mendel and ending with a general explanation of genetic engineering and the Human Genome project. This section of the course emphasizes the inability of science to resolve the moral dilemmas that it creates. Students are led in discussions focussing on how these developments affect our philosophical views of man, God, and the value of life; and case studies are used to work through the ethical decisions involved with genetic screening, *in vitro* fertilization, and abortion.

This sequence — cosmology, nature of matter, biology — preserves the rough historical outline of their development. We have found it helpful to keep disciplinary topics together although it interrupts the pure historical sequencing of the course. Therefore, relativity is discussed before evolution so that it can follow on the heels of Newton, thus maintaining that historical continuity.

Besides the broad lecture series outlined above, EMES also includes a variety of topics covered by guest lecturers. One popular topic is a presentation of the Near Eastern cosmological model that forms the framework for the Genesis account. We find it particularly useful to make the students aware of the way that the writer of Genesis incorporated elements of the prevailing cosmology (firmament, for example) in his account. When the students realize this (many refuse to do so!), it helps them focus on the theological aspects of the account and not be distracted by the apparently scientific aspects of the account. Another popular topic is the tendency for philosophical movements to use science as a part

Fig. 5. The Black Box: An Exercise in the Use of the Scientific Method

In this popular activity, students are assigned to a "research team" and given $8,000 to run their "research project." Each team is given a box that is painted black with a number on each side and told to devise a model/hypothesis/theory that explains what is inside the box. We explain that the black box is analogous to many scientific systems, using the atom as an example. We cannot "see inside" the atom and therefore must make educated guesses about its internal structure based on indirect experiments. In the same way, the students cannot see inside the black box and must therefore do experiments (each of which cost $1,000) with the black box to try to figure out what is happening in this small part of the universe that is inaccessible to them.

Experiments are simple operations such as "shaking the box in the three-six direction with the four side up." The number of experiments they can do is limited to mimic real scientific research and so that they will think carefully about what kinds of experiments will confirm or reject their hypotheses. The group is required to record their approach to the problem and their experimental data in a table and are encouraged to think about the actual process with the help of the "Scientific Method Cycle" Figure. We discuss this process following the exercise highlighting the following ideas: (1) a *hypothesis* is based on a number of simple observations and is thus inductive; a prediction, on the other hand, is based on the hypothesis and is deductive; (2) a scientist moves back and forth between the "World of Facts," which he or she observes, and the "World of Concepts" multiple times in the quest for a suitable hypothesis; and (3) as a hypothesis is confirmed by several different experiments confidence in its veracity is gained. Eventually when a high level of confidence is present, the explanation can be elevated from a hypothesis to a theory. As students begin the experiments, they almost always follow a predictable path of shaking the box from side to side or rolling the box 90°. Occasionally some groups will shake the box from corner to corner — a critical experiment since inside the box there is a string running diagonally between two corners with a weight that slides along the string. When the teams present their models at the close of the exercise, we talk about "paradigm shifts" in science — how looking at the same system from a different perspective often yields great new explanations. Then as we lecture on the history of science, we use this exercise to illustrate the work of Copernicus, Newton, and Einstein.

of their foundation — determinism, materialism, relativism — as well as ideas like capitalism, Nazism, and communism that claim support from evolutionary biology.

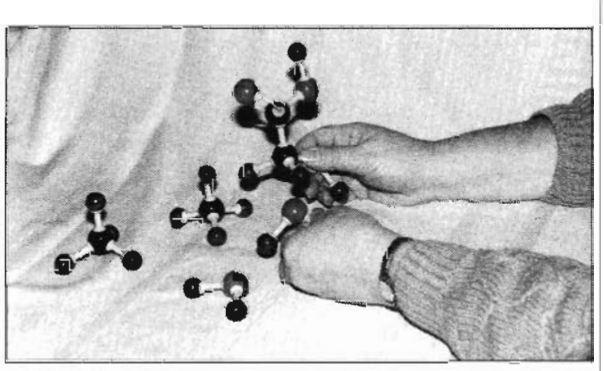
The students also explore some of these ideas in a series of small group discussions, led by the better students and overseen by the faculty. These discussion groups are begun before the topic of evolution is considered formally in a lecture, since this is the most difficult part of the course for our students to interact with spiritually. In these groups the students are provided with a series of discussion questions that go with the text. The first session asks students to identify the voices of authority that have shaped their world view and gets them to begin thinking about how world views can change and how to resolve internal conflicts within a world view. The second session deals with inspiration and interpretation of Scripture and focuses on the purpose and style of Genesis 1. The third session reviews evolutionism and scientific creationism, and asks students to distinguish between fact and faith in the various positions regarding origins, highlighting the idea that both are sources of truth. The student questions ask them to explore their religious background and see if it can be integrated with the material that they are studying in class. For texts, we have used *Worlds Apart: The Unholy War between Religion and Science* written by Karl Giberson, Charles Hummel's *The Galileo Connection: Resolving Conflicts between Science and the Bible* and Richard Wright's *Biology Through the Eyes of Faith.*

There are three hands-on activities in EMES, all of which are immensely popular with the students (perhaps because they interrupt the series of lectures; or maybe because they use no math). They are: (1) the Black Box (Fig. 5) in which students are given a large black box that makes a pounding noise when shaken. The assignment is to formulate testable hypotheses about the internal structure of the box that will account for the observations. (2) Tinker Toy Time (Fig. 6) in which students construct molecular models of the chemicals involved in the primordial soup and then try to find an energetically efficient chemical pathway to an amino acid. This activity helps the student see that chemical origin-of-life scenarios are speculative but that science can realistically study the plausibility of such scenarios. (3) Blockhead (Fig. 7) in which students are given nine blocks and told that one is missing and they must identify its characteristics by properly organizing the nine available blocks. Once the nine blocks are organized, a variety of patterns become apparent and the properties of the missing block are readily predicted from the patterns. One of the several patterns admits of more than one solution, thus allowing the students to experience the very real frustration common to scientists who venture down attractive "blind alleys." The Blockhead activity is an example of the kind of reasoning used by Mendeleev as he predicted missing elements on the periodic table and Murray Gellman as he predicted the existence of certain elementary particles.

Fig. 6. Sesame Street Presents "Tinker Toy Time with Chemical Evolution"
(Brought to you by the letters C, H, N, and O)

This activity is designed to acquaint students with the use of models to represent our scientific understanding of a particular system. Standard atomic model kits are used as teams of students repeat the Miller-Urey experiment by figuring out how to build glycine from H_2O, CH_4, and NH_3. A discussion of the need for energy to break bonds between atoms precedes the exercise. Students are given ten "Energy Bills" and told that they must spend one each time they break a connection. Students are then asked to determine the path of building this molecule that requires the least amount of energy.

Although there is usually a fair amount of confusion at the beginning of this exercise, the students generally work out a method of synthesizing glycine from the precursor molecules. They begin to appreciate the amount of "luck" it would take to establish a biological molecule in the primordial soup "by chance." At the close of the exercise, we discuss the fact that scientific models are not perfect. Students are asked to evaluate the validity of the model system they have been using by listing the ways that the "tinker-toy" creations correspond to real molecules (eg., C always has 4 connectors) and the ways in which these models are flawed (eg., C is not a hard round ball).

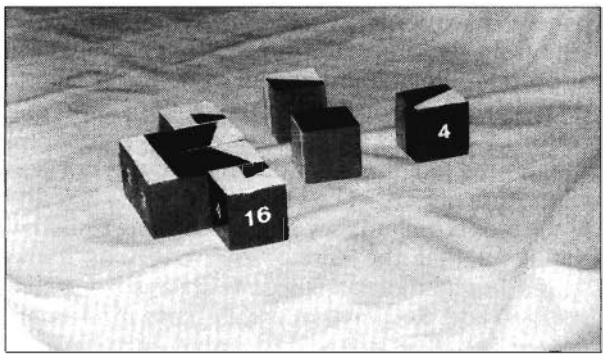


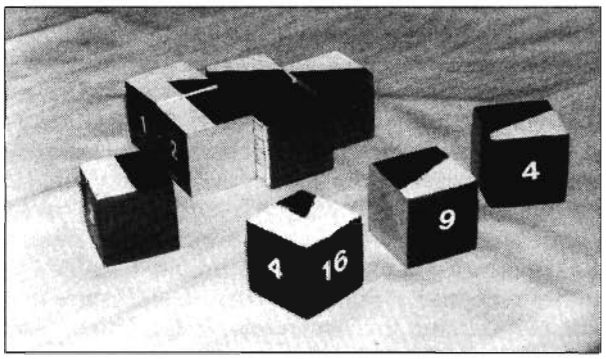
Pedagogical difficulties

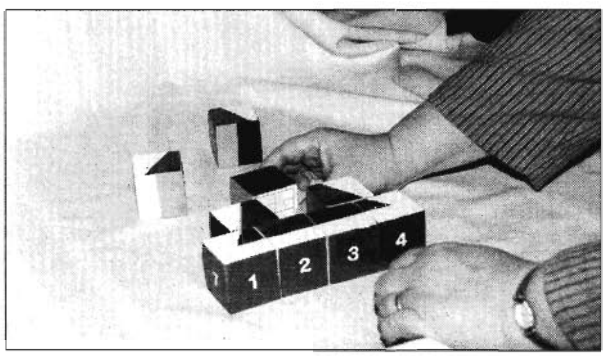
There are several major challenges — both practical and theoretical — to teaching a course such as EMES. On the practical side, the team teaching format is very difficult to manage. With so many different lecturers, the students never really get "in the groove." Though the course has always had a single director, it has never been possible to instill a single vision in the various instructors. Some lecturers feel that the students need to know more science and thus include material solely for the sake of science literacy; other instructors feel that the integration of science and faith is all that matters and

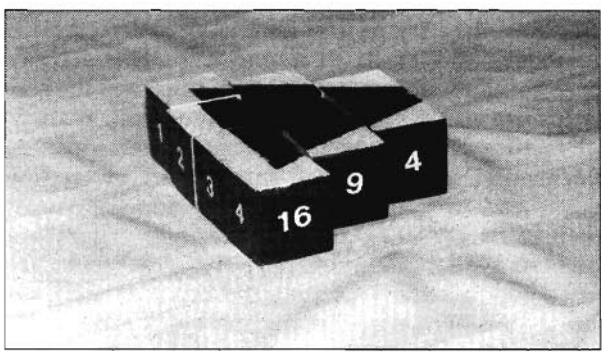
Fig. 7. The Blockhead Activity

In the Blockhead Activity, students are exposed to a third strategy of science — the recognition of patterns which enable us to understand how nature is organized. Students are introduced to the activity with a historical discussion of Mendeleev and the development of the periodic table. We point out that by the mid-1800's scientists had discovered fifty-five chemical elements and were energetically looking for ways to organize them. They considered many of the characteristics of the elements and ordered them in various ways, but in Mendeleev's chart, he left several spaces blank and predicted the characteristics of the elements which would someday fill those spaces. We tell the students that they will be performing a similar task with the nine blocks they have been given. Each block has six characteristics (one on each side) that fit into a pattern. One block is missing and, after the pattern has been solved, it will be possible to predict what characteristics the missing block could have. The patterns on each of the six sides range from easy (a painted triangle) that forms the basic organizational framework to medium difficulty (patterns of numbers and colors) to very difficult (the sixth side has grids which contain a complex pattern of circles and x's) Usually, within thirty minutes, the students have solved the pattern (see photo series below), and can confidently predict five of the six "characteristics" of the missing "element." The sixth side, however, has more than one logical solution. As students make predictions and explain their reasoning, the instructors, aware of the actual pattern that "Mother Nature" used (which means they have the missing block in their pocket!), acknowledge that a particular "wrong" solution may be logical, but such an "element" is not found in nature. Although this frustrates students, it clearly illustrates that scientific research often allows multiple hypotheses to be held simultaneously and that during the process of discovery there is rarely only one obvious solution.









include no more science than is necessary to accomplish that goal. A format with a single instructor, which we have also used, provides more coherence but sacrifices the broad based expertise that is helpful in an interdisciplinary course of this nature. In conversations with students, it has also been our impression that students in different majors were pleased to discover that one of "their" professors had something to contribute to this course. One strategy that we are attempting for maintaining coherence despite the diversity of lecturers is to have an elaborate study guide produced for the students, in which each lecturer's material is summarized in a similar format.

Another ongoing source of concern has been textbooks. It has never been possible for us to find a single text which would meet even a significant portion of the need. So we have been forced to rely on a variety of texts, including one produced "in-house" by several instructors. There are a few (precious few) good history of science texts on the market but it is hard to get general agreement on a single text when it has to be used by so many separate instructors. ("Galileo is presented from a biased perspective." "There is not enough chemistry." "Quantum theory with no math?") Most history of science texts, for example, contain little or no discussion of the important role that religion has played in the lives of most of the major figures of the scientific revolution. There are, however, some excellent texts that cover portions of the course material. Timothy Ferris' *Coming of Age in the Milky Way* does a superb job with the history of cosmology and is written in a style that humanities students appreciate; Miller and von Loon's *Darwin for Beginners* does an excellent job of presenting the philosophical and scientific origins of evolution (although the irreverent cartoon format of the book may offend the sensibilities of some readers). We currently use Hazen and Trefil's *Science Matters: Achieving Science Literacy* as background reading for students with poor high school science backgrounds. Most students like this book and consider it quite helpful; we find this alarming since it is written at a junior high school general science level.

Evaluation

Is "Epoch Making Events in Science" a success? Course evaluations show that the general student response is positive, although there is certainly a contingent of nay sayers. Better science majors find the course too easy (even though they don't make A's!); some dogmatic conservative students question the "orthodoxy" of some course content; and many students complain that they don't need to know "all this stuff." But many students are quite excited by the class. Some students bring a strong "Science vs. Religion" interest to the class and, once it becomes apparent that the instructors are not dogmatic about their positions, these students begin to reflect in a more mature way on their world view. Most science majors find the historical discussions to be nicely complementary to their studies in their major, and humanities majors appreciate the discussion of the human side of science. The course is very eclectic and everybody finds something to like (and to dislike!).

We have attempted to assess student opinions regarding origins questions at the beginning and end of the course using an anonymous matched pair survey. A series of statements regarding the origin of life, the early chapters of Genesis, the time course of creation, and human origins were presented to the group of students characterized in Figs. 1 and 2. Students were asked to choose one of five options ranging from strongly disagree to strongly agree. Following these, two multiple choice questions asked the student to choose a view regarding the inspiration of Scripture and a position for relating science and the Bible.

This survey pointed out that there was a great deal of change occurring in students' thinking during the course and they are clearly engaged in trying to process these questions. It also showed that although movement on these issues was occurring in both directions (toward a creation science position and toward a naturalist position), in some cases it seemed that there were trends in our population. Regarding the early chapters of Genesis, there was a trend away from agreement with the statements, "God created the universe as we know it in six 24-hour days" and "The early chapters of Genesis are based on myths." There was an increase in the number of students, who at the end of the course agreed with the statement, "The early chapters of Genesis have a theological meaning only." Concerning human origins, there was a trend away from agreement with the statements, "Humans originated from animal ancestors by chance naturalistic processes" and "Humans originated when God created Adam from the dust." There was also an increase in the number of students who at the end of the course agreed with the statements, "God created the universe as we know it through evolutionary processes that took millions/billions of years" and "Humans originated from animal ancestors by evolutionary processes that were directed by God." Finally, the students moved away from a strict inerrancy position which claims that the Bible is scientifically accurate and

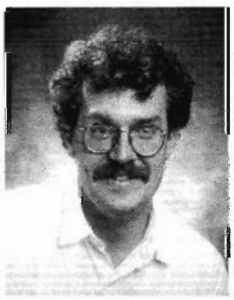
toward a complementary view of relating science and Scripture. We are encouraged by these data because the course enables some students to abandon dogmatic positions at the extremes in favor of a more mature world view that allows for some tension.

For other students, however, making such a transition is extremely threatening. One serious issue with which we constantly seem to struggle is the extent to which students' religious assumptions should be challenged in a course of this sort. As the readers of this journal are very aware, there are millions of Christians who passionately believe that there are no factual errors of any kind in the Bible, scientific or otherwise, and it is unsettling to them to hear lectures on how Genesis is based on Near Eastern cosmologies, or that human beings were not created from literal dust, or that the universe originated billions of years ago in a Big Bang. Some of our students are appalled at what they hear in our classroom and "came to a Christian college so they wouldn't have to hear that kind of stuff." While we firmly believe that Christian liberal arts students need to understand modern science, the destruction of their faith is too great a price to pay for that enlightenment. But there is an alarming (and widening) intellectual gulf between conservative Christianity and the broader intellectual community and the Christian college cannot sit idly by while the Church loses touch with contemporary science and wanders aimlessly back into the Dark Ages.

Conclusion

In spite of the concerns expressed above, we do feel that a course such as EMES is an excellent place to begin the "opening of the student mind." One of the advantages of discussing controversial scientific ideas in a course like EMES, rather than a course in say "Science and Christian Faith," or "Origins" is that science can be presented as a united enterprise. The students are much more receptive to the Big Bang Theory when it is presented in the development of cosmology rather than in its confrontation with religious theories of origins. Similarly, when evolution is presented in the context of a developing awareness of a changing and ancient earth, it seems less demonic. An unfortunate feature of the creation/evolution debate is that evolution and the Big Bang are often presented by the scientific creationists as if they originated in a conspiracy of secular humanism, rather than the more noble pursuit of truth about the natural world. When controversial ideas are discussed in the context of the whole of science, including a history which most students find interesting, the controversial ideas seem more benign.

We believe that "Epoch Making Events in Science" is a valuable component in the education of a liberal arts student. The history of science is becoming recognized as an important component in the canon of the Liberal Arts, and modern Christians need to come to grips with science and the perspectives that it is providing on the creation. *



Karl Giberson is Professor of Physics and Director of the General Science Program at Eastern Nazarene College, where he has taught physics, astronomy, and history of science for 11 years. He holds the Ph.D in atomic physics from Rice University. Giberson has published numerous technical articles in the field of atomic physics as well as more popular articles and review essays in the field of science and religion. He is the author of Worlds Apart: the Unholy War Between Religion and Science, *which was reviewed in the December 1995 issue of this journal. He is currently teaching a new course "Science & Religion" developed as a part of the Templeton program.*

Dr. Frederich is an Associate Professor of Biology and Health Professions Advisor at Eastern Nazarene College. She has published research articles in the field of cellular aging and growth factor signal transduction as well as more general articles on sleep disorders, leukemia, and euthanasia. She and her husband, Bob, were visiting professors in the Department of Biochemistry at Nanjing University, People's Republic of China in 1987-89, and have since adopted a daughter from China.

Book Reviews

WRINKLES IN TIME by George Smoot and Keay Davidson. New York: William Morrow and Co., 1993. 331 pages, index. Hardcover; $25.00. Reissued in 1994 by Avon Pub. in paperback; $12.50.

On April 23, 1992 at 8:00 a.m. in Washington, DC, George Smoot and his team electrified the scientific community when they presented the results of their observations with the Cosmic Background Explorer satellite (COBE). Their data finally answered one of the long standing criticisms against big-bang cosmology: Where is the evidence for galaxy formation after the big-bang? Countless hours of observations and data reduction gave the answer. The evidence is in the minute fluctuations ("wrinkles") in the otherwise uniform cosmic background radiation that impinges upon us from all quarters of the universe. Smoot's team had discovered what Stephen Hawking declared was "the scientific discovery of the century, if not all time."

Wrinkles in Time, with co-author Keay Davidson, an award winning science writer for the *San Francisco Examiner*, serves as a well written, popular presentation of the subject of cosmology. The book is also Smoot's autobiographical account of his scientific studies that led up to his historic results. Thus, the book is his personal odyssey as a scientist, which began when Smoot was a kid and dreamed of space research. Eventually, he pursued a career in nuclear physics at MIT where he studied under such luminaries as Dave Frisch, Steven Weinberg, and Victor Weisskopf. His work at MIT on quarks was fortuitous, for it gave him the tools to understand the melding of modern cosmology and particle physics.

In 1970 Smoot realized that the field of particle physics was becoming too crowded, so he left for Berkeley to work with Luis Alvarez. There he became involved in sending instruments aloft in balloon flights to study cosmic rays. His somewhat humorous account of several balloon accidents (not funny at the time) gives the reader insight into the kind of difficulties that can befall all experimenters. In time, however, he grew to dislike balloon flights intensely because of their inherent difficulties. Before moving on to the next project, his team in 1975 obtained the best results to date that contradict Hans Alfven's matter/antimatter cosmology. (Basically, they found far fewer antimatter nuclei than theory predicts.)

From balloons Smoot "graduated" to the use of converted U2 spy planes that carried scientific payloads to measure anisotropies in the uniform cosmic background radiation. This is a difficult measurement which he describes as "like listening to a whisper during a noisy beach party while radios blare, waves crash, people yell, dogs bark, and dune buggies roar." In spite of the difficulties, he and his team announced in 1977 that our galaxy was moving approximately 600 kilometers/second towards the constellation Leo. Such a rapid motion on the part of our galaxy shocked astronomers, but these results still stand. This was the first inkling of the "Great Attractor" that was confirmed later by other astronomers.

The beginning of the universe has been one of Smoot's ongoing interests. He strongly believes that big-bang cosmology is correct, and this work gives an understandable explanation of the evidence on which he bases his belief: the dark night sky (Olbers paradox), primordial element abundance, the expanding universe, the general cosmic background radiation, and finally the "wrinkles" in the space-time continuum his team observed with COBE.

The book is loaded with interesting history. Smoot and Davidson discuss the well-known "paradigm shift" from Aristotelian to Copernican thinking, the modifications Einstein's relativity theories brought to the Newtonian world view, and the modern attempts to synthesize general relativity and quantum mechanics. They also discuss the important contributions of Galileo, Kepler, Bishop Berkeley, and Ernst Mach. Most of the history, however, concentrates on the personalities and on the events that led up to the formulation, discussions, and acceptance of big-bang cosmology. This includes the works of Slipher, Humason, Hubble, Ryle, and Penzias and Wilson. Also analyzed is Gold, Bondi, and Hoyle's steady-state cosmology, along with the reasons it was discarded in the late 60s.

The authors examine the necessity for dark matter as seeds for galaxy formation, along with the evidence that it exists. It appears that dark matter accounts for most of the material in the universe, and 90% of it is nonbaryonic. That is, most of the universe exist in a form of matter that is different from that which comprises our everyday world. Dark matter may include such exotic species as WIMPs (weakly interacting massive particles), axions, and strings.

Discussions of cosmology invariably bring in the question of God's role. It was Smoot who used the metaphor that the COBE results were like "beholding the face of God" — a statement that landed him in hot water with some of his peers. The significance of a creator is downplayed in the book. Smoot entertains the possibility that God put the universe together, but he does not commit himself to this proposition. He disagrees, however, with Steven Weinberg that the universe seems more pointless the more we understand it. On the contrary, Smoot believes that the complex nature of the universe reveals an underlying unity that, in a sense, is programmed into the cosmos, but he does not discuss the origin of this program.

I have read many popular accounts of cosmology, and I would rate *Wrinkles in Time* among the best. The readable

text and the large number of diagrams and photos simplify complex issues without "dumbing down" the science or patronizing the reader. And the book is personal. All along I felt that I was a friend, along for the ride, while Smoot explained his work. All in all, this is an enjoyable book that I highly recommend.

Reviewed by Perry G. Phillips, adjunct physics professor, Gordon College, Wenham, MA 01984.

REDEEMING CREATION: The Biblical Basis for Environmental Stewardship by Fred Van Dyke, David C. Mahan, Joseph K. Sheldon and Raymond H. Brand. Downers Grove, IL: InterVarsity Press, 1996. 180 pages. Paperback; $14.99.

This multi-authored book is unique in that the authorship of particular chapters is not indicated. All four authors are affiliated with the AuSable Institute for Environmental Studies. The book originated as a project of their membership on the Global Resources and Environment Commission (GRAEC) of the ASA. Furthermore each author has had extensive teaching and research experience in forestry and/or field biology in several geographic areas.

The ten chapters of the book describe the various environmental crises and propose ways in which Christians can become involved — as individuals, as part of the Christian church, and as citizens — in a global environment. There is extensive attention given to the Bible as it relates to the original creation, to God-given stewardship responsibilities, and to the impact of sin in bringing about this crisis situation. But the authors constantly provide encouragement with real life experiences that have made them and others optimistic and even joyful as they contemplate some of the marvels of God's creation.

As might be expected in a multi-authored book, there is some repetition of themes. There are even some apparent contradictions. In Chapter 2 the author, while emphasizing the importance of the recognition of God as a truly awesome Creator, suggests that: "the church of Christ does not need another 'ism,' like Christian environmentalism, to grow strong in faith." On the other hand, Chapter 10 states that Christians should act corporately "by forming and joining environmental advocacy groups that are explicitly Christian, such as the Christian Environmental Association and the Christian Society of the Green Cross." However, such differences are of value in stimulating Christians of a variety of backgrounds to think of what they should be doing and/or thinking in regard to a major area of crisis in today's world.

Each chapter has a central theme. Through biblical references, news items, and personal anecdotes, the authors bring together the major theme of the book: the biblical basis for environmental stewardship. The book deals with the following topics. "A Creation in Crisis" outlines the problems. "God the Creator" focuses on the awesomeness of the Creator. "The Value of Creation" emphasizes the importance of creation as a work of God and its value to the human race. "Out of the Dust" describes the unity of creation as derived from God. "Covenant & Redemption" reminds us of God's covenants with humanity and all creation. "Ruling and Subduing" spells out our God-given human role in using, cultivating, and preserving the world around us. "God's World Today" elaborates on the current crisis with emphasis on population, resource depletion, and pollution. "The Consequences of Disobedience" summarizes from the Bible, from history, and from current events the serious nature of human involvement in the environment. "A Christian Response" and "Ecology and the Christian Mind" both deal with how Christians should be changing their attitudes, their worship, and their stewardship.

Although written by people with hands-on experience, this book is neither too technical nor too popular/superficial. I recommend this book for all who are interested in both the ecological and the theological parameters of the environmental problems facing the world today. Furthermore, it contains many practical reminders of how our lifestyles have contributed to the problem and some of the challenging suggestions of things we can do. At the end of each chapter there are "Questions for Thought and Discussion" that could be valuable in classes or small groups. Above all, the authors constantly remind us that Christians have a God-given stewardship role in relation to the awesome creation of our Almighty God who is the Creator and Sustainer of the universe.

Reviewed by Wilbur L. Bullock, Professor Emeritus, Zoology, University of New Hampshire, Durham, NH 03824.

SERIOUS TALK: Science and Religion in Dialogue by John Polkinghorne. Valley Forge, Pennsylvania: Trinity Press International, 1995. 117 pages. Paperback; $13.50.

Polkinghorne is a theoretical physicist, Anglican priest, and President of Queens College at Cambridge University. Many of his works on science and religion have been reviewed in this journal. His current book does not offer any new ideas. What it does do is introduce his thought in short, winsome lectures which are intended for an audience convinced of the power of scientific inquiry, but not yet of the Christian faith.

He begins by describing his method: start with a particular experience and then ask what best explains the observed phenomena. He describes such a method as the basis of scientific investigation and proposes that it is suitable for theology as well. In that mode he looks at creation, God's engagement with the material world, historical evidence for the resurrection of Jesus Christ, and likely human destiny. His writing is clear and to the point. Arguments are not in detail, but their direction is established as an invitation to further investigation.

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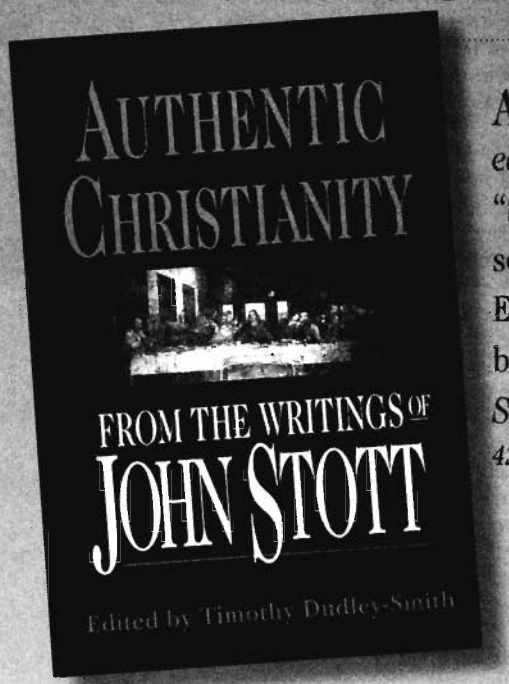

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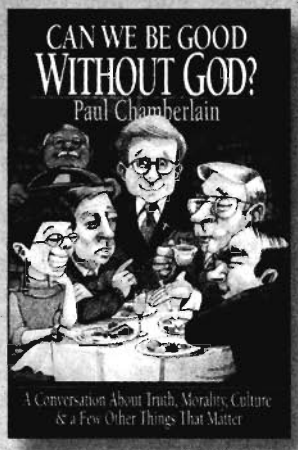

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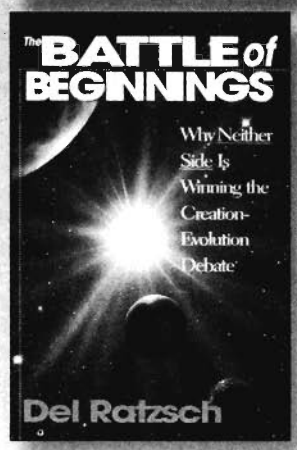

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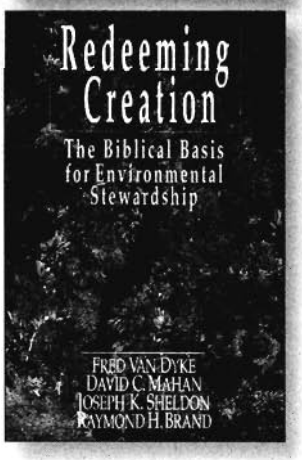

Redeeming Creation ***The Biblical Basis for Environmental Stewardship, Fred Van Dyke et al.***

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James C. Peterson, C. C. Dickson Chair of Ethics, Director of the Program in Religion, Ethics, and Technology, Wingate University, Wingate, NC 28174.

IN THE BEGINNING: The Birth of the Living Universe by John Gribbin. New York: Little, Brown and Company, 1993. 288 pages. Paperback; $12.95.

"Two of my main scientific interests have long been cosmology ... and evolution," states astrophysicist and science writer John Gribbin at the outset of his book. Defending a version of the Gaia hypothesis, he attempts to synthesize these interests (in light of the COBE satellite discoveries) to show that the universe "might, indeed, be alive — literally, not metaphorically — in its own right" (p. viii). Gribbin expresses his desire for cosmologists to think more like biologists (p. 254).

In Part One ("The Birth of the Universe"), Gribbin briefly looks at Hubble's law and its implications [i.e., the expanding universe (based on galactic red-shiftedness), the length of the universe to be measured in billions of light years] as well as the Special and General Theories of Relativity (which point toward the emergence of space, time, and energy from a singularity 15 billion years ago). This discussion paves the way for COBE's significance: the discovery of ripples in the cosmic background radiation has strongly confirmed the Big Bang theory. The existence of massive amounts of dark matter in the universe, which underlay the ripples, keeps galaxies from flying apart from one another and actually comprise nearly all of the universe's mass.

Part Two ("What Is Life?") is a discussion of the nature of life, DNA, biological evolution, and the interplay of various environmental and biological factors that give the appearance that the earth is somehow "alive." Gribbin defines living things not only as having "the ability to reproduce themselves, to grow, and to respond to changes in their environment" (p. 45), but also as being complexly interdependent. Gribbin argues that evolution, which happens through the process of "mindless copying [of DNA], with occasional [beneficial] mistakes" along with natural selection, adequately describes our history.

In Part Three ("What Is the Universe?"), Gribbin gives a helpful summary of some of the remarkable phenomena in our universe — the gravitational orbits of galaxies, the process of nuclear fusion, types of stars, black holes, and dark matter. He examines the "Goldilocks effect" in the universe — everything seems to be "just right" for its order and life. Any slight altering of the delicate balance of the early universe's conditions would have made the formation of stars and planets, life itself, and the continued expansion of the universe impossible.

Part Four ("Is the Universe Alive?") turns out to be quite speculative in parts — especially with regard to the origin of our universe. Gribbin believes that our own universe is just one of an infinite number of universes (a concept which itself is fraught with self-contradiction) that have come into existence "out of nothing at all" (p. 247) — that is, out of the activity of quantum vacuums. Since so many possible universes exist, at least a few will end up looking as finely-tuned as ours.

Although Gribbin's book is informative and lucid in many ways, its blanket assertion that the Gaia hypothesis is to be considered superior to the theistic model reflects Gribbin's underlying *philosophical naturalism.* Apart from metaphysical prejudice, why should a naturalistic cause be preferred over against a supernaturalistic one? Why can't the theistic hypothesis (God as creator, designer, sustainer) provide a simpler, more adequate explanation for the cause of the Big Bang itself, the origin and existence of life, and the universe's delicate balance?

Moreover, the belief that something can come into existence uncaused out of nothing is a metaphysical absurdity. Gribbin confuses the *unpredictability* of a quantum vacuum with *uncausedness.* Further, a quantum vacuum is not "nothing;" it is a humming hive of activity. Moreover, according to relativity theory, no quantum vacuum could have possibly existed "before" the Big Bang.

What Gribbin has in effect attempted to do — and what should make the reader quite suspicious — is basically create the condition whereby no amount of evidence, no matter how intricate, could ever serve as evidence for an intelligent Designer. Thus, Gribbin's view, which appears "scientific," is masking a broader metaphysic which excludes God from the outset.

Reviewed by Paul Copan, N49 W28661 Chardon Drive, Hartland WI 53029.

THE SEARCH FOR INFINITY: Solving the Mysteries of the Universe, by Gordon Fraser, Egil Lilliestøl and Inge Sellevåg. Introduction by Stephen Hawking. New York: Reed International Books Ltd., 1995. 144 pages, index. Hardcover; $22.95.

If you are a scientist, and you have a coffee table, this book should be on it. It is not a scientific book. It tells about the history of modern science, especially history of discoveries in small particles, and in large stellar constellations and galaxies. The pictures are great. "Explanations" are in nontechnical language. You read about the discoverers. Your friends may begin to understand a bit about your work. If you leave it lying around, people will ask questions. They may even learn about the importance of your work. Or, if you do not want to talk about your work at home, you may display it in your office. It is even suitable for a staff room. Somebody will explain technical details to some newcomer. High schools and elementary schools should have this book in their

libraries. The book's price is not excessive for what you get.

The original idea for the book came from Lilliestøl and Sellevåg, who wrote a series of articles in the Norwegian newspaper, *Bergens Tidende.* They developed these articles further in cooperation with Gordon Fraser of The European Laboratory for Particle Physics in Geneva. I heartily recommend the book.

Reviewed by Jan de Koning, Box 168, St. Michael's College (University of Toronto), 81 St. Mary Street, Toronto, Ont., M5S 1J4, Canada.

SCIENCE, RELIGION AND THE FUTURE by Charles Raven. Harrisburg, PA: Morehouse Publishing, 1994. 125 pages. Paperback; $9.95.

The lectures which form the heart of this book were first published in 1943 by Cambridge University Press. This new edition is one volume in Morehouse's Library of Anglican Spirituality, accompanying works by such well-known figures as Dorothy Sayers and William Temple. The inclusion of a book on science and faith in such a library ought to be encouraging to those who think that the science-theology dialogue should be a major concern of the Church.

The editor of this series, Susan Howatch, has provided a brief introduction to Raven's life and to these lectures. Trained in both the biological sciences and theology, he became Regius Professor of Divinity at Cambridge in 1932 and was always an ardent proponent of dialogue between religion and science. He wrote well, and his language in matters of controversy, which he did not shy away from, is colorful but civil.

About half the book is devoted to the historical development of science and its relationships with Christian thought. Not surprisingly, the greatest attention is given to the biological sciences. The emphasis on the role of induction in scientific work seems a bit dated, but Raven was ahead of many of his contemporaries in his awareness that one could not simply trace "the scientific method" back to Bacon. His criticisms of amateurism in work on the history of science highlight one area in which there has been considerable improvement in the past half century.

Of course, a good deal of attention is given to the conflicts connected with evolution. Chapter III focuses on this, and should be very helpful today especially for Americans, who are likely to be unfamiliar with the scientific and theological aspects of British Victorian society and the personalities involved. It is only to be wished that for once Wallace would be given more than passing mention as the co-discoverer of the role of natural selection.

Evolution is central to Raven's view of the connection between science and Christianity and to his view of reality. His call for a "new Reformation" which would take seriously all the developments in modern science involves especially advocacy of "a thorough-going evolutionism" (p. 70). He saw the work of Bergson and Whitehead as pointers toward the future, and his ideas can profitably be considered in connection with process thought. Like Teilhard de Chardin, Raven believed the development of human personality, the life of Jesus, and the formation of community to be at the forefront of the evolutionary process. And, like Teilhard, Raven's views on evolution would be rejected not only by Christian fundamentalists, but also by the scientific fundamentalists who think that natural selection is everything and that design is nothing (pp. 106-110).

It would often be unreasonable to expect a writer to foretell the future, but it is perhaps not unfair to ask how well a book of half a century ago with the present title has done in discerning the way in which developments at the science-theology interface would take place. Certainly Raven did not always predict accurately the course of developments: his dislike of neo-orthodoxy shows him out of step with a major current of theology, and especially with its discernment of the radical character of sin and evil in the world (e.g., pp. 78-79). On the other hand, his "modernism" and insistence upon a holistic view of reality clearly presage much of what is said today in the science-theology dialogue. And, for all the casual attitudes which Raven shows toward some traditional Christian ideas, his look toward the future is inspired by basic Christianity. "The hour is coming," he says in conclusion (p. 125), "when we shall invigorate theology by recovering the Alexandrine doctrine of Christ as the Word of God, as being not merely the Saviour of men but the Redeemer of the whole creation which has been created through him."

Reviewed by George L. Murphy, Pastor, St. Mark Lutheran Church, Tallmadge, OH 44278.

A MATHEMATICIAN READS THE NEWSPAPER by John Allen Paulos. New York: Basic Books, 1995. 212 pages. Hardcover; $18.00.

This is a delightful and entertaining book. The spin it puts on the news is right on target. Math plays a role in every section of the newspaper, and Paulos illustrates this in the book's fifty-three short chapters.

His chapter on religion in the news will interest readers of this journal. Paulos points out that while the news covers stories about the sociological relevance of religion, it seldom ventures into realms of different belief systems. (And it should not, according to Paulos, in order to promote religious peace and harmony.) Paulos' illustrations on how the news distorts information on science, medicine, and the environment are also helpful. For enlightenment, new insights, and yes, even entertainment, this book is well worth its price.

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

REASON IN THE BALANCE: The Case Against Naturalism in Science, Law and Education by Phillip E. Johnson. Downers Grove, IL: InterVarsity Press, 1995. 245 pages, index. Hardcover; $19.99.

Phillip Johnson, a graduate of Harvard and the University of Chicago Law School, and a professor at the University of California at Berkeley, is a scholar in criminal law. This is a sequel to his previous much-praised and debated book, *Darwin on Trial.*

Johnson protests the marginalization of religion in chapter one, "Is God Unconstitutional?" There is a tendency for a religious viewpoint on an ethical issue to be disputed in the public arena because this viewpoint is based on a belief in God. This phenomenon is due to a change in the prevailing religious philosophy from a traditional theism to metaphysical naturalism. Johnson criticizes the scientific basis of this new philosophy, a purely naturalist account of creation. He points out that the proposal of Stephen Hawking in *A Brief History of Time* about the origin of the physical laws and the conjecture of Francis Crick in *The Astonishing Hypothesis* about materialistic theory of mind are metaphysical stories, not science. These philosophical speculations rest on the success of the Darwinian theory of evolution. Johnson then summarizes and updates his criticism of evolution in "Is there a Blind Watchmaker?"

After the publication of *Darwin on Trial,* Johnson engaged in debate and defense of his viewpoint with scientists, Christian and non-Christian alike, and theologians. Here he bemoans theologians who accommodate theology to scientific naturalism and criticizes some Christian scientists in their espousing methodological naturalism as their epistemological base. This methodology holds, by definition, that there is no God of the gaps, and it is inconsistent with theistic realism. He further elaborates in the Appendix about the difference between methodological naturalism and theistic realism in their philosophy and possible scientific hypotheses.

Johnson argues that metaphysical naturalism leads inevitably to relativism in ethics and politics, ultimately to tribalism or partisanship. Also due to the influence of metaphysical naturalism upon law and education, welfare, sexual promiscuity, divorce, and abortion become problems of society. Johnson laments the phenomenon of the cultural war and praises the virtues of civility and open debate in a free and pluralistic society. He points out that conservative Christians are angry, not because of disagreement, but because of marginalization through a subtext of contempt.

Overall this is a learned and thoughtful book which depicts the troubles of American society. The author demonstrates his knowledge of science, literature, philosophy, education, and law.

Most of the book is accurate, especially about the description of problems. However, Johnson places too much blame on the scientific community for social ills. The limits of science regarding origin, purpose, and destiny of humankind are recognized by some eminent scientists. The metaphysical speculations of popular scientists have not been accepted by the scientific world in general. Good science journals are careful about their statements; e.g., the journal *Science* (14 July 95, p.164) reported about limitations of epidemiological studies. The scientific community also worries about exaggeration, misconduct, and fraud in science.

The author proposes that theistic realism can generate different hypotheses on the question of common ancestry from those based on naturalism. These hypotheses should be falsifiable in the language of Karl Popper. Christians hope that the data from experiment or observation can differentiate these two kind of models derived from theism or naturalism. If so, then natural theology will find its completion and people may recognize God. However, this does not lead to the Triune God as revealed in the Scripture. If natural theology cannot succeed, then Christians need to admit that science is in the realm of general revelation or common grace, and theology covers mostly special revelation or particular grace (Karl Barth also argued for the autonomy of theology). In their natural condition, people are not able to comprehend spiritual truth; similarly, observing the nature world and making logical inference may not open the eyes of faith (the created order is now under a curse, see Gen. 3:17-19).

To lead people to salvific knowledge requires more than natural theology (Ps. 19:7-14 complete verses 1-6). It requires Christian examples and the work of the Holy Spirit. Johnson blames liberal Christianity for leading the path to naturalism. Conservative churches may also be culpable in their neglect of social justice. To solve the problems of the society, Christians have to follow the example of believers in the early church who, according to T. R. Glover, out-thought, out-lived, out-died the adherents of the non-Christian religions in the Roman world. The only way to have a respectable voice in science and intellectual world is to nurture more good scientists and scholars from the evangelical fold.

Reviewed by T. Timothy Chen, National Cancer Institute, Bethesda, MD 20892.

BELIEFS AND VALUES IN SCIENCE EDUCATION by Michael Poole. Buckingham, Great Britain: Open University Press, 1995. 130 pages, notes and references, index. Paperback; £ 12.99.

This book is a member of a series on "Developing Science and Technology Education" and is authored by Michael Poole, who for 20 years served as a lecturer in Science Education at King's College, London where he is currently Visiting Research Fellow. The series is designed to "encourage teachers and curriculum developers to continue to rethink how science and technology should be taught in schools ... what is the relationship between science and technology?" The author's own purpose is summarized in the final words of the book: "I have argued in this book that science should be neither deified, deni-

grated, nor forced into demise. Rather it should be promoted as a fascinating and worthwhile human endeavor practiced by fallible people." It is his purpose to "help science teachers to show how spiritual, moral, social and cultural factors affect science." In the helpful way characteristic of his previous writings, he provides the reader with many examples of an attitude that understands the significance of genuine science and seeks to integrate insights gained from science and Christian theology.

In the first chapter, "'Everybody needs Standards' — bases of decision-making," Poole discusses beliefs (such as justice, truthfulness, and honesty) and values that typically involve thinking, feeling and willing. He starts early to describe a set of attitudes toward science and science-teaching that are much needed in today's general environment. One of the first of these is, "Some of the most important aspects of life are not amenable to scientific testing." Insights into the value of the book can be obtained simply by collecting a few of these basic statements that are often misunderstood. The following are collected from the first chapter. "The task would appear to be to try to discover these truths, 'truth' being taken as some kind of correspondence to what is the case." "Relativism is only tolerant of relativists. It does not matter what you believe, except that you must believe that it does not matter." "Whereas social explanations of the *origins* of knowledge are logically possible, social explanations of the contents of knowledge are not." "Instead of taking *truth* as some kind of *correspondence* with the way things objectively are, independently of knowing subjects, they have taken it as the *consensus* of believing people." The book continues in this vein to set forth fundamental statements at critical junctures throughout its length.

The second chapter "'What science cannot discover, mankind cannot know'?" deals with beliefs and values about science, and traces the heritage of positivism. A recognition of the failures of logical positivism lead to the need "to help pupils recognize the limitations as well as the strengths of science as one important way of thinking about experience, but not the only one," and "the reinstatement of moral, theological and metaphysical questions as meaningful ones." A clear definition is given: "The doctrine of the omnicompetence of science belongs to *scientism* not to science." On their part, movements to denigrate science lead to arguments for subjectivism and relativism, which in turn, if accepted, "would put in jeopardy the whole of the scientific enterprise." Arguing for a position of "critical realism," the author states helpfully, "although you can construct a theory, or a model, or a *view* of reality or an *interpretation* of the world, you cannot construct *reality* and you cannot construct *the world!*"

The third chapter deals with the way in which evaluations and beliefs "affect the choices of analogies and models used in science and in science education." Examples of intrinsically valuable emphases may be seen from the following quotes: "When we try to describe something inaccessible or conceptually demanding, we make comparisons with the familiar," using similes and metaphors. After describing the various functions of a scientific model, the author points out also that "models are used *within* science, but there are also models *for* the activities of science itself; and both are important in teaching science." In drawing examples from evolution, he points out, "it could be said that evolution stressed God's *continuous* activity," and *"a theory of occasional intervention implies as its correlative a theory of ordinary absence."*

The final four chapters of the book deal in turn with environmental beliefs and values, cosmology and creation, the Galileo affair, and the Darwinian controversies. Poole points out how many commonly used phrases "all bear testimony to moral and aesthetic issues in science education which reflect people's world-views, their ideas about *nature.*" He describes parallels between science and theology: "It is the interpretive aspect of reading the Book of Scripture which I wish to compare with 'reading' the Book of Nature, referring in particular to the *hermeneutical circle.*" Other striking clarifications may be cited. "So it is a form of *category mistake* to claim that an *act* of creation has not occurred because the *process* has been explained." "The theological position of the 'god-of-the-gaps' has probably done more damage to theology than anything else. But, more relevant to our study here is the damage it can do to *science.*" "To claim that mechanistic explanations displace explanations about plan and purpose, is to commit the *explaining = explaining away* fallacy." "A clear distinction needs to be maintained between *evolution*, the biological theory, and *Evolution*ism, the philosophical system-building which has often been parasitic upon it."

This is an excellent book for use in science education in a Christian context, and as a book for adult consideration of these important topics.

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

PERSPECTIVES ON TECHNOLOGY AND CULTURE by Egbert Schuurman. Sioux Center, Iowa: Dordt College Press, 1995. 164 pages. Paperback; $10.95.

As one reads this book, one gets the impression of listening in on only half of the conversation, or maybe that there were complications in translation from the Dutch. Schuurman brings impressive credentials to the topic as a widely published professor of philosophy at the technological universities of Delft and Eindhoven, a senator in the Dutch Parliament, and chairman of the Lindeboom Center for Medical Ethics, yet the book is filled with sweeping assertions without explanation or support. For example, "Engineers, instructors, and employees must all ask themselves whether their contribution to technology does justice to the plant and animal kingdom, to our sources for raw materials, to consumers, to society, to culture, to third world countries, and the like" (p. 99). The book does not unpack this sentence. It simply goes on to other points as if all is clear. What does Schuurman mean by "justice"? How does one "do justice" to culture or the plant kingdom? While Schuurman probably has clear ideas in mind, in this work they are often left unexplained.

There is a repeated conclusion. We should actively use technology to serve people, while avoiding the pervasive pretension that human beings can bend all of reality to our will through technological control. Science maps reality. By such observation it abstracts patterns that can be manipulated and managed, but such abstractions do not capture the whole. Technology is useful, but only in its limited place. We are impoverished if we become completely absorbed in its pursuit as if it could answer all human needs and concerns.

That caution is well worth remembering.

James C. Peterson, Wingate University, Wingate, NC 28174.

ARE WE ALONE? Philosophical Implications of the Discovery of Extraterrestrial Life by Paul Davies. New York: Basic Books, 1995. 149 pages. Hardcover; $20.00.

With the recent discovery of 51 Pegasus, a planet orbiting a distant star similar to our sun, the subject of extraterrestrial life no longer seems the reserve of Steven Spielberg and *The X-Files*. Paul Davies, professor of natural philosophy at the University of Adelaide in Australia and recipient of the 1995 Templeton Prize for Progress in Religion, discusses the implications of alien communication for religion and philosophy in *Are We Alone?* The erstwhile mathematical physicist spent his early career working with famed scientist Stephen Hawking (author of *A Brief History of Time)*, and has written over twenty books on modern physics and cosmology since the 1970s.

Are We Alone? comprises six chapters, the first of which briefly chronicles man's attempt to discover intelligent life in outer space. Reflecting on NASA's recent program to search for extraterrestrial intelligence (SETI) by way of radio telescopes, which scan distant star systems to detect radio signals of alien origin, Davies takes the next three chapters to consider arguments for and against the existence of extraterrestrial life, and the impact a discovery of alien intelligence would have on three theories of the origin of human existence — (1) miracle, (2) improbable accident, and (3) inevitable consequence. He proposes the discovery of alien life "with novel biochemistry" (e.g., *left-handed* DNA) to rule out panspermia, wherein material is conveyed from Earth to another planet by asteroid impact. Davies argues that the discovery of extraterrestrial life with an origin independent of the Earth would present the greatest difficulty for cosmologies based on miracles or strict Darwinian evolution.

Simply stated, religious folk see a special relationship between man and God, and hence would find their view of creation upset by the discovery of alien life-forms. As for strict evolutionists, who understand the development of complex life (i.e., intelligent beings) from simple origin as natural albeit highly improbable, the discovery of alien intelligence would shake the foundation of their reigning paradigm. Davies rejects the belief in non-teleological, non-progressive evolution, arguing instead for an evolution driven by natural self-organization. This theory renders a divine origin of the universe unnecessary, while accommodating if not anticipating the discovery of extraterrestrial life.

Davies devotes the longest and most problematic chapter to examining "consciousness." Because "nature has a propensity to self-organize, that is, simple physical states tend to arrange themselves into more complex states, entirely spontaneously and without the aid of any external manipulator," Davies concludes that consciousness represents the culmination of a trend that is "part of the natural outworkings of the law of physics." He offers this as an alternative to a Darwinian interpretation of the development of life as a process of random, chance events. In short, Davies's project is to supply a teleological explanation of life — refuting the accidental universe theories of Richard Dawkins and Stephen Jay Gould — that can incorporate the existence of alien life without violating the principles of mathematical physics or evolutionary biology.

The problem with this approach stems from his belief in consciousness as an "*emergent* property." Because the mind eludes description by an appeal to just its material embodiment or physical principles, Davies decides that consciousness must arise from a particular ordering or structure of a physical system "when it reaches a certain level of complexity." Davies sees dualist attempts to explain how a nonmaterial entity — the mind — can influence a material entity — the body — as futile. Instead, he describes the mind in light of "how it is organized as far as its functions are concerned," which sidesteps the mind-body nexus altogether. But describing an entity according to "functionalism" is not the same as defining what it is, i.e., its nature. To presume that man's intellect, a non-material entity, follows as a matter of course from the mere development of increasingly complex physical states of life is a philosophical non sequitur.

To his credit, Davies highlights the principle of self-organization, an important concept for theists to consider, especially as the artificial intelligence community makes increasing gains in devising simple computer programs (called cellular automata) that mimic plant and animal life. Moreover, his desire to inform the common man's notions of cosmology with the findings of quantum physics is commendable, though his descriptions of quantum mechanical properties like subatomic particle complementarity remain as daunting as this sentence!

Davies glories in his walk across the cosmological tightrope without the use of a divine safety net, but must the rope subsist sans *deus ex machina?* Ironically enough, Davies discusses alien communication and the Incarnation in a chapter entitled "Alien Message" without exploring the Incarnation as *the* alien message that mankind should consider above all others. His concluding chapter suggests that the search for alien life can be seen as "part of a long-standing religious quest as well as a scientific project." However, instead of searching for the Creator behind creation, the motivation for Davies remains the search for answers within "creation" itself — the "majestic process of cosmic self-knowledge." For starters, ASA members

would do well to consider Davies's offerings alongside C. S. Lewis's "Religion and Rocketry," which reminds physicists and non-physicists alike that "What we believe always remains intellectually possible; it never becomes intellectually compulsive."

Reviewed by Lucas E. Morel, Assistant Professor of Political Science and History, John Brown University, Siloam Springs, AR 72761.

LATE EDITIONS 2: Technoscientific Imaginaries, Conversations, Profiles, and Memoirs by George E. Marcus, (Ed.). Chicago: University of Chicago Press, 1995. 551 pages. Cloth and paperback.

This is the second issue of *Late Editions*, which is scheduled to appear yearly for at least the next several years. The theme of this book of the series, "Cultural Studies for the End of the Century," is a look by twenty-four writers, mostly anthropologists, in a series of fifteen papers, at "scientific cultures." There are also two papers reflecting on last year's *Late Editions 1: Perilous States*, which dealt with changes in the political orders of nation-states, and one paper looking forward to next year's *Late Editions 3*, which will deal with the media. The editor is chair of the Anthropology Department at Rice University.

In spite of an introduction in which turgidity and pretentiousness strive for ascendancy, this work has a lot going for it. I don't see it as useful in a personal library, unless one is an anthropologist, but as a reference book in a college/university library, it ought to find substantial use.

The fifteen papers are grouped into six categories, as follows:

1. Scientists, Families and Friends. Livia Polanyi writes about her father and uncle, the brothers Polanyi, and their family. Unevenly written, assuming much prior knowledge of these scientists, it will appeal to the physics community; I cannot see a wider audience. Then Michael Fisher writes on "scientific autobiographies;" his paper is directly aimed at anthropologists.

2. Mind, Body and Science. An interesting discussion of how the "mind" materializes through the use of PET technology by Joseph Dumit is followed by a fascinating, but nearly incomprehensible chapter by several contributors in the form of conversations with oncologists. Medical students will find much of interest here.

3. Science, Inc. Paul Rabinow, Allucquere Rosanne Stone, and Gary Lee Downey contribute three separate papers on how science is done in institutional situations. While interesting, the situations portrayed in these three papers were, from my viewpoint as one who worked in an "institution" (IBM) for thirty-seven years, pathological. I would have at least liked to have seen a depiction of a more mundane scenario, for I cannot believe these three are in any way representative of the whole.

4. Arms and the Scientist. Diana Hill interviews Roger Hill (her father) on how he negotiated nuclear testing treaties with the Soviets during the cold war. Useful reading for students of government, as well as budding physicists. Then Hugh Gusterson interviews a female, Japanese-American scientist, whose family had been touched by the Hiroshima explosion, who makes her living designing nuclear warheads for the U. S. Government! If there is any "nugget" in *Late Editions 2*, and I believe there are several, this essay stands out as the most brilliant. Gusterson was once an antinuclear activist; the paper tells much about him as well as his subject! This would be an excellent paper for use in a college ethics course — as well as outside reading in other subjects.

5. Science and the Hope of Nations. Kim Laughlin writes on the Union Carbide disaster in Bhopal, reminding us, once again, that technology practiced with good intentions and without base competency has an increasing potential for great tragedy. Kathryn Milun writes on the (sad) state of Lithuanian science. Leszek Koczanowicz interviews the Polish physicist, Andrzej Staruszkiewicz, and Sharon Traweek reports on the "science city" of Tsukuba, Japan. The Bhopal paper is another work which may well be of general interest to a wide variety of students; the last three may appeal to physicists.

6. Science Beheld. Kathleen Stewart writes a sensitive essay on the reactions of Las Vegas residents to plans for a nuclear waste dump, followed by a most amazing description by Mario Biagioli on the "Museum of Jurassic Technology" (quotation marks intended) in Los Angeles. This is a second "shiny nugget" in this anthropological compendium. Fans of Alfred E. Neuman will enjoy; those who "worship science" will be offended.

The two papers looking backwards to *Late Edition 1* are probably of interest primarily to readers of that issue. A single paper by Christopher Pound looks forward to next year in a discussion of the evolving communications "Net." The Net is growing in double-digit rates; the culture changes it will bring are likely to be the "real stuff" future scholars will focus on when the 1990s are ancient history.

For many years, the phrase, *fin de siecle*, has been used as an adjective to refer to the artistic climate of effete sophistication characteristic of the last part of the nineteenth century (AHD, 1985). Editor George Marcus is making a valiant effort in these volumes to redefine it as a noun, "the culture of the 1990s." It is possible he will succeed.

In summary, the book is recommended (1) for institutional libraries, (2) for selected student references and (3) for people with an intense interest in anthropology. This last group may want to consider acquiring the entire series.

Reviewed by John W. Burgeson, 6715 Colina Lane, Austin, TX 78759. E-mail: Compuserve 73531,1501

CREED OR CHAOS? by Dorothy L. Sayers. Manchester, NH: Sophia Institute Press, 1995. 116 pages. Hardcover.

Dorothy Sayers was a Christian apologist, fiction writer, and scholarly lecturer who lived in the first half of the twentieth century. She is not as well-known as C. S. Lewis or Gilbert Chesterton, two well-known defenders of the faith. However, as an intellect, writer, and creative person, she is their equal. Nearly 100 of Sayers's books are still in print, many of them "Lord Peter Wimsey" detective stories. (Chesterton has half as many in print; Lewis has nearly 200.)

This volume is an excellent introduction to Sayers's sharp intellect and keen wit. In these pages, she is a sterling witness to the importance of Christian orthodoxy. In her own words: "It is a lie to say that dogma does not matter; it matters enormously. It is fatal to let people suppose that Christianity is only a mode of feeling; it is vitally necessary to insist that it is first and foremost a rational explanation of the universe."

And of course, ASA members agree with Sayers that Christianity provides that rational explanation. For those interested in the interface between the Christian faith and science, it is important to have a firm grip on both. Dorothy Sayers presents the Christian fundamentals in a passionate, informed, lucid, and sometimes hilarious way. This book provides an excellent introduction to the wit and wisdom of Sayers, and I highly recommend it as a trenchant apologetic for the faith.

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

EVOLUTION IS NOT SCIENTIFIC: 32 Reasons Why by Albert Sippert. Mankato, MN: Sippert Publishing Company, 1995. 448 pages, bibliography, index. Paperback; $6.00.

This is an enlarged edition of an earlier book entitled *From Eternity To Eternity*. The author is a Lutheran pastor who totally rejects the idea of macroevolution. He has clearly studied this issue carefully and seeks to present the basic arguments against evolution, writing in the language of the average person. The book does summarize the basic arguments against evolution quite well. While I agree with the basic position of the author, I am sure evolutionary scientists would dismiss this book out of hand. They would correctly affirm that the author is biased and that his opinions concerning evolution are simply hearsay. Far more persuasive are books written on this subject by Christians who are also scientists, or even those non-Christian scientists who have written and called into question the theory of evolution.

The author begins with a discussion of the early history of mankind leading up to the flood of Noah. He then tackles the main evolution arguments, addressing such issues as dinosaurs, evolutionary hoaxes from the past, the "missing link," Archaeopteryx (the creature supposed to be a link between reptiles and birds), geology, fossils, the Big Bang, scientific dating methods, the laws of thermodynamics, etc. He concludes that the theory of evolution has no basis in the scientific data. He categorizes evolution as a humanistic theory designed by godless persons. He then reviews the teaching of evolution/creation in the public schools from the Scopes trial on through more recent legal battles in Arkansas, Louisiana, California, Alabama, and Tennessee. He concludes with a theological postlude entitled "A Tribute to our Creator-Redeemer God."

This book probably will not receive much attention from the scientific community. On the other hand, many persons are quickly confused (myself included) when reading technical scientific data concerning evolution. Non-scientists who want a good summary of the basic arguments against evolution will find this book to be very helpful. I believe Rev. Sippert has done an adequate job of summarizing a complex subject in language readable for the average person.

While I found nothing new in the book, I believe the author has done us a favor by amassing under one cover the arguments against evolution. His 32 reasons are given in summary form on pages 404-411. This material is discussed in greater detail in the body of the book. For those unfamiliar with the evolution debate, this book would be a good place to begin.

Reviewed by Richard M. Bowman, Director of Research and Publications, Disciple Renewal, Lovington, IL 61937.

THE DESCENT OF THE CHILD: Human Evolution from a New Perspective by Elaine Morgan. New York: Oxford University Press, 1995. 197 pages, index. Hardcover; $19.95.

I have recently reviewed the book, *The Scars of Evolution: What Our Bodies Tell Us about Human Origins*, by Elaine Morgan, for *Perspectives on Science and Christian Faith*. In that book, the author presents the arguments to support the aquatic theory of human evolution which suggests that humans evolved from the arboreal apes in an aquatic environment or wetland ecosystem, instead of savannah.

A pre-publication announcement of this book, *The Descent of the Child*, states that the same author "adds new evidence to support the Aquatic Ape Theory." I was, therefore, anxious to have a chance to review this book. However, after reading it, I became disappointed, because this book is mainly a comprehensive description of child development from conception to puberty, and provides only weak or no new evidence to support that aquatic theory. For example, the hairlessness and subcutaneous fat layers in our bodies have already been mentioned in the earlier book, *The Scars of Evolution*, and so are not new evidences. The other evidences, namely: (1) large brain from plentiful nutritious foods and from three-dimensional locomotion

in water; (2) speech capability as a result of voluntary breath control and the descended larynx; and (3) accelerated growth rate and slow development rate due to a decrease in gravitational pull in water, are, in my opinion, weak in supporting the aquatic theory of human evolution.

Nevertheless, this book is well written and organized. The author points out many interesting biological, physiological, and sociological features during child development that are different from the apes, other primates, and other animal species. The book should be refreshing to read for parents and definitely educational for parents-to-be.

As in her previous book, *The Scars of Evolution*, the author cites many works of others, but again fails to provide the exact references to these citations in this book. Thus, the literature sources of 42 out of a total of 104 citations are missing from the list of references in *The Descent of the Child*. Such a deficiency in bibliography may be acceptable to those readers who either are quite familiar with the citations, do not bother to read the original works, or do not care to check for accuracy. But, for me, and perhaps other members of the American Scientific Affiliation, reading a citation without knowing its exact source can often be frustrating.

Reviewed by James Wing, 15212 Red Clover Drive, Rockville, MD 20853.

THE MYTH OF NATURAL ORIGINS: How Science Points to Divine Creation by Ashby L. Camp. Tempe, AZ: Ktisis Publishing, 1994. 133 pages, annotated bibliography and index. Paper; $11.95.

Camp indicates in the preface that he has been interested in the subject of origins since he became a Christian in 1978. This book is an outgrowth of his desire to provide an alternative for his daughter to the "evolution propaganda flooding our society." He "began collecting and organizing evidence that contradicts the notion that natural processes are an adequate explanation for our existence." Camp earned a degree from Duke University School of Law in 1977 and worked as a trial attorney for ten years. In 1990 he graduated with a degree from Harding University Graduate School of Religion and currently ministers at University Church of Christ in Tempe, Arizona.

The intent for this book is to present a "concise and scientifically credible critique of the naturalist's theory of origins." The author acknowledges that this book is based largely on the research efforts of other people and he is very careful to reference his extensive quotation of other work. In fact, a main strength of this work is that it presents an up-to-date summary of much of what has been published in the last ten years on origins from a creationist perspective. The book is divided into four main chapters: "Origin of the Cosmos" (12 pages), "Origin of Life" (18 pages), "Diversification of Life" (46 pages) and "Origin of Humans" (36 pages).

I think the author has well accomplished his goal of presenting a clear and concise summary of creationist arguments for a Creator and against naturalist theories of origins. For anyone interested in the subject but who has not had opportunity to read many of the books published from a creationist world view over the last decade, this is an excellent place to begin. While I have read nearly all the works cited, I still found this book by Camp a very helpful summary with good arrangement of topics and quotations. I will enthusiastically recommend this book to my students and to others who do not have strong science background in this area.

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

REINVENTING DARWIN: The Great Debate at the High Table of Evolutionary Theory by Niles Eldredge. New York: Wiley, 1995. 244 pages, bibliography, index. Hardcover; $27.95.

Niles Eldredge is a curator in the Department of Invertebrates at the American Museum of Natural History. With Stephen Jay Gould, he formulated the theory of punctuated equilibria in the early 70s. Based on observations of fossil distributions in the geologic column, Eldredge and Gould concluded that the dominant pattern of evolution is long periods of stasis interrupted by brief periods of rapid evolutionary change. While the punctuated equilibria model appeared to fit the geological data better than the gradualism of conventional Darwinism, it was not received with great enthusiasm by the evolutionary biology community.

In this book Eldredge describes many of the skirmishes which have occurred between the geneticists in the evolutionary biology community — whom he refers to as "ultra-Darwinians" — and the community he calls "naturalists" — mostly paleontologists — who prefer the punctuated equilibria model. He delineates the points of disagreement between the two camps, and explains *why*, in his view, the punctuated equilibria view is superior to the conventional population genetics view.

The book takes its title from the British practice of reserving a high table in college dining rooms for the academic elite. Eldredge relates that the elite who dominated evolutionary theory from the 1950s were mostly geneticists who did not take paleontology seriously. In 1984 John Maynard Smith, in an article in *Nature*, invited paleontologists to rejoin the metaphorical High Table of evolutionary theory.[1]

According to Eldredge, the dominant view in evolutionary biology today is that all evolutionary development can be explained in terms of the competition among individuals to leave the maximum possible copies of their genetic material for the next generation. According to this view, all entities in biology above the organism level — species, genera, orders, etc. up to and including ecosystems

— are merely epiphenomena of reproductive competition, as are all forms of competition other than the fundamental competition to leave more of one's own genes. The extreme of this view is represented by Richard Dawkins' claim that the genes themselves are the real players in this contest. Eldredge sees this as a peculiar reversal of cause and effect, which makes selection an active force rather than a passive recorder of what works and what doesn't in the struggle of organisms for survival. This reductionist view has the advantage of permitting geneticists to focus on development of a rigorous, mechanistic "physics of biology," but what is sacrificed is the ability to explain much of the fossil record.

Eldredge provides a rich overview of what paleontologists see of the dynamics of species development. He sees a species as a distinct entity which appears at some point in the fossil record and persists with little change for perhaps several million years. Changes in environmental conditions are more likely to lead to migrations and extinctions than adaptive change (evolution). Periods of adaptive change, when they occur, cluster around environmental changes that lead to migrations and extinctions. To explain this pattern, Eldredge considers the distributions of species observable in nature, both in the fossil record and extant. His conclusion is that ultra-Darwinians, by concentrating on reproduction almost exclusively, are missing the importance of economic interactions — exchanges of matter and energy among organisms and between organisms and their environment. Indeed, he points out that reproduction is a luxury in that many organisms don't reproduce unless their other needs are met. Eldredge argues for a science of evolution which endeavors to account for the complex interactions in nature rather than narrowly focusing on genetics and reproduction.

Reinventing Darwin will provide little comfort to young-earth creationists. Eldredge aims not to destroy evolution, but to show how it must proceed to be consistent with observable patterns in the fossil record and among species living today. However, Eldredge's view of evolution acknowledges the complex web of interconnected nonlinear dynamical systems which comprise nature. Such a model is chaotic and exhibits sensitive dependence on initial conditions and disturbances. In principle, infinitesimal disturbances can cause significant redirection of the system trajectory. Such behavior may explain how an omniscient Creator influences nature undetected. Whether or not God uses the properties of nonlinear dynamics to direct nature, a model which aims to account for all relevant natural influences seems more satisfying than one which simply claims that all phenomena result from the drive to reproduce.

The book is written for a nontechnical audience and will be of interest to anyone wanting to understand the debate over punctuated equilibria.

Reference:

[1]Smith, John Maynard, 1984. "Paleontology at the high table," *Nature*, vol. 309, pp. 401, 402.

Reviewed by William E. Hamilton, Jr., General Motors Research and Development Center, 30500 Mound Road, Warren, MI 48090-9055.

GOD'S CHRONICLER: Darwin: A Discourse on How Mankind Can Achieve the Balance of Society by Gene B. Williams. Moses Lake, WA: Desert Oasis Publishing Company, 1994. 208 pages, index. Hardcover.

> Both reason and faith are considered valid sources of knowledge, so when they produce what appears to some people to be conflicting information, a difficult sorting process follows. And when this sorting process is to be presided over by a retired aeronautical engineer, it should be intimidating. Yet 'fools rush in,' and so have I.
>
> Having started this book at age 70, there have been limitations on the time available for research — certainly I haven't devoted anywhere near as much time to research as Charles Darwin, whom I presume to criticize. Nevertheless I've gone ahead, and have done my very best to provide real substance in this first edition.

This statement from the prologue, following as it does acknowledgement from sources such as physiology and anatomy textbooks, encyclopedias, television programs, and popular books — none of which are more recent than 1988 — combine to tell us about the level of presentation. It is a collection of moralizing, stressing self discipline and expatiation upon Darwinian evolution as an explanation of the biological world. At the same time, Williams argues for a morality based on the Bible yet in the whole book only cites one or two Bible verses. There are also ramblings about amino acids, heart function, immunology, and comments on the Roman Catholic church's position on evolution. An epilogue defines a sinner (but not in the usual biblical way), espouses the role of African-Americans in sports, suggests new amendments for the U. S. constitution, etc. I like statement 12 of the prologue: "Get some sanity into our Post Office Department." The same could be said of the book. This volume, well intentioned as the author might be, cannot be recommended for the biologist, student of the Bible, or general public.

Reviewed by Lytton J Musselman, Professor of Biological Sciences and Eminent Scholar, Old Dominion University 23529.

LIFE SCIENTISTS: Their Convictions, Their Activities, and Their Values by Gerard M. Verschuuren. North Andover, MA: Genesis, 1995. 273 pages, index. Hardcover; $34.50.

This book aims to help those in the life sciences to identify the philosophies that are inherent in their work. Verschuuren does this by defining and explaining the domain of science in the first section of the book (Foundations). The second section (Methodology) examines how ideas and inferences become transformed into scientific theories, culminating in the third part of the book "Ethics." A section entitled "Further reading" contains references to relevant articles, but the text itself is not referenced.

All the examples come from the life sciences, but the sections are of interest to scientists in general. For example, Verschuuren clearly separates functionality from the related idea of purpose. "What was created for a purpose

may or may not actually serve the function for which it was intended, and what has a function may or may not have been created for that purpose. If a biologist asks the *purpose* of some feature, it is better to say that he wants to know its *function*. Eye patterns on butterfly wings have the effect of warning enemies; that is the function of eye patterns, not a purpose of butterflies" (p. 45). The entire book follows this style.

New ideas are introduced clearly, followed by excellent examples that illustrate the concept. Using this approach, Verschuuren explains the intricacies of several topics such as objectivity, falsification, ethics, experimental animals, and responsibility in science.

The section on ethics begins with a clear discussion on ethics, freedom, and determinism that are again illustrated with poignant examples. This final section is easy to read and entertaining, but after reading the entire section the reader is left with few practical guidelines for making ethical decisions.

The value of the book lies in identifying experimental parameters that may be influenced, unknowingly, by a scientist's presuppositions. The book could be a great asset to upper level students for instilling a more realistic vision of science, and would be a good book for stimulating discussions with colleagues.

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

THE LUCIFER PRINCIPLE: A Scientific Expedition into the Forces of History by Howard Bloom. New York: The Atlantic Monthly Press, 1995. 466 pages, index. Hardcover; $24.00.

Polite and professional exaggeration among book reviewers is endemic; sometimes it is warranted. It is nonetheless a bit surprising to find on the book jacket a rather impressive list of academicians who tout Bloom's work in such terms as "Unlike anything you've read before," "Will have a profound impact on our concepts of human nature," "The details — historical and scientific — constitute an education in themselves;" a more sedate scholar did make reference to his "brash speculations." It is, therefore, with some trepidation that this reviewer concludes that such exaggeration is not at all warranted.

Bloom's career as a researcher and writer has ranged widely from public relations for the pop music industry to more scientific research in the areas of programmed learning and cancer research. The work is very readable, reflecting the author's journalistic flare and perspective.

Bloom proposes an "entirely new interpretation" of the human experience, "a very different approach to the anatomy of the social organism" (p. 3). He constructs his proposal around a "Lucifer Principle:" "a complex of natural rules" crafted into each individual by nature facilitated through genetic deviancy. Not only is the deviancy genetic and individual, it has a social counterpart, the meme, which allows ideas to exert mind control over large groups of individuals called superorganisms. Throughout history, this "enemy within" has blinded mankind because it disguises itself as noble ideals which eventually distort into exploitive practices such as communism, Mao's Cultural Revolution, imperialism, and Fundamentalisms of various sorts: "We have failed to see that our finest qualities often lead us to the actions we most abhor — murder, torture, genocide, and war." Bloom concludes that in understanding the Lucifer Principle we can expose it and, through employing evolution's gift of imagining peace, we can "dismantle the curse that Mother Nature has built into us" (p. 3).

To substantiate his thesis, he draws a number of parallels (the cell and the body, tribal life and more modern society, and animal and human behavior) in an effort to establish a causal link between genes/memes and individual/social behavior. He is convinced that these comparisons portray similarities so compelling that they demonstrate "scientific evidence" for his Lucifer Principle; a conclusion many, if not most, scholars would not find as convincing.

One of the greatest weaknesses of the book is that it does not adequately, sometimes woefully, live up to its sub-title, "Scientific Expedition." Bloom moves indiscriminately between valid and widely accepted scientific conclusions and speculative theory. He uses an impressive list of sources that range broadly over many disciplines (endnotes and bibliography make up about one quarter of the book), but evidently assumes that a source cited is automatically verification of the point being made. He often overlooks the speculative nature of some research that may have been conducted along scientific lines, but whose conclusions have not yet been demonstrated enough to be widely accepted as valid by the larger scientific community. This is particularly true of many of the resources from the social sciences (psychology, psychiatry, sociology, anthropology), upon which he relies very heavily.

The problem is compounded with his use of historical examples in which he again moves indiscriminately between valid research, historical novel, epic poetry, and other types of literature without realizing that they cannot all be used in the same way. He is also evidently unaware that some of the sources he cited have been clearly demonstrated to be in need of revision, sometimes considerably so. For example, Original Sin is far more Augustinian than Pauline (p. 3); the Third World did not "stampede" to the Soviet Union after sputnik (p. 208); the austerity of English parental treatment of children in the early mod-

ern period (p. 242) has been shown to be more exceptional than general; Frederick Jackson Turner's "Frontier Thesis" (p. 316) has also been shown to be less tenable than Turner proposed; there are many other such examples.

Bloom pursues his thesis energetically, writes well and draws from a broad range of sources, though not always effectively. His "Lucifer Principle" may be couched in unique terms (memes), but is not as new as he suggests; it fits a genre of literature that has largely expanded on earlier efforts to galvanize the natural and social sciences. Overall, it makes for interesting reading, though not as revolutionary as the book jacket proclaims.

Reviewed by Wes Harrison, Professor of History/Political Science, Alderson-Broaddus College, Philippi, WV 26416.

BEYOND PREJUDICE: The Moral Significance of Human and Nonhuman Animals by Evelyn P. Pluhar. Durham, NC: Duke University Press, 1995. 370 pages, index. Paperback. $19.95.

This is not a book for anyone who wants a general overview of the moral issues involved in animal rights. Written by one of the leading thinkers on the subject, Pluhar is a faculty member in philosophy at Pennsylvania State University. The book is a detailed series of philosophical arguments on theories espoused by contemporary thinkers on the topic. The five chapters are: "Human superiority and the argument from marginal cases;" "Responses to the argument from marginal cases;" "Speciesism and full personhood;" "Utilitarianism and the protection of innocent life;" and "Justification and judgment: Claiming and respecting basic moral rights." As I understand the author's position, any being who is able to care about what happens to him or her (what Pluhar consistently calls a sentient being) should be accorded full moral significance. For a biologist with little philosophical background, this book is pretty heavy going.

Readers of *PSCF* will find little common ground with Pluhar. She perfunctorily dismisses any biblical authority because there is no "convincing grounds for their claim of scriptural infallibility" (p. 12). All the arguments in the book are based on suppositions other than the Scriptures.

Despite the detailed philosophical nature of the volume that makes it unlikely that many biologists will read it, Pluhar's work is an important reminder of how little thought most scientists operating from a scriptural perspective have given to animal rights.

I read Pluhar's book just after finishing Noll's *Scandal of the Evangelical Mind*. *Beyond Prejudice* was a glaring reminder of how vacuous evangelical theology — and by extension, philosophy — is on such current topics as animal rights. Texts such as Leviticus 25:7 and Jonah 4:11 expound God's concern for the welfare of animals. More importantly, the delight God so often expresses in his creation demands that we give careful thought to his creatures, including the care and protection of animals.

Reviewed by Lytton J. Musselman, Eminent Professor of Biological Sciences, Old Dominion University, Norfolk, VA 23529-0266.

THE NEW WELLNESS ENCYCLOPEDIA by the Editors of UCB Wellness Letter. New York: Houghton Mifflin Company, 1995. 624 pages. $52.96.

The major thrust of this book is an overview of what people can do to avoid illness and premature death. Up-to-date medical advice is given on longevity, nutrition, exercise, self-care, the environment, and safety. A revised, updated, and expanded version of an early volume, this book has information on traditional topics like cholesterol, hypertension, smoking, and alcohol; nontraditional topics like free radicals, radon, antiperspirants, and depletion of the ozone layer are also discussed. For a current overview on preventing disease and maintaining well-being, this book is a splendid choice.

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

EMBRACING EARTH: Catholic Approaches to Ecology by Albert J. LaChance and John E. Carroll, (Eds.). Maryknoll, NY: Orbis Books, 1994. 280 pages. Paperback; $18.95.

This book is a diverse collection of essays edited by Albert LaChance, a counseling psychologist and adjunct faculty at the University of New Hampshire, and John Carroll, professor of environmental conservation at the University of New Hampshire. It offers the chance to listen in on the Catholic conversation regarding the environmental crisis. Most of the contributors have been influenced by Thomas Berry, but the book encompasses a bewildering array of intellectual projects of uneven worth. The book could be recommended to those looking for spiritual resources within the Catholic tradition to help with environmental problems and for innovative socio-economic analysis. It is weak, however, on the integration of science and religion and on biblical exegesis.

Reviewed by C. R. Boardman, graduate student in environmental studies at UW Madison.

LIFE ON THE LINE: Ethics, Ending Patients Lives, and Allocating Vital Resources by John Kilner. Grand Rapids, MI: Eerdmans, 1992. 310 pages.

Kilner has produced a thought-provoking text on medical ethics that is valuable in that it goes beyond most medical ethics textbooks by focusing on the basis for de-

velopment of an ethic, rather than just limiting discussion to particular contemporary ethical dilemmas. Kilner's text is heavily referenced and demonstrates a substantive reflection of critical issues facing physicians and health care providers at the end of the twentieth century.

Life on the Line is divided into three sections. In the first section, Kilner develops his ethical system by first establishing three guiding principles in which any ethical statement must be: (1) God-centered; (2)reality-bounded; and (3) love-impelled. He thinks that this best expresses the ethical system of Paul and Christ. In the second section, Kilner applies the principles of the first section to the question of end-of-life issues, such as physician-assisted suicide, the termination of life, and the management of the critically ill. The final section is a discussion of how we allocate scarce medical resources, with a focus on the case of renal failure and allocation of organs for transplant.

Kilner wishes us to perceive a love-impelled ethic as providing a superseding principle that governs our obedience to God's laws. An example that Kilner provides is the question of the Sabbath: the Scriptures to him seem to imply that the Sabbath is not a moral imperative but a command to be exercised only as it does not interfere with the higher principle of loving one another. To this end, he implies that principles, imperatives, and duties are not intrinsically binding on people and thus argues against a deontological ethic. The contention is supported that since a deontologic ethic written in biblical times could never encompass all the moral dilemmas of modern times, another ethical principle, that of love, must be the guiding factor. Finally, since Kilner's ethic is an act-based ethic, Kilner thinks that deontologic ethics are allegedly faulty for never taking outcomes into consideration.

Kilner confuses several issues. First, the law, as explained by Christ in the Sermon on the Mount, if interpreted with the Pharasaical finesse of Kilner, must be interpreted by the letter rather than the spirit of the law. Even still, the law remains deontologic. Thus, a command not to kill implies far more ethically than simply not to murder. This is why David would plead for understanding of God's law (Ps. 119:18); he knew that obedience to the law reached far deeper than a superficial obedience to the overt commands. Secondly, the law of love does not provide a superseding principle to the legal demands of the law, as Joseph Fletcher and Kilner might suggest. Rather, deontologic ethics must be viewed through the glasses or lenses of love. This perspective can only be provided by the Spirit of God, and would never contradict, but instead illuminate the deeper implications of the law. The law of love provides us with not only the prohibitions of the law, but demands far more of us, indicating that we are morally obligated to be our brother's keeper. The law of love thus does not grant us increased permissiveness, but rather, increased demands to maintain love toward neighbors, enemies, and brothers. The deontologic demands of the "Great Commandment" do not relieve us from the moral obligations of the rest of Scripture. Without belaboring the point, it can be shown that while Paul's thinking was distinctly God-centered and practical, he also thought deontologically, just as Christ thought deontologically. Neither abrogated the law or in any way suggested that principles would now order or subjugate specifically stated commands. A love-based ethic opens insurmountable problems, as Fletcher has suitably demonstrated. How does one know whether a given action is morally acceptable? God does not (usually) verbally communicate his will to us, and love is tainted by a fallen psyche. Our only hope in discerning God's will is to look into his Word as contained in the Holy Scriptures. His will in both the Old and New Testaments is manifested through ordinances, laws, principles, and commands.

It is impossible to have a strict deontologic ethic without postulating an infinite moral lawgiver. Any set of rules derived by man would either be random or arbitrary and thus irrational, or a set of rules that were derived to provide the greatest good for all or some, and thus in reality be a consequentialist ethic. The Judeo-Christian law-giver has clearly stipulated laws for society. While we may disagree as to the extent or interpretation of this law, the entirety of the discussion centers around understanding the mind of God when he issued a given command. Like David, we say, "Open my eyes that I may see wonderful things in your law" (Ps. 119:18, NIV), and "Let me understand the teaching of your precepts ..." (Ps. 119:27, NIV). Psalm 119 reflects on even a teleological domain, a benefit from a deontological ethic. David Jones in *Biblical Christian Ethics* would argue also for the teleological domain of Christian ethics, while never succumbing to the notion that we base ethics on the "ends," but on the laws of God. The law provides illumination, joy and delight, strength, salvation, and life. It does so because it is based on a covenantal relationship with God, perfectly fulfilled by the active obedience of Christ, and obeyed by us as the servants of Christ.

Chapter 4 centers around the ethics of clearly eliciting and following a patient's wishes. A patient decision according to Kilner can be moral only when necessary and sufficient information has been conveyed to the patient (pp. 84-85). Kilner omits the role of the moral physician in doing what should be best for the patient based on experience. Any physician realizes the impossibility of a completely informed consent; the patient rarely fully understands the implications of a decision. It often would be harmful to the decision-making process to most thoroughly inform a patient of any possible factors that may influence a decision.

The moral approach to the mentally incapacitated patient according to Kilner is the living will (p. 88). Contrary, the living will is primarily a document intended to appease lawyers; it cannot and must not govern the physician-patient relationship. If a given medical situation has a reasonable chance of a positive outcome, the living will does not give me the moral capacity to "pull the plug." Likewise, an unreasonable chance of success will of moral necessity get the "plug pulled" whether or not there is a living will. Kilner argues (p. 92) that God has given us the freedom to make bad decisions; that is true, but that still does not make the decision a morally correct decision, which is what we are concerned with. Kilner seems preoccupied by the desire to grant to a patient freedom and

autonomy. He will not include any substantive discussion of possible higher laws that govern a physician.

In chapter 6, Kilner muddies the already difficult issue of withholding or withdrawing treatment. In Kilner's mind, one must soul-search the criterion of an action of withdrawing or withholding treatment, resulting in probable death. Those are motives impossible for a physician to entirely ascertain, and the simplest recourse in thinking this way is to resort (often immorally) to maintaining treatment at all cost, lest the motive be blurred. Kilner recognizes this (p. 126) but fails to direct the moral physician in this issue. He is ambivalent, first stating that "death entails much more loss than gain" (p. 122) and yet "to die is gain" (p. 128). Tentativeness and ambiguity do not help a physician in the trenches of medical care.

Kilner discusses allocation of resources in a manner that has little application outside of transplantation medicine. From my perspective as a surgical oncologist, issues of allocation of resources have been hypothetical rather than practical. As an example, a great fear was created by the unavailability of taxol and the morality of fairly distributing the drug, long before the drug had any proven efficacy. We now realize taxol is not the life-saver it was billed to be, and pharmaceutical ingenuity has made the drug readily available, although expensive. On p. 179, Kilner implies that a biblical ethic means delivery to the person most in need. He is silent as to any references, because there are none. He never mentions disease as a consequence of actions; if persons develop liver failure from alcoholic cirrhosis, they should not necessarily be transplanted based on need.

Kilner is very concerned about criterion for non-medical exclusion of the elderly, but discusses matters mostly in hypothetical terms. Discussion of the care of the elderly imply an extreme shortage of medicine and medical care, which simply isn't true. The only shortage is in the money to pay for medical care. Kilner offers no discussion as to those factors that drive up the cost of medical care, such as legal interference, governmental regulatory interference with the practice of medicine, and a societal attitude that medicine is a right to be obligatorily provided rather than as an honored privilege and responsibility.

Kilner thus imagines that inability to pay is an immoral criterion for denying medical care! I suppose he wishes to extend this attitude toward the other exigencies in life, such as provision of food, shelter, clothing, etc. If an individual cannot pay, only four options exist: (1)The physician and hospital provide services for free or at a discounted rate; (2) the community of the church assist the patient; (3) the government coercively tax the public to pay for individual's medical care; or (4) the patient goes without medical care. Kilner complains that the poor receive insufficient medical care, yet substantive evidence suggests that it is as available, if not more available, to the poor. Therefore, if a patient goes without medical care, it is usually for factors other than availability. The community is better than government at providing compassion in a manner that demands patient responsibility, and the community and church efforts are voluntary acts of love, rather than coercive acts of the state. Our ethic must emphasize the role of the church over the role of government.

At the end the book, Kilner refuses to adapt any selection criterion for the states' allocation of hypothetically "limited" resources, and does the ultimate cop-out. He decides on a random allocation of resources, after certain limited criteria have been met (p. 228). Thus, for Kilner, justice and morality becomes a toss of the dice. The Bible never defines justice like this; neither is "justice" equivalent to "equality" in the Bible as Kilner implies elsewhere (p. 229). The lottery evolves into the means of allocating justice and moral principle. Kilner thus trivializes the entire book by implying that biblical principles are inadequate to allow for rational moral decisions. The Christian community is challenged to make principled decisions in difficult matters, and not rely on the lot, the dice, or drawing straws to make our decisions.

Kilner discusses tough issues in his text. I commend Kilner for his willingness to tackle problems which often do not have immediate answers. I argue against both his philosophical approach to medical ethics, and his resultant practice of ethics. I would agree with Kilner that the ethical practice of medicine must be derived from a physician with moral character. I would hope that ethical decisions would be made by physicians practicing in a community that is theocentric in its thinking, and intent on exploring the application of God's law in the contemporary medical environment.

Reviewed by Kenneth Feucht, a practicing surgical oncologist in Puyallup, WA.

WHEN ELEPHANTS WEEP: The Emotional Life of Animals by Jeffrey Moussaieff Masson and Susan MacCarthy. New York: Delacorte Press, 1995. 236 pages, notes and index. Hardcover; $23.95.

The theme of this book is unsophisticated. As ordinary people, that is, as people not "practicing science," we understand that animals, at least some animals, have feelings and emotions. But, "By dint of rigorous training and great efforts of the mind, most modern scientists — especially those who study the behavior of animals—have succeeded in becoming almost blind to these matters." This theme, set out in the first paragraph of the prologue, is repeated, again and again. Anecdote after anecdote is told, usually with great story-telling expertise (there are some exceptions) to drive home that assertion.

In one sense, the book is a naive plea for "credulity." But to ignore it on this account, or because it is frustratingly repetitive, is to miss its value. One value lies in the examination of the statements of certain biologists/philosophers, and asking oneself if they might constitute, in the words of George Orwell, "nonsense so bad only an intellectual could believe it!" *The Selfish Gene* comes in for such criticism, particularly where the author, Richard

Dawkins, insists that "altruism — something that has no place in nature ..." and pictures animals as "robot survival machines." One example given is two swans, mating for life, where the scientist sees "gene transference maximization mechanisms" and the rest of us see animals expressing monogamous affection, which in the human species we recast as "love."

Emotions come in many kinds — fear, hope, friendship, love, grief, joy, anger, compassion, shame, appreciation of beauty, and others; all these are discussed as the book progresses. Frequent references are made to a little-known work by Charles Darwin titled "The Expression of the Emotions in Man and Animals," although most of the references are to much more current works. The issue of anthropomorphism, "a form of scientific blasphemy," is met head on, and compared with the equally grievous sin of anthrocentrism. In an interesting aside, the concept of "zoomorphism" (animals seeing themselves in humans) is explored.

In the prologue, Masson and MacCarthy pose the question this way: "... how can anyone know that an animal feels nothing if the question has never been investigated? To conclude without study that it has no feelings or cannot feel is to proceed on a prejudice, an unscientific bias, in the name of science ... comparative psychology ... discusses observable behavior and physical states of animals ... but shies away from the mental states that are inextricably involved in that behavior." Again, "... the causal explanations center on theories of ultimate causation, — the animal pairs because this increases reproductive success — as distinguished form 'proximate causation,' — the animal pairs because it has fallen in love." The authors point out that this policy of ignoring animal feelings and emotions makes it easier to support animal experimentation, particularly experimentation involving pain, loneliness, and mental anguish. Such an argument is not their main thrust, though the book does conclude with a chapter written by Masson on this subject.

I must confess that I find the idea of two animals "falling in love" a little hard to swallow. Yet, I do know what "falling in love" means, first as an adolescent, then as a man in my mid-20s, in marriage, then as a first-time father, now as one of a "settled pair" with offspring independent. That one phrase covers a wide range of emotions and feelings. Not being a sophist, it is simple to extend that concept to human friends, to say, for instance, that "Doug and Jean are in love." It would sound ridiculous, of course, for me to say "Doug and Jean behave as a tight bonded pair." Yet this appears to be the only descriptive way some scientists (the book argues) will allow people to describe birds mated for life, female elephants nurturing their young, and the like.

Love, of course, is not the only emotion discussed, nor even the most controversial. Dolphins inventing games, a bear enjoying a sunset, an elephant who keeps a pet mouse, sadness, shame, compassion, and most all of the other feelings we know to be part of our own (human) life, and by extension grant to other humans, are shown to be logically part of the animal kingdom as well. Pet owners, speaking as "real people," usually say "It's obvious." Scientists, speaking as such, declare "It's an enormous claim." This book attempts to bridge the gap between these two groups. To the extent it raises the issue, it is successful. To the extent it tries to solve that issue, it is not. Too much reliance on anecdotes; too little science of measurement. But then, isn't that where most new ideas begin? "What is anecdotal?" the authors ask. "It's a careful description of an unusual event." The discovery of penicillin was so initiated!

The book suffers greatly from one curious omission. Although there are well over 200 footnotes, these are nowhere noted in the text! A bibliography of about 200 citations is offered, alphabetical by author name, with no indication of which the authors thought to be important vs. secondary.

With all its failings, however, this book is highly recommended, for it does three things well. It educates one about the complexity of animal behavior, it raises an important issue concerning the fuzzy boundaries between anthropomorphism and anthrocentrism, and, most importantly, it is fun to read! Kudos to the authors.

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SOUL SEARCH: A Scientist Explores the Afterlife by David Darling. New York: Villard Books, 1995.

Darling holds degrees in physics from Sheffield University and in astronomy from the University of Manchester. He is the author of *Equations of Eternity and Deep Time* where he discusses the philosophical and metaphysical implications of quantum mechanics and celebrates the pantheistic view of cosmology. In *Soul Search*, the author attempts to answer the questions: What happens when we die? Does everything we are just stop? Is consciousness lost forever? As with many contemporary scientists who have rejected ontological naturalism, but have refused to adopt the Judeo-Christian world view, Darling attempts to answer the above questions introducing near-death experiences from the perspective of robust pantheism. In that sense, he is in good company with the authors, Moody (*Life After Live*) and Kubler-Ross (*Death: the Final Stage of Growth*), who made near-death experiences (NDE) popular. The important contribution of this book, however, is Darling's critical analysis of the various phenomena common in NDE. Darling argues persuasively that two of the NDE phenomena, i.e., going through a tunnel and the brilliant light, are identical to experiences under drug induced hallucinogenic conditions (see Siegel's article, "Hallucinations," *Sci. American*, Oct. 1977).

Two other phenomena, however, remain outside known natural explanations. These are: (1) the ability by the patient to describe in detail, events in the operating room *in spite of* recorded brain wave cessation; and (2) an extraordinary sense of deepening and broadening of

consciousness experienced by the patient when there is no perceptible brain wave activity. This is what Darling calls the "*core enigma*" of NDE, and attempts to provide an explanation in his book, drawing mostly from Zen and Tibetan Buddhist philosophies (in the monistic, non-dualistic Shankara tradition).

The book has a long introduction and ten chapters. In the introduction, Darling discusses the question, "What happens after death?" from both naturalistic and religious perspectives. He then proceeds to show the inadequacy of the purely naturalistic explanation. To get a comprehensive answer to the question of consciousness continuing after death, Darling states, "It is time that we looked at the question through the eye of a scientist *and* a mystic, by synthesizing science, religion and mysticism." The remaining ten chapters are an elaboration of this premise.

Chapter 1 discusses the biological origins of death, that evolution of self-awareness in *Homo sapiens* has made death something to be feared, and has led to man's eternal quest for survival after death, which he then covers in Chapter 2. In Chapter 3, the author shows that death is a black hole, with no possibility of any information coming back, except through the "event horizon" which he identifies with NDE. He dismisses paranormal phenomena associated with mediums and channels as deception, and avoids discussing the belief in reincarnation. However, in spite of his attempts to be comprehensive in treating the problem of death from physical, psychological, and spiritual angles, the author completely ignores the concept of resurrection, so pivotal to three major religions (Judaism, Christianity, and Islam), and believed in by three-fifths of the world population. His only mention of monotheistic beliefs in an afterlife is a quick dismissal of visions of paradise where the soul experiences eternal bliss with his/her loved ones and a mention of Paul's experience of being caught up in the third heaven, which he categorizes as a Pauline NDE.

Chapter 4 is devoted to analyzing the various phenomena associated with NDE with its core enigma (mentioned above) as the residue with no possible naturalistic explanation.

The rest of the book attempts to develop a thorough monistic/pantheistic view of nature, reality, and self in an attempt to explain the "core enigma." Here, the author shows great kinship to Capra (*Tao of Physics*, *Turning Point*), but goes even more forcefully into the self awareness and the physical world as illusions, with "change, impermanence and undividedness" as the only "true qualities of the universe." Darling spends two chapters studying very rare, but very abnormal case histories of brain damage as ammunition to question the reality of the self and our perception of the flow of time as real.

Descartes' famous insight, "I think therefore I am," is thus replaced with the Eastern-Pantheistic-Monistic version "I think *as if* I am!" In the final three chapters, linear time, objective reality, the individual self, and analytic thinking undergo the traditional monistic lashing by a scientist (the author himself) whose very scientific credentials depend on the reality of linear time, objective truth, and analytic thinking. It seems like Darling is killing the "goose that laid the golden egg!"

In his attempt to emphasize the importance of losing one's self as key to conquering man's ubiquitous fear of death, the author quotes the second great commandment "You shall love your neighbor *as* yourself," then proceeds to chastise self-awareness as inimical to cosmic consciousness, that it should be eradicated through meditation and mystical experiences. Oddly, most of the deep experiences sought by religious mystics, especially Indian gurus, often represent acts of extreme selfishness themselves.

The "core enigma" is thus resolved when the "I," the "inner self" is dissolved in the Great Cosmic Consciousness, transcending rational thought, in an ineffable state. Darling concludes, "Only when there is no self left is there no one who can die."

It is gratifying to see more and more scientists like Darling, reject the sterile world of ontological naturalism, and start seeking holistic, integrated answers to life's deepest secrets, including the nature of the soul and the spirit. However, it is deeply disturbing that great twentieth century scientists like Einstein, Shroedinger, Heisenberg, and many contemporary scientists of repute such as Hawking, Penrose, Wheeler so readily embrace pantheistic views of truth, in spite of its glaring philosophical inconsistencies. They forget the fact that modern science owes its very existence to the Judeo-Christian view of a transcendent God and contingent creation.

Reviewed by Kenell J. Touryan, the National Renewable Energy Laboratory, Golden, CO 80401.

TWENTIETH-CENTURY DICTIONARY OF CHRISTIAN BIOGRAPHY by J. D. Douglas, (Ed.). Grand Rapids, MI: Baker Book House, 1995. 439 pages. Hardcover.

Douglas is a leading editor of reference works, having previously edited the popular *New Twentieth-Century Encyclopedia of Religious Knowledge*. In producing this book, he was assisted by more than 130 writers from North and South America, the United Kingdom, Australia, New Guinea, Singapore, and Africa.

The biographies of about 700 people who have influenced the church in this century are covered. The biographies cover people worldwide, but prominence is extended to Western theologians, missionaries, pastors, evangelists, musicians, authors, artists, statesmen, educators, and leaders of organizations. My cursory survey of the contents found few scientists, although there are a few, including Robert Boyd and Donald MacCrimmon MacKay.

The biographers describe the person's life, theology, major writings, and evangelical significance. Most scholars would probably agree that the individuals included in this selection are meritorious while also thinking that a

significant figure was omitted. The editor anticipated that some readers "will react indignantly over who has been left out." Although many readers might not recognize Robert Gordon Clouse (I did because I attended school with him), doubtless everyone will recognize the likes of James Dobson. If Ralph Waldo Emerson was correct when he said, "There is properly no history; only biography," this book may take on added importance for your library.

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

IS JESUS THE ONLY SAVIOUR? by Ronald H. Nash. Grand Rapids, MI: Zondervan Publishing House, 1994. 188 pages, indexes. Paperback.

Nash is currently a professor of philosophy at Reformed Seminary in Orlando, Florida, and for almost three decades served as professor and then chair of the philosophy department at Western Kentucky University. He has written many books dealing with current religious issues. Among them are: *Beyond Liberation Theology, Worldviews in Conflict,* and *Faith and Reason.*

In *Is Jesus the Only Saviour?* Nash makes a significant contribution to our understanding of the biblical and theological basis for the traditional or conservative view called "exclusivism." His writing is clear and non-technical and he succeeds in making important issues clear to the average reading Christian. He provides a five-page selected bibliography.

This book is about three kinds of answers to the question its title poses: Pluralism, Inclusivism, and Exclusivism. "Pluralism," with which Nash ardently disagrees, holds that there are many paths to salvation. John Hick's pluralistic approach occupies at least half of Nash's pages. Hick attacked what he called "the myth of Christian uniqueness." Christianity must not, in his view, be placed above any other faith, such as Hinduism or Islam, as a valid way of attaining salvation. Nash shows what he believes are fallacies and contradictions in Hick's pluralism. One example must suffice: after arriving at the belief that God is finally unknowable, Hick still wishes to posit certain truths about God — he asserts the truth that one of God's attributes is love. Nash alerts thoughtful Christians to a current tragedy: many college and seminary professors are presenting John Hick to their students as a compassionate and brilliant thinker. In so doing, they are seriously undermining biblical faith.

The remaining half of the book is divided between an attack on inclusivism and a biblical and theological defense of exclusivism. Inclusivists answer the question, "Is Jesus the only Saviour?" with the reply, "Yes, but..." Inclusivism tries to occupy a middle ground between exclusivism and pluralism. It agrees with exclusivism in seeing Jesus Christ as the only source of salvation, and it agrees with pluralism in seeing other religions as legitimate paths toward reaching the salvation won by Christ. In other words, it is not necessary to have ever heard the name of Jesus or to have specifically put faith in him to receive salvation. Christ has made salvation possible for all, but knowledge of Christ is not essential for all. To put it theologically, Christ's work as redeemer is ontologically necessary, but his work as redeemer is not epistemologically imperative. Nash's target in this section is primarily Clark Pinnock. In his book, *A Wideness in God's Mercy,* Pinnock thoughtfully and creatively sought a middle ground for evangelicals. He expressly invited further discussion and even criticism of his views. Nash has accommodated him. Nash acknowledges that Pinnock's views are much more clearly in the evangelical camp than those of pluralists like Hick, yet Nash sees the inclusivist trend as unbiblical. Nash asserts that his book is not about universalism, although it is clearly a related subject. He makes it clear that inclusivists like Pinnock are not universalists, they do not believe that all human beings will eventually be saved.

This book is recommended for thinking, concerned Christians. Although there are other books on the subject, Nash offers an up-to-date analysis of current trends with an easily understood defense of the exclusivist position. After all, in a pluralist world that seems to be in need of greater tolerance, one needs to be able to give a reason for claiming that Christianity alone holds saving truth.

Reviewed by Richard L. Niswonger, Professor of History and Bible, John Brown University, Siloam Springs, AR 72761.

THE SOCIAL ECOLOGY OF RELIGION by Vernon Reynolds and Ralph Tanner. New York: Oxford University Press, 1995. 321 pages, chapter notes, index, illustrations. Softcover; $17.95.

The present reviewer saw two significant strengths and one disturbing weakness in this book. The first strength is that it attempts to be empirically fair in its dealing with religious beliefs. The writers do not directly attack or criticize religion. They simply attempt an empirical study of "what people do when they are acting in religious ways" (p. 15). The only criticism of supernaturalism is that which is unavoidable or innate to their empirical methodology. The writers do not grind an anti-supernatural ax.

Second, it is a very good source of fascinating religious knowledge, both trivial and significant. The present reviewer found the materials relating to female circumcision (pp. 120-126) to be both spellbinding and abhorrent. He was especially surprised to learn that, in cultures practicing female circumcision, women may regard this rite as a desirable "sign of adult womanhood" (p. 124), rather than as a painful trapping of male dominance. Evangelicals will generally be surprised to learn that "in early Talmudic times, abortion was not considered a transgression unless the fetus was viable." (p. 92)

The major weakness is that the book's defense of its major thesis is weak. The basic thesis of this book is that religion grows out of practical needs. Thus the defining force in religion is practical utility. With Maslow's hier-

archy of needs in mind the writers assert that "religion relates to ... needs at all levels." These needs deal with both society and the natural environment (p. 42). Even when religion touches on morality, it is really responding to "social needs" (p. 45). In light of this perspective, the reader would expect a reasonably complete and spirited defense of the practical utility of religion both in society and in the material environment. However, the book poorly defends this thesis. For positive argument the book presents nothing more than vaguely plausible reasons for seeing the utility of some religious phenomena. Then when response to an apparent impractical religious feature is called for, such response is usually lacking. Thus the book lacks rigorous, systematic argument for its thesis.

The treatment of circumcision, both male and female, serves to illustrate this failure. For positive argument the writers do no more than speculate on plausible areas of practical utility for circumcision. The rite might inhibit "penile and possibly cervical carcinoma" (p. 125). It can strengthen "male control over women" by reducing "the intensity of immediate sensual pleasure" for the woman (p. 126). The discussion lacks solid, positive evidence which passes beyond such plausible speculations.

Also, the writers generally offer no response when alluding to apparent examples of non-useful religious rites. We must respect their honesty in admitting that such features exist. For example, they comment that "in the primary reproductive process" circumcision "seems to make little or no biological sense" (p. 125). But this honesty, alone, constitutes a weakness in their presentation. Such examples call for an argumentative response.

Both supporters and opponents of the book's major thesis will be disappointed with this weakness.

Reviewed by Andrew Bowling, Division of Biblical Studies, John Brown University, Siloam Springs, AR 72761.

THE BIBLE, VIOLENCE, AND THE SACRED: Liberation from the Myth of Sanctioned Violence by James G. Williams. Valley Forge, PA: Trinity Press International, 1995. 288 pages, index, endnotes. Paperback.

Author James Williams' primary objective in writing this book was to shed light on the violent structures in society, and to show how the biblical witness to the innocent victim and the God of the victims demystifies and unmasks these structures. He aims to show how the God of Scripture stands against these universal structures of violence, and unravels man's mysterious bent on rivalry and violence. Although he does it by methods of biblical interpretation unacceptable to evangelicals, the author accomplishes his objectives. As a Christian, Williams argues that God enters into the picture precisely for the purpose of defending victims. Unlike sinful humans, God refuses to participate in the pathology of scapegoating. God is there to free us from our enslavement to rivalry and the violence which flows from it.

I read *The Bible, Violence, and the Sacred* during the final days of the O. J. Simpson trial. The attitudes of most Americans toward the O. J. Simpson trial and the scapegoat theory espoused by author James Williams were fascinating. Both agreed upon public discontent, the identification of a scapegoat, dealing with the scapegoat, and presumably re-establishing harmony in society.

While complaining about the ridiculousness of the trial, why did most Americans remain glued to their television sets as the trial unfolded? Why did thousands of Chinese crowd around a local courthouse last month to witness the execution of three bank robbers? Why were 3000 men killed at the installation of the first Levitical priests (Ex. 32)? Why this universal fascination with violence? These are the types of questions which led author Williams and his ideological mentor, Rent Girard, to develop their "mimetic," "scapegoat," or "victimage" theory of religion.

Girard's theory, as defended in this book by Williams, sees culture itself as rooted in rivalry. Ever since the time of the hominids, men have tended to imitate one another (from which comes the word *mimetic).* As the imitator becomes more successful in imitating his model, competition ensues. The more like his model he becomes, the more violent becomes their rivalry. Eventually the only resolution to the conflict is group identification of a scapegoat who is then expelled or killed. Williams and Girard find this description of reality to be the common denominator of all cultures, including the biblical culture. In *The Bible, Violence, and the Sacred,* Williams sets out to defend this thesis from a biblical angle.

Williams is professor of Hebrew Bible and New Testament at Syracuse University. His approach to Scripture was a challenge to me and should be to any diligent ASAer. He implies that any biblical truth must accord with the theories of other sciences (in this case, anthropology). But what are we in the ASA to make of Williams' imposing extra-biblical meanings on biblical texts? For example, Williams suggests that the meaning of kingship in Ex. 4:22-23 must be understood from the viewpoint of Egyptian myth and culture. From the lips of Williams, we hear Carl Jung on Job, Egyptian mythology on Moses, Freud on Jewish identity and oppression, and Shakespeare on nearly everybody. The Bible has no authority except when it receives it from Williams and his chosen authorities.

The struggle I had with Williams was the same one I have with every myopic theology; they read everything in Scripture through one lens. We've had liberation theology, feminist theology, and now we've got "scapegoat theology." Quoting and endorsing Girard, Williams writes: "The Word [Scripture] that states itself to be absolutely true never speaks except from the position of a victim in the process of being expelled." I do not have the theological qualifications of Williams, but I know better than to muzzle the voice of Scripture. Williams's desire to harmonize Scripture with social theory has cost him a great deal in terms of Christian orthodoxy. It was clear that he was first convinced of his theory from the conclusions of anthropology, and then as a biblical scholar, set out to show how the Bible confirms his theory.

While challenged by *The Bible, Violence, and the Sacred,* I really only enjoyed the last chapter which focused on contemporary American culture from the vantage point of scapegoat theory.

Reading this book requires a solid background in Bible and social theory. A theologian who knows anthropology or a sociologist who knows his Bible might appreciate it. Personally, I could not recommend this book to anyone I know.

Reviewed by Mark A. Strand, Medical Team Director, Evergreen Family Friendship Service, Taiyuan, Shanxi Province, China, 030002.

THE DISAPPEARANCE OF GOD by Richard Elliott Friedman. Boston: Little Brown and Co., 1995. 284 pages, notes, bibliography, index. Hardcover; 24.95.

Friedman is Professor of Hebrew and Comparative Literature at the University of California, San Diego. He also wrote the book, *Who Wrote the Bible.* In the opening chapters the author reviews materials in both the Old and New Testaments. He then switches to some analysis and comparison of Nietzsche and Dostoevsky, and ends up with a discussion of the big bang theory of creation, comparing it to the Jewish Kabbalah. The theme running throughout the book is the idea that God, at times, seems to disappear from history. He was clearly present early in Old Testament history, then seemingly disappeared. He was manifested openly in the ministry of Jesus, but again seems to fade away in the later New Testament writings. This is presented as a new observation, but one that many Bible scholars have noted in the past (e.g., Sir Robert Anderson's book, *The Silence of God*).

The shift to Nietzsche and Dostoevsky was initially puzzling to me. I later assumed that Friedman used these two authors as examples of persons who wrestled with the idea of an absent God. His comparison of the two, especially the pointing out of some striking parallels, was new information to me and quite interesting. They seem to represent, in philosophy and literature, how man tries to cope with life in a world where God is absent.

The author also finds a parallel between the big bang theory and the Kabbalah, a Jewish mystical system formulated by certain rabbis in the Middle Ages. Both see the origin of the universe in terms of a single point. While that was an interesting observation, the author said nothing else about the Kabbalah and its relationship to science. Is he suggesting that we should embrace Kabbalah based on this one point in harmony with modern science?

The book wrestles with the idea that if there is no God (or if God is absent from history), there is no basis for morality. If there is no absolute moral standard beyond the competing human moral systems, it is difficult to find a reason to pursue morality at all. The author reflects some concern that we in the twentieth century, perhaps more than any other time in history, are a generation that lives as though God were absent or irrelevant. We are the generation where the death of God theology originated from within the believing community.

The book suggests that while science may initially have contributed to the idea that God is unnecessary in today's world, science today may be pointing us back to the reality of God. His comments about Stephen Hawking and other scientists were of interest to a scientific layman, such as this reviewer. In some ways, says Friedman, Hawking's *A Brief History of Time* is a religious book. Carl Sagan admits as much in his introduction to Hawking's book, and the book itself ends on a religious note. (The famous final sentence is, "Then we will know the mind of God.")

Friedman is an excellent writer and the book was full of interesting facts and ideas, but I struggled to answer the basic question, "What is the point?" The book was an interesting survey of how several societies and individuals have viewed God (or the absence of God), but the hard hitting conclusion I searched for was never found. The book ends with the statement, "There is some likelihood that the universe *is* the hidden face of God." An entire book only to end up with "some likelihood?"

Further, as a believing Christian, I thought the book more or less ignored the fact that there are millions of Christians who will testify to the presence of God in this world. While Nietzsche and those influenced by his writings may act as if God is dead, those who have found new life in Christ live in a world where God is very real. The author's bias may be in the direction of Kabbalistic pantheism rather than in Christianity. True Christians are not searching for an absent God, but abide in the presence of the Living God.

Reviewed by Richard M. Bowman, Director of Research and Publications, Disciple Renewal, PO Box 109, Lovington, IL 61937.

Letters

A Response to David Siemens, Jr.

In a letter to the editor (*PSCF* 47: 284, December 1995), Siemens interprets my views on theistic evolution (*PSCF* 47: 112-122, June 1995) as limitations on God's omniscience and God's omnipotence. This interpretation is clearly incorrect. My views do not limit God in what he could or could not do. Siemens paraphrases my views as: "Their God has to tinker repeatedly and directly with the developmental sequence in order to produce a working universe: I choose my words carefully, and I never suggest that God is tinkering. As noted in my article in the *Christian Scholar's Review* (XXIV, 414-458, 1995), biblical scholar John Stek has this to say regarding the biblical use of the term, *bara'* or create: "... it is silent as to the utilization of preexistent materials *or the time ... or the means involved.* In biblical language, *bara'* affirms of some existent reality *only that God conceived, willed and effected it.*" My proposed theory of theistic evolution, a design theory, is clearly in accord with that interpretation. God could choose to bring about his creation in whatever manner and in whatever time he chose.

Some of Siemens' statements indicate a lack of understanding of modern biochemistry and molecular biology. He uses these statements to suggest that modern science is closing all of the gaps on our scientific knowledge; that events that were considered to fall in the realm of the miraculous are now fully explained. He states: "I recall when it was claimed that a protein (enzyme) was absolutely necessary to process hereditary material. Now I read of self-catalyzed RNA reactions." If by "process," Siemens means formation of functional RNA and DNA by cells, proteins (enzymes) are still absolutely necessary. Even in laboratory syntheses of RNA and DNA, protein enzymes (polymerases especially) are extensively utilized. Also, there was never any stipulation that all catalysis had to be brought about by proteins (enzymes). Hydrogen ions, metal ions, etc., have for many years been known to catalyze reactions; RNA had simply not been known to be capable of catalysis. Cech and others found that certain RNA sequences of defined structure could catalyze a limited number of reactions. They function as nucleotidyl transferases, nucleases and in some cases, esterases. This has led some to propose a hypothetical RNA world, in which all reactions were catalyzed by RNA. In a paper that is in press ("The RNA World: a Critique," in *Origins Research*), this writer has examined the evidence and the presuppositions that are required if one chooses to accept that hypothesis. In summary, present evidence provided little support for the RNA World hypothesis. It does not have any substantial hard evidence as a foundation.

In regard to protein folding, it is true that some proteins do fold naturally in functional three-dimensional structures. However, many proteins do not fold naturally and require other proteins (chaperonins) to fold into their functional state. A whole new field has developed involving the characterization and functioning of the unique chaperonin proteins.

Siemens notes that: "the list could be extended tremendously, with more and more gaps closed as research continues." My experience as a research scientist is that for every question that is answered, there are two or more new questions that appear. (Note that I do not really like the term, "gaps.") In regard to the "God of the gaps" question raised by Siemens, I have dealt with that topic in my *PSCF* paper and will not expand on my previous treatment. Scientific research continues to show the increasing complexity of all living organisms, rather than providing final answers or simply filling gaps.

Siemens makes the following statement about the chance synthesis of cytochrome c (probability of 2×10^{-65}): "I suspect that there are reasonable ways to recalculate the probability, and that the apparent difficulty of synthesis will be reduced as new discoveries are made." Since Yockey's original paper in 1977 in the *Journal of Theoretical Biology*, a number of modifications in specific amino acids in the cytochrome c molecule have been made. In large measure, these have confirmed that data used by Yockey in his original calculations. If Siemens wishes to challenge the data, I suggest that he do it on the basis of the evidence, not a mere suspicion.

I am a biochemist and a molecular biologist and I have chosen to formulate my theory on the basis of the evidence from those fields. I am not a philosopher, theologian, or a cosmologist, but I believe there are others who can deal with ramifications of my theory as they affect those fields. Van Till speaks of God's governance (see my *PSCF* paper) as an expression of God's sovereignty. Siemens considers that "God is active in providence." These terms, governance and providence, are considered appropriate to theologians and Christian philosophers. However, at the molecular level, the terms are quite nebulous, and I find it difficult to determine their meaning as applied to the molecular biology of living organisms. My phrasing, "a continuing provision of genetic information" is actually only a slight extension of Van Till's use of the term "governance." Van Till indicates: "... every one of these processes and every connective pathway in the possibility space of viable creatures is a mindfully designed provision from a Creator possessing unfathomable intelligence." Van Till speaks of the Creator's "designed provision," I have proposed how the "designed provision" may have been effected by the Creator.

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Tanner Revisited

I would like to point out that William F. Tanner's ("How many trees did Noah take on the ark?" vol. 47, December 1995) own assumptions refute his hypothesis. Given (1) his interpretation of Gen. 7:20 that only the lowlands and high hills in Noah's region were covered with water, (2) that trees cannot survive for long under water, and (3) that olive trees do not grow in high altitudes, he should have concluded that the Bible is in error. The dove could not have brought back an olive leaf, since all the places in that area where olive trees could grow would have been covered over.

Yet his hypothesis can still be made consistent with his interpretation of Gen. 7:20 if the reasonable assumption is made that olive tree *seeds* survived the flood, and sprouted quickly in the rich post-deluge mud. Yet again, if this latter assumption is made, then there is no reason that the same thing could not have happened after a world-wide mountain-covering flood, as per the traditional interpretation of the verse.

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An Answer to Touryan

In answer to Touryan's question whether anyone has considered Schroeder's resolution of the 6 day/15 billion year time difference (*PSCF*, 47:289, December 1995), at least one ASAer has. See my review of Schroeder's book (*PSCF*, 45:66f, March 1993), specifically the second paragraph. But apparently the problem I noted needs to be explicated more precisely.

The relativistic factor, $[1-(v/c)^2]^{1/2}$, applies to length, time and mass, that is, to the physical universe. Specifically, on the view underlying Schroeder's argument, space and time are inseparable, as are mass and energy, all four being united in the well-known $E=mc^2$. Since Einstein's universe is finite and unbounded, all space and time are within it. Therefore, if God's time is to be slowed by a factor of about 150 billion, he must be part of the universe, necessarily within it.

This cannot be equated to the immanence of God in Christian theology, which holds (1) that God is infinite and transcendent, (2) that he is eternal and timeless, and (3) that his immanence springs from his being the external source, i.e., the Creator, of the universe, making all space and time directly and timelessly open to him. In contrast, Schroeder's approach at most could posit God as the whole universe, or at least its space-time framework if mass-energy can somehow be considered a distinct and separable entity. However, for the divine 6 day-material 15 billion year ratio to work, the deity must be moving about $1-10^{-26}$ times the velocity of light relative to a universe "at rest." Since it seems impossible for the whole to move relative to itself, though parts may obviously move relative to the whole, this speeding deity will necessarily be only a part of the universe. Hence this theory not only denies theism but rejects the normal core of pantheism, for his deity is not even immanent.

In addition, an anonymous reviewer, besides helpful analyses and suggestions, has noted that both Schroeder's view and my response are based on special relativity, whereas general relativity is the proper approach.

In sum, Schroeder's "solution" fails as soon as one asks what the collateral consequences are. It "solves" one problem only by producing a number of more serious ones.

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Whimsy

Re: The inseparability of good and evil in Randy Isaac's "Chronology of The Fall" — which is, of course, after Summer and before Winter (p. 41, March 1996).

Perhaps there is no such thing as evil. We experience dark and cold as conditions, yet they are not real in the same sense as light and heat. Dark and cold are not "things," they are the absence of things.

If there is no evil "thing," then there is no need to postulate an evil force. It also suggests that the only avenue to eliminating evil is to overcome it with good. It makes the phrases "Light of the World" and "Prince of Darkness" more interesting to me.

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A Proposal

There is an urgent need for evangelical scientists and theologians to respond to the war of words in the Christian community over creation and the age of the earth. Since about 1980, I have closely followed the debate within the *lay* Christian community regarding creation and origins. I have been concerned about the divisiveness among evangelical Christians on this issue. Although there has been a healthy debate among evangelical scientists and theologians on the issue of creation and science,[1] many popular books on this subject have equated a particular exegetical viewpoint with orthodoxy. This is especially true in Christian educational resources. For example, we home school our children, and I have had difficulty finding elementary education materials that present a balanced biblical view

of science and creation.[2] In spite of the range of exegetical viewpoints in many conservative commentaries, the majority of popular books on science and creation are from the "young earth" viewpoint. Many evangelical theologians do not hold to a strict "24 hour" day, and the majority of evangelical scientists are probably not "young earth" creationists. I am concerned that the views of most evangelicals are shaped by organizations like the Institute for Creation Research, and that the rhetoric against other perspectives seems to be getting worse. I commend this organization for its critique of secular evolution, but most lay evangelicals believe this viewpoint is the only orthodox position. A "young earth" interpretation of Genesis is perceived by much of the evangelical populace as a tenet of biblical faith, even though many Christian scientists and theologians feel that it presents problems intellectually and apologetically.

The ASA has provided a resource and forum for discussion of other approaches to questions of origins, and many valuable books have been written by ASA members that present alternatives to the young earth position. However, this information often does not reach our churches,[3] and most of the secular and religious world equates "creationist" with a young earth position. Some estimate that 50% of Christians believe that the earth is less than 10,000 years old, but that only 1% of Christian scientists hold that position.

Several recent publications poignantly illustrate the need for a cooperative response from the evangelical academic community to this widely held position. In his book *Creation and Time*, ASA member Hugh Ross discusses that issue of the age of the earth and calls for a "lasting peace" among evangelicals.[4] However, this appeal for cooperation has been met with opposition and criticism from young earth creationists.[5] This issue has implications for all Christians, not just those who are interested in science. It is one of the central themes of Mark Noll's powerful indictment of evangelical Christianity.[6] *Christianity Today* recently published an excellent review on this subject that alludes to the broad implications of this issue for evangelicalism.[7] The participants expressed concern about the failure to adequately address questions of science and faith, but did not offer a specific solution.

Evangelical leaders in both the scientific and theological community need to collectively address this issue in a public format.[8] The wisdom from evangelical commentaries needs to be integrated into the content of our popular publications. Evangelical positions on general and special revelation need to be clarified. We need to emphasize that a dogmatic "24 hour day" exegesis of Genesis 1 is not the consensus view among theologians, and discuss the diversity of views among evangelical scientists. We need to support Hugh Ross and others who have attempted to find areas of consensus among all creationists,[9] regardless of how old we consider the earth. We need to collectively affirm the central truths of creation ad exhort all evangelicals to practice tolerance within the parameters of orthodoxy. We need to agree to disagree, and focus more on responding to secular evolutionism and naturalism.[10]

The idea of an Evangelical Creation Network (ECN), similar to the Evangelical Environmental Network (EEN), has recently been proposed as a possible way to begin this effort.[11] This could be an umbrella organization for all organizations that agree about the inerrrancy of Genesis One, and provide a forum for all theologians and scientists who believe in creation. A statement that affirms the essential truths of Creation, but recognizes the diversity of opinions among evangelicals on specifics, could be developed. This would provide a valuable resource for both the secular and Christian community on issues of science and faith.

I believe that there is a "scandal of the evangelical mind"[12] on this issue, and that we need to collectively pursue a more balanced perspective and more "loving" discussion of our differences.

Notes

[1]For example, the March 1996 issue of *Perspectives on Science and Christian Faith* has several articles and an interesting editorial (J. W. Haas, "Is Anyone Reading This Journal?") that reflect how much attention has been paid to this issue among ASA members.

[2]The high school biology textbook, *Of Pandas and People*, is a notable exception but it is not aimed at elementary students.

[3]See discussion, "ASAers Want Outreach to Churches," *ASA Newsletter* 37, no. 6 (Nov/Dec 1995).

[4]H. Ross, *Creation and Time* (Colorado Springs, CO: Navpress, 1994).

[5]Van Beeber and Taylor, *A Report on the Progressive Creationists Book By Hugh Ross*, Eden Communications.

[6]Mark A. Noll, *The Scandal of the Evangelical Mind*, (Grand Rapids, MI: Eerdmans Publishing, 1994).

[7]"The Scandal of The Evangelical Mind," *Christianity Today*, Aug. 14, 1995.

[8]Dr. Robert C. Newman is the new Chairman of the ASA Creation Commission. His long-standing leadership in both the theological and Christian scientific communities may provide the opportunity to bring both disciplines together.

[9]R. C. Newman, "Scientific and Religious Aspects of the Origins Debate," *PSCF* 47:3 (Sept. 1995), 164-175.

[10]Dr. Phillip Johnson has led the way in critiquing the scientific establishment for treating Darwinism as fact rather than theory, and discussing the pervasiveness of naturalism as "the established religious philosophy of America." His two books on these issues, *Darwin on Trial* and *Reason in the Balance*, are published by InterVarsity Press.

[11]D. W. Munro, "The Executive Director's Corner," *ASA Newsletter* 38, no.1 (Jan/Feb 1996).

[12]Noll, Ibid.

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Response to Kline

In regard to Meredith Kline's article, "Space and Time in the Genesis Cosmogony" (*PSCF* 48:1, March 1996, 2-15), I have several comments. This article raises many methodological questions, not just for biblical exegetes but also for all those who seek a way of relating their faith and

their science. The two most prominent are: What constitutes a "good" or "valid" interpretation; and how does a non-expert evaluate competing interpretations?[1]

I speak here as a professional exegete (formerly an engineer) who has focused on the scientific study of the biblical languages from the perspective on contemporary linguistic semantics and text linguistics. These methods are based on the study of how language works to communicate; and hence can offer guidance in how we should interpret acts of communication, such as written texts. I believe that these tools, carefully applied, would help restore theology to a (Thomistic) "scientific" status: by this I mean, it would help to diminish the widespread impression that "there is no way to decide upon one 'correct' meaning of, say, a poem or story or a work of art"[2] and by implication, of a biblical passage. I am currently at work on a model to describe the interpretative process (whether of natural science, social science, or exegesis), that takes into account the personal involvement of the observer, and the way the observer correlates conclusions in one realm (say, physics) with those in another (say, theology).[3] Of course, in theology the issue of one's personal commitments comes into play much closer to the data than in physics, and the tools of analyzing language are not so easily reduced to equations, so we will hardly eliminate all competing interpretive schemes (any more than the natural sciences do), but at least we will make the issues clearer. I hope that one benefit of this model will be a delineation of how one who is not expert in a particular discipline can come to responsible conclusions about the subject matter of this discipline, especially about how it relates to other realms of study.

The editor of *PSCF* has declared "a moratorium of articles related to interpretation of early Genesis," so I will have to content myself with asserting some things in this letter, which I will only later be able to argue. Professor Kline criticized a few points of an article of mine in his notes 24 and 26.[4] Now, his own argumentation depends upon the acceptance of his "two register" scheme and its consequences on the interpretation of the passage. This in turn depends on accepting his interpretations of various verses used to support his two register scheme (many of which are debatable); and it also involves one in questions of directionality in applying imagery (i.e., he seems indifferent to questions of whether a supporting passage was written before or after Genesis 1, and what implications that will have on our use of it in interpretation. And finally, his approach is what is called a "top down" hermeneutic: he starts by assuming the validity of his big picture, and interprets all detail in the light of it (even to the point of relegating the "evening and morning" refrain to the status of "simply a detail in the creation-week picture"[5]). All of this produces something quite complicated and hard to follow, even for the biblical specialist, and this raises the obvious question: what kind of communication was this from Moses to his audience?

A text linguistic approach, on the other hand, would lead us to treat the intra-textual relationship (i.e. how the details of the text relate to the overall workings of the text)[6] and the extra-textual relationship (e.g., genre; communicative function; communicative intent in light of social conventions). It is my view that this kind of hermeneutic would go a long way toward clearing up some traditional difficulties, such as the grammatical relationship of Gen. 1:1-2 to the rest of the chapter (e.g., when does the first "day" begin; is this *ex nihilo*?); the relationship of the prominence of the sixth "day" to the communicative intent of the passage; what we are to make of the unusual features of the seventh "day;" how we connect this passage with Gen. 2:4-25 (indeed, how do we know where the passage boundaries are, and what role do we give to putative sources in interpretation?); and what kind of referentiality (connection with the "real world") this passage is supposed to have (including: Is it properly called a "cosmogony" at all? Do the words "literal" and "figurative" have any useful meaning in this discussion?). I think further, that in the interests of being scientific, a good method would make clear its grounds and assumptions, and the means by which its results are to be correlated with conclusions in other realms of study.

One of these days I hope to write such a comprehensive text linguistic study of this passage. My 1994 article includes some of this, but not enough. There I concluded that the "days" of the creation week are an anthropomorphism to describe God's activity (an exegetically-based articulation of a view found in Augustine, and even earlier). In so far as Gen. 12 touches on time, we are not linguistically able to eliminate completely all succession in the days;[7] however, since that succession is itself part of the anthropomorphic description, there will always be uncertainty as to how this related to "the experience and knowledge of us earthbound men" (Augustine's phrase). I further tried to suggest that therefore empirical investigation, and not exegesis, can help us learn such things as how long ago God created the universe; what kind of overlap there is between the various "days" of the creation week; to what extent items of a particular "day" have been classed together for logical rather than chronological reasons (clearly not an exhaustive list).[8] I did not try in any extensive way to translate my exegetical conclusions into the kinds of statements that could be "tested:" I am still thinking about that.

Non-theologians will perhaps smile condescendingly at us, though, when they realize that there are similarities

in the cash values of these two exegetical schemes for practicing scientists.[9] However, I contend that the methods behind the two schemes do have important differences, and hence consequences. Further, I find many of the ideas associated with the two register scheme unconvincing and diversions from the text itself. One important difference for the ASA context is this: Profess Kline's view is explicitly non- (or even anti-) concordist, at least for Gen. 1 (I think his last footnote makes it clear that his position is more concordist for Gen. 2-3); while my own conclusions, though they could perhaps be construed in a non-concordist (e.g., complementarist) way, lend themselves more to a mildly concordist mode. I want to be careful about what this entails, however (which is why I am still thinking about "testable" ways of stating my conclusions).[10] On this I welcome input.

Notes

[1]For example, I claim an expertise in biblical studies, and I differ from Professor Kline in some significant ways: how are, say, other ASA members, who for all their commitment to the Bible are mostly not experts in the technical disciplines behind exegesis, to decide between us (or to go with someone else, or to decide it's okay not to decide)?

[2]Richard D. Alexander, "A Biologist's Approach To Human Nature," in Michael Bauman, Ed., *Man and Creation* (Hillsdale: Hillsdale College Press, 1993), 191-207, at 193. He contrasts religion, as a part of the humanities, with science, which he sees as being more objective.

[3]In some ways my model resembles that of W. Jim Neidhardt, "Realistic Faith Seeking Understanding," *JASA* 36:1 (March 1984), 42-45, especially his diagram on p. 44. However, his model lacks the explicit component of *correlating* (or better, *contextualizing*) that a comprehensive model needs.

[4]D. John Collins, "How Old Is the Earth? Anthropomorphic Days in Genesis 1:1-2:3," *Presbyterion* 20:2 (1994), 109-130. I consider it a great honor to be taken notice of at all by someone of his stature!

[5]Kline, 10. In my own article (p. 118), by contrast, I found this refrain to be a key contributor to my interpretation (as well as strong evidence *against* the usual literalist claim that this refrain establishes the ordinary day view).

[6]This would include a "bottom up" use of the details (e.g., lexical and grammatical) to build a big picture, and to refine or even overthrow our preliminary perception of the big picture.

[7]This, of course, is a strong difference between my conclusions and Kline's: however, even though I express in a footnote a willingness to consider a phenomenological interpretation of "made" in day 4, to which Kline apparently took strong exception (see his p. 8 and note 26; I think he took my footnote as indicating my *settled position*, which it does not), I am not sure that in practical terms it actually produces as large a gap as his amount of text might suggest.

[8]One of my concerns was to show that, at least under certain conditions, it is not a *denial* of biblical authority to allow empirically gained knowledge a role in interpretation, but an *application* of it.

[9]Cf. Kline's note 47 with my conclusions. I don't think they are identical though; but of course a lot depends on what one means by "evolutionary"! But this also involves more issues than just the interpretation of Gen. 1.

[10]I suppose the conclusions themselves could go with a strongly concordist approach such as Robert Newman's or High Ross', but they do not require that. A lot depends on what kind of "speech art" Gen. 1 is supposed to be, and what kind of space-time claims it is making. Conclusions on that question, though, should be the result of study and not the starting point of it.

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Books Received and Available for Review

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

Peter Bakken, *Ecology, Justice, and Christian Faith: A Critical Guide to the Literature*, Greenwood, 1995
Deborah Blum, *The Monkey Wars*, Oxford University Press, 1995
Joel Cohen, *How Many People Can the Earth Support?* Norton, 1995
Michael Cromartie, Ed., *Creation at Risk*, Eerdmans, 1995
Donald Goldsmith, *Einstein's Greatest Blunder*, Harvard University Press, 1995
William Howells, *Getting Here: The Story of Human Evolution*, Compass Press, 1993
Leszek Kolakowski, *God Owes Us Nothing: A Brief Remark on Pascal's Religion and on the Spirit of Jansenism*, University of Chicago Press, 1995
D. H. Larson, *Times of the Trinity: A Proposal for Theistic Cosmology*, Peter Lang, 1995
Ernest Lucas, *Genesis Today: Genesis and the Questions of Science*, 1995
John McLeish, *Cosmology: Science and the Meanings of the Universe*, Bloomsbury, 1995
Thomas Morris, (Ed.), *God and the Philosophers: The Reconciliation of Faith and Reason*, Oxford, 1994
George Murphy, *Cosmic Witness: Commentaries on Science/Technology Themes*, CSS Publishing Co., Inc., 1996
Terence Penelhum, *Reason and Religious Faith*, Westview, 1995
E. C. Pollard, *Sermons in Stones: Scientific Revelations*, Woodburn Press, 1993
Michael Rivage-Seul, *A Kinder and Gentler Tyranny: Illusions of a New World Order*, Praeger, 1995
D. N. Robinson, *An Intellectual History of Psychology*, Wisconsin University Press, 1996
Alwyn Scott, *Stairways to the Mind: The Controversial New Science of Consciousness*, Copernicus, 1995
James Shreeve, *The Neanderthal Enigma: Solving the Mystery of Human Origins*, Morrow, 1995
Robert G. Simons, *Competing Gospels: Public Theology and Economic Theory*, 1995
R. Sokolowski, *The God of God of Faith and Reason*, Catholic University of America Press, 1995
John Stott, *Authentic Christianity: From the Writings of John Stott*, IVP, 1995
Laura Dassow Walls, *Seeing New Worlds: Henry David Thoreau and Nineteenth Century Natural Science*, 1996
Brian Walsh, Ed., *An Ethos of Compassion and The Integrity of Creation*, University Press of America, 1995
Harold Wells, *A Future for Socialism?* Trinity Press, 1996

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

Books. ASA titles such as *Teaching Science in a Climate of Controversy* and the *Membership Directory* are sent to all new members when available. From time to time other books and resources are available for purchase through the home office.

One book which can be purchased is *Contemporary Issues on Science and Christian Faith: An Annotated Bibliography,* which offers an expansive book list, as well as a Speaker's Bureau listing, book service information and other science/faith resources.

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

Church Affiliation _____

How did you learn about the ASA? _____

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

Name _____

Street _____

City _____ State _____ Zip _____

I am interested in the goals of the American Scientific Affiliation. Upon the basis of the data herewith submitted and my signature affixed to the ASA Statement below, please process my application for membership.

Statement of Faith

I hereby subscribe to the Doctrinal Statement as required by the ASA Constitution:

1. We accept the divine inspiration, trustworthiness and authority of the Bible in matters of faith and conduct.
2. We confess the Triune God affirmed in the Nicene and Apostle's creeds which we accept as brief, faithful statements of Christian doctrine based upon Scripture.
3. We believe that in creating and preserving the universe God has endowed it with contingent order and intelligibility, the basis of scientific investigation.
4. We recognize our responsibility, as stewards of God's creation, to use science and technology for the good of humanity and the whole world.

Signature _____ Date _____
(required for Member, Associate Member, Student member status)

I have enclosed (Please check one):

____ $55, Full Member ____ $55, Friend of the ASA ____ $45, Associate Member

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

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

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

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

a. Affiliations

Affiliation of Christian Biologists
Affiliation of Christian Geologists

b. Commissions

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

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

WHAT EXACTLY IS THE AMERICAN SCIENTIFIC AFFILIATION?

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

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

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

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The American Scientific Affiliation

Founded in 1941 out of a concern for the relationship between science and Christian faith, the American Scientific Affiliation is an association of men and women who have made a personal commitment of themselves and their lives to Jesus Christ as Lord and Savior, and who have made a personal commitment of themselves and their lives to a scientific description of the world. The purpose of the Affiliation is to explore any and every area relating Christian faith and science. *Perspectives* is one of the means by which the results of such exploration are made known for the benefit and criticism of the Christian community and of the scientific community.

Canadian Scientific & Christian Affiliation

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

Local Sections

of the ASA and the CSCA have been organized to hold meetings and provide an interchange of ideas at the regional level. Membership application forms, publications, and other information may be obtained by writing to: American Scientific Affiliation, P.O. Box 668, Ipswich, MA 01938-0668, USA or Canadian Scientific & Christian Affiliation, P.O. Box 386, Fergus, ONT N1M 3E2, CANADA.

Chicago–Wheaton	D.C.-Baltimore	Guelph, ONT	Indiana–Ohio	Los Angeles
New York–New Jersey	North Central	Oregon	Pittsburgh	Rocky Mountain
San Diego	San Francisco Bay	Southwest (AZ)	Washington	Toronto, ONT

INDICES to back issues of *Perspectives* are published as follows:

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Vol. 16-19	(1964-1967)	*Journal ASA*	19	126-128	(1967)
Vol. 20-22	(1968-1970)	*Journal ASA*	22	157-160	(1970)
Vol. 23-25	(1971-1973)	*Journal ASA*	25	173-176	(1973)
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Vol. 45-47	(1993-1995)	*Perspectives*	47	290-296	(1995)

A keyword-based on-line **subject index** is available on 5 1/4" or 3 1/2" computer disks for most IBM compatible computers with a hard disk or two floppy disk drives. It includes all software and instructions, and can be ordered from the ASA Ipswich office for $20.

Articles appearing in *Perspectives on Science and Christian Faith* are abstracted and indexed in the CHRISTIAN PERIODICAL INDEX; RELIGION INDEX ONE: PERIODICALS; RELIGIOUS & THEOLOGICAL ABSTRACTS, and GUIDE TO SOCIAL SCIENCE AND RELIGION IN PERIODICAL LITERATURE. Book Reviews are indexed in INDEX TO BOOK REVIEWS IN RELIGION. Present and past issues of *Perspectives* are available in microfilm form at a nominal cost. For information write: University Microfilm Inc., 300 North Zeeb Rd., Ann Arbor, MI 48106.

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

Volume 48, Number 2 **June 1996**