PERSPECTIVES on Science and Christian Faith

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In this issue . . .

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

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Perspectives on Science and Christian Faith

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The Freedom to Think Otherwise and to Build Bridges

Our *Newsletter* and the pages of *PSCF* have chronicled the recent struggles of various individuals with the scientific establishment over real or potential deviation from biological orthodoxy. We are rightly outraged at the suppression of academic freedom and seek to hold up to the light of day the actions of those who would force their view of scientific orthodoxy on those who teach or write. The doyens of secular science, stung by the attacks of the creationist movement, feel it necessary to sweep the plate clean of those whose faith might cause them to question its canons. It seems that the plenary authority, credibility and political power of science are at stake.

There is, however, another equally repressive orthodoxy that holds sway in the Evangelical academy and conservative Christian community. This one is seldom mentioned except when it emerges in denominational courts or faculty dismissals. How many people have lost their positions or been forced to leave their church over their views on origins? However many this has been, I suspect that their number is small compared to those who keep their views on God and nature to themselves when in the house of God. Sadly, some religious orthodoxies find little place for the voice of nature. Here, plenary authority, credibility and political power — the Protestant hegemony of an earlier day — are at stake.

It will require more than editorial comment to change the mindset of a religious people who see evolution as intimately involved in immorality and the secular humanism which pervades American culture. The issue is deeper than "the Bible alone" or particular "integrations" of science and scripture.

If this analysis rings even partially true, the ASA needs to reexamine its strategy. For almost five decades this Journal has offered weighty discussion of issues in fields ranging from archeology to zoology, and has included lengthy excursions into theology and philosophy — yet there has been little concern for how to communicate this information to the publics we seek to serve. We have seen ourselves as a bridge over troubled waters between church and science. Today that bridge must be upgraded. We need to consider ways to push through the persistent, growing barriers at each end. Please join me in dialogue on these critical matters.

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In This Issue

In this issues we revisit the problem of evil in our first paper, by Gary Emberger. He draws together recent thinking in theology and science to assess the place of evolution in addressing this issue. Biochemist Gordon C. Mills then offers a critique of the molecular evolutionary clock. He finds deficiencies both in the scientific arena and for developing a Christian world view.

Jim Moore's Communication responds to reviews of *Darwin* (which he co-authored with Adrian Desmond) by several evangelical historians. R. S. Beal, Jr. then counters Al Truesdale's contention (June 1994) that evangelicals with premillennial convictions have abdicated responsibility toward the environment.

Russell Maatman offers a revisionary interpretation of the causes of Galileo's trial in line with recent research. The life and cosmological ideas of Nobel Laureate Arno A. Penzias are described by Jerry Bergman. In our final communication, Robert Fischer discusses the many ways that God is defined in the writings of current scientists. We should be wary of equating the God of Scripture with the god of science.

Theological and Scientific Explanations for the Origin and Purpose of Natural Evil

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Events such as earthquakes and crippling illnesses are often viewed as evils and raise troubling questions about God's goodness. While science does not recognize these events as evils, it does offer insights into their origins. Theodicy attempts to explain theologically how evil originated and for what purpose God allows it to exist. Adopting either Augustinian or Irenaean theodicy has important implications concerning the question of whether evolution could be one of God's creative mechanisms. Finally, recognizing that all truth is God's truth, Christians seek to develop a world view that includes both scientific and theological understanding of harmful natural events.

Suffering, extreme pain, and death are part of the natural world. Consequently, Christians tend to view the natural world with ambivalence. We believe God created it, pronounced it good, and rules over it. We read that God provides food for the lion and raven (Job 38:39, 41), birds of the air (Matthew 6:26), notes the death of sparrows (Luke 12:6), sports with leviathan (Psalm 104:26), creates the beauty of the flower (Luke 12:27), and that all of creation praises him (Psalm 148). The complexity, beauty, and apparent design of our world is presented in the Bible as a clear witness to God's "invisible qualities — his eternal power and divine nature" (Romans 1:20). And yet, what about aging and death? What about disease, parasites, predators, droughts, earthquakes, birth defects, floods, blindness, mental retardation, and accidents? Are these the stuff of God's good creation? Or, more likely, are these not considered evils by many, Christian or not?

Christian attempts to account for the origin and purpose of suffering, pain, and death arise from a serious theological question — how could an all-powerful, all-knowing, loving God have created a world that includes evil? Hick (1966, p. 5) states the dilemma as follows. "If God is perfectly good, he must want to abolish all evil; if he is unlimitedly powerful, he must be able to abolish all evil: but evil exists; therefore either God is not perfectly good or he is not unlimitedly powerful." To many non-Christians, this argument is a stumbling block to finding faith. To many Christians, these questions weaken faith already present. We find it difficult to reconcile ourselves to the presence of evil in a world created by an omnipotent God of love.

Christian Explanations for the Origin and Purpose of Natural Evils

Attempts to resolve this dilemma must, as Lewis states,

> guard against two sub-Christian theories of the origin of evil — Monism, according to which God himself, being "above good and evil," produces impartially the effects to which we give those two names, and Dualism, according to which God produces good, while some equal and independent power produces evil (1962, p. 69).

Against these views, the Bible asserts that evil is real, is attributable to sin, represents an intrusion into God's world, and will one day be removed. Further, the Bible reveals that only God is eternal and that he is completely sovereign. Evils and evil beings arise through the misuse of free will and

continue to exist only by God's will and for his purposes.

Christian explanations for the origin and purpose of suffering, pain, and death belong to the theological discipline of theodicy. Theodicy is "the philosophical attempt to justify the ways of God to humanity, an attempt to think about what God does with evil and why" (Willimon, 1985, p. 34). Most theodicies attempt to classify evils as either moral or natural. Moral evil is that which human beings originate: lying, stealing, murdering, greediness and selfishness. Natural evil is that which originates independently of human actions: hurricanes, tetanus, drought, birth defects, earthquakes, extreme pain in animals and humans. Problems occur with all attempts to define and classify evil. There are uncertainties and questions as to what is truly evil. For example, Clark (1961, p. 206), states that "man's struggle against nature is not, as a rule, a struggle against something evil, but a struggle to keep something potentially good and useful in the right place." Clark (1961) and Harrison (1989) suggest that animal pain is not a problem for theodicy because animals suffer little or no pain. Wennberg (1991) disagrees. Hick (1966, p. 18) states

> ...that it is a basic question whether events in nature which do not directly touch mankind, such as the carnage of animal life, in which one species preys upon another, or the death and decay of plants, or the extinction of a star, are to be accounted as evils. Should evil be defined exclusively in terms of human actions and experiences, with the result that events in the natural universe and in the sub-human world do not as such raise questions for theodicy? Or should the scope of the problem be extended to include the whole realm of sentient life, or perhaps only vertebrates, or perhaps only the higher mammals?

To this question he offers a moderate position, accepted in this paper, suggesting that

> ...the organic cycle in non-sentient nature offers no problems to theodicy, but wherever there is pain, as there appears to be far down through the animal kingdom, there is a *prima facie* challenge to be met. On this view, natural evil consists in unwelcome experiences brought upon sentient creatures, human or sub-human, by causes other than man himself (1966, p. 19).

Hick (1966) explains the two major types of theodicy, Augustinian and Irenaean, which offer contrasting explanations for the origin and purpose of natural evils. Augustine (A.D. 354-432), the Bishop of Hippo, saw evil as arising from misused freedom — the wrong choices of free rational beings, either man or angels. The sin of these beings resulted in the corruption of God's good and perfect world. A radically different theodicy is attributed to Irenaeus (A.D. 130?-202?), Bishop of Lyons. To Irenaeus, the world containing natural evils was the type of world God originally intended "as a divinely appointed environment for man's development towards the perfection that represents the fulfillment of God's good purpose for him." (Hick, 1966, p. 221). In this view, man and creation never were in the paradisical state pictured in the Augustinian theodicy. Irenaean theodicy has not been the dominant view of western Christianity, but its tenets, in one form or another, are held by significant numbers of people.

In the Augustinian tradition, natural evils are traced to the sin of free, rational beings. This is the view of most recent creationists, who believe that natural evils truly are evil and originated with the fall of Adam and Eve and with God's subsequent judgment on them and on creation. Accordingly, God created a perfect world without moral or natural evils less than 10,000 years ago (Morris and Clark, 1987). Man and at least the higher animals were created immortal, not susceptible to illness or aging. Carnivores did not exist, animals were herbivores. Evolution — or at least macroevolution — was not one of God's creative mechanisms. The Second Law of Thermodynamics — stating that all things move toward increasing disorder — either was not in effect or was neutralized by God's continual sustaining

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or organizing power. Into this world came moral sin, the willful turning from God, with natural evils quickly following. All of creation was corrupted. Parasites, predators, and disease organisms are postulated to be post-Fall microevolutionary developments. Aging and death began. Sin was followed by further judgment, with the Flood and accompanying movements of the earth's crust giving rise to earthquakes, volcanoes, the ice age, massive extinctions (as evidenced by fossils), and other natural evils. In short, natural evil exists because of man's sin.

"If God is perfectly good, he must want to abolish all evil; if he is unlimitedly powerful, he must be able to abolish all evil: but evil exists; therefore either God is not perfectly good or he is not unlimitedly powerful." This is the dilemma.

Other Christians (Lewis, 1962; Wennberg, 1991) are persuaded that the earth is much older than recent creationists allow and see a fossil record showing evidence of death and suffering as having occurred long before the Fall of Adam and Eve. Yet, not wanting to say that God willed these events as part of his creation, they have suggested that these ancient natural evils originated with an angelic fall occurring long before Adam and Eve were created. Satan, cast down to earth with the other fallen angels, attacked God's perfect creation, disrupting and distorting it, causing earthquakes, volcanoes, disease, predation, and death. The fall of Adam and Eve resulted in further evils including human death and the further corruption of the natural world due to man's broken relationship with God and thus his broken relationship with God's creation. This theodicy leaves room for evolutionary processes but it is an open question as to how much "good death" could have occurred. Lewis (1962) speculates that carnivory with an accompanying high fecundity to compensate for it are both a Satanic perversion of God's original design.

All variations of Augustinian theodicy maintain the innocence of God and the guilt of his creatures in terms of the origination of natural evils. Hick, critiquing Augustinian theodicy, finds it inconceivable that evil could arise *"ex nihilo"* with "wholly good beings in a wholly good world becoming sinful" (1966, p. 286).

Hick advocates, instead, Irenaean theodicy. Here, ultimate responsibility for natural evil in the world is placed on God. Man, arising through an evolutionary process, imperfect and immature, came to a point in his development where he was capable of fellowship with God, capable of acknowledging his presence. But God could not "force" the next phase of his purpose for man — to bring into existence children of God, beings who will freely choose to love God and to grow in this knowledge. In order to accomplish this second phase it was necessary to place humans in an ambiguous world much like our current world.

Hick argues that if God were unambiguously present in the world, man would not truly be free to choose to come to God, he would be overwhelmed by God. And so, God created an ambiguous world...

Hick argues that if God were unambiguously present in the world, man would not truly be free to choose to come to God, he would be overwhelmed by God. And so, God created an ambiguous world — a world with pointers to himself, but also a world where he could be seen as absent. Man was placed in this world at what Hick terms "epistemic distance" from God (1966, p. 317). It was a world filled with good things but also real evils and real challenges. Hick, using a phrase of John Keats, describes this world as a "vale of soul-making" (1966, p. 289). Only in this kind of world, through a long process of creaturely experiences, both good and bad, could people freely choose to love God and develop the kind of goodness God values.

Hick sees the fall as almost inevitable when man, struggling to survive in a hostile world and distanced from God, chose to think that the natural world was all there was and God did not exist. The justification for creating a world with evil is eschatological — that an "infinite future good will render worth while all the pain and travail and wickedness that has occurred on the way to it" (Hick, 1966, p. 376).

To account for the origin of natural evil, Augustinian theodicy looks back in time to a perfect creation and to the misuse of free will by God's creatures. To justify the creation of a world with natural evils, Irenaean theodicy looks forward to a future resolution. What about scientific study of the natural world? Can scientific theories shed light on events that, to the Christian, have moral causality and are supernaturally based? On the surface it would not seem likely, because science views the natural world as nonmoral. Furthermore, one of the goals of science is to explain the material universe in terms of purely physical and material causes, without invoking the supernatural. For example, death is not viewed scientifically as good or evil or as the consequence of sin; it is just the cessation of life. Biological death may sometimes be spoken of as good but only in terms of it facilitating ecosystem functioning, allowing the flow of energy through food webs, or leading to the recycling of nutrients by decomposers. And yet, it may be that not all death is due to sin. To whatever extent death is part of God's good creation, scientific theories of its origin and functioning will be necessary for a more complete understanding of our world.

Scientific Explanations for the Origin and Purpose of Natural Evils

All scientific accounting for the origin of "natural evils" will draw on geological or biological processes operating in accordance with natural law. Earthquakes and volcanoes, for example, originate with the shifting, colliding, and subduction of the earth's crustal plates, as understood by plate tectonic theory. These processes are viewed as the natural outcome of our planet's formation. Similarly, hurricanes, tornadoes, floods, droughts, and lightning storms are meteorological phenomena that, if not reliably predictable, are at least fairly well understood in terms of the laws that govern the dissipation of heat energy and the movement of air masses on a spherical planet. Biologically, many parasites are thought to be evolutionarily derived, structurally simplified (degenerate) forms of previously free-living organisms (Raven & Johnson, 1992). Viruses are considered by many to be escaped portions of DNA from the cells of hosts they now infect (Raven & Johnson, 1992). The origin of many pests, including vertebrate pests, microbial disease organisms, and insects, is attributed to the activities of humans who have moved organisms around the world. As a result, some of these organisms reach locations suitable for their proliferation — places that either lack natural competitors or have new hosts without resistance (Schumann, 1991). It is well known that exposure to chemical mutagens or harmful radiation causes certain cancers and birth defects.

To account for the origin of natural evil, Augustinian theodicy looks back in time to a perfect creation and to the misuse of free will by God's creatures. To justify the creation of a world with natural evils, Irenaean theodicy looks forward to a future resolution. What about scientific study of the natural world?

All these scientific explanations for the origination of "natural evils" are simply stating that our world operates according to natural law and that suffering, pain, and death are the unavoidable outcomes of living in such a world. The earth is still active, geologically, and destructive events will occur as they have always occurred. Severe meteorological disturbances will occur as they have always occurred and sometimes people and other organisms will suffer. Evolution will continue to generate parasites and pathogens and predators. Host and prey organisms will continue to evolve defenses. Scientific theories offer no other explanation of origin or purpose of these events other than that they are part and parcel of our world. Can the puzzling "evil" of death be similarly explained? For even if they escape accidents, diseases, or predators, organisms still die. They age, degenerate, and then expire. Why would natural selection not select for immortality? What insights into aging and death are offered by science?

My discussion on aging and death will be restricted in this paper in two ways. First, it will be limited to the death of multicellular animals because, interestingly, not all organisms die. Single-celled prokaryotes reproduce by dividing. Each new cell then divides. Infinite cell replication (immortality) is possible (Arking, 1991). Certain single-celled protists reproduce in this manner as well. Some multicellular plants (Hartmann, et. al., 1990) and fungi (Brasier, 1992) have the potential to persist as long-lived clones, effectively blurring the distinction between life and death of the organism. Secondly, discussion will be limited to vertebrates having iteroparous (reproducing more than once in their adult lives) life histories. This group of organisms,

including most mammals and birds, is of most concern theologically because the question of animal pain in theodicy is most often discussed with these animals in mind.

This group of organisms, including most mammals and birds, is of most concern theologically because the question of animal pain in theodicy is most often discussed with these animals in mind.

Theories that explain the evolution of death fall into two camps, adaptive and nonadaptive (Kirkwood, 1985). Adaptive theories share a common idea that senescence and death have some positive value, offer some selective advantage, increase the fitness or ability of organisms to adapt. One possible advantage to a finite life span is that in a world of limited resources, death is necessary to remove old individuals so that resources are available for their progeny. Aging and death would also ensure a more rapid turnover of generations (and genotypes) which would allow greater genetic adaptiveness (evolution) to a changing environment. Adaptive theories, then, view it as "advantageous, or even essential, to set a finite limit to the life of the individual" (Kirkwood, 1985, p. 36). Several lines of evidence argue against adaptive theories. The "living space" argument weakens with the observation that obvious senescence is rarely observed in wild populations. Accidental mortality is high enough that "there is neither need for a mechanism specifically to terminate life nor opportunity for it to evolve" (Kirkwood, 1985, p. 37). Also, given two genotypes differing only in that one has a mechanism to terminate life at a fixed age, it is difficult to see how the self-terminating genotype is reproductively more fit than the other. To do so would require "that selection for advantage to the species or group was more effective than selection among individuals within the group for the reproductive advantages of a longer life" (Kirkwood, 1985, p. 37). This seldom appears to be the case.

Because of the evidence against adaptive theories, nonadaptive theories, which view senescence as detrimental to the genotype causing it, have become more prominent (Kirkwood, 1985). These theories must explain the evolution of aging more indirectly by suggesting that (1) the force of natural selection declines with age, because the cumulative effects of accidental mortality will progressively reduce the number of individuals surviving to increasingly older ages, or (2) death is a by-product of other, adaptive traits. For example, it has been suggested that aging is due to pleiotropic genes (genes having more than one phenotypic effect) that have good effects early in life (and would be positively selected for because of the large number of young, reproducing individuals) but have negative effects late in life (but would not be selected against because so few old individuals are left due to accidental mortality). Selection against these late-acting deleterious genes, then, may be outweighed by selection for their beneficial effects earlier in life. Aging and death would have evolved as a by-product of selection for the adaptive aspects of such genes.

According to the disposable soma theory, multicellular organisms can be thought of as consisting of the germ and soma line. The germ line, represented by the reproductive cells, is potentially immortal. The soma or somatic cells (body cells) are derived from the germ cells and are destined to age and die. The theory states that greater reproductive fitness is gained by allocating a smaller amount of energy to the soma line than would be required for it to last indefinitely.

Discussion of the disposable soma theory is pertinent here. According to this theory (Kirkwood, 1985; Arking, 1991), multicellular organisms can be thought of as consisting of the germ and soma line. The germ line, represented by the reproductive cells, is potentially immortal. The soma or somatic cells (body cells) are derived from the germ cells and are destined to age and die. The disposable soma theory states that greater reproductive fitness is gained by allocating a smaller amount of energy to the soma line than would be required for it to last indefinitely. Somatic cells (and consequently the organism) age due to the cumulative effects of a variety of random degradative events and processes. These processes are thought to occur at a constant rate

but cellular repair processes are not 100% efficient. As a result, the energy needed to repair the steadily accumulating damage and maintain the soma increases with age. No soma, because of the likelihood of accidental death, can last indefinitely. At the eventual and certain death of the soma, all resources invested in maintaining it are lost. In view of this, it is considered wasteful for the organism to allocate the energy necessary to indefinitely maintain the soma. By allocating some lesser amount of energy to soma maintenance the extra energy can be used for increased reproduction. When the energy cost of soma repair begins to outweigh the energy cost of reproduction, evolutionary theory would suggest that the repair activities of the aging organism would decrease, resulting in increased senescence and eventually in death. The disposable soma theory ties in with the concept of pleiotropic genes as discussed earlier. If the genes in question are those that govern the levels of somatic maintenance, then the benefit of reduced maintenance earlier in life would be increased reproduction and the disadvantage later in life would be earlier senescence. And so aging and death, along with the other evils of this world, can have a naturalistic explanation for its origin and purpose.

Augustinian Theodicy — Two Difficult Questions

In this section, my operative premise is that truth is revealed in the Bible and gained through the scientific study of the created world. Rejection of one over the other will invariably lead to conflict and misunderstanding.

The central tenet of recent creationism, its complete rejection of scientific (and biblical) evidence for an old earth, is open to severe criticism for its biblicism. The evidence for an old earth is strong, and it seems presumptuous to reject it out-of-hand when there are other, legitimate interpretations of the Bible that considerably lessen the tensions between science and faith on this issue (Blocher, 1984). Given an old earth, there are no compelling reasons to attribute all natural evils to the sin of the first humans. Rejecting recent creationism, however, is not rejecting Augustinian theodicy.

Irenaean theodicy perhaps errs on the other extreme by not doing justice to the veracity of the biblical revelation (Wenham, 1985). Hick sees the first humans set at a greater epistemic distance from God than the biblical text warrants. The fall becomes a virtual inevitability, and as such, almost understandable. The horribleness of it is minimized, as is the difference between good and evil. Finally, to attribute to God the origination of natural evils does not allow us, as Wennberg (1991, p. 134) states, "to preserve the principle that God never directly wills or creates evil; he uses evil that others have created, brings good out of evil, but does not himself call into existence the evil he employs for his own good ends."

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The most plausible theodicy, in my opinion, involves the Augustinian notion of an angelic fall giving rise to the natural evils of our world and the corruption of an originally perfect creation. This view maintains God's innocence, attributes evil to the misuse of free will, allows for an old age of the earth, and recognizes suffering and death as existing long before the sin of Adam and Eve. But serious questions remain. For example, why would God have permitted Satan to disrupt his world? Secondly, much controversy occurs over God's creative mechanisms. Did God use evolutionary mechanisms or did he create from nothing? Does Augustinian theodicy help here?

A traditional response to the first question is the free-will defense, as outlined by Plantinga (1967). This response, summarized by Wennberg states that "it is possible that the possession and exercise of free will, by both humans and angels, and the use of free will to do more good than evil (something that God foreknows will be the case), is a good of such value that it outweighs all the evil in the world" (1991, p. 136). God may have permitted an angelic distortion because of the value he places on free will.

An additional response to the first question involves the soul-making theodicy outlined by Hick and discussed earlier. If God's purpose in creating humans is to bring into existence beings who are capable of freely choosing to know and love God, and capable of being transformed into the image of Christ, then the kind of world we live in is the best possible world to allow this decision-making and soul-making to occur. God is not overwhelmingly and dominatingly present in our world. Natural evils

exist — causing pain, suffering, and death — but there are also pointers to God in the beauty, harmony, goodness, and order of the world. In this ambiguous kind of world our free commitments and loyalties are worked out. Wennberg writes,

> An ambiguous environment, one in which there is good and evil, light and darkness, is one in which one's hopes and desires must play a role in one's ultimate commitment, because of the fact that matters are not clear beyond all doubt. And so one moves toward the light and goodness, in part because one wants it to be the truth about the universe, one wants there to be a God of love and justice who will ultimately triumph over all forces of evil, death, and destruction, and one's faith is partly expressive of that hope. (1991, p. 138)

It has been suggested that it is a commitment made to God under these circumstances that has deep value and significance to God. And so God permitted fallen angels to distort his perfect creation because the resultant kind of world was the best possible kind of world for fallen humans to develop the freely-given love and loyalty that God desires.

It has been suggested that it is a commitment made to God under these circumstances that has deep value and significance to God. And so God permitted fallen angels to distort his perfect creation because the resultant kind of world was the best possible kind of world for fallen humans to develop the freely-given love and loyalty that God desires. The necessity of this kind of world for fallen humanity is confirmed by Lewis, who states, "Try to exclude the possibility of suffering which the order of nature and the existence of free wills involve, and you find that you have excluded life itself" (1962, p. 34). What if Adam and Eve had not sinned? Lewis speculates about their unfallen biological state, their possible task of redeeming the angelically distorted creation, and about the biological consequences of their fall (1962). Wenham speculates that in an unfallen world even something like an earthquake might be seen as a good (building mountains) and that harm

> ...comes when man, out of touch with his Maker, is in the wrong place at the wrong time. Man, in touch with his Maker, being in the right place at the right time, enjoys divine protection, so that Jesus could safely sleep in the storm (1985, pp. 196-197).

What about animal pain in this theodicy of soul-making — especially that of sentient animals such as mammals and birds? Wennberg addresses its role in forming a soul-making environment and examines whether it allows us "to make peace with a vision of a God whose compassion extends to all his creatures" (1991, p. 121). Certainly, human soul-making should not be seen as the only reason for the existence of animals. Animals have intrinsic value to God. They are part of his creation which he pronounced as good.

Could a mechanism (evolution) that emphasizes selfish efficiency be one of God's creative mechanisms? Could the death that accompanies it be considered good?

Now the second question — how much did God employ evolution as his creative mechanism in view of a theodicy that attributes natural evils to fallen angels? An accompanying question is — just how much did the angelic fall corrupt God's creation? It is helpful to look at two extremes.

In examining this question, one view is that God does not use evolution as his creative mechanism. Van Dyke (1986) and Rice (1987) argue that evolution is an inherently selfish process based on resource scarcity, competition, and death. Generations of organisms live and die, slowly adapting to a changing environment. Species become extinct as others form. Individuals are concerned with perpetuating themselves, not with the good of the ecosystem. Could a mechanism that emphasizes selfish efficiency be one of God's creative mechanisms? Could the death that accompanies evolution be considered good? If the answer to these questions is *no*, what might the original creation have been like? It was probably without death, without parasites, carnivores, mutations, or birth defects. Sentient animals were immortal and were created from nothing — perhaps at intervals over the long history of the earth.

The angelic fall introduced extensive changes. Parasites, pathogens, predators, and death became perversions (perhaps through a satanically guided evolutionary process) of God's plan. Angelically caused imbalances led to the extinction, as evidenced by fossils, of various species over time — perhaps even dinosaurs! For reasons discussed, God permitted these disruptions and has worked to bring good out of these evils.

Would this kind of world be possible? Perhaps. We must be careful not to measure the world that was by that which is. A danger here, though, is to begin seeing God's creation as so corrupted by evil angels that it, itself, is evil. This is a form of dualism which has been implicated by Granberg-Michaelson (1988) as contributing to the lack of concern by Christians for stewardship of the environment.

On the other hand, evolution can be accepted as one of God's creative mechanisms. Rice suggests that evolution is an example of the spiritual principle of God bringing blessings out of adversity.

On the other hand, evolution can be accepted as one of God's creative mechanisms. Rice (1989) suggests that evolution is an example of the spiritual principle of God bringing blessings out of adversity. Murphy states that "the biblical picture is precisely that God brings life out of death, being out of chaos, and hope in hopeless situations" (1986, p. 23). Perhaps we are not to derive moral teachings from a nonmoral creation, but rather from the written word of God (Rice, 1987). Murphy (1986) and Wilkinson (1976) suggest that the death involved with evolution is not truly an evil. In this view, death was part of God's good creation, part of the "harmonious pattern of exchanges that God made and declared good" (Wilkinson, 1976, p. 323). Death became seen as an evil only after man's fall. At that point, because of man's broken relationship with God, death was viewed as an enemy, as a rejected good. As a result, all death — past (fossils), present, and future — is interpreted as evil. These writers suggest that the paleontological record and all extant life be accepted as the history and outcome, respectively, of a divinely guided and good evolutionary process. But questions remain. Does adversity originate with God? Is it unreasonable to expect to see something of God's moral nature in his creation? The distinction between good and evil seems blurred. What evil did the fallen angels cause?

Perhaps the truth is at neither extreme. Perhaps God, over the long history of the earth, brought organisms into existence through some combination of evolutionary and *ex nihilo* creative acts. Perhaps these organisms died good deaths at the end of finite life spans. Perhaps parasites, pathogens, predators, excessive pain, and the debilitating effects of aging are, guided by evil beings, evolutionarily derived perversions of this created order. Might destructive meteorological and geological events also represent Satanic attacks on God's world? Human beings, created in the image of God, died spiritual (and physical?) deaths because of sin — the willful turning away from God. How much does the sting of our penalty color our view of the possibly good (sinless) deaths found in the rest of creation? It must also be remembered that many of the evils found in the natural world have their roots in the moral evil of man's world.

We will probably not know for certain the answers to the questions discussed here until Heaven, but it is important to recognize that definite answers are not necessary in order to resolve the apparent logical inconsistency of an all-powerful God of love creating a world that contains real evil. It is only necessary to show that evil ultimately does not originate with God, and that he has his purposes for allowing it to continue.

Integrating Theological and Scientific Views of the Origin and Purpose of Natural Evils

For the Christian, what points of agreement and disagreement occur between theological and scientific explanations of the origin and purpose of suffering, pain, and death? In general, theology and science are in agreement when we recognize that each offers a partial view of reality. Disagreements occur when explanations reflective of biblicism and scientism are offered in place of theology and science. The balance here is always precarious, but it seems to me that in today's scientific climate, with its rejection of the spiritual dimension of reality (Granberg-Michaelson, 1988), the balance has swung too far from theology and is in need of correction. For example, scientific understanding of the causes of destructive geologic and meteorological events has increased tremendously, allowing them to be explained using known scientific laws. But scientific

laws are descriptions of reality, not prescriptions. To describe the way the earth works is not the same as saying how the earth *must* work. If the origin of these destructive events truly is due to the activity of fallen angels, then our earth, free of such activity, would function without earthquakes and volcanoes. Also, science cannot say that a particular flood, drought, storm, or earthquake occurring at a particular time in history was not precipitated by the activity of supernatural beings and used by God for his purposes. This matter is outside the domain of science.

Evolution is often described as purposeless, random, and without guidance. These are not scientific statements as much as they are statements reflecting the naturalistic philosophy of certain scientists. The science of evolution is concerned with understanding the mechanisms of change: with how, for example, a tapeworm might have evolved from a free-living ancestor. To whatever extent God or fallen angels used evolutionary processes, there was purpose. To science, the products of evolution (whether panda bears or tapeworms or lions) are morally neutral. If there was malevolent purpose, then tapeworms or lions could be interpreted as evils, perversions of God's intentions for these creatures.

If nonhuman animals were created mortal, with their deaths part of God's good design, then models such as the disposable soma theory may be quite insightful in helping us understand how God planned finite life spans. If, however, animal death is the result of satanic attack, then these theories are not sufficient. No level of scientific understanding or theorizing would reveal that the mechanisms of aging originated as an evil aberration of God's intent. Scientifically, humans are just another species of animal. It can be demonstrated that we age and die for the same reasons as other animals. And yet the Bible, as interpreted by many, indicates that Adam and Eve were potentially immortal. Our spiritual dimension, our being created in the image of God — these aspects of human life are beyond the realm of science. Scientism says that spiritual beings and a bodily resurrection are impossible. The Bible reveals otherwise.

Christians can readily accept scientific understanding of the origin of physical processes such as earthquakes and storms that sometimes cause pain, suffering, and death. This understanding is useful, for it allows us to avoid and sometimes ameliorate these destructive events. Scientific understanding of the origin of viruses, parasites, disease-causing bacteria and the processes causing senescence and death is also useful because it allows us to struggle more effectively against these debilitating agents. However, if these physical and biological events are due to the fall of angels or man, then scientific explanations for the origin of those events will always be incomplete. If these evils exist by God's sovereignty and for his purposes, then science will never be able to explain the full significance of these events.

The Christian's world view must be informed by both science and theology. Christians should look to science for explanations of how our world functions but must look to theology to find ultimate meaning and purpose. ✸

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The Molecular Evolutionary Clock: A Critique

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The molecular evolutionary clock hypothesis may be defined as the thesis that changes in amino acid sequence of a specific protein proceed at a constant rate in regard to time. Since it was proposed thirty years ago, this concept has been the primary molecular basis for evaluating organismal relationships (phylogenetic trees) and for estimating times of divergence of the various branches of those trees. We will consider recent developments in molecular biology and their relationship to the molecular clock concept. We will also discuss the lack of any theoretical basis for the molecular evolutionary clock and evaluate experimental data to show that there has been very little experimental verification of a constant rate of change. Finally, we will examine the relationship of the molecular clock hypothesis to some theological and philosophical beliefs.

The molecular evolutionary clock hypothesis may be defined most simply as the hypothesis that changes in amino acid sequence in a specific functional protein proceed at a constant rate in regard to time. The impetus for many of these protein sequence studies has been, as suggested by Jukes (1987, p. 87), that the theory provides a molecular means of measuring the course of evolution. The molecular evolutionary clock concept has been developed to the point that its precision has been considered by many to be of sufficient accuracy to be utilized as a means of calculating the time of divergence of homologous proteins. These divergence times and calculated branching points have been utilized in constructing PHYLOGENETIC TREES* showing postulated ancestral relationships of known organisms (Fig. 1, p. 161).

In the definition of the molecular evolutionary clock hypothesis, it is important to note the words "specific" and "functional" since the apparent rate of change is different for different proteins, and the function of the protein has been considered to be the primary constraint on the rate of change. When phylogenetic trees are constructed using only MOLECULAR SEQUENCE DATA, the greater the sequence distance, the greater the possible error in calculating points of divergence (Romero-Herrera, et al; 1979). As generally constructed, molecular phylogenetic trees often utilize only the most parsimonious (i.e., economic) data. In this technique, data are weighted to bring them into accord with morphologic and/or paleontologic data, particularly for divergence points (Romero-Herrara, et al; 1979). Although initially the molecular clock concept was based on sequences in functional proteins, and in genes for those proteins, more recently it has been extended to include segments of DNA (e.g., PSEUDOGENES, INTRONS, etc.) that are considered by some to be nonfunctional.

**For definitions of this and other terms printed in SMALL CAPS, see the glossary on page 167.*

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Historically, the concept of a constant change of rate with time was proposed by Ingram (1961) and Zuckerkandl and Pauling (1962) using amino acid sequences in proteins. Zuckerkandl (1987) has reviewed some historical aspects and conceptual perspectives of the molecular evolutionary clock. As techniques for sequencing NUCLEOTIDE units in DNA became available, the concept was extended to include DNA sequences. This would be a very logical extension, since the genetic information for protein sequences resides in CODING SEQUENCES of DNA. However, DNA is made up of more than coding sequences, and hence DNA sequence studies give a much broader picture, but also one that is much more complex. It should be emphasized that both protein sequence comparisons and DNA sequence comparisons deal with only a tiny fraction of the GENOMES of organisms.

More recently, DNA hybridization techniques have been developed that compare much larger portions of the genomes of organisms. However, these techniques suffer from being much less precise than amino acid or nucleotide sequence studies. Hybridization studies are based on the long known principal that double-stranded DNA will separate into single strands with an increase in temperature as a consequence of breakage of hydrogen bonds. On slow cooling, the two strands will come back together in the form of a double helix. If one mixes single-stranded DNA from two different organisms, the extent of formation of double helices depends on the extent of similarities in DNA molecules of the two organisms.

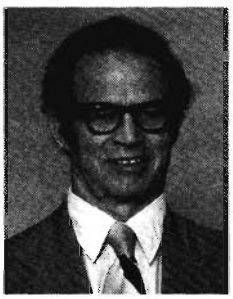
There are many other types of studies that provide comparisons between organisms at the molecular level (e.g., ELECTROPHORETIC comparisons of proteins, studies of metabolic pathways, immunologic studies, etc.). These have been of great value for taxonomic comparisons of organisms, but most of these have not been utilized as extensively for the molecular evolutionary clock hypothesis, so they will not be considered further here.

The Molecular Evolutionary Clock: Is There a Theoretical Basis?

There has been no adequate proposal of a theoretical basis of the molecular evolutionary clock hypothesis. I will consider this aspect of the hypothesis from the standpoint of (1) rates of occurrence of mutations, (2) establishment of mutations in the genome, (3) change with chronological time vs. generation time, and (4) change as a consequence of single mutational events.

(1) It should be noted that there is no sound theoretical basis for a constant rate of incorporation of mutations in genes for a particular protein. There are multiple causes of mutations, ranging from exposure to ultraviolet light and to radiation from radioactive isotopes, to exposure to mutagenic chemicals from air, water or diet. None of these would be expected to be constant with respect to time in all geographical areas, or under all environmental conditions. During replication, DNA is copied with an amazing degree of fidelity, but occasionally copying mistakes will be made, leading to point mutations, or possibly to deletions or insertions. It is possible that this type of mistake could have a relatively uniform rate even among different species. However, in vitro, the rate of copying mistakes varies quite markedly and depends on pH, ionic strength, ion concentrations, etc of the environment. It seems likely that both external and internal environmental conditions might affect the rates of copying errors. Other mutational events may occur at the time of cell division as a result of gene conversions. However, there is no reason to believe the rate of these events would be constant as they relate to chronological time.

There is also another important factor that affects mutation rates. Cells have the capacity to repair most mistakes in DNA, whether mistakes are made prior to or during the replication process. Neel (1982) notes that at least eight different types of repair systems have been demonstrated. Some of these utilize ex-



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cision of damaged bases followed by replacement with the correct base and subsequent ligation of the broken DNA strand. In general, these repair systems are rather sophisticated, utilizing several enzymes, coenzymes and energy resources of the cell. Recent studies have indicated that these repair mechanisms may have specificity for certain genes or for certain regions of chromosomes, and may respond to specific signal sequences. DNA repair is of great significance in reducing the incidence of malignant tumors in humans (as well as in other organisms), but for this paper we are more interested in DNA repair in GERMINAL ORGANS (ovaries and testes) that would minimize the number of mutations that are transmitted from parents to offspring. There is no reason to believe that the overall effect of DNA repair would permit a uniformly constant rate of mutations.

(2) Once a mutation has occurred, its establishment in the genome for a particular species would be a very rare event. Factors such as geographic or reproductive isolation of a very small population with the mutant gene would play a major role in the rate of establishment of the mutant gene in the genome. There is clearly no theoretical reason why these processes should yield a constant rate. It is widely accepted that a gene for each protein has its own rate of mutation with regard to time. The differences in mutation rates are generally attributed to the presence or lack of functional restraints in the protein molecule, a concept which we will discuss separately. Classification of mutation rates for different types of gene segments is arbitrary. Generally, coding sequences of genes are expected to have lower mutation rates than introns or noncoding sequences because the latter are considered to be less functional.

(3) As has been pointed out by many others, if the mutation rate is constant, it should be related to generational time, rather than chronological time (Williams, 1974). This is a consequence of finding that most mutations are incorporated into the genome at the time of cell division. There is obviously a tremendous variation in generational times for different organisms. Since we are dealing with passage of mutations from one generation to the next, the cell divisions would be those of germinal cells (ova or sperm or precursors of ova or sperm).

(4) Inherent in the concept of a molecular clock is the idea of gradual change, i.e., one mutational event at a time. If the change is indeed gradual, we should expect to find a great many more intermediate (i.e., very closely related) informational molecules in a single species. Although there are a few closely related molecules (e.g., the γ^G and γ^A GLOBINS, which differ in only one amino acid), in many cases the informational molecules for different ISOZYMES within a particular species are quite divergent. This is illustrated by the two different cytochrome c isozymes in the mouse, or the two different cytochrome c isozymes in the fruit fly (Mills, 1992), or by the marked sequence differences in alpha, beta and gamma globins. It is clear that the evidence for very gradual change (e.g., establishment of single mutational events) is not present in genomes of organisms. Does this suggest that very closely related molecules tend to be eliminated from the genome or be corrected (repair mechanisms, gene crossovers, etc.)? Neel (1982) has argued strongly that corrective

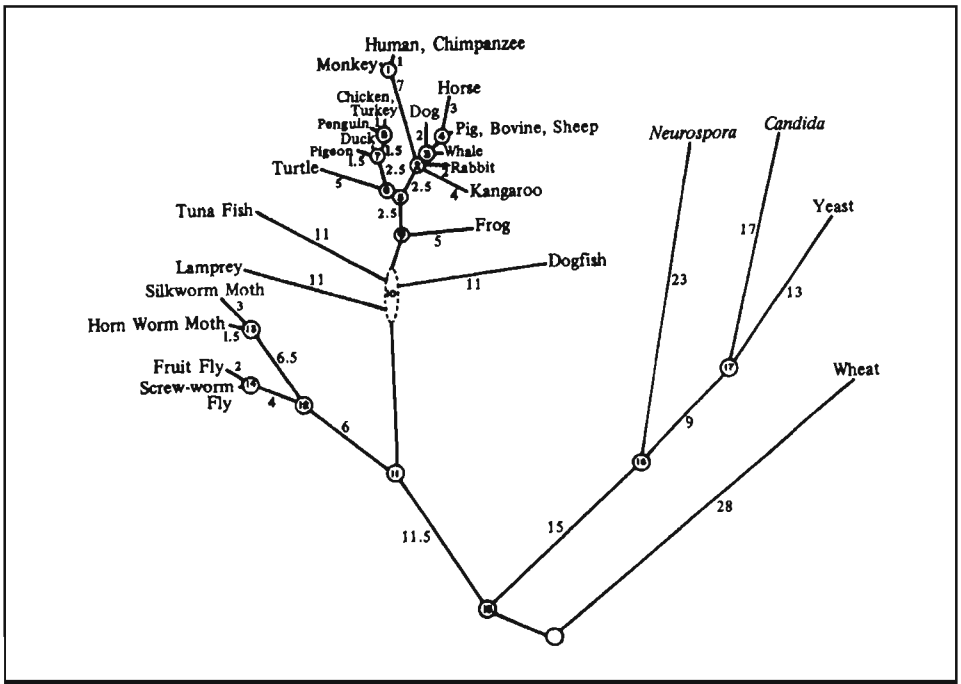

Figure 1. Phylogenetic tree of cytochrome c. Branching points (nodes) are designated by the circled numbers. The numbers of inferred amino acid changes per 100 links are shown on the tree. The branching points and the evolutionary distances in this diagram depend upon having a constant rate of change in amino acid sequence of cytochrome c. (From Dayhoff, 1969; used by permission).

mechanisms play a major role in preventing change in the cellular genome.

Functional Constraints and a Molecular Clock

One facet of the molecular evolutionary clock theory that has been recognized by all proponents of the theory has been that the rate of sequence change was different for every protein. For example, according to the theory, the time required for a 1% change in sequence of proteins is 20 x 106 years for cytochrome c, 5.8 x 10^6 years for hemoglobin, and 1.1 x 10^6 years for FIBRINOPEPTIDES (Dickerson, 1971). Thus, amino acids in fibrinopeptides change twenty times as rapidly as do those of cytochrome c. Others have noted that HISTONES have the slowest rate of change. Histone H4 has about one-thirtienth the rate of change of cytochrome c (Behe, 1990). These differences in rates of change have traditionally been attributed to differences in functional constraints built into the three-dimensional structures of protein molecules. Nevertheless, until recently, the concept of functional constraints had not been subjected to any quantitative test.

In recent years, techniques have become available to modify genes at specific sites and determine whether the modified genes (and the corresponding modified proteins) would function in cells. Behe (1990) notes that Grunstein's studies show that histone H4 may still function when as many as ten amino acids are deleted. This clearly shows that the concept of functional constraints cannot be applied to histones. Whether the concept of functional constraints still has merit for explaining the differences of evolutionary rates of cytochrome c and hemoglobin is an open question.

Despite our knowledge of the three-dimensional structures of cytochrome c and hemoglobin, no one has been able to show quantitatively that the cytochrome c molecule is more functionally constrained than the hemoglobin molecule. Consequently, the concept of functional constraints as an explanation for differences in rates of change in protein molecules still lacks experimental support.

Modern Molecular Biology Developments

Let us examine briefly some developments in modern molecular biology that are important in understanding literature related to the molecular evolutionary clock hypothesis. With a genetic code of three PURINE AND PYRIMIDINE BASES per CODON and four different bases in DNA, there are 64 different possible combinations of three bases (i.e., 64 different three letter codons). Since there are only 20 amino acids to be coded, plus INITIATION and TERMINATION CODONS, there is more than one codon per amino acid (Fig. 2). Consequently, the number of codons per amino acid range from one each for methionine and tryptophan to six each for leucine and arginine, with two to four codons for each of the other amino acids.

With a few exceptions, the different codons for an amino acid differ in the third position of the codon. Consequently, we can experimentally find differences in third positions of codons in a coding sequence of a gene for a specific protein without

The Genetic Code

1st Pos.	2nd Position				3rd Pos.
	T	C	A	G	
T	Phe	Ser	Tyr	Cys	T
	Phe	Ser	Tyr	Cys	C
	Leu	Ser	Ter.	Ter.	A
	Leu	Ser	Ter.	Trp	G
C	Leu	Pro	His	Arg	T
	Leu	Pro	His	Arg	C
	Leu	Pro	Gln	Arg	A
	Leu	Pro	Gln	Arg	G
A	Ile	Thr	Asn	Ser	T
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	Init. Met	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	T
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val	Ala	Glu	Gly	G

Figure 2. The genetic code. The three-letter codons of DNA and the amino acids for which they code. Note that there is more than one codon for most amino acids; also that there is an initiation codon (Init.) and three termination (Ter.) codons. The mitochondrial DNA code differs slightly from that shown. A, adenine; G, guanine; C, cytosine; and T, thymine. Amino acid abbreviations: Phe, phenylalanine; Leu, leucine; Ile, isoleucine; Met, methionine; Val, valine; Ser, serine; Pro, proline; Thr, threonine; Ala, alanine; Tyr, tyrosine; His, histidine; Gln, glutamine; Asn, asparagine; Lys, lysine; Asp, aspartic acid; Glu, glutamic acid; Cys, cysteine; Trp, tryptophan; Arg, arginine; and Gly, glycine.

noting any change in amino acids. These are referred to as *synonymous* changes in the gene; when the codon change would cause an amino acid change, it is referred to as a *nonsynonymous* change.

Simply from examining the genetic code (Figure 2), it is evident that purine to purine, or pyrimidine to pyrimidine changes (TRANSITIONS), would be more apt to be synonymous than purine to pyrimidine, or pyrimidine to purine changes (TRANSVERSIONS). For example, a change in a phenylalanine codon from TTT to TTC would be a transition and a SYNONYMOUS CHANGE, while a change from TTT to TTG would be a transversion and a NONSYNONYMOUS CHANGE. (TTG is a codon for the amino acid leucine.) Rats and mice, two rodents, have identical amino acid sequences in cytochrome c, but the nucleotide sequences in coding regions of the genes for cytochrome c differ in nine positions. These differences are all in third positions of codons and are all synonymous in nature.

Various equations have been devised to correct for multiple hits, but all are only approximations. It should be emphasized that the larger the correction for multiple hits, the larger the possible error.

In comparing sequences, it is also important to note that for any given point in a gene, there may have been more than one change, referred to as multiple hits (e.g., A→G→C, where all that we may note experimentally is the A→C change). Multiple hits may also result in back mutations. A back mutation being one where an initial change is reversed by a subsequent mutation (e.g., A→G→A). Since the overall effect of this would be no change, a back mutation would not be detectable. Theoretically, one fourth of multiple hits would result in back mutations.

Various equations have been devised to correct for multiple hits, but all are only approximations. It should be emphasized that the larger the correction for multiple hits, the larger the possible error. When no corrections in data are made for multiple hits, the convention is to use the term "differences" in comparisons of genes or protein sequences; when multiple hit corrections are made, the term "substitutions" is utilized. Most recent papers conform to these usages, although earlier papers may not.

It is very important to note various types of changes that may occur in genetic material. First, point mutations involve a change in a single nucleotide base of DNA (or possibly several bases). Causes of point mutations were discussed earlier. Point mutations would usually cause either no change in amino acid sequence in the expressed protein or a single amino acid change. Occasionally, a point mutation might introduce a termination codon, which would terminate any synthesized polypeptide at that point. If the mutation involved nucleotide insertions or deletions, unless the event involved three (or a multiple of three) nucleotides, the coding sequence from that point on would change (this is called a frame-shift), and any expressed protein would have *no similarity* from that point on to the protein expressed by the gene prior to the insertion or deletion. If the insertion or deletion involved three (or a multiple of three) nucleotides, there would be an insertion or deletion of an amino acid(s) in the expressed protein.

Other types of intraspecies changes are often grouped together as gene conversions. They are of various types, but all would involve transfer within an individual of much larger portions of genetic material. For example, gene crossovers might involve a transfer of a DNA segment containing as little as only a portion of a gene (but many nucleotide units) up to many genes. The transfer might be from one chromosome to another or within a single chromosome. It should be immediately evident that transfers of large segments of genes would markedly complicate any interpretation of molecular evolutionary clocks involving those genes. In most comparisons of nucleotide sequences in genes, one can rule out the possibility of transfers of large gene segments. If the transfer involved a small gene segment (e.g., eight to fifteen nucleotides), it might be more difficult to detect.

Syvanen (1987) discusses evidence for the interspecies transfer of genetic information. In most cases, the transfer involves RNA viruses known as RETROVIRUSES. It has long been known that portions of viral genomes may appear in mammalian genomes. More recently, however, it has been demonstrated that retroviruses may also carry an occasional host gene along with the viral gene when they are transferred. Thus there is the possibility of transfer of a gene or a gene segment from one organism to another of the same species or even to a different species. Because of host-viral specificities, this type of interspecies gene transfer would occur most often in

closely related species. However, there are some retroviruses that may infect a wide variety of mammalian species, so there is a possibiity of gene transfer between quite diverse species (e.g., mouse to man).

Some molecular evolutionary clock studies have utilized an inactive type of gene known as pseudogenes as a means of estimating diversion dates and in establishing phylogenetic trees. (For a discussion of pseudogenes, see Mills; 1992). However, pseudogenes are particularly prone to interspecies transfer of the type described above. Hence, molecular evolutionary clocks based on pseudogene studies are even less likely to be reliable. The possibility of interspecies gene transfer also opens its use as an explanation for discarding results that are not in accord with the molecular evolutionary clock theory.

In closing this part of the discussion, we can note that there are many experimental studies showing that point mutations occur (e.g., see my review of the mutations occurring in human hemoglobins (Mills; 1975)); gene conversions also are well established experimentally. Interspecies gene transfer studies are relatively new and the extent of these is still an open question. That they do occur, however, appears to be beyond doubt. The question is not whether mutational events of the types discussed do occur; they clearly do. The question is whether, or to what extent, mutational events can account for ancestral relationships, and what is their value in establishing phylogenetic relationships. The question must be asked: Does an amino acid difference or a nucleotide difference in comparison of proteins or in comparison of genes provide *proof* of a point mutational event, or is it only an *indication* that there *may have been* a past point mutational event? This distinction is very important, and conclusions reached in discussing either ancestral or phylogenetic relationships are dependent in considerable degree on our answers to those questions.

Experimental Data: Does It Support a Constant Rate of Change?

Although the proposal of the molecular evolutionary clock was made initially by Zuckerkandl and Pauling (1962) and by Ingram (1961), Dickerson (1971) provided the first thorough examination of protein sequence data in relation to evolutionary time. Plots of his data appear to show a linear relationship between amino acid changes and times of divergence for cytochrome c, the globin chains, and fibrinopeptides. A replot of Dickerson's cytochrome c data on a slightly expanded scale (Figure 3) indicates that there are some points that differ markedly from linearity. For example, cytochrome c amino acid changes per 100 residues comparing primates and other mammals is given as 9.7, with a divergence date of 90 million years, while the corresponding amino acid change is 9.5 when mammals and birds are compared. However, the listed divergence date in the latter instance is 300 million years. It should be immediately evident that this would represent over a three-fold variation in the rate of change.

Romero-Herrera, et al (1979) noted considerable variations in rates of changes in amino acid sequence for particular proteins. For example, myoglobin amino acid sequences of the pig and the bat differ by 9, whereas the corresponding sequences of the more closely related pig and ox differ by 28. There is no reasonable explanation for this unusual finding, which clearly contradicts the concept of a molecular evolutionary clock.

Baba, Darga, Goodman and Czelusniak (1981) tabulated the changes in cytochrome c using all known sequences and the best available paleontological data. They found that nucleotide replacements per 100 codons per 100 million years for cytochrome c has varied from 1.4 to 17.3.

Jukes (1987) has noted the nonconstancy of the molecular clock for cytochrome c in different species. He and Holmquist (1972) noted that the rate of replacement of amino acids was nearly twice as fast in the rattlesnake as in another reptile, the snapping turtle. Beintema and Campagne (1987) utilized amino acid sequences of insulin in 10 species of rodents to prepare phylogenetic trees. The evolutionary rate of change was comparable to that of other

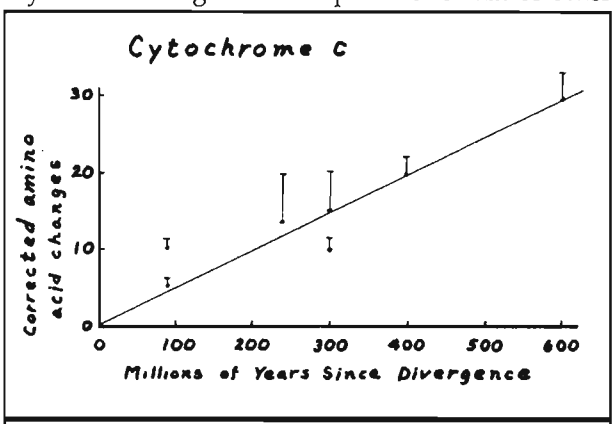

Figure 3. The rates of change in the sequence of cytochrome c. The amino acid differences between divergent lines of evolution are corrected for multiple changes. Mean errors in amino acid differences are indicated by vertical bars. Data is from Dickerson; 1971.

species in the rat, mouse and hamster. However, they found moderately increased evolutionary rates in the porcupine and chinchilla, and markedly increased evolutionary rates in the guinea pig, cuis, copyu and casiragua. The differing rates made it nearly impossible for them to produce reasonable phylogenetic trees for these rodents, and the authors present three very different rodent phylogenetic trees.

Britten noted that rates of change in DNA among these various taxonomic groups differ by a factor of five.

Schwabe (1986) has examined amino acid sequences in the hormone relaxin in six species. Relaxin is a hormone that widens the birth canal during parturition. It is a polypeptide with some sequence similarity to insulin. Yet amino acid sequences of relaxin do not fit any possible phylogenetic tree. For example, pig relaxin is more similar to that of sharks and snake than it is to relaxin of the rat.

Shaw, Marks, Shen and Shen (1989) have studied nucleotide sequences of the alpha-globin gene in a number of primates. They noted a burst of evolution in nonsynonymous sites of the alpha-globin gene of baboons subsequent to their separation from the rhesus monkey. There was no corresponding increase in the rate of change for synonymous sites of the alpha-globin gene.

Catzeflis, Sheldon, Ahlquist and Sibley (1987) utilized DNA:DNA hybridization studies to estimate relationships among eight species of arvicoline rodents (mostly voles) and six species of muroid rodents (mostly rats and mice). They estimated the rate of divergence in these rodents as about 10 times the rate of divergence in hominoid primates.

Britten (1986) summarized DNA sequence data from a wide variety of taxonomic groups. He considered silent subsitutions (synonymous substitutions) in coding sequences of DNA. He also compared the data with that obtained from DNA:DNA hybridization studies. He noted that rates of change in DNA among various taxonomic groups differ by a factor of five. The slowest rates were noted for higher primates and some bird lineages, while faster rates were seen in rodents, sea urchins and *Drosophila*. Caccone and Powell (1990) utilized DNA:DNA hybridization studies to estimate rates of change in DNA of *Drosophila* (fruit flies). They concluded that the rate of change was five to ten times faster in fruit flies than for most vertebrates.

Brunk, Kahn and Sadler (1990) studied differences in amino acid sequences in H3II and H4II histones of nineteen species of *Tetrahymena* (a ciliate protozoan). In most other species, histones have an extremely low rate of change. However, these authors found much greater rates of change in the histones of ciliate protozoans. In regard to ciliates, Syvanen notes: "The ciliates differ so much that the molecular clock calculations place divergence of *Tetrahymena*, for example, back to more than 3 billion years ago; a clearly absurd result" (1986, p. 64). Hickey, Benkel, Boer, Genest, Abukashawa and Ben-David (1987), utilizing DNA sequences of alpha amylases, found substitution rates varying by as much as tenfold. In a comparison of viral oncogenes, Gojobori and Yokoyama (1987) noted that the rate of substitution in viral oncogenes was one million times that of their human counterpart.

Scherer: "It (the protein molecular clock) can neither be used as a tool for dating phylogenetic splits nor as reliable supportive evidence for any particular phylogenetic hypothesis...It is concluded that the protein molecular clock hypothesis should be rejected."

Scherer (1990) has recently provided a critical evaluation of the protein molecular clock hypothesis. After reviewing data for eight different types of protein molecules, he concludes: (p. 102, 103) "It (the protein molecular clock) can neither be used as a tool for dating phylogenetic splits nor as reliable supportive evidence for any particular phylogenetic hypothesis...It is concluded that the protein molecular clock hypothesis should be rejected." Various authors have proposed means of testing whether a particular protein clock is a "good" clock or a "poor" clock. Scherer (1990) has also reviewed data from these tests and concludes that they are not valid for testing usefulness of a particular protein clock.

The references cited above should clearly demonstrate the lack of constancy in rates of change in genomes of organisms. This lack of constancy puts investigators in the peculiar position of using data if it agrees with the molecular clock hypothesis, or

discarding it or explaining it away if it does not agree with the hypothesis. Surely this cannot be legitimate science!

We must question whether sequence studies have a legitimate role in future studies of genetic relationships. Some authors have insisted that they have a role in studying relationships of closely related species. Yet, as noted above, some of the greatest variations in evolutionary rates have been shown in closely related species (e.g., rodents). At best, it would seem that sequence studies should be interpreted cautiously and only in relation to morphologic comparisons of the same organisms. In my view, nucleotide or amino acid sequence studies have little or no value in the estimation of divergence dates of ancestral organisms, and only limited value in identifying ancestral relationships. Their use in constructing phylogenetic trees for the entire animal kingdom is so subject to error that the generated trees have little value. This is because the calculation of branching points in molecular phylogenetic trees assumes a *constant* rate of divergence. If the rates of divergence are not constant, then calculated branching points are not likely to be correct!

Theological Implications of the Molecular Evolutionary Clock Theory

For many advocates of scientific naturalism, molecular evolutionary clock theory is a cornerstone of their belief in ancestral relationships, i.e., that every organism on earth today is a descendent of one archtypal organism. In other words, ancestral relationships of all organisms may be represented in a branching phylogenetic tree (Figure 1, for example). Moreover, all branches in the tree are a consequence of chance events, with natural selection being the driving force for diversification.

This role of the molecular evolutionary clock theory is illustrated by Thomas Jukes (1990) in his rebuttal to Phillip Johnson's (1990) arguments on the establishment of naturalism. To quote Jukes:

> As more hemoglobin molecules became sequenced, the steady increase in divergence, calculated from reference points in the fossil record, showed evidence of a so-called *molecular evolutionary clock*. The same evidence was found in another family of proteins, the cytochromes c, and this made it possible to conclude that the common ancestor of yeast, plants, and vertebrates lived about 1.2 billion years ago. (Jukes, 1990, p. 17)

Surely this statement by Jukes indicates a commitment to scientific naturalism, when he proceeds to extrapolate from limited data to the grand theme of that philosophy. This interpretation of the above statement by Jukes is in complete accord with his earlier statement (Jukes, 1987, p. 87) that the molecular evolutionary clock provides a molecular means of measuring the course of evolution.

Despite claims of the more extreme evolutionists that all organisms (and hence all genetic material in these organisms) are products of natural causes, there has been no scientific explanation for the formation of new genetic information.

Quotations from Holmes Rolston (1992) provide an indication of the changing views of some scientists: "In stark contrast to divine design, natural selection is blind. Random genetic variations that are accidentally useful are selected; the most worthless are discarded." Rolston then continues with suggestions of purpose and possibly even design: "Contemporary geneticists are insisting that, though not deliberate, the process is cognitive. A vast array of sophisticated enzymes cuts, splices, rearranges, mutates, reiterates, edits, corrects, translocates, inverts and truncates particular gene sequences."

Despite claims of the more extreme evolutionists that all organisms (and hence all genetic material in these organisms) are products of natural causes, there has been no scientific explanation for the formation of new genetic information. In fact, as has been shown mathematically by Yockey (1977), even the chance formation of a single enzyme protein such as cytochrome c is beyond the realm of possibility (probability is 2×10^{-65}). Even the simplest organisms have thousands of different proteins. Eukaryotic organisms (organisms with nucleated cells) are far more complex than prokaryotic cells (e.g., bacteria, etc.); vertebrates are more complex than invertebrates, etc. This increase in complexity comes as a consequence of new genetic information, but from where does this new genetic information come? Even if the molecular evolutionary clock theory were valid, it omits entirely the question of the origin of new genetic information, since any concept of design is considered to be outside the realm of science.

As a Christian and as a scientist, my belief is that I should leave open the possibility that God in his

sovereignty may have chosen to provide genetic information as needed, thus guiding the diversification of species that one sees today and which is evident throughout the fossil record. In the molecular evolutionary clock theory, I see an effort by some scientists to force data into a mold where it doesn't really fit. Melnick (1990) has summarized the proceedings of a recent conference that considered the molecular evolutionary clock hypothesis. His review provides an indication of the diversity of opinion on the subject, and also of the desire by many to hold on to some remnant of the hypothesis, even though nearly all agree that there is no constant rate of change. My faith in the integrity of science has been partially restored when I see that papers are now being accepted in the scientific literature that demonstrate the failures of the molecular evolutionary clock hypothesis. More often than not, however, the authors consider these as exceptions to the rule rather than as an invalidation of the original hypothesis. ✸

Glossary

Coding region of a gene: The portion of a gene that provides the sequence information for the formation of a specific protein.

Coding sequences, Non-coding sequences: Coding sequences are those portions of DNA which are translated during protein synthesis into specific sequences of amino acids. Non-coding sequences are found at either end of coding sequences; they often contain regions involved in controlling the expression of the DNA.

Codon: The three-nucleotide segment of a gene that codes for a particular amino acid.

Electrophoretic: Separation of molecules based on their electric charge.

Expressed Proteins: Genes in a cell may be expressed (used in the process of translation to produce a specific protein) or suppressed (not used for protein production).

Fibrinopeptides: Polypeptide fragments released during formation of a fibrin clot from fibrinogen.

Frame shift: Deletion of a nucleotide base from a codon would cause a misreading of all codons downstream from that point; insertion of a single nucleotide base would have a similar consequence.

Genome: The total of DNA informational molecules in the cell nucleus of an organism.

Germinal organs/cells: Germinal organs — ovaries and testes. Germinal cells — ova or sperm or precursors of ova or sperm.

Globins: The polypeptide chains, which, when linked to heme, make the red blood cell pigment, hemoglobin. The different polypeptide chains are designated by Greek letters, (e.g., alpha, beta, gamma, etc.).

Histones: Basic proteins closely associated with DNA in the cell nucleus.

Initiation codon, Termination codon: Codons that signal the starting or stopping of protein synthesis.

Intron: An intervening DNA segment within the gene that is precisely excised following transcription prior to use of the mRNA for protein synthesis.

Isozymes: Two different but similar proteins that perform the same enzymatic function. In most cases, they have appreciable amino acid sequence similarity.

Molecular sequence data: Data obtained from comparison of a large number of DNA or protein sequences from a number of different organisms.

Nucleotide: A purine (adenine or guanine) or pyrimidine (cytosine, uracil or thymine) linked to a sugar (ribose or deoxyribose) which is linked to a phosphate.

Phylogenetic tree: A diagrammatic means of showing relationships of organisms; often used to indicate possible ancestral relationships.

Pseudogenes: DNA segments in the cell nucleus with nucleotide sequences similar to coding sequences of known functional genes. They are not expressed as proteins. Processed pseudogenes do not have introns or most non-coding control sequences.

Purine and pyrimidine bases: Purines (adenine and guanine) or pyrimidines (cytosine, uracil or thymine) are linked to a pentose sugar and a phosphate to form a nucleotide; RNA and DNA are made up of lengthy sequences of nucleotides.

Retrovirus: An RNA virus that is transcribed into a complementary DNA after it penetrates a cell.

Synonymous change, Nonsynonymous change: A synonymous change in a codon of DNA is a nucleotide base change that does not cause a change in an amino acid of the expressed protein, a non-synonymous change in a DNA codon would cause a change in the amino acid.

Transition: A nucleotide base change in DNA involving a purine to purine substitution or a pyrimidine to pyrimidine substitution.

Transversion: A nucleotide base change in DNA involving a purine to pyrimidine substitution or a pyrimidine to purine substitution.

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In 1925
the American Association for the Advancement of Science
Committee on Freedom of Teaching in Science
ruled that:

"Students have a right to know the pros and cons of controversial subjects in every field.
Teachers should be free to present those subjects
and to express their own position in regard to them.
It is only the things that are not true
which have anything to fear from freedom of discussion,
and it is only by the maintenance of this freedom
that we create conditions under which the truth will most rapidly prevail."

Alien, et. al. "The Report of the Committee on Freedom of Teaching" in Science, *p. 277, March 13, 1925.*

Communications

Cutting Both Ways — *Darwin* Among the Devout:

A Response to David Livingstone, Sara Miles, and Mark Noll

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Recent evangelical reviews suggest how Adrian Desmond's and my *Darwin* (1991; Norton Paperbacks, 1994) may be a double-edged sword, a terrible swift tool for dividing asunder not only the bones and marrow of divinity, but the thoughts and intents of historians' hearts.

For a century Christian apologists have tried in vain to do what *Darwin* has won secular prizes for. It historicizes natural selection, restores the "social" to Darwinism, and makes Darwin a man of his times. In 800 pages the "Devil's Chaplain" is enrolled in heresy's Hall of Fame, joining the other members of the modern Unholy Trinity, Marx and Freud. Darwin's theory is shown to be, not "fact, *fact*, FACT," but the contingent product of complex inferences between the Victorian natural and social orders.[1]

This is all Good News — to evangelical innocents. Not David Livingstone. In his lucid and generous review he picks up *Darwin*'s sword gingerly.[2] He is helplessly attracted to its edgy, full-blooded portrait and notes approvingly that "the comfortable territorial boundary between Darwinism and social Darwinism has simply been erased." He also realizes that *Darwin*'s "defiantly social" historiography can cut two ways.

"Crude sociological reductionism" haunts him. He fears that *Darwin* may encourage it. "It is not always easy to fathom precisely *how* the political and the scientific, the cultural and the natural, are meant to snap together." He wants reassurance about *Darwin*'s political language; he needs its "sociology of scientific knowledge" spelled out. "We need help ... to ascertain precisely what explanatory power" it has. For unless one knows "precisely what kind of biographical account" is offered, Darwin's interest in "pure scientific investigation" might be erased by "crass social necessitarianism." Truth would be a will-o'-the-wisp, "seeing 'the light'" impossible.

"Precisely" — more or less. Livingstone may ask too much of a popular biography, but he is shrewder than some.[3] *Darwin* has theological implications. Even so, doubtful dichotomies litter his argument: "constitutive" v. "decorative" metaphor; "a political biography" privileging "the private"; "a life as it is *lived*" v. "a life as it is *told*"; and above all "Darwin speaking" v. "his speech being stage-managed."

Do dead authors speak? Can texts interpret themselves? If the Bible's don't, why *a fortiori* should Darwin's?

The biographical passage that worries Livingstone describes Darwin's seed-floating experiments in connection with the on-going Crimean War. In the passage "beachhead" is used to refer to the landing point where sea-borne seeds struggle to form a new biotic community. Livingstone would rather have heard the word "from [Darwin's] own lips." This, I presume, would satisfy him that the war in-

fluenced Darwin's dispersal ideas. But sadly no; "beachhead" is the authors' gloss, and Livingstone wrings his hands: "Do we have a telling exposé of a militaristic basis for the migration theory, or is it just an extremely arresting mode of writing that is used to carry the narrative? ... Do we find here *constitutive* links between cultural conditions and scientific theory, or just dexterous textual juxtapositioning?"

Now consider: Darwin began experimenting on seeds — immersing them in bottles of brine, even keeping the bottles in tanks of snow — on March 30, 1855, at the end of that bitter Crimean winter, when tens of thousands died.[4] His first results were reported in an article, "Does Sea-Water Kill Seeds?" one of his six publications on seed vitality during the latter months of the war. The article ends:

> It should be borne in mind how beautifully pods, capsules, etc., and even the fully expanded heads of the Compositae close when wetted, as if for the very purpose of carrying the seed safe to land. When landed high up by the tides and waves, and perhaps driven a little inland by the first inshore gale, the pods, etc., will dry, and opening will shed their seed; and these will then be ready for all the many means of dispersal by which Nature sows her broad fields, and which have excited the admiration of every observer. But when the seed is sown in its new home then, as I believe, comes the ordeal; will the old occupants in the great struggle for life allow the new and solitary immigrant room and sustenance?[5]

This was published on May 26th, 1855. The siege of Sebastopol was then eight months old. The English invaders were closing on the south fortifications from the port at Balaklava, the French from the southwest and their base at Kamiesh Bay. The tide had turned on the 24th with the French capture of Kerch, and the mopping up lasted until October. In all the siege cost over 100,000 lives.

Of course Darwin's words "ordeal," "great struggle," "old occupants," and "immigrant" may not have been penned with Sebastopol in mind, but we know from other passages that he saw the "struggle for existence" as all of a piece, among plants, animals, and humans. "The doctrine that all nature is at war is most true."[6] "Beachhead" or no, political parlance applied.

> No country can be named in which all the native inhabitants are now so perfectly adapted to each other and to the physical conditions under which they live, that none of them could anyhow be improved; for in all countries, the natives have been so far conquered by naturalized productions, that they have allowed foreigners to take firm possession of the land. And as foreigners have thus everywhere beaten some of the natives, we may safely conclude that the natives might have been modified with advantage, so as to have better resisted such intruders.[7]

This is from the *Origin of Species*. Who dares say that the book, which "omits man," was *not* about human evolution? Or that "cultural conditions," via metaphor, were *not* constitutive of Darwin's science? The *Origin*'s language was as political as a *Times* editorial.

Sara Miles, too, is haunted by sociology, worrying that *Darwin*'s double edge may injure evangelical readers. While being informed and entertained they "may find themselves accepting the implied conclusions derived from the authors' implicit interpretative stance." In an otherwise most kind and careful review she closely associates this stance with the "extreme" view that "external factors, not the reality of Nature, determine the content and expression of science ... Nature does not do the informing; society does."[8]

Although this dichotomy is false, and characterizes neither *Darwin* nor recent work in the historical sociology of scientific knowledge, Miles, like Livingstone, is shrewdly aware of the relativizing potential of *Darwin*'s example. Theological truth, not just scientific, is at stake. "God *may* exist, but truth claims about his nature and activity are as invalid as truth claims in science about natural objects and events. Theology becomes nothing more than a socially-shaped statement of what we believe about God; it is not limited or shaped by what God says about himself."

Unfortunately, Miles does not explain how unmediated, univocal knowledge of God is to be acquired, or how it could be held objectively (rather than existentially) to be "true." Perhaps she would say that, as in science, the "framing" of theological explanations, "while originating in our experience" of God's revelation, "nevertheless is always partial, always biased, always influenced by a particular historical context, and constantly requiring reformulation."[9] If so, the question of "influence" is just one of degree. *Darwin*'s contextualism merely outstrips Miles', in science and theology alike.

Among *Darwin*'s evangelical reviewers, Mark Noll has sounded the tocsin in the most dulcet tones. His long, judicious, and winsome commentary (abbreviated in 1992 as a *Christian Century* cover-story) correctly identifies its authors as "more or less materialist historians" who see "class, gender, and eco-

nomic factors as providing great explanatory power in accounting for ideas and beliefs." If, however, *Darwin* is to be applauded for "relativizing the imperialistic claims of science," Christians should beware that its "methods ... are just as subversive of efforts to explain the grounds of Christian belief apart from the political and economic interests shaping that belief." In *Darwin*, "claims to the objectivity of religious belief ... come off just as badly as claims for the objectivity of science."[10]

Which is highly inferential — but never mind. Noll's response is a new form of the old *tu quoque* trotted out by Miles and Livingstone. Miles asks, "What social factors determined what Desmond and Moore could see?" Livingstone warns that if "all knowledge claims" in the history of science are "socially reducible, then the whole project seems caught in a hopeless self-referential dilemma." Neither Livingstone nor Miles believes this to be the case, nor does Noll. But instead of conjuring the bogeys of determinism and reductionism, he augurs "a Christian faith that might escape the conventions of Desmond and Moore's view of the world," just as *Darwin*'s authors "make it possible to conceive of a Christian faith that escaped the conventions of William Paley's proprieties." Noll's hopeful faith would not be "always subservient to social interest" and would, I presume, be based on "the traditional Christian God," not "the traditional Christian God as interpreted for the ideological needs of Enlightenment England."[11]

Here the orthodox supernaturalist assumption is that knowledge of uninterpreted, essential, and timeless Christian truths can be acquired by humans within history. This is not unlike the orthodox rationalist belief that there are ultimate truths of nature of which humans can have knowledge through the historical progress of research. Both views presuppose the existence of a non-natural, unconditioned, or transcendental knowing mind; both have been contested repeatedly by historical sociologists of knowledge (not to mention philosophers, anthropologists, and psychologists). But the debate arose first and most instructively in theology, as David Bloor explains.[12]

F. C. Baur and his Tübingen school of church historians in the early nineteenth century argued for the "social construction" of the New Testament and early Christian doctrine. Their aim was not to prove one party or another theologically correct, nor to pass judgment on the authenticity of individuals' inner religious experience. What mattered was the political process (Hegelian or not) in Christian communities, the development of all doctrine through pressure, negotiation and compromise, and its reformulation from age to age.

The Tübingen "strong programme" was savaged by confessional supernaturalists. To them Christian history had two aspects: the record of apostolic truth faithfully expounded; and the record of heresy and doctrinal deviation. The life of the early church was to be reconstructed without confusing these two records. Apostolic truth, flowing from divine sources, was its own historical explanation, self-attesting and self-perpetuating among consecrated minds. Heresy, however, was caused by finite factors clouding the vision of the faithful and leading them astray. Ambition, greed, ignorance, lust — social sins — explain historic deviations from the path of true doctrinal development.

Many historians of science today are studying their world's most cherished beliefs in the same way that Baur and his colleagues studied theirs. And just as the Tübingen school was accused by supernaturalists of attacking Christianity (which was hardly Baur's design), so a sociologically informed or "contextualist" analysis of scientific knowledge is often read by rationalist historians as if it were an attack on science.

Livingstone, Miles, and Noll appear, in varying degrees, to have read *Darwin* in this way. Indeed, for them rationalism in philosophy of science and supernaturalism in theology evidently stand or fall together. Bloor explains the connection:

> Both are dualist theories. Both divide the world into opposing principles with a characteristic asymmetry of evaluation and explanation. The opposition of spirit and flesh becomes the opposition of knowledge and society. The word of God expressed through Church doctrine is replaced by the inner dialectic which drives knowledge forward. Dogma becomes the hard core and heuristic of a research programme. The internal history of science thus replaces the history of apostolic truth. The category of error replaces that of sin, and heresy in its modern form is hunted down under the name "irrationality."[13]

Darwin has not yet been "hunted down," but its evangelical reviewers have picked up an unsavory scent. They are shrewd. Like Darwin himself, a "Devil's Chaplain," the book is oxymoronic and subversive. It impresses the innocent while promoting an even-handed — or double-edged — social history of truth. That such magnanimous critics as Livingstone, Miles, and Noll also welcome the book gives me hope and great pleasure. ✸

Notes

[1]Michael Ruse's phrase in *Darwinism Defended: A Guide to the Evolution Controversies* (Reading, MA: Addison-Wesley, 1982), p. 58.

[2]David Livingstone, "A Commentary on *Darwin*," *Perspectives on Science and Christian Faith*, 46 (June 1994), 123-127.

[3]E.g., in *Science and Christian Belief*, 5 (1993), 73-78. Paul Marston finds nothing objectionable in *Darwin*'s history. Its "method," he says, "(allowing for a certain sensationalism) is generally credible."

[4]Frederick Burkhardt and Sydney Smith, eds., *The Correspondence of Charles Darwin* (Cambridge: Cambridge University Press, 1989), 5:300 n. 1; Paul H. Barrett, ed., *The Collected Papers of Charles Darwin* (Chicago: University of Chicago Press, 1977), 1:264.

[5]*Gardeners' Chronicle and Agricultural Gazette*, May 26, 1855, in Barrett, *Collected Papers*, 1:258. On a clipping of his article Darwin underlined "solitary" in the last sentence and wrote in the margin "no": Burkhardt and Smith, *Correspondence*, 5:334 n. 10.

[6]R. C. Stauffer, ed., *Charles Darwin's Natural Selection: Being the Second Part of His Big Species Book written from 1856 to 1858* (Cambridge: Cambridge University Press, 1975), p. 175.

[7]Charles Darwin, *On the Origin of Species by means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life* (London: John Murray, 1859), pp. 82-83.

[8]Sara Miles, "Darwin: A Man of His Times — A Theory of Its Time?" *Perspectives on Science and Christian Faith*, 45 (1993), 193-94.

[9]Ibid., p. 194.

[10]Mark Noll, "Science, Religion, and a New Biography of Charles Darwin," *Intellectual History Newsletter*, 15 (1993), 54.

[11]Ibid., p. 55.

[12]David Bloor, "Rationalism, Supernaturalism, and the Sociology of Knowledge," in Imre Hronszky, Márta Fehér, and Balázs Dajka, eds., *Scientific Knowledge Socialized: Selected Proceedings of the 5th Joint International Conference on the History and Philosophy of Science organized by the IUHPS, Veszprém, 1984* (Dordrecht: Kluwer, 1988), pp. 59-74; David Bloor, *Knowledge and Social Imagery*, 2d ed. (Chicago: University of Chicago Press, 1991), pp. 183-85.

[13]Bloor, "Rationalism, Supernaturalism," p. 62.

Can A Premillennialist Consistently Entertain A Concern for the Environment? A Rejoinder to Al Truesdale

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Al Truesdale has raised some significant and worthwhile questions in his paper, "Last Things First: The Impact of Eschatology on Ecology" (*PSCF*, June 1994, p. 116-122). One question many of us probably have not well considered is whether our particular brand of evangelical theology significantly influences our attitude toward care of the earth. Truesdale believes that it does. The thrust of his argument is that those evangelicals with premillennial convictions have abdicated their responsibility towards the environment by subscribing to a belief in an earth under a sentence of destruction at the imminent return of the Lord Jesus Christ.

As I listened to Dr. Truesdale's presentation of his paper at the August 1993 Seattle Annual Meeting of the ASA, I could not help asking, "About whom is he really speaking?" There are probably few more convinced premillennialists than I, yet few who are more personally distressed by the continuing wholesale ravaging of creation by developers, recreationalists, industrialists, logging, cattle and mining interests, and many others. I think there are few who exercise more personal care of the world than I do. Perhaps I have not raised my voice as loudly as I might have, but in my biology classes I have constantly sought to instill in students a sense of enlightened Christian responsibility toward the world God has made.

Perhaps I do so in contradiction to my "religiously unnecessary and logically impossible" point of view. I simply may be inconsistent. But I do not think so.

Before presenting my response, however, I want to thank Dr. Truesdale for graciously reading and thoughtfully responding to an earlier draft of this paper. He has sharpened my own thinking as well as corrected some of my errors. I wish space permitted a more detailed reply to some of his pertinent observations. Could I offer them, I am sure I would gain much hearing his responses to my replies.

At any event, we need to confront two questions. The first is what the Bible teaches when read in a normal, grammatical, contextual, historical sense. Dr. Truesdale did not address the question of Biblical hermeneutics, but one must. Secondly, if on hermeneutical grounds premillennialism is inescapable, on what possible grounds can a premillennialist justify an environmental concern? I believe the two questions are related.

Premillennialism comes in several varieties, just as does amillennialism. An environmental apology proposed for one variety may not logically follow from another. Christian people of my generation learned an approach to the Scriptures particularly associated with the names of J. N. Darby (1800-1882) and William Kelly (1821-1906). This was largely through notes found in the immensely popular *Scofield Reference Bible*, but also through a host of pastors and Bible teachers trained at Dallas Theological Seminary, Moody Bible Institute, the Bible Institute of Los Angeles, and similar schools. Darby, Kelly, and other early premillennialists began with a principle of interpretation that was quite foreign to both Reformation and Roman Catholic approaches. Darby and Kelly argued that the covenant God made with Abraham, Isaac, and Jacob was to be understood in the sense in which it was understood by Jews in Old Testament times. If God promised the land of Palestine to Israel as a permanent possession, then that promise would be, must be, will be, kept. To this extent they helped lay a foundation for subsequent premillennial thinking. Reformation writers, on the other hand, quite generally interpreted the Abrahamic covenant in a spiritual sense, applying it to the Church or to the community of the elect.

Although the Darby/Kelly view still has many advocates, its popularity has greatly diminished. Darby's strained interpretation of the Gospels probably had much to do with that. He understood the terms *kingdom of God* and *kingdom of heaven* in the Gospels to have overlapping but nevertheless distinct meanings. His explanations made for some beautiful spiritual applications and allowed people to think of the kingdom of God in some sense as present while at the same time viewing it as the literal, earthly fulfillment of all of God's ultimate designs. His views, however, have not convinced people who try to read the Gospels in a normal sense.

Apparently replacing the Darby/Kelly view in most premillennial circles is the interpretation of the late Fuller Seminary professor George E. Ladd. Ladd's approach began with his supposition that the Jews in the time of Jesus had no consistent eschatological view.[1] The meaning of the kingdom, therefore, must be determined primarily from its use in the New Testament. Ladd then asserted, accepting the conclusions of a number of modern philologists, that the basic concept of the Greek word for kingdom is *majesty, regal power,* or *authority,* rather than *realm* or *domain.*[2] With these foundational concepts Ladd examined New Testament passages and determined that they teach a present spiritual authority of God in the world and a future glorious manifestation in an earthly reign of Christ, a "rule of force." His is not a dispensational view according to the Darby/Kelly format.

Ladd's arguments for premillennialism leave me with many misgivings. Admittedly, if his foundational principles are allowed, his analysis of New Testament texts would seem to follow. The principles, however, are at least open to question. Are the philologists whom he follows correct in making *regal power* or *authority* the primary meaning of the Greek word for kingdom? Space prohibits examination of the question here, but I think it can be argued that the philologists who examined corresponding Hebrew and Greek words were themselves prejudiced by presuppositions about the nature of the biblical doctrine of the kingdom. Their reasoning may have been circular. Secondly, it seems to me that the Jews did have a consistent concept of the kingdom in the time of Jesus. To be sure, they held various views on some facets of the doctrine, but on certain critical aspects I believe they were more or less agreed.

Over the years there have been other premillennialists who built on a more coherent and defensible interpretation and who avoided the rather convoluted interpretation of the Gospels espoused by Darby and Kelly. The most thorough exposition was published in 1884 in three enormous volumes by the Lutheran minister George N. H. Peters.[3] To my knowledge no anti-chiliastic writer has ever attempted a systematic refutation of Peters' arguments. Those amillennial writers who have inveighed against either premillennial or dispensational teaching appear to have been ignorant of the work. Few, at least, have ever referred to it or cited it in their bibliographies.

Although Peters did not use modern literary terminology, he insisted on reading all Scriptures in what we today would generally consider a literary sense. He demanded for Scriptures the meaning they must have had for those who originally received them. How indeed did people in the time of David understand the Abrahamic Covenant, he asked. How did Isaiah, Jeremiah, Daniel and other prophets understand it? If a Bible student accepts the Bible as divine revelation and faithfully follows this principle of reading the Bible in its normal, grammatical, historical sense, what will unfold? Nothing less, Peters insisted (and I am personally convinced), than a premillennial interpretation of the Bible. A short synopsis may help us see why this is so, and also what it may imply for a concern for creation.

The Abrahamic Covenant, announced five distinct times to Abraham beginning with Genesis 12, announced twice to Isaac, and reiterated three times to Jacob, includes at least seven distinct terms, not the least of which is the promise of the land to the descendants of Abraham through Isaac and Jacob (Genesis 15:18-19, Josh. 1:4, etc.). There seems to be no question but that Jews throughout the Old Testament took these promises literally.

This is, of course, the watershed issue on the whole interpretation of eschatology. Amillennialists presume the Abrahamic covenant must be understood in the light of what Christ and the apostles taught regarding the kingdom of God. Peters, however, insists that we can understand Christ's and the apostles' teaching on the kingdom of God only in the light of the historical meaning of the kingdom.

There is, however, a consistent picture that emerges when the covenant is taken in its normal, grammatical sense. Note carefully three basic elements of the covenant. First, it was *unconditional.* There were no terms with which Abraham had to comply. Some have said that circumcision was a condition, but circumcision was not mentioned when the covenant was first announced. It was introduced later on, but not as a condition for the fulfillment

of the promises but rather an obligation for the individual who expected to remain within the line of promise. The covenant was all of grace; it was a favor from God. Secondly, the covenant was repeatedly stated to be *everlasting*. Once received it would belong to the heirs in perpetuity (Genesis 17:8, 19, etc.). The argument is sometimes made that the covenant was fulfilled in the days of Solomon. At that period Israel exercised economic sovereignty from the Nile to the Euphrates. But this could not have been the fulfillment, since within a few years the kingdom was divided, shrunk, the people overcome with misfortunes and harassed by their enemies. If the promise was fulfilled at that point, "everlasting" is a mighty short time. Thirdly, there was *no time limit* set for the fulfillment of the promise. Abraham was told that his descendants would be sojourners and slaves "in a land that is not theirs," hence the promise could not be fulfilled for 400 years (Genesis 15:13). Nevertheless there was no indication that in 400 years it *would* be realized; no time was ever set. These observations have a large bearing on how the kingdom is to be understood throughout the rest of Scripture.

When the people of Israel left Egypt at the Exodus, God himself became their actual, functional king (Num. 23:21; Deut. 33:5; I Sam. 8:7; 12:12). This is not to be confused with the universal sovereignty of God, for God acted toward Israel in a unique way as the legislative, judicial, and executive head. He was available for consultation and direction (Exod. 25:22; 33:11). Unlike what we today term a theocracy, that is, a government directed by a presumed representative of God, this was a real theocracy. God exercised genuine rulership, not only authority, over the people.

At Sinai God gave Israel the law with the ten commandments and all its many other terms and regulations. The great significance of the law was that it provided the nation a means whereby, once they were established in the land, the terms of the Abrahamic Covenant might be fully realized. Here is an often overlooked point. The Abrahamic covenant specified no time. The law in contrast said, "*Now* you may have it, but the condition is obedience." Obedience would bring all the promises (Lev. 26, Deut. 7-8, etc.). Failure to obey, however, would result in frightful chastisement. Nevertheless, even if disobedience and chastisement should follow, as historically they did, the promises to Abraham remained inviolable.

Tired of the judges, the people begged Samuel for a king. God allowed them to have an earthly king who would be subordinate to himself, the actual king. Nonetheless, this was not the end of the theocracy (II Kings 19:15; Isa. 41:21; 43:15; etc.), although the *effectiveness* of God's rule diminished in proportion to the rebellious wickedness of the people. After Saul's failure, God selected David, making a unilateral covenant guaranteeing that a descendent of his would have his throne over the nation established forever (I Chron. 17). The promise included peace for the people of Israel, who would be planted "that they may dwell in their own place" (I Chron. 17:9). It is difficult to believe that historically this was understood in any other than its literal sense or that the Jews in Jesus' time understood it otherwise.

Ultimately the Northern tribes were taken into captivity and finally the heavy hand of judgment, embodied in the Babylonians, fell upon wayward Judah. The theocracy came to an end, and when God no longer ruled the people neither were they permitted to enjoy an earthly prince. With it all, the prophets described a future glory for Israel, expanding the Abrahamic covenant far beyond its original bounds. When Israel should be brought back into the land, the theocracy re-established, the Gentiles of the world would also be brought under its umbrella. Israel, however, would be the jewel in the kingdom's crown. Nevertheless, the law stood as a solemn and grim sentinel over the future (Jer. 12:14-17, etc.). The law's fulfillment was the prerequisite to the magnificent restoration of the kingdom.

When Jesus and John came preaching, "The kingdom of heaven is at hand," how did the Jews understand these words? Whether they accepted Jesus' authority or not, whether they believed him or not, they could only have understood him to be declaring that the theocracy, the reign of God over the nation, was available. The kingdom was ready for final realization.

To insist that the kingdom had some other meaning, a meaning to be known from the New Testament context only, is exegetical folly. The Jews understood what Jesus was talking about. They may have had differing notions about a number of details of the kingdom, but not about the literal fulfillment of the Abrahamic covenant (otherwise the words of Jesus in Matt. 3:9 make little sense). Neither did they misunderstand that they needed to keep the law for the kingdom to be established. The famous, disbelieving, German scholar Albert Schweitzer[4] (following Johannes Weiss) correctly understood this. He saw that the interpretation of the message of Jesus had to start with the historical Jewish understanding of the kingdom. The view embraced by this critic was that he thought Jesus was mistaken in preaching that God would establish a literal kingdom. Accord-

ing to Schweitzer, Jesus discovered his mistake only as he hung on the cross, but his followers never themselves made that discovery.

We find no place in the Gospels where Jesus sought to correct the supposed misapprehensions entertained by either the Jews or the disciples over the nature of the kingdom. The great points of contention were not the nature of the kingdom but what constituted obedience to the law and whether Jesus had authority for his teaching. The scribes and Pharisees supposed they were keeping the law by outward observance. It was in the Sermon on the Mount that Jesus showed what it really meant to keep the law. Obedience had to come from within. It is commonly alleged that as a master teacher Jesus sought gradually to disabuse his followers of mistaken and carnal notions about the kingdom. If so, it is astounding that after his resurrection the disciples still had not learned their lesson. Even at that time they must have been expecting the restoration of the nation according to Old Testament prophecy, for they asked, "Lord, will you at this time restore the kingdom to Israel?" (Acts 1:6). Jesus answered, "You knuckleheads, have I been with you this long and you still haven't got it right?" Or did he?

If we start with a historical understanding of the kingdom, the Synoptic narratives and teachings fall into a consistent and easily defined pattern. If we reject this understanding, we have to resort to some tortuous and improbable explanations or else deny the full authenticity of the accounts. The outline is simple enough. There is increasing hostility to Jesus on the part of the Jews. In the middle of his public ministry Jesus announced privately to his disciples that there would be a delay (Matt. 13). Shortly before his crucifixion the delay was made public (Matt. 21:28-22:14 and note 23:39). Then in the Olivet Discourse (Matt. 24-25) Jesus clearly taught not only a period of delay but a great tribulation, after which the kingdom, the theocracy, would be established at his coming (Matt. 25:31).

There are many verses which might be used against this view (e.g., Luke 17:21; John 3:3; 18:35; Rom. 14:17), but all these are susceptible of a consistent understanding with the concept of the kingdom being the promised earthly reign of the Messiah. This understanding is at the heart of premillennial conviction. It is a conviction that is not easily dismissed as unrealistic apocalyptic fervor or fundamentalist eisegesis.

The question of how this may lead to a concern for the environment may not be immediately obvious. If all is to be destroyed in a great conflagration at the coming of Christ (most amillennialists) or at the end of the 1,000 year reign of Christ (premillennialists generally), why be concerned? The premillennialist would seem to have particularly little reason to be concerned, even if the final conflagration is more than a thousand years away, since the coming great tribulation will be a time of cataclysmic judgments. The terrors of an imminent tribulation would seem to trivilize any concern for the environment. Pending the coming judgments and/or the annihilation of the physical earth, why not take advantage of whatever residual benefits a doomed earth has to offer? It will soon be gone, so it might as well be used up. Or perhaps one might simply withdraw from any concern. Two answers to these arguments follow.

First, the premillennialist, if consistent in his or her devotion to the Word, believes God places great value upon his creative work. The earth belongs to God and manifests his works and wisdom (Psalm 104, especially verses 24, 31-33; I Corinthians 10:26; etc.). Man is responsible for it (Psalm 8:3-8, etc.). Since God treasures his creation, no less should be expected of those placed upon the earth to keep it and honor him through use of it.

If someone is inclined to suppose that what is destined for destruction is of no concern to God and therefore can legitimately be exploited, these biblical principles are forgotten. Suppose that a Christian man is told by his physician that he has an incurable malignancy. Because his days are numbered does he therefore live the remainder in debauchery and fornication? Not at all, because he still belongs to God "body, soul, and spirit." Likewise, should destruction be the destiny of the material world, the Christian's responsibility toward it is no less diminished.

The second answer stems from a premillennial/dispensational view that recognizes the Christian's freedom from legalism and his or her freedom to live in love. (I add the word "dispensational" because the term is now generally applied to all who recognize (1) that Israel nationally has promises not realized in the Church and (2) that the believer is no longer under the law of Moses.) Those who hold such views have been thoroughly excoriated as heretical antinomians by J. H. Gerstner in his book *Wrongly Dividing the Word of Truth.*[5] Dr. Gerstner's condemnation demonstrated an unhappy ignorance of what the Rev. G. N. H. Peters unfolds in his eminently fair and thorough presentation of the kingdom of God.

Christ offered the kingdom to Israel, but it was — it had to be — on the condition that the people

obey the law from the heart. He was ready to give them divine help, but except for a few, the willingness was not there: the necessary law-obedience from the heart was wanting. Consequently the nation was set aside, dispersed until the time of their future regathering. When they are finally redeemed, it will be apart from the law. Believing Gentiles will share in the glory, apart from the law. This is because when Christ died on the cross he satisfied every demand of the law, becoming a penalty in the sinner's stead. For the believer the law is not an avenue to salvation, and it is not a rule of life. This applies equally to those theological classifications termed the ceremonial, civil, and moral codes. (The New Testament itself does not divide the law into three parts.) What Scriptures shall I quote to validate this most peculiar position, that the Christian is not under the law in any respect? Romans 6 (particularly verse 14) and 7, II Corinthians 3, and the whole book of Galatians, for starters!

If the law is not the rule of life for the believer, what possibly can be? The answer is the "new commandment" of John 13:34, the principle of totally unselfish, wholly giving love, *agape*. The person who practices love has satisfied the purposes for which the law was given — without being under the law (Rom. 6:14 with 13:8-10). The person who loves others with insightful, understanding love is indeed "pure and blameless for the day of Christ," is "filled with the fruits of righteousness" (Phil. 1:8-11). The person who lives in *agape*, unlike the person living by the acquisitive love characterizing the flesh, is willing to sacrifice of himself or herself and of his or her interests that others might prosper, might live, might have their rights, might be built up to enjoy God's riches.

Precisely here is where the premillennial/dispensational Christian exercises a concern for God's handiwork in nature. It is not his or hers to despoil. In radical love it is to be kept, not for one's own sake, but that others might enjoy it, might be privileged to rejoice in the wondrous and intricate delights of divine providence. Genuine love looks out for the welfare of others. A polluted environment surely does not serve the good of others. When a Christian treats the earth and its living forms with disregard, it can only be concluded that such a person is terribly ignorant of what he or she is doing, or is living "in the flesh," gratifying his or her personal desires at the expense of others — the Corinthian syndrome. But God has not called us to the flesh, but to the spirit!

The Christian recognizes the depravity of the human heart outside of Christ and the propensity of the unredeemed person to exploit both creation and other humans for wholly selfish purposes. The Christian, however, has been liberated from the necessity of sin. The Christian alone is in a position to view creation apart from self-interest and to see it as a manifestation of the bounty and glory of God. A Christian walking with the Lord, rather than eager to exploit the earth for self-gratification, is eager to celebrate creation with thanksgiving and to care for and preserve it.

To this argument, let me annex one other thought that has not been carefully considered by most current premillennialists. The destruction of the physical world may not, after all, be a doctrine taught in Scripture. For one thing, a number of scriptures describe the kingdom, once established, as eternal (e.g., Dan. 2:44; Heb. 1:8). The Darby/Kelly scenario places the millennium first, then the great conflagration of II Peter 3:10, followed by "a new heaven and a new earth." Granted, this interpretation makes a certain kind of sense. Revelation 21 and 22, which describe the new heavens and the new earth, follow the description of the establishment of the millennium. One might suppose that the visions are arranged chronologically, so the new heaven and the new earth are viewed as following the thousand years and the great white throne judgment. Militating against this chronological interpretation is the section in Isaiah 65 and 66 from which John took the expression. In Isaiah "new heavens and a new earth" refer, clearly I believe, to the time of Israel's restoration. This follows from the whole context, but especially from Isaiah 66:18-21. The new heavens and new earth refer to what will be established when Israel is brought back to the land. The expression refers to the beginning, not the end, of the "times of restoration." Since (in my opinion at any rate) the Book of Revelation is cyclical in its literary structure, chapters 21 and 22 may well be a symbolic description of the perpetual reign of Christ overlapping but continuing beyond the millennium to the "age of the ages."

But what does the sincere Bible student do with the statement in II Peter 3:10 that "the heavens will pass away with a loud noise, and the elements will be dissolved with fire, and the earth and the works that are upon it will be burned up"? Without a detailed exposition, I might point out the following. (a) Whatever it refers to, it is an event associated with "the day of the Lord," which in other passages refers to the judgments and cleansing immediately preceding and accompanying the advent of the Messiah. (b) "Elements" most probably does not refer to elements in our modern chemical understanding. In all five other New Testament instances the word

refers to "elementary rules." It can be so understood here, but seems not to be generally translated this way out of deference to tradition. (c) The word for "will be burned up" in most Greek texts is not this word at all but another word meaning "will be discovered." In short, one can legitimately think of the passage as declaring that at the time of Christ's return fundamentally self-centered societal rules will be exhibited for what they are, destroyed, and replaced, in a graphic metaphor — being burned up and dissolved.

If these considerations are valid, at the return of Christ the earth will be renovated, restored, brought into a new and greater splendor. The original splendor has been and is being corrupted by the greed and selfishness of mankind. But God, who created all things, will not let the rot of sin ultimately thwart his work. Rather, he must judge sin and set free an earth now in bondage to decay (Romans 8:21). Creation is his perfect work, and although it was "subjected to futility, not of its own will" but for the purposes of God, it will be redeemed just as much as we who have put our faith in Christ (Rom. 8:21-23). *All that God cherishes enough for redemption, the Christian can and ought to cherish.*

It seems to me without question that the premillennialist enjoys every possible motivation to exercise a concern for the environment. Indeed, he or she is obligated to have such a concern. This concern ought to be second only to that for the salvation and spiritual growth of men and women about us, members of a race that is corrupted and dying even more than the physical world. ✸

Notes

[1]George E. Ladd, *Crucial Questions About the Kingdom of God* (Wm. B. Eerdmans Publishing Co., Grand Rapids; 1954), p. 70.
[2]Ibid., pp. 78-81.
[3]George N. H. Peters, *The Theocratic Kingdom of Our Lord Jesus, the Christ* (Funk and Wagnells, New York; 1884), 3 vols. Republished by Kregel Publications, Grand Rapids, MI; 1988.
[4]Albert Schweitzer, *Quest of the Historical Jesus: A Critical Study of Its Progress from Reimarus to Wrede*; transl. W. Montgomery (A. & C. Black, London; 1945; first printed 1910), pp. 1-410.
[5]John H. Gerstner, *Wrongly Dividing the Word of Truth* (Wolgemuth & Hyatt, Inc., Brentwood, Tenn.; 1991), pp. 1-275.

The Galileo Incident

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Is the conventional evaluation of the "Galileo incident" correct? Many people buttress their claim that religion and natural science cannot mix by citing a single historical horror story: the tragic error made by the Roman Catholic Church when it interfered with the work of Galileo Galilei (1564-1642) in the seventeenth century. In my view, however, a different story emerges from recent studies.[1]

The Prevailing Attitude

Colin A. Ronan, in his biography of Galileo, states:

> Galileo does stand as a classic example of the evils of a totalitarian regime. He was persecuted [by men who] were afraid of the power of independent thought. Galileo ... cut right across the religious authority of the Church .... [His persecutors] took the one course they could: they stifled the dissension at its source.[2]

A.G. Fraser, an English geologist, says:

> [W]e need to be careful, in case, in the name of biblical orthodoxy, we again place greater limits on science than are proper. The falsely based hostility of the church to Galileo's acceptance of the Copernican system of astronomy is a very unhappy historical precedent.[3]

Paul Liben recently claimed:

> In centuries past, science's boundaries were continually threatened with invasion by the forces of institutionalized religion. One of the most egregious examples of this was the persecution of Galileo at the hands of the seventeenth-century Roman Catholic Church .... [This is] an example of the bullying of science by those having an apparent stake in the upholding of a particular religious world view.[4]

Clearly, what many people are saying, then, is that we should not repeat the mistake the church made when it condemned Galileo's work.

Background of the Controversy

Charles Hummel's analysis suggests an accurate attitude might be somewhat different:

> The real authoritarianism that engineered Galileo's downfall was that of the Aristotelian scientific outlook in the universities. Only after Galileo had attacked that establishment for decades did his enemies turn their controversy into a theological issue.[5]

What about the Aristotelian scientific outlook in the universities to which Hummel refers? I believe that historical studies, particularly those concerning the role of Aristotelianism, lead us to a conclusion different from the conventional one.

During the early centuries of the New Testament era, Christians began to provide answers to pagan Greek philosophers. Augustine (354-430), who wanted to Christianize philosophy, emphasized that Christianity is a religion not only of redemption but also of creation. In the centuries after Augustine, the source of much natural scientific learning in the West continued to be Greek natural science, transmitted by the church fathers. Christian thinking was incorporated and eventually there was a synthesis, which, however, did not lead to a crisis before the twelfth century. Christian theologians could emphasize the creation aspect of this teaching, while insisting that matter and God were not co-eternal.

Later, beginning in the twelfth century, scholars translated many more ancient Greek works, including those of Aristotle, into Latin. Translation was completed by about 1225. The situation was then, as Edward Grant says, "truly menacing" for the church: scholars like Honorius of Autun (fl. 1122) and Thierry of Chartres (d. ca. 1155) advocated study of "nature for its own sake" and resented ecclesiastical authority looking over their shoulders. They wanted reasons for physical phenomena, not, as Grant says, a "mere appeal to God's omnipotence or a biblical passage .... " Instead of using the Bible to understand nature, natural science would en-

croach upon theology. Grant continues: "Thus were the seeds of science-theology confrontation planted, the bitter fruits of which would grow to maturity in the thirteenth century following upon the introduction of Aristotle's scientific works."[6]

There were several unsuccessful attempts early in the thirteenth century to ban Aristotle. But from about the mid-13th century to 1650 his works were an important part of the arts curriculum.

Evidently some scholars were saying that God, because of the very nature of creation, was limited. But some thinkers wished to adhere to traditional Christian doctrines; others were affected by Aristotelian natural philosophy, a philosophy that limited God. The traditionalists questioned the teachings of Thomas Aquinas (ca. 1225-1274), who held that Aristotle was a great philosopher-scientist who had reached a very high level without the benefit of revelation. According to Gary Deason, Aquinas held that Aristotle's principles of nature were put there by God and used by him in his providential work. Deason adds, "God *cooperated* with natural powers in a way that respected their integrity while accomplishing his purposes."[7] Eugene Klaaren states that this synthesis led to serious difficulty:

> [S]iger of Brabant's fusion of the classical Greek view of the natural world and a thoroughly ontological orientation to creation was read as a dangerous sign. Such a complete union of Christian belief in creation and Aristotelian natural philosophy called into question the basic direction of Thomas' achievement.[8]

Eventually traditional theologians realized that it was not enough to warn of the dangers of applying Aristotelian philosophy to theology. At their urging, the Bishop of Paris condemned thirteen propositions in 1270, and in 1277 expanded the list to 219 articles. This was the Condemnation of 1277.[9] It is a landmark in the interaction between theology and natural science, even though its articles are diverse, repetitious, and sometimes internally contradictory. Certain articles were directed at specific people, such as Siger of Brabant and Thomas; some of those were nullified in 1325. Even so, the effect of the articles was very great throughout the fourteenth century.

The Condemnation insisted that God has absolute power and opposed Aristotelian natural philosophy where it compromised this absolute power. Thus, some articles maintained that the world has not existed from eternity, that God did create the world from nothing, that he could move the world in a straight line and leave empty space behind, that he could create more than one world, and that species have not existed eternally.[10] Grant summarizes: "God could produce actions that were naturally impossible in the Aristotelian world view. It was thus Aristotelian natural philosophy on which the Condemnation of 1277 pressed most heavily."[11]

The Condemnation did not inhibit scientists. It was actually positive. It said that God can create other worlds; God, not creation, is eternal; God can move our world and create a vacuum; God can bring about events we cannot explain. Contrary to the natural and perpetual motion in the heavens postulated by Aristotle, God can counteract heavenly motion: he, not the natural world, is in control. The declarations of the Condemnation condemned those who would limit God, those who said in effect, "If my net [my natural science] cannot catch [explain] it, it isn't a fish [a fact]." The opponents of Aristotle emphasized God's free will; creation is completely dependent on God.

From the fourteenth century to Galileo, there was a compromise. The church permitted Aristotelians to deny the *existence* of other worlds — providing they allowed that God *could* create them. They were even allowed to hypothesize that the world has existed from eternity. Thus one was allowed to *consider* the ideas rejected in the Condemnation, but not teach them.

The Condemnation was probably responsible for people considering ideas that would otherwise not have been taken up — a first step away from Aristotelianism. Insistence that God can do anything opened the way to new possibilities. Since God could make many worlds, what would things then be like? Near the end of the thirteenth century, Richard of Middleton (d. ca. 1300) claimed that such other worlds would be like ours; then there would be no one "center" of creation.[12] During the fourteenth century others, including William of Ockham (ca. 1300-1350) and Nicole Oresme (ca. 1320-1382), made similar claims. Emphasizing God's absolute power, they concluded that it was not necessary to hold with Aristotle that the earth is at the center of the universe. Some natural philosophers went beyond consideration of hypothetical situations: for them, certain new models reflected reality. For example, God's immensity suggests infinite space.

Biblical exegesis was less literal concerning physical phenomena in the latter part of the Middle Ages. A great deal of allegorical interpretation of Scripture was acceptable. Even though allegory was not allowed to account for descriptions of the motion of

the sun, Nicole of Oresme developed an interesting idea. He assumed the biblical account of the sun standing still for Joshua (Josh. 10:12-14) is based on the smallest possible change in the normal order. The observed effect could be obtained if the relatively small earth, not the sun and the rest of the heavens, stood still; then night and day occur because the earth rotates daily. But he did not suggest that the earth moves around the sun. Eventually he made his statement about daily rotation only hypothetical; he succumbed to the compromise concerning the actual and the hypothetical.[13]

Thus, people like Nicole of Oresme compromised when they said their deductions did not correspond to reality: yes, the earth *can* rotate, but no, it actually does not. Their compromise was an unstable situation. When Copernican data influenced Galileo, the inevitable occurred: the yes-it-can but no-it-doesn't situation had to end. Marinus Stafleu explains that the practice of "double truth" could not continue:

> The practice of the "double truth" provided the medieval scholars with a certain margin, within which they were free to investigate and discuss anything, if only they ultimately submitted themselves to the authority of the church .... [When this authority waned] the practice of double truth became discredited.[14]

The Condemnation had positive effects. The general acceptance of the ideas that God was free to act was one good result. Thus, God freely decided to create, and acts from outside of history. Those who stressed the freedom of God's will presaged the new science. They disagreed with the church that persecuted Galileo, whose openness toward creation was in line with the spirit of the Condemnation and many pre-thirteenth-century theologians, not with certain ideas preeminent in parts of the Roman Catholic Church by Galileo's time. Klaaren lists specific beneficial consequences of the realization that God created freely. First, humility enhanced empirical respect for fact. Second, reason was nurtured. Third, emphasis on asking questions of creation — with the discovery that it is ordered — encouraged law-like explanations. Fourth, people had a "more liberated exercise" of reason in judging "probable opinions."[15]

"Conservative" can mean one thing in one context, the opposite in another context: in the Soviet Union it referred to hard-line Communists, while in the West, to hard-line anti-Communists. Similarly, pre-Condemnation theologians were conservative. But contemporary liberals, who advocated fusing Aristotle and Christian doctrine, prevailed. By the seventeenth century the earlier liberal position had become the conservative, orthodox position. On the other hand, examining possibilities (Can other worlds exist? Is the earth at the center?) allowed by the orthodox of the thirteenth century, blossomed into Galileo's liberal position. The conservatives' possibilities of the thirteenth century became the liberals' realities of the seventeenth century.

Had the church heeded the warnings of the Condemnation of 1277, Galileo could have said, "You know that Aristotle was wrong in limiting God. You know we may contemplate the existence of other worlds; that the earth might not be the center of creation; and that the earth might rotate. You also know that parts of the Bible may be interpreted allegorically. If allegorical interpretation is possible, might not some of those contemplations correspond to reality? Will you please look through this telescope?" If the church had not linked Aristotle's limitations on God to the interpretation of the Bible, might not the Galileo incident been something other than a confrontation?

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Analysis of the Galileo incident often rests on a false premise. The false premise is not the assumption that the church unjustly persecuted Galileo — it *was* unjust — but that the incident is an example of persecution of a natural scientist by untaught nonscientists. Rather, natural scientists who disagreed with the Condemnation of 1277 — and insisted on Aristotle — taught the nonscientists. The church should have adhered to the spirit of the Condemnation. Instead, those who led the church away from that spirit said that God is limited.

Today many churches and theologians have great respect for natural scientific conclusions. Sometimes they suppress ideas they would espouse in the absence of those conclusions. Of course, it is wrong to take the opposite approach and reject all natural scientific conclusions related to cosmological questions, such as those concerning origins and order. Not many take that approach. But holding unwarranted respect for all things scientific is dangerous. It was ever so: when Greek science became widely available in the West in the thirteenth century, it eventually helped to provide theologically dogmatic answers to the great cosmological questions. Will modern theologians and churches adopt uncritically modern natural scientific ideas concerning origins and order and convert those ideas to theological dogma today? ✸

Notes

[1]See, for example: David C. Lindberg and Ronald L. Numbers (eds.), *God and Nature: Historical Essays on the Encounter between Christianity and Science* (Berkeley: University of California Press, 1986); Charles E. Hummel, *The Galileo Connection: Resolving Conflicts Between Science and the Bible* (Downers Grove, IL: InterVarsity Press, 1986); Eugene M. Klaaren, *Religious Origins of Modern Science: Belief in Creation in Seventeenth-Century Thought* (Grand Rapids, MI: Eerdmans, 1977); and Marinus Dirk Stafleu, *Theories at Work: On the Structure and Functioning of Theories in Science, in Particular During the Copernican Revolution* (Lanham, MD: University Press of America, 1987).

[2]Colin A. Ronan, *Galileo* (New York: G.P. Putnam's Sons, 1974), p. 253. Quotation taken from Hummel, p. 13.

[3]A.G. Fraser, "The Age of the Earth," in *Creation and Evolution: When Christians Disagree*, Derek Burke (ed.) (Leicester, England: InterVarsity Press, 1985), p. 40.

[4]Paul H. Liben, "Science Within the Limits of Truth," *Perspectives on Science and Christian Faith*, 44 (1992), 163-68.

[5]Hummel, p. 123.

[6]Edward Grant, "Science and Theology in the Middle Ages," in *God and Nature*, pp. 51-52.

[7]Gary B. Deason, "Reformation Theology and the Mechanistic Conception of Nature," in *God and Nature*, p. 169.

[8]Klaaren, p. 34.

[9]Grant, pp. 53-54 and n. 17, pp. 71-72; Deason, p. 170; Klaaren, p. 33.

[10]Grant, pp. 54-59; Klaaren, pp. 34-35.

[11]Grant, pp. 54-55.

[12]This analysis is found in Richard of Middleton's commentary on the *Sentences of Peter of Lombard* (ca. 1100-ca. 1160), a collection of opinions of the church fathers.

[13]Grant, pp. 65-67. Besides Nicole of Oresme, others who considered the possibility of the daily rotation of the earth were Jean Buridan (ca. 1295-ca. 1358) and Nicholas of Cusa (1401-1464); see Stafleu, pp. 35-36.

[14]Stafleu, p. 36.

[15]Klaaren, p. 38.

Arno A. Penzias: Astrophysicist, Nobel Laureate

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From their observations made in 1964 and 1965, Dr. Arno A. Penzias and Dr. Robert Wilson of Bell Telephone Laboratories first discovered the now estimated 3 K background microwave radiation in the universe — one of the first and still one of the major lines of evidence in support of Big Bang cosmology. In the minds of many in the scientific community, this discovery supports the view that the universe created itself. Browne (1978) interviewed several of the world's leading physicists, astronomers and cosmologists. "A majority clearly shared the somewhat gloomy view of Dr. Steven Weinberg, a well-known [former] Harvard University particle physicist whose book about the origin of the universe, *The First Three Minutes*, appeared recently." In Weinberg's words, "The more the universe seems comprehensible, the more it also seems pointless.... The effort to understand the universe is one of the very few things that lifts human life a little above the level of farce, and gives it some of the grace of tragedy" (Weinberg, 1977).

Browne discovered in his research that some scientists shared "a contrasting view" to that of Weinberg. One of these scientists was Dr. Penzias himself, who, "despite the part his observations played in expanding the thinking of such physicists" as Dr. Weinberg, "believes that they are wrong in asserting that the universe is pointless" (Browne, 1978). The crux of the matter, as Penzias sees it, is that the empirical evidence actually argues for a created universe.

> If the Universe hadn't always existed, science would be confronted by the need for an explanation of its existence. Since scientists prefer to operate in the belief that the universe must be meaningless — i.e., reality consists of nothing more than the sum of the world's tangible constituents — they cannot confront the idea of creation easily, or take it lightly. Well, I hope that we, as modern people, might be able to leave dogma aside and be willing to look at facts, at least the facts as we understand them today (Penzias, 1983, pp. 3-4).

Specifically, Penzias' research into cosmology has caused him to see "evidence of a plan of divine creation." He says that "the best data we have are exactly what I would have predicted, had I had nothing to go on but the five books of Moses, the Psalms, the Bible as a whole" (Browne, 1978). Penzias asks:

> How could the everyday person take sides in this dispute? ... trying to fit dogma and fact into the same mind seems too difficult....wanting to hold on to the teaching of faith, but as a rational person wanting to keep a grasp on everyday facts — [one is] being pulled by two opposing "truths." One held that the universe was created out of nothing, while the other proclaimed the evident eternity of matter. The "dogma" of creation was thwarted by the "fact" of the eternal nature of matter .... This dogma comes from the intuitive belief of people (including the majority of physicists) who don't want to accept the observational evidence that the universe was created — despite the fact that the creation of the universe is supported by all the observable data astronomy has produced so far. As a result, the people who reject the data can arguably be described as having a "religious" belief .... These people regard themselves as objective scientists. The term "Big Bang" was coined in a pejorative spirit by one of these scientific opponents who hoped to replace the evolutionary universe idea with a steady state theory — one which said that the universe has always looked exactly as it looks now. More recently, this now-discredited attempt has been replaced by an oscillating universe theory, one in which the cosmos explodes and collapses throughout eternity. (Penzias, 1983, p. 3)

Unfortunately, Penzias has not published much on his theological views, but in his few interviews

and papers on this topic, he has made his general views clear, as the following comment reveals.

> I invite you to examine the snapshot provided by half a century's worth of astrophysical data and see what the pieces of the universe actually look like .... In order to achieve consistency with our observations we must ... assume not only creation of matter and energy out of nothing, but creation of space and time as well. Moreover, this creation must be very delicately balanced. The amount of energy given to the emerging matter must be enough to move it fast enough to escape the bonds of gravity, but not so fast that the particles lose all contact with each other. Enough of the initially-created matter must pull together under gravity to form galaxies, stars, and planetary systems which allow for life. Thus, the second "improbable" property of the early universe, almost as improbable as creation out of nothing, is an exquisitely delicate balance between matter and energy. Third — and this one puzzles scientists at least as much as the first two — somehow all these pieces, each without having any proper contact with the others, without having any way of communication, all must have appeared with the same balance between matter and energy at the same instant. (Penzias, 1992, p. 80, 82)

Penzias also argues that theology can tell us much about what we would expect the universe to be like. For example, he concludes that if it is open, expanding forever, the universe would be "precisely the universe that organized religion predicts." Specifically, he notes that

> a theologian friend of mine ... told me once he could not conceive of Calvary happening twice. He said his faith as a Christian would be shaken if it could be proven to him that the universe, with its finite number of particles, could be reconstructed an infinite number of times. It would mean that every event — the creation of man ... everything — would be repeated again and again an infinite number of times, simply by random chance. That is the meaning of infinity. In other words, a closed universe would be [as] pointless as the throw of dice. But it seems to me that the data we have in hand right now clearly show that there is not nearly enough matter in the universe, not enough by a factor of three, for the universe to be able to fall back on itself ever again. (Browne, 1978)

Penzias recognizes that these views are uncommon in science. In his words, "very few winners of Nobel Prizes in science, and for that matter very few scientists generally, have been strong religious believers" (Browne, 1979). Penzias believes drawing conclusions in the faith-science area is compounded by the fact that:

> As our sophistication increases, we habitually categorize the sum of experience, using names like "theology" and "astrophysics." But categorization leads to separation. In particular, our understanding of the world around us has grown along two parallel courses, based on largely separate portions of the entirety of human experience. (Penzias, 1992, p. 78)

He not only questions the wisdom of separating reality into artificial divisions such as science and theology, but concludes that doing so may impede a complete understanding of the universe:

> ...In ancient times, theology outweighed the barely-formed precursors of physical science. But physical knowledge soon began to grow in prestige as well as size. By the end of the middle ages, theology could no longer ignore science. The resulting dichotomy between tangible and intangible knowledge perplexed many of our own great scholars — none greater than Rambam himself ... [said:] "The foundation of our faith is the belief that God created the Universe from nothing; that time did not exist previously, but was created; for it depends on the motion of the sphere, and the sphere has been created" (1946). Maimonides' "dogmatic" position that the universe was created out of nothing conflicted with [contemporary] "empirical" data — data from none other than Aristotle himself — that matter was eternal. (Penzias, 1983, p. 1-2)

Although recognizing that some questions are outside of science, he nonetheless values asking questions in all areas, concluding that the ability to ask "good questions" rather than just the ability to learn, is the factor that "best distinguishes organisms that possess intelligence from those that do not" (Aleksander, 1989, p. 310). Good questions can also help to distinguish truth from lies:

> In [Panzias'] 1989 book ... he compares the rigidly defined terrain of computer logic with the improvisational thinking of Sir Arthur Conan Doyles' Sherlock Holmes. Holmes, in Penzias' view, uses his intelligence to distinguish between the truth and lies presented as fact. This is what separates man from machine, Penzias notes, for no machinery exists today with the human ability for judgment or opinion. (Fleming, 1990, p. 28)

The Man Behind These Words

Penzias is not only a Nobel laureate, but has earned numerous other awards, such as honorary doctorates by Rutgers University (*New York Times*, 1975) and many other institutions. He was born in Munich, Germany in 1933. When he was four years old, his parents fled Nazi Germany, eventually arriving in Brooklyn, New York (Webber, 1980). His father was a Polish citizen and his mother was German. Once in America, Penzias attended Brooklyn Technical High School and City College of New York

from which he graduated in 1954 (his alma mater later honored him with an honorary doctorate — *New York Times*, 1979). Penzias served in the U.S. Army Signal Corp., then pursued graduate studies in physics at Columbia University (Moritz, 1985).

His thesis was under Nobel Laureate Charles Townes and focused on the measurement of free hydrogen radio emissions from the Pegasus I cluster of galaxies (Webber, 1980). Penzias began his lengthy career at Bell Telephone Laboratories in 1961, where he has continued his research, taking advantage of the excellent radio astronomy facilities there (Lubkin, 1978). As Vice President in Charge of Research since December of 1981, he is still very involved in science advancements (Bernstein, 1984, p. 215). As of 1990, Bell Labs employed 22,900 workers, and had a budget of 2.9 billion dollars (Crease, 1991). Penzias explains how he became involved in the field of physics in the following words.

> After about one semester ... [at the City College of New York] I was sick of chemistry. I had taken so much in high school .... It involved a lot of memorization of stuff that I already knew. I also took elementary physics, which was taught by a very nice teacher named Hardy. I went to see Professor Hardy and I asked him, "Can a physicist make a living?" ... He said that physicists think they can do anything that an engineer can do, and if they can do that they can at least make a living as engineers. I said, "Fine" and switched majors to physics. (Bernstein, 1984, p. 220)

Working with him at the Columbia Physics Department were Nobel Laureates I. I. Rabi, Polykarp Kusch, Tsung Dao Lee, and Charles Townes. Penzias says that he struggled to get through Columbia and sometimes managed only by receiving incompletes and taking the exams later. The problem was not Penzias' abilities — he was extremely bright and capable — but because the Columbia physics department was highly demanding. He recalls he was once given five questions on a test in an optics course, of which he was sure about *none* of the answers. When he looked around the room, it appeared that the rest of the students could do the exam, so he plunged in. Penzias ended up with a score of 54 — the second highest mark in the entire class. For his Ph.D. thesis with Professor Townes he built the world's second radiation detection radio telescope. This unit was designed to pick up the specific radio wavelength emitted by hydrogen atoms, namely 21 centimeters. Penzias also worked on developing a large radio antenna to help detect hydrogen in space — the gas then thought to be present in the space between the galaxies — in order to complete an intergalactic hydrogen catalog. He found that many critical published calculations were incorrect, and had to modify his equipment, but still finished the study with "disappointing results" (Moritz, 1985, p. 329). Nonetheless, the young student learned a great deal and earned his degree.

When Penzias joined Bell Laboratories, he was put on the antenna pointing committee to solve measurement errors that occurred because the steel antenna bends under gravity, wind load, and temperature changes. Nor were the antenna's gears perfect, and its foundation was not perfectly horizontal either. A committee was formed to solve the precision problem, and Penzias' solution was to place a second receiver in the antenna which could be pointed at a known natural source of radiation, such as the remnants of an exploded star (Bernstein, 1984, p. 225). Then, by comparing the radio telescope's data to the star's known position, the operator could tell how far off of calibration the instrument was. After Penzias marked success in this area, he began working with the horn antenna at Crawford Hill doing radioastronomy.

One reason Bell Telephone Company funded basic research was because it allowed the company to exchange information with other scientists, who would then reciprocate with information that Bell needed which was developed at other science labs. Penzias was researching the hydroxyl molecule (-OH) in outer space when Robert Wilson joined the Bell Laboratory team in 1963. Bell had at this time moved out of the satellite communication area, and so the horn antenna that was built to communicate with the ECHO and TELSTAR satellites became available for full time radioastronomy. The two scientists then proceeded to make numerous discoveries. For example, in 1970, along with Keith B. Jefferts, they discovered carbon monoxide in the Orion Nebula. Soon after this feat they discovered ethyl alcohol, hydrocyanic acid and scores of other molecules in space. In Penzias' words: "The millimeter portion of the spectrum is so rich that it is hard to take an antenna and point it at certain sources in the sky and not find new lines" (Bernstein, 1984, p. 227).

It was in 1978 that Penzias and Wilson were awarded the Nobel Prize in physics for their discovery of the 3K background radiation because of its perceived significance for Big Bang cosmological model (Hudson, 1978). Prior to this, Bell Lab's radio telescope unit, which was originally designed for satellite communication, was modified to help Wilson and Penzias measure the intensity of radio waves emitted by the gas halo which surrounds our galaxy. A major advantage of this unit was that it was more directionally sensitive than other units of the day. The two scientists were researching the intensity of

radio waves emitted from this halo of gas at the Holmdel, New Jersey radio telescope when they made their best known discovery (Lubkin, 1978).

The discovery which, according to Gwynne (1978) "changed the face of modern cosmology" occurred while Penzias and Wilson were doing their routine communication research. They picked up a disconcerting background noise which persisted even after replacing the components which they felt could be producing the mysterious hiss. Since the background static interfered with their communications research, they were concerned to try to determine the cause, so as to eliminate it. Attempted solutions included cleaning pigeon droppings from their twenty-foot horn reflector antenna, as well as removing a pair of pigeons. However, the problem still persisted. They finally stumbled upon the idea that the noise was not interference, but that they were picking up a cosmic background noise. This is now generally interpreted to be what is left of the detectable echo of the Big Bang, which still permeates space.

Originally believed to be in the visible light area of the electromagnetic spectrum, the radiation has decayed to the microwave frequency and is now estimated at 2.73 K. When Penzias and Wilson discovered that the radio waves in the microwave frequency band were in fact emitted in every direction that they could measure, they began the research to find out why (Donovan, 1978). Researchers at Princeton, primarily Professors Robert H. Dicke and P.J.E. Peebles, first led them to the idea that this static may in fact be the first direct evidence of the Big Bang model. This model predicted that the universe emitted black body radiation at a temperature of about 5.0° C above absolute zero, about twice that actually found (Webber, 1980). Penzias' thoughts on the Big Bang cosmology that his research was so important in establishing are reflected in these words:

> ...proposed modifications to the Big Bang theory such as the "bubble theory" ... have to do with hypotheses for how this universal perfection could have happened without violating our understanding of the laws of physics. The bubble theory is a mathematical attempt at getting around our third "improbable" observational fact. As of now, the attempt seems to have been unsuccessful, but the importance of the challenge suggests that scientists will continue to pursue such lines of attack.
>
> Before concluding, I can't resist bringing up the "Missing Mass:" the difference between the amount of matter astronomers find in the Universe and the much larger amount needed to reverse the flight of the galaxies (and ultimately pull them back into a single condensed state). Naively, one might imagine hunting for matter as a kind of astronomical inventory, one in which the total climbs as overlooked nooks and crannies are examined ... [A]s astronomers "weigh" the sun by measuring the motion of the earth, we infer the mass of the universe from the motion of the galaxies themselves. Those motions point to a universe which will fly apart indefinitely — not one which will someday collapse to a point. Thus, observations also contradict the notion that our Big Bang is just one of an infinite series of such events. (Penzias, 1983, pp. 7-8)

Much is still not known about cosmology, and this is reflected in the many debates about the widely accepted, but still hotly disputed Big Bang model of cosmology (Odenwald and Fienberg, 1993; Lerner, 1991). And just what does all this lead up to? Penzias says:

> In summary, therefore, astronomy leads us to a unique event, a universe which was created out of nothing, one with the very delicate balance needed to provide exactly the conditions required to permit life, and one which has an underlying (one might say "supernatural"), plan. Thus, the observations of modern science seem to lead to the same conclusions as centuries-old [creation beliefs].... At the same time, most of our modern scientific intuition seems to be more comfortable with the world as described by the science of yesterday. (Penzias, 1983, p. 7-8)

Although most famous for the discovery that is now most often used to support broad Big Bang cosmology, Penzias' greatest achievements are in other areas, primarily information technology. This is not unexpected, in view of the primacy of the "information argument" in the designed universe world view that he holds (Johnson, 1991). As head of the largest and most productive information technology research lab in the world — they publish around 3,000 papers a year — he has been a leader in the information revolution that has changed our world (Fleming, 1990; Penzias, 1989a; 1989b; Gilder, 1989). He also is active in his own research and continues to make contributions to radio-astronomy and related areas. That his discovery is not unequivocal evidence for the Big Bang, and can be interpreted in other ways, does not detract from his achievements. One alternative explanation is that the background radiation arises "from dust grains that have been heated by starlight" (Goldsmith, 1985). A major cause of microwave background radiation may also be from extremely distant quasars (Narlikar, 1981, 1991).

* * * * * *

Scienctists have gathered an enormous amount of empirical data in their quest for an understanding

cosmology and the universe as a whole. Science, by its very nature and through replication, is able to produce empirical data that is widely accepted as valid, but, unfortunately, the interpretations of this data often vary. Because this scientific data is frequently used by many individuals in order to support their atheistic world views, the views of eminent scientists such as Arnold Penzias are useful in helping others to evaluate common interpretations of data. This review of one aspect of Penzias' work, although he has written only briefly about this subject, provides much insight into other possible conclusions in the admittedly rapidly evolving, and currently highly debated, field of cosmology. It is also apparent that it is not uncommon for pronouncements about cosmology and origins made in the mass media, and even by scientists, to be premature, and at times irresponsible. The importance of one's world view often is of major importance in interpreting the data, and understanding this concern is paramount in evaluating the conclusions of researchers. ✸

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Uses of the Word "God" in Scientists' Writings

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The word "God" often appears in the writings of scientists, especially those who are more philosophically inclined and/or who write for more popularized readerships. It is not unusual to find this word used over and over again in books and articles in the areas of cosmology, fundamental particles and forces, the origin of the universe, and the significance of scientific methodology and knowledge. This has been the case for many years, even for centuries, and it continues today.

For example, the word "God" appears in *A Brief History of Time*, a highly regarded book by Stephen Hawking, a noted theoretical physicist and cosmologist, five times in the first chapter and eight times in the last four pages of the final chapter.[1] The final paragraph is as follows.

> However, if we do discover a complete theory, it should in time be understandable in broad principle by everyone, not just a few scientists. Then we shall all, philosophers, scientists, and just ordinary people, be able to take part in the discussion of the question of why it is that we and the universe exist. If we find the answer to that, it would be the ultimate triumph of human reason — for then we would know the mind of God.[2]

Carl Sagan, a noted astronomer and writer, concluded his introduction to Hawking's book with this paragraph,

> This is also a book about God ... or perhaps about the absence of God. The word God fills these pages. Hawking embarks on a quest to answer Einstein's famous question about whether God had any choice in creating the universe. Hawking is attempting, as he explicitly states, to understand the mind of God.[3]

This use of the expression "the mind of God" was adopted as a book title by Paul Davies, a mathematical physicist and cosmologist. Davies' book, *The Mind of God*,[4] is a "more considered attempt" to grapple with issues discussed in his earlier book, *God and the New Physics*. The name "God" appears in the titles of several other highly regarded books on modern developments in science, including *Does God Play Dice*,[5] by scientist Ian Stewart, *The God Who Would Be Known: Revelations of the Divine in Contemporary Science*,[6] by financier and investment advisor John M. Templeton and biochemist Robert L. Herrmann, and *The God Particle: If the Universe is the Answer, What Is the Question?*,[7] by physicist Leon Lederman with Dick Teresi.

The word "God" appears numerous times in a highly regarded book by science writer James Gleick on the new science of chaos, with appearances from the first page of the second chapter to the next to last page of the last chapter.[8] Indeed, the term is included in the index with seven page references.

These examples and others which could be mentioned lead inevitably to the conclusion that the word "God" is often encountered in the writings of many scientists and science writers. This observation may be placed in the larger context of the prevalence of religion and of religious thinking among scientists. Astronomer Fred Hoyle is quoted as stating (or, as some would say, overstating) this factor thus: "I have always thought it curious that, while most scientists claim to eschew religion, it actually dominates their thoughts more than it does the clergy."[9]

What does the word "God" mean? Does it always have the same meaning? Who or what is the God which these frequent usages refer to?

A closer examination reveals a variety of meanings, essentially all of which are commonly found among other scholars and contemporary lay persons as well as among scientists and science writers. Let us list several of these meanings, recognizing as we do so that there is overlap from one to another and that this list may not be exhaustive.

First, the name "God" is equated to *a vague, general principle* of superior intelligence, or of goodness, or of whatever it may be that is supreme or ultimate. For example, in a discussion of uncertainty in quantum mechanics, Stewart wrote,

> An infinitely intelligent being with perfect senses — God, Vast Intellect, or Deep Thought — might actually be able to predict exactly when a given atom of radium will decay, a given electron shift in its orbit. But, with our limited intellect and imperfect senses, we may never be able to find the trick.[10]

Second, the word "God" is used with reference to a *transcendent initiator of the universe*, which has proceeded ever since in its mechanistic, deterministic ways without any further involvement of the God who initiated it. This is in essence the classical philosophy and theology known as deism. Note, for example, a reference to "the god of this machine universe, free to choose the laws of nature as he pleased."[11] How about a statement attributed to someone else in a discussion of the practical impossibility of writing wave function equations to describe the totality of the real world: "Maybe God could do it, but no analytic thought exists for undertaking such a problem."[12] Perhaps: "The biological world may not fulfill God's design, but it fulfills a design shaped by natural selection," in a discussion of Darwinian teleology.[13] Hawking wrote, "At the Big Bang and other singularities, all the laws (of physical science) would have broken down, so God would still have had complete freedom to choose what happened and how the universe began."[14]

Third, the concept of God to which a number of these uses of the name refer is that of *a "God-of-the-gaps."* This simply means that the name "God" is invoked to fill in whatever gaps may exist in human scientific knowledge at a particular point in time. Then, as scientific knowledge develops, the gaps may appear to become smaller and smaller, and the need for this God diminishes. This concept of God has been prevalent for many centuries among persons with and without any particular scholarly expertise. Dean Wooldridge, a noted scientist and industrialist, wrote a few decades ago,

> A paradoxical consequence of man's predilection for logical thought was his invention of the important concept of the supernatural .... to provide an "explanation" for matters he despaired of understanding. The development of science can be described as the process of transferring one after another aspect of human experience from the supernatural category into the realm of natural law .... It is good that our ancestors invented the concept of the supernatural .... The physical scientist has at least managed to consign it to a corner of his mind where it does not greatly interfere with his day-by-day activities.[15]

A more recent use of the God-of-the-gaps concept is encountered in the title of a recent book, *The God Particle*, by Lederman and Teresi.[16] In his response to questions as to why this title was chosen, Lederman stated, "I didn't really mean God," then explained that his use of the word symbolized "everything we don't understand yet."[17] In a further commentary on this book title, coauthor Teresi wrote, "It was meant as a joke."[18]

Hawking, in describing the earlier views of Laplace, stated that scientific determinism was ...

> ...incomplete in two ways. It did not say how the laws should be chosen and it did not specify the initial configuration of the universe. These were left to God. God would choose how the universe began and what laws it obeyed, but he would not intervene in the universe once it had started. In effect, God was confined to the areas that nineteenth-century science did not understand.[19]

The God-of-the-gaps meaning of the term "God" is illustrated also in Gleick's discussion of the complex, non-linear equations that would be required if we were to describe the weather completely, where he stated "God has not made the actual equations available."[20]

Fourth, and closely interrelated with some of the others, is a concept of *dualism, in which the physical realm of nature and the realm of the spiritual* (however this term may be defined) *are considered to coexist.* This and other forms of dualism have been prominent in philosophical and theological circles for many centuries. For example, Plato developed the concept of an ultimate dualism of ideas and matter. Aristotle followed him with an alternative view that ideas are not necessarily ultimate or transcendent, but he was unable to escape a dualism of form and matter. Kant drew an ontological distinction between what a thing appears to humans to be and what it is in itself. Theologies over the ages have tended to recognize the dualism of a principle of ultimate evil and a principle of coeternal good.

Yet another form of dualism is that between an individual's professed beliefs and his or her practice. A personal example of this pragmatic and very common dualism is described by Davies.

> Many practicing scientists are also religious. Following the publication of *God and the New Physics*, I was astonished to discover how many of my close colleagues practice a conventional religion. In some

> cases they manage to keep these two aspects of their lives separate, as if science rules six days a week, and religion on Sunday. A few scientists, however, make strenuous and sincere efforts to bring their science and their religion into harmony. Usually this entails taking a very liberal view of religious doctrine on the one hand, and on the other hand imbuing the world of physical phenomena with a significance that many of their fellow-scientists find unappealing.[21]

Presumably those scientists who are in agreement with, and take seriously, the Statement of Faith of the American Scientific Affiliation are included among Davies' "few scientists," but may not fall into either of his "usually" groups.

Fifth, the term "God" is used to represent *a deeper level of explanation than scientific explanation with respect to basic questions concerning the universe.* This concept is well-identified by Davies, "There must, it seems to me, be a deeper level of explanation. Whether one wishes to call that deeper level God is a matter of taste and definition."[22]

Sixth, the term God is used to represent *the God of the biblical Christian world view.* This is the God identified in the Statement of Faith of the ASA, and is used, for example, by Templeton and Herrmann: "Judeo-Christian theology ... viewed God as Creator and Supreme Ruler of nature, one who had not only brought the cosmos into being, but governed it by laws that reflected his faithfulness and consistency."[23]

I will make comparative comments on these diverse meanings of the term "God" shortly, but let me make a brief detour before I do so. Several of the major writings which we have quoted thus far make reference to Albert Einstein and to his use of the name of God in his writings. But what did Einstein himself mean by this?

In his own autobiographical notes, Einstein wrote,

> In the beginning, if there was such a thing, God created Newton's laws of motion together with the necessary masses and forces. This is all; everything beyond this follows from the development of appropriate mathematical methods by means of deduction.[24]

On one occasion, he was asked in a cablegram from a rabbi in New York, "Do you believe in God?" Einstein cabled back, "I believe in Spinoza's God, who reveals himself in the harmony of all being, not in a God who concerns himself with the fate and actions of men."[25]

In a philosophical study of Einstein's conception of religion in general, Hinshaw identified three levels in Einstein's thinking,

> First ... the most primitive conception of religion with its anthropocentric God. Second ... on the higher levels of social life, the religion of morality predominates. Third, there is what Einstein thinks of as "cosmic religious feeling." It is this last conception of religion in which Einstein believes; or, rather, it is this sort of religion which he lives.[26]

A statement by Einstein that he does not believe in a God who plays dice has been widely quoted by many others, often in a context far different than the one in which it was made. Actually, it appeared in correspondence in 1944 between Einstein and Max Born, a German physicist, in a discussion of physical phenomena which Born described as random events requiring statistical interpretation. Einstein believed that the physical realm is understandable somehow, while Born maintained that the universe was too complex for human understanding without resorting to random, statistical considerations. According to Bohr's published account of this correspondence, Einstein wrote, "In our scientific expectation we have grown antipodes. You believe in God playing dice and I in perfect laws in the world of things existing as real objects which I try to grasp in a wildly speculative way." Born then commented,

> If God has made the world a perfect mechanism, he has at least conceded so much to our imperfect intellect that, in order to predict little parts of it, we need not solve innumerable differential equations but can use dice with fair success.... I think this situation has not changed much by the introduction of quantum statistics; it is still we mortals who are playing dice for our little purposes of prognosis — God's actions are as mysterious in classical Brownian movement as in radio-activity and quantum radiation, or in life at large.[27]

This difference of opinion between Einstein and Born has frequently been paraphrased in the form of a question, "Does God play dice?" It is, in essence, the age-old question of whether or not the realm of nature is deterministic or chaotic, whether orderly or disorderly. Stewart used this question in the title of his book, and then concluded his own advocacy of deterministic chaos by stating that the question is not *whether* God plays dice, but *how* he does so: "Either God is playing dice, or he's playing a deeper game that we have yet to fathom,"[28] and "If God played dice, he'd win."[29] In a similar fashion, Joseph Ford, a leader in the new science of chaos, stated "God plays dice with the universe, but they're loaded dice. And the main objective of physics now is to find out by what rules were they loaded and how can we use them for our own ends."[30]

Now let us return to the listing of six meanings of the term "God" in the writings of scientists. It is obvious that each of the first five differs markedly from the God of the biblical Christian world view.

(1) ...the name "God" is equated to *a vague, general principle* of superior intelligence, or of goodness, or of whatever it may be that is supreme or ultimate.

The God of the Bible is not a vague, general principle or impression of anything. He is infinite and humans are finite, so we can not fully comprehend him. Nevertheless he is personal and knowable through his general and special revelations of himself to humankind.

(2) ...the word "God" is used with reference to a *transcendent initiator of the universe,* which has proceeded ever since in its mechanistic, deterministic ways without any further involvement of the God who initiated it.

God indeed is the transcendent initiator of the universe. However, the biblical concept of God does not stop with his transcendence, for he is also immanent within that which he initiated, the sustainer of that which he created. Scientific laws as delineated by human beings are not descriptive statements of how the universe runs without God, but rather are descriptive statements of ways in which he normally sustains it.

(3) ...the concept of God to which a number of these uses of the name refer is that of a *"God-of-the-gaps."*

The biblical concept of God is not at all that of a God-of-the-gaps useful only to fill in whatever blanks may exist in human scientific knowledge at a particular point in time. Rather, the God of the Bible is sovereign, and nothing is exempt from his sovereignty. He permeates all reality, whether or not that reality is explainable by the present state of scientific knowledge.

(4) ...a concept of *dualism, in which the physical realm of nature and the realm of the spiritual* (however this term may be defined) *are considered to coexist.*

The God of the Bible is not merely one part of a dualism. He is not limited to a realm of the spiritual coexisting with a realm of the physical. These two realms are intimately interconnected because both are within the sovereignty, the transcendence and the immanence of the God of the biblical Christian world view.

(5) ...the term "God" is used to represent a *deeper level of explanation* than scientific explanation with respect to basic questions concerning the universe.

God does provide a deeper level of explanation than scientific explanation of the physical universe, but the word "God" is not merely a name for that deeper level. The God of the biblical Christian world view transcends scientific explanation, is in no way dependent on it, and is not a mere extrapolation from scientific knowledge.

What conclusions may we draw from the readily observable fact that the word "God" is commonly used in writings of contemporary scientists and science writers? The most obvious one, perhaps, is that the meaning of this word varies considerably from one usage to another. Thus, we should be careful in gaining understanding of each such usage to insure that we understand just what the author means by it.

A few additional points are worthy of mention. (a) Concepts of some sort of supreme being(s) have been prevalent in all times and cultures throughout all human history, and they are by no means any less prevalent in our own era, including among persons who are scientists. (b) Much can be learned regarding the essence, the meaning and the significance of the God of the biblical Christian world view by means of careful study of both his general and special revelations to humankind. (c) Some of the major writings of contemporary scientists represent valiant efforts to see just how far we can go in learning about God and the "mind of God" from study of the general revelation alone, and much can be learned from these studies. (d) Nevertheless, to ignore or to deny either the general or the special revelation is to become subject to serious incompleteness and error. (e) The existence of God can not be ultimately "proved" by purely scientific investigations of the physical universe, but such observations and studies can and do provide powerful evidence in support of the biblical Christian faith. ✱

Notes

[1]Hawking, Stephen W. *A Brief History of Time: From the Big Bang to Black Holes*, Bantam Books, New York, 1988.
[2]Hawking, p. 175.
[3]Hawking, p. x.
[4]Davies, Paul. *The Mind of God*, Simon and Schuster, New York, 1992.
[5]Stewart, Ian. *Does God Play Dice? The Mathematics of Chaos*, Basil Blackwell, Ltd., Oxford, 1989.
[6]Templeton, John M., and Robert L. Herrmann. *The God Who Would Be Known: Revelations of the Divine in Contemporary Science*, Harper and Row, San Francisco, 1989.
[7]Lederman, Leon, with Dick Teresi. *The God Particle: If the Universe is the Answer, What Is the Question?* Houghton Mifflin, New York, 1993.
[8]Gleick, James. *Chaos: Making A New Science*, Penguin Books, New York, 1987.
[9]Davies, p. 223.
[10]Stewart, p. 229.
[11]Gleick, p. 12.
[12]Gleick, p. 185.
[13]Gleick, p. 201.
[14]Hawking, p. 173.
[15]Wooldridge, Dean. *The Machinery of Life*, McGraw-Hill Book Company, New York, 1966. p. 2.
[16]Lederman, Leon, with Dick Teresi.
[17]Stine, Richard (editor). "Science Scope," *Science*, vol. 259, January 29, 1993, p. 587.
[18]Teresi, Dick. "Letters," in *Science*, vol. 260, April 30, 1993, p. 607.
[19]Hawking, p. 172.
[20]Gleick, p. 168.
[21]Davies, p. 15.
[22]Davies, p. 16.
[23]Templeton and Herrmann, p. 7.
[24]Schilpp, Paul Arthur (editor). *Albert Einstein: Philosopher-Scientist*, Tudor Publishing Company, New York, 1951. p. 19.
[25]Schilpp, p. 103.
[26]Schilpp, p. 660.
[27]Schilpp, p. 176.
[28]Stewart, p. 293.
[29]Stewart, p. 303.
[30]Gleick, p. 314.

Book Reviews

Two Views of Gish's *Creation Scientists Answer Their Critics*

CREATION SCIENTISTS ANSWER THEIR CRITICS by Duane T. Gish. El Cajon, CA: Institute for Creation Research, 1993. 451 pages, bibliography, two indexes, footnotes. Paperback; $16.95.

Reviewed by John W. Burgeson, Senior Staff, Market Research, IBM Corporation, 6715 Colina Lane, Austin, TX 78759.

The appearance in recent years of a plethora of publications attacking creation-science has led many people to wonder if the Institute for Creation Research (ICR), and in particular, its most prominent proponent, Duane Gish, has been both refuted and discredited. Many readers of *Abusing Science* (Kitcher, 1982), *The Monkey Business* (Eldredge, 1982), *Evolution versus Creationism* (Zetterberg, 1983), *Scientists Confront Creationism*, (Godfrey, 1983), *Science on Trial* (Futuyma, 1993) or any of the many other anti-creationism books published between 1976 and 1985 may have concluded as much. If this is your experience, this book is for you. Gish rebuts several of these authors on selected portions of their work, doing an excellent job of refutation.

The first chapters set the stage. Following a short historical overview, there is a well written discussion of terminology and the theme of "scientific integrity." Next follow two topical chapters. The first is on the fossil record, in which Gish responds to the arguments of Eldredge, Godfrey, Gould, Kitcher and Futuyma. The second is on thermodynamics, where the arguments of Huxley, Asimov and Patterson, among others, are rebutted. Three chapters then address specific anti-creationist books: Gish's tongue-in-cheek chapter headings — "Kitcher Abuses Science," "Eldredge and His Monkey Business," and "Science Confronts Evolutionists" make them easy to identify! The last chapter, which ought to be an appendix, is a compendium of many of the quotations which ICR loves to use and which cause so much unhappiness in the ranks of the scientific-naturalist community.

Espousal of a minority viewpoint is difficult; when this viewpoint is unpopular, doubly so. Creation Science, as defined and proclaimed by ICR, goes beyond this level, attacking, as it does, the intellectual foundations of whole areas of inquiry. As scientists have a long history of name-calling on much less volatile issues, it is hardly unexpected that many bitter anti-creationist works appeared. What is surprising, however, as Gish documents, is their apparent lack of responsible scholarship — "errors of fact," as opposed to "differences in opinion," in many places.

Those committed to the "evolution is fact" position will do well to avoid this book. It will not do nice things to your blood pressure and it will give you uneasy feelings about some rather well known scientists. Those committed to the "evolution is myth" position can also ignore the

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Last year, the Institute for Creation Research (ICR) published Duane Gish's *Creation Scientists Answer Their Critics*, a 451-page book which, according to its back cover, "evaluates the major arguments for and against special creation and evolution and defends creation scientists against the distorted, inaccurate, and often vicious attacks of evolutionists."

The book is, in effect, the creationist counterpart to Arthur N. Strahler's 1987 book, *Science and Earth History: The Evolution/Creation Controversy*. A comparison of the two books is instructive. Strahler's 552 pages provide an introduction to mainstream views of the sciences involved in the creation/evolution controversy, while also describing and rebutting numerous creationist objections to those views. But while Strahler's book is sober and scholarly in style, and generally allows creationists to speak for themselves, Gish uses inflammatory language and is usually highly selective in his quotations from critics. Strahler sampled a wide variety of creationist works, drawing from about 100 creationist books and articles, including numerous articles in the ICR's *Impact* series and Technical Monographs, the *Ex Nihilo Technical Journal*, the *Creation Research Society Quarterly*, and *Origins Research*. Gish, on the other hand, selects only a tiny sample of anti-creationist works. While Strahler took great pains to make his book up-to-date, with 328 (45%) of the 722 entries in his bibliography less than eight years old, Gish ignores a great deal of recent work — only 26 (6%) of his 428 references are from the eight years preceding his book's publication. In short, while Strahler's book is fair, balanced, and up-to-date (as of 1987, at least), Gish's book is neither fair, balanced, nor up-to-date.

According to Gish, evolutionists are "smug" (pp. 12, 16), "gripped ... firmly [by] dogma" (p. 13), "arrogant" (pp. 16, 295, 306), "vicious" (pp. 19, 71, 162, 194, 205, 334, 343, etc.), "slanderous" (pp. 88, 96, 193), "virulent" (pp. 98, 141, 275, 334), and "bitter" (pp. 343, 357). Creationists, on the other hand, are "the voices of scientific reason" (p. 13), taking part in a "renaissance" (p. 15), and are promoting "an open, free, and thorough scientific challenge to evolutionary theory" (p. 18). It is impossible to read more than a few pages of Gish's book without encountering these types of emotion-laden adjectives. And if Gish can describe an evolutionist as an "atheist," a "humanist," or a "Marxist," he rarely hesitates to do so (pp.

Burgeson, *continued*

book. Unless you are willing to read the opposition — in detail and carefully — it is simply a sermon you've heard before.

Those who have read — carefully — one or more of the books cited above, and also have given prior publications by ICR a fair hearing, will benefit from Gish's work. For such, I recommend it as a permanent library acquisition. The footnotes are copious, the quotations meticulously documented, the bibliography extensive, the index comprehensive.

There are weaknesses in this book. Gish frequently repeats himself and sometimes sermonizes (not biblically). His critics are usually described as "virulent" (Raup is an exception); the book would have benefitted from a little more thesaurus activity. Section headings are needed. The Chatterjee find in Texas is described as if no controversy existed about it, which weakens the argument around it substantially. Finally, Creation Scientists are frequently referred to as if they constituted a significant minority of all scientists. It is high time ICR made an attempt to quantify that minority. My estimate, from 30 years of study of the issues, is that such scientists are well under 1% of the whole. Your milage may differ.

Did Dr. Gish answer his critics?

Absolutely. The ball is in their court.

Were the central issues discussed?

Incompletely. Both Gish, and his naturalistic critics, appear to focus on science as a "search for truth," rather than a "search for models." In popular writings on both sides, the tenuous line between science and philosophy is often blurred. This book continues the confusion. Yet, it is a worthwhile contribution to the continuing debate, certainly belonging in any library that welcomes the anti-creationism publications.

Does this end the controversy?

Surely you jest! ✸

Lippard, *continued*

21, 22, 29, 72, 145, 253, etc.). It is ironic, then, that Gish advises evolutionists to avoid "vicious, *ad hominem* attacks" (pp. 71, 107).

Gish maintains his picture of evolutionists as atheists, agnostics, humanists, and Marxists by ignoring Christian critics of creationism. The reader of Gish's book is left in the dark not only about Christians who advocate some form of theistic evolution, but about old-earth and progressive creationists as well. The ASA, the Interdisciplinary Biblical Research Institute, and the Reasons to Believe Institute are all absent from the book — only young-earthers are mentioned. In part this maneuver is made possible by Gish's refusal to defend a young earth or flood geology, despite the fact that these tenets of Scientific Creationism are a central focus of ICR literature.

Christian critics of Scientific Creationism are hardly the only critics ignored. Gish refers to only a few anti-creationist works: only three books in any detail, all published prior to 1984. He responds (p. 103) to only a single article from the thirty issues of the National Center for Science Education's *Creation/Evolution* (*C/E*) journal published prior to his book: a 1981 article about Gish's bombardier beetle claims by Christopher Gregory Weber. Even here, Gish lets Robert Kofahl's reply (also published in *C/E*) do the work of responding, and ignores Weber's rebuttal in the same issue. And 100 pages later (p. 204), Gish falsely claims that "evolutionists made no attempt to answer my challenge to explain how an ordinary beetle could have evolved into a bombardier by any mode of evolution" — contradicting his mention of "Weber's attempt to explain the evolution of the bombardier beetle from an ordinary beetle" on the previously cited page.

One other article from *C/E* is mentioned by Gish (pp. 88-89); Kenneth Miller's "Answers to the Standard Creationist Arguments" from 1982. Gish writes (p. 89) that "in a critique later in this book, we will return to a discussion of Miller's attempt to provide answers," but he never does. Instead, he attacks Miller for falsely charging him with quoting E. J. H. Corner out of context, ignoring the fact that Miller corrected and apologized for his mistake in *C/E* (IX:41-43).

Had Gish made use of *C/E*, he would have had to correct his erroneous statements about Karl Popper (pp. 35- 36; *C/E* XVIII:9-14), been unable to claim that Richard Lewontin "neither names the culprit nor provides any documentation" for his charge of being quoted out of context by creationists (pp. 252-253; *C/E* VI:34-36; the culprit was Gary Parker of the ICR), been forced to deal with the pseudogene evidence for common ancestry (*C/E* XIX:34-46; XXVII:45-49), needed to respond to Edward Max's thermodynamics challenge (*C/E* XXVII:53-55), and been unable to repeat his misleading defense of his false claim that there are chicken and bullfrog proteins that more closely resemble human proteins than the corresponding chimpanzee proteins (pp. 96-101; *C/E* XVII:1-9). On top of all this, Gish incorrectly identifies the editor,

Lippard, *continued*

publisher, and address of *C/E* by using information that was about two years out-of-date at the time.

It is also apparent from Gish's book that he has not read one of the most significant popular works arguing for evolution in recent years, Richard Dawkins' *The Blind Watchmaker* (1985). If he had, he would not have made the mistake of claiming (p. 54) that "The white coat color of the polar bear cannot be adaptive, however, since he has no predator" — an argument rightly ridiculed by Dawkins on pp. 38-39 of his book.

When Gish does cite anti-creationist sources, it is often in an odd way. Chris McGowan's 1984 book, *In the Beginning... A Scientist Shows Why The Creationists Are Wrong*, is almost entirely about the fossil record, and much of it criticizes Gish. Gish cites McGowan's book only once, on p. 163, regarding thermodynamics. On the other hand, Gish cites (p. 62, via secondary source) E. O. Wiley and Daniel Brooks' *Evolution as Entropy*, regarding the significance of natural selection, but ignores their work in his thermodynamics chapter.

Finally, Gish sometimes seems to go out of his way to miss a critic's point. He discusses David Raup's statement that the geologic column was established by creationists prior to Darwin, and not based on the assumption of evolution (pp. 303-304). Gish quotes Raup saying that "Geochronology depends upon the existence of a virtually exceptionless sequence of distinctive objects in rocks." Gish suggests that this is contradicted by Raup's later statement that "Not uncommonly, however, demonstrably young rocks are found *beneath* older rocks," but only by ignoring what Raup says immediately thereafter about the geological evidence for thrust faulting. Raup explicitly states that when there is such evidence, "the reversal of the order is not a meaningful exception to the Law of Superposition." Such structural deformations can be detected and the original order of rock sequences restored using geometric principles which are taught in any good introductory geology text, and not, as Gish goes on to claim, "by the fossils they contain." This is demonstrated by their routine application to rocks without fossils. Further, Gish describes Raup as criticizing "some creationists." He doesn't mention that he himself wrote that the geologic column "is based on the assumption of evolution" (*Evolution: The Challenge of the Fossil Record*, 1985, p. 47) — three years after having admitted, when shown a 1795 geologic map, that this was a mistake (McGowan, *In the Beginning...*, p. 100).

Gish's book is not entirely without value. He does demonstrate that critics of creationism have made mistakes — sometimes sloppy ones — in their arguments against creationism and creationists. He has made some objections against evolution which show the need for continued research. But this is entirely overshadowed by the fact that his book suffers from the same flaws he finds in the work of evolutionists, and to a much greater degree. To have accomplished the goal of the book's title, he should have begun with *C/E*, some old-earth creationist works such as Daniel Wonderly's *Neglect of Geologic Data: Sedimentary Strata Compared with Young-Earth Creationist Writings*, and a copy of Strahler's book — to which Gish makes not a single reference. ✸

NOVELTIES IN THE HEAVENS: Rhetoric and Science in the Copernican Controversy by Jean Dietz Moss. Chicago: The University of Chicago Press, 1993. 353 pages, bibliography and index. Paperback.

The thesis of this book is that rhetoric was first used to advance scientific theories during the time of Galileo. The book is structured in three parts: "The Celestial Revolution," "The Hermeneutical Crisis," and "The Triumph of Rhetoric." The text is well indexed and contains a ten page bibliography.

The opening chapter summarizes the historical development of rhetoric and various technical terms that are used to analyze prose. Dialectical or probable reasoning, for example, is defined as reasoning that can not be demonstrated directly, but can be shown from known proofs, as opposed to rhetorical reasoning, which is used to persuade an audience about a particular proposition.

The book really begins in the second chapter with a comparison between Ptolmeys' *Almagest* and Copernicus's *De Revolutionibus*. Most of the dialectical arguments contained in *De Revolutionibus* use geometric and mathematical proofs to refute the Ptolmeic model. Copernicus employed rhetoric only in the non-scientific areas, such as preface and introduction. Kepler followed a similar style, which the author contrasts with Galileo's prolific use of rhetoric. For example, Galileo is said to have used rhetoric in reporting the discovery of Jupiter's satellites ("the Medicean Stars") so that he could secure an academic position at the court of the Medici.

The second major section changes the emphasis from rhetoric in science to rhetoric in theology. The discussion begins with works by Zuniga and Foscarini, who reinterpreted scriptures that seem in conflict with a heliocentric universe. Following the writings of these two respected priests are those of Campanella, a blighted Dominican friar who sought to clarify "[w]hether the way of reasoning that Galileo practices is reconcilable with the Scripture or not" (p. 153), and Giordano Bruno. The author shows how Galileo's later works included stylistic elements used by both Campanella and Bruno.

The final chapter in this section analyzes Galileo's "Letter to Madame Christina of Lorraine, Grand Duchess of Tuscany," and both the interplay among those who read the original letter and the letter's passage to the Holy Office. As the writings of Galileo become the focus of the book the author highlights the use of rhetoric and the adept way in which Galileo used analogy and dialectical reasoning.

The third section of the book begins with the Inquisition's conclusion (1616) that deemed heliocentrism con-

trary to Scripture and "therefore cannot be defended or held" (p. 217). However, a report of three new comets in 1618 showed that the heavens are not without change, although the location of the comets lead to a heated debate between Galileo and Orazio Grassi (a Jesuit at the Collegio Romano). The author covers enough of the reasoning used in the debate to convey the developments, and focuses on the more vitriolic examples of rhetoric that are employed.

The climax of the book is an extensive discussion of Galileo's "Dialogue Concerning the Two Chief World Systems." Galileo used all the rhetorical elements he can to promote Copernicanism, while trying to convince the Holy Office that he was presenting both sides of the argument and so remain within the bounds set by the church. Galileo's work is seen "not only [as] an apologia for Copernicanism but a masterpiece of rhetorical literature" (p. 265).

As a kind of epilogue, the author examines the impact of Galileo's writings in England, through the writings of John Wilkins, a founding member of the Royal Society and later Bishop of Chester. Moss contrasts Galileo's provocative style with Wilkins' soft tone and impartial style, although a number of arguments put forward by Wilkins are derived from Galileo's books, suggesting that Wilkins was able to filter out Galileo's rhetoric from his dialectical reasoning.

The beauty of this book is the excellent background to the scientific and religious atmosphere, and the politics that occurs between the different characters. Consequently, we can better understand the subtleties and innuendo used in the various writings. Several chapters conclude with a summary of the way in which a particular writing style was used in the delivery of different ideas. Some topics that may be of interest to ASA members fall outside the scope of the book (for example, there is no analysis of Galileo's trial). The author is skilled in portraying the characters and has obviously expended a great deal of effort to see how different events effected the protagonists, making this lively and fascinating reading.

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

SHOOTING FOR THE STARS by Ross Clifford and Philip Johnson. Claremont, CA: Albatross Books, 1993. 224 pages, appendices, endnotes. Paperback.

Look over there! It looks like a duck, it walks like a duck, it even quacks like a duck: it must be a duck, right? Well, not in this case. This book, *Shooting for the Stars*, is decidedly a "bird of a different feather" despite first appearances. The cover of this paperback looks like others on shelves of New Age literature. As you scan the table of contents and the headings throughout the book, you probably would still think you were about to explore human potential from a New Age perspective.

The authors of this book are Australians Ross Clifford, a lecturer in theology at Morling College, and Philip Johnson, a columnist for *Australian Presbyterian Living Today Magazine* and a part-time lecturer on cults at the Presbyterian Theological Centre. They have adopted the strategy of the Apostle Paul when he spoke with those who were "seekers" in Athens (Acts 17:16-23). In this book, which is directed to New Age devotees and seekers, they adopt Paul's conciliatory tone, and attempt to stimulate interest in exploring the Christian alternative even while operating within the non-Christian context.

In examining this book I was struck by the tone of the writing. Genuine respect is expressed for those who are searching for answers to life's deep questions and coming up with answers which fall outside the Christian faith.

It is apparent that the authors have a strong sense of security in their personal beliefs and in the authenticity of the biblical record. The book is written in a journalistic style and is based upon discussions which occurred between the authors and those they met at Australia's largest New Age festival. Over 60,000 people were in attendance at the Mind-Body-Spirit festival held at Sydney's Darling Harbour in 1992. Clifford and Johnson set up a booth at this festival and offered to pray for healing for those in physical need. They also provided a video on Jesus and entered into dialogue with all who showed interest in discussing their perspective.

This book discusses near-death experiences, astrology, reincarnation, and cosmic consciousness. It also briefly alludes to various "psycho-technological tools" such as alchemy, auras, channelling, clairvoyance, crystals, enneagrams, firewalking, geomancy, meditation, rebirthing and soul travel. In discussing healing through the use of different types of myth, they refer to the gospel in a way which reflects their style throughout the book.

> We explained that myths like Sleeping Beauty have an actual objective base. They are not just good internal realities, but are historical encounters. The champion (Master Jesus) actually did come into our dimension to rescue the princess (us) by a kiss (the cross) and restore paradise (heal our lost, soul-sorrow [sic.] lives). This brings a unique light to the Sacred Writings (p. 125).

The main strength of this book is as a model for how it is possible to communicate the truth of the Christian message within the social context of a specific group.

On the negative side, the book frequently provides definitions of New Age terms which are so brief as to be of little value. Even some of the more strategic concepts alluded to are not defined at all. For example, in the introduction while describing the New Age festival the authors state "The exhibition incorporates 'Neo-Pagan' paths to recovery" (p. 9). The term recovery is used again several times, but the special meaning in this context is never discussed, let alone formally defined. The academic who may be interested in locating the source of some of the ideas in the text will be disappointed. Numbers in the text refer to endnotes which have only incomplete

citations. When one turns to the bibliographic entries they are alphabetical, but only so within six different categories of books. You can find the material, but it seems to be unnecessarily cumbersome.

Reviewed by Craig E. Seaton, Associate Professor of Sociology and Psychology, Trinity Western University, Langley, BC V3A 4H9, Canada.

THE PROMISE OF NATURE: Ecology and Cosmic Purpose by John F. Haught. Mahwah, New Jersey: Paulist Press, 1993. 156 pages, index. Paperback; $9.95.

Haight is a professor of theology at Georgetown University. In this book he asks if the religions of the world, in particular Christianity, have resources to contribute anything to substance to the resolution of our current ecological predicament. I regret that he often looked to non-Christian religions for the answer.

Haught looks at Muslims, Hindus, Buddhists, Lakota Indians, Taoists and others in the first part of his book. He says that all religions share the fact that they have an ultimate horizon or truth, indicated by Haught with the word "mystery" (p. 74). He goes on to say that to be wholesome this movement toward mystery has four distinct aspects: sacramental, mystical, silent and active. It is striking that he does not mention the importance of Holy Scriptures. Consequently biblical quotes are almost missing.

Excluding the work of other Christians had, for example, the unfortunate consequence that Haught did not acknowledge the work of Calvin De Witt of the University of Wisconsin, well known for his ecological work based on Christian principles. He also did not study or mention the "Report of the Committee on Creation and Science" to the 1991 Synod of the Christian Reformed Church. There he would have found a theocentric vision, which sees God's hand in evolution, not chance, *and* that condemns the present ecological disasters and attitudes. We cannot agree with Haught and accept a "God of evolution" who "allows for the play of chance in the emergence of species" (p. 34). That is an unbiblical God.

Haught does make some good points. For example, it is true that an elevation of spiritual life at the cost of our daily life has been harming the environment. His stressing "sacramentality" is clearly Roman Catholic. That does not mean we (Cathoic *or* Protestant) should forget that God gave us the task to take care of creation. Ruling creation is serving creation, taking care of it.

Anybody concerned about the present ecological crisis may learn something from this book. Keep your Bible open, though, and do not depend on "human reasoning."

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

REBIRTH OF VALUE: Meditations on Beauty, Ecology, Religion and Education by Frederick Turner. Albany, NY: SUNY Press, 1991. Paperback; $12.95.

Some people see modern science, and even all of modern scholarship, including art, as value-free, as if there is no such thing as value, as if beauty is just the product of brain chemistry, different in each individual. Frederick Turner argues passionately that there are such things as real value and beauty.

Turner begins by reversing Freudianism: beauty is real, and sexual passion is derived from it. Beauty is a real entity, not a product of human imagination: why else, he argues, would poetry in all cultures have similar characteristics? A sense of beauty confers evolutional advantage. Therefore evolution will lead us, he says, to greater beauty, to "...the Son of Man — the daughter of humanity — toward whom we have yearned unaware so long." However, recent artistic trends have been towards the denial, even the destruction, of beauty. Turner suggests that these artists should study a little science. If they did, they would see with Schrodinger that randomness is not freedom, and with the astronomers that in the beginning "[t]he universe fled randomness as fast as it could...." At the same time that technology was wasting fossil fuels, the artists were strip-mining our artistic heritage, "laid down over past ages ... of slow cultural fermentation," "tossed into the furnace" to release its stored energy, "a ship that tears up its own planking to feed its furnace." Randomness is no escape from determinism, "as if one were to escape death by claiming to be a stone, which cannot die." "Deconstructionism has now begun to turn its acids on itself; as it does so, it will encounter the paradox of what container to keep the perfect corrosive in."

He then applies his ideas to ecology. We belong on earth, he asserts; a wilderness area, without people, is artificial, and even eroded landscapes can be beautiful. He points out that, according to current geological theory, "our precious oxygen ... is the toxic waste of the first polluters." Nature, whatever it is, is not innocent. Nor is it wise. "The flowers growing in the desolation of Mt. St. Helens testify to what in human beings we would call a lunatic hopefulness, the optimism of the amateur ... Nature sends in the clowns." Therefore, Turner rejects both the polluter and the "ecology freak": "they both perpetuate a theory about nature that allows no alternative to raping it or tying it up in a plastic bag to protect it from [human] contamination."

Turner then turns to religion. He describes televangelists as junk religion, which people crave because humans have an innate hunger for true religion. "Genuine religion is playful, holy, reckless, and hilarious in all of its seriousness; the nature and meaning of the universe is risked, up for grabs, friendly only to the generous, the fools of god." Spirit is real, he argues; just as the existence of ears is evidence for the reality of sound, so the existence of religion is evidence for the reality of spirit. Greater religions than any the world has yet seen are in store, he promises. In another brief chapter, he says he solves

the riddle of immortality: we live forever in the form of talk, of being remembered and talked about by people who outlive us.

He then makes some novel proposals for improving education by restructuring it to reflect the reality of the universe. Education should begin, he says, with exploring "the why of the world." One cannot draw lines between "disciplines." "Science teachers ought to be poets; it goes without saying that poets have to be scientists." For instance, fiction can help us better understand history. Education ought to "get those sweet and potent brain chemicals flowing." We are hard-wired to be infinitely inventive, he says. He considers his late father, Victor Turner, to be the ultimate educator, who "wandered over [the fragmented academic] landscape like some prophet of apocalypse." Victor Turner invited students to his house to discuss academic topics, and they sometimes stayed and argued all night. He wandered fearlessly across the borders of academic disciplines. If we followed his system, universities would abolish departmental structures altogether. Turner nearly convinces us to try this approach. But how do we get started? He does not give us clear instructions.

And so I finish the book, exhausted and elated from exploring these insights, and go right back to believing and doing what I did before. But I was glad to have read it. The book is not well-crafted and logical, but is a flood of insights. It has more philosophical one-liners than any other book I have recently seen. Like Birch and Cobb's *Liberation of Life* (reviewed in *PSCF* 40: 246-247), this book is about everything.

Perhaps the most interesting and valuable statement Turner makes in this book is one that is relevant to environmental ethics.

> That ecological modesty which asserts that we are only one species among many, with no special rights, we may now see as the abdication of a trust. We are, whether we like it or not, the lords of creation; true humility consists not in pretending that we aren't, but in living up to that trust that it implies by service to the greater glory and beauty of the world we have been given to look after. It is a bad shepherd who, on democratic principles, deserts his sheep.

Reviewed by Stanley Rice, Department of Biology, Southwest State University, Marshall, MN 56258.

THE EARTH IS THE LORD'S: Christians and the Environment by Richard D. Land and Louis A. Moore (Eds.). Nashville, TN: Broadman & Holman, 1992. 207 pages. Paperback; $10.95.

The pantheistic and New Age excesses of non-Christians concerned about the environment often cause Christians to abandon this area of important stewardship. This book grew out of discussions at the Southern Baptist Christian Life Commission's meeting in March 1991 entitled "Christians and the Environment: Finding a Biblical Balance Between Idolatry and Irresponsibility," and seeks in many ways to overcome this frequent challenge to evangelical Christianity. The first words of the Preface set the stage with a quote of Psalm 24:l: "The earth is the Lord's, and the fullness thereof; the world, and they that dwell therein." In the Introduction, the book elaborates on this theme further:

> Christians must find the biblical balance or middle way between the idolatry that worships the "created things rather than the Creator" (Rom. 1:25, NIV), and the irresponsibility that assumes the right to treat God's creation as its own to do with as it pleases (Luke 12:1321).

Editor Richard D. Land is Executive Director of the Christian Life Commission of the Southern Baptist Convention. Editor Louis A. Moore is Director of Media and Products for the Christian Life Commission. The editors have written an introductory section, and each contributes one of the chapters in the book.

The book is divided into five sections: Introduction, The Theological Imperative, the Ethical Application, The Homiletic Challenge, and The Practical Application. The four main sections consist of thirteen chapters by twelve different authors; two chapters are written by Millard Erickson, Research Professor of Theology at Southwestern Baptist Theological Seminary. Most of the authors have or have had an official position in one of the organizations of the Southern Baptist Church.

The biblical view of the environment is set forth in the first chapter by Land and is repeated for emphasis in a variety of forms in many of the chapters in the book. This biblical view encompasses: (l) God is the Creator, (2) the creation is valuable to God, (3) care for creation survives the Fall, (4) care for the creation has an eschatological dimension (Rom. 8:19-21), (5) God has placed human beings first in creation, (6) God is the Lord of creation, while we are vicars and vice-regents, (7) the role of human beings is to care for the creation on behalf of God.

Chapter 3 sets forth a more detailed "Biblical Theology of Ecology," and it is followed by a warning in the following chapter, "Humanistic and New Age Ideas and Ecological Issues." In this chapter, the author cautiously, but determinedly, sets forth the argument that the biblical perspective must be based on a literal, totally historical view of Genesis.

In Chapter 5, Millard Erickson effectively contrasts a legalistic approach to environmental ethics with a situation ethics perspective, and argues that a "principle" approach is superior to either of these. This leads to the positive statement, "This means that indeed an objective — good or bad, right or wrong — exists for each situation, but the rule expressing it may be much more complex than some have thought" (p. 74). Possibly more questionable is the suggestion that the Southern Baptist Convention take direct action in pronouncements and activities related to political as well as social action, protesting, for example, a polluting product through a resolution of its annual

assembly, notifying the manufacturer of this resolution, and leading individual congregations to vote to boycott the product.

The New Age movement and its interaction with environmental concerns is treated again at some length in Chapter 6. After a useful and comprehensive treatment, the author states, "Planetary consciousness, defined earlier as the New Age term for a world view which places loyalties to all living beings, including the earth, above loyalties to self, individual people, groups, or nations, is one of the driving forces behind New Age practices" (p. 103). Understanding the implication of words is not always easy, but this statement of higher loyalties (corresponding to being a citizen of heaven) does not seem to be a good point to stress for differences with a Christian world view.

In the midst of excellent treatments, often repeating in different words points made in earlier chapters, there are occasional troublesome phrases that seem susceptible to misinterpretation. In the chapter on "Accepting our Responsibility," the author says, "and so, we are stewards with a message. I don't think our primary issue is Styrofoam cups" (p. 153). In a chapter on "Theology of Creation," the author says, "The creation is personal, not impersonal" (p. 161). An unfortunate typo appears in a chapter on "How to Deal with The Media on Ecological Issues," when the text in three different places refers to the famous quote from McLuhan, "the medium is the message," as "the medium is the massage." It may still be true, but ....

In a chapter on "Environmental Issues Around the World," the author gives a helpful and complete analysis of technical questions involved in environmental concerns. In the final chapter, "How a Local Church Can Begin a Recycling Program," careful consideration is given to a number of very practical efforts and programs that can be undertaken.

Overall this is an excellent contribution to the growing literature seeking to express, relate, and expedite a Christian awareness of our stewardship responsibilities for the environment. It would be a useful focus for discussion groups on this subject.

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

CHRISTIANITY, WILDERNESS, AND WILDLIFE: The Original Desert Solitaire by Susan Power Bratton. Scranton, PA: University of Scranton Press, 1993. 350 pages, indexes. Hardcover, $49.50.

Although it would be an unusual course that could use Bratton's book as its main text, she still has produced an interesting and readable book. It is about spiritual experiences in the wilderness throughout history. As far as I know, Bratton has found a unique niche. I am not aware of any other books on this topic, and I don't think there are likely to be any more. This is not to say that *Christianity, Wilderness and Wildlife is* not a good book, or that the topic should be ignored, however. Her book deserves to be read by all Christians concerned about the environment, and this should include all Christians. Bratton has both the academic and experiential credentials to write the book, a rare combination. For example, she is on the editorial board of *Environmental Ethics.* Bratton intersperses her own wilderness experiences throughout the history portrayed in the book. She has obviously had spiritual experiences in the wilderness, and believes that this should be, and has been, the norm for Christians. She cites numerous examples from biblical sources and from Christian history. Because she finds wilderness a friend to Christianity, she does not agree with those who would blame Christianity for our current environmental problems, nor with any Christians who believe that the natural world is not necessary. To quote the last portion of Bratton's first chapter, an introduction:

> ...I hope this book enhances the reader's appreciation of wild nature as a work of God as creator and raises further questions about our treatment of our fellow creatures and our care of wildeness areas. I also hope it helps to unravel some of the confusion over Christian spiritual practice in wilderness and provides some guidance to individual Christians about the use of natural settings in pursuit of a deeper Christian spirituality....We will never understand our spiritual heritage unless we begin to appreciate the trials, the songs, and the victories of those who walked the mountains and deserts before us. (pp. 25-26)

The text more or less follows history. It is obvious that Bratton takes the Bible seriously. There are references to twenty Old Testament books, one intertestamental book, and eight New Testament books. The first extensive discussion is of Hagar's experiences in Genesis 16 and 21. She considers carefully the meaning of the text. Her conclusion is that Hagar had a spiritual experience in the wilderness. I confess that it had never occurred to me that the location and the experience had any necessary relationship. This is from the Genesis chapter. There are also chapters on the Exodus; on David and Jonathan; on some of the poetic books; on Elijah and Jonah (who both found themselves in solitude, except for God); on later prophets; on Christ, John the Baptist and the time between the Testaments; on Acts and Revelation; on desert monasticism; on Celtic monasticism; on St. Francis; on the Reformation; on the present Christian experience in the wild; and on protecting the wild. I will let Bratton speak for herself on Christian experience in wilderness solitude:

> The wilderness sojourn has never been the predominant mode of Christian worship or of community interaction, yet wilderness spiritual experience receives a great deal of attention in the Bible and in early Christian literature.... The necessity for wilderness is correlated to the potential of the national social environment to inhibit the execution of God's will or to mute God's voice, which, in the case of contemporary western culture is considerable. Wilderness spiritual experience does not require the natural splendor of Yosemite Valley, nor does it require the drought of the deserts around the Dead Sea. It does, for full development, require solitude, struggle, and contact with creation, and a place expansive enough for God to be God. (p. 277)

The book is well written and fascinating. There are abundant quotaions in the text. There are sixteen pages of notes, six pages of bibliography, an index, and over three pages of biblical citations.

Reviewed by Martin LaBar, Central Wesleyan College, Central, SC 29630-1020.

SIX BILLION AND MORE: Human Population Regulation and Christian Ethics by Susan Power Bratton. Louisville, KY: Westminster/John Knox Press, 1992. 217 pages, index. Paperback; $12.95.

This book proports to be a Christian perspective on global population matters. It is also is a history of birth practices and population control measures from ancient times, particularly during the period of the Old Testament, and throughout the history of the church. The intent is "to bring the major issues to the attention of the Christian community and to precipitate thoughtful discussion" (p. 200).

The author, Susan Power Bratton, has been a Professor of Biology at Messiah College. She also has written other books and articles on ethics, biology, botany, and ecology.

Bratton states that a Christian ethic for human population regulation must have the following characteristics: (1) The ethics for individual families and local congregations must be consistent with policies for nations and recognize world concerns. (2) The ethic must involve social and economic factors as well as reproductive. (3) The ethic must be cross-cultural. (4) The ethic must be able to withstand changing social and economic conditions — it must be based on spiritual principles. (5) The ethic must be individual, considering the rights and feelings of the individuals. (6) The ethic must be just, which Bratton defines in contemporary economic terms, rather than biblical terms. (7) The ethic must be based on Christian values, but it needs to go beyond the Bible and Christian traditions in developing solutions for other eras (p. 26f).

In the stating of these criteria, Bratton is showing her hermeneutical bias. She is quite in danger of going beyond scriptural norms to create a "Christian" ethic. Specifically, her notion of "justice" finds its roots in the Christian left rather than in Scripture. There is a leap between the prohibition against oppressing the widow, the fatherless, the alien or the poor (Zech. 7:10) and allowing the poor to make their own decisions, without bearing the consequences of their actions. She is being consistent with the advocates of messianic government, where the government removes the consequences from a person's own faulty decisions. Scripture both teaches that a person suffers for his own sin, and presents the grace of God that provides healing. It is the grace of God that provides healing, not an all-pervasive government.

Since Bratton's expertise is in ecology, not in economics, there are several gaps created by her failure to understand the economic ramifications of population studies. She ignores that persons, given adequate information, will act in their own self-interest. Nor does she understand the basis of wealth. For example, she correctly observed that England was able to expand its wealth through conquest (p. 32). But she contends that Third World countries are not free to conquer other lands today, implying that the main source of wealth comes from exploiting others, rather than, as Adam Smith correctly observed, through production of goods and services. Hence, countries can use trade to provide those goods or services in which that country has a comparative disadvantage.

One would have expected a Christian work on population matters to reflect the three-fold work of God: creation, providence, and redemption. The first is not absent. The second work is woefully neglected. To ignore providential governance over human affairs is to opt for a neo-Malthusian solution. While Bratton is careful to distance herself from Mathus, she is not as careful to separate herself from Paul Ehrlich (*The Population Bomb*) or Garrett Hardin ("The Tragedy of the Commons"). True, she seeks to distinguish her position from theirs. But, lacking a truly biblical understanding of the providential role of God in human history, her position is inadequately different.

Bratton does raise many important issues; her book is important to read to raise the neglected issue of population concerns and to develop a Christian perspective. But more work is needed. Specifically, we need to think through the relationship between God providentially governing history and human affairs on the one hand, and our responsibility as bearers of the Gospel to influence our society and culture with the ramifications of the Christian message. Her well-researched presentation does not give the definitive Christian ethic on population regulations and control. But it does much to prompt further research and much-needed thinking on the issue.

Reviewed by Hadley T. Mitchell, Adjunct Professor of Economics, Huntington College, Huntington, IN 46750

THE EXTRAORDINARY STORY OF HUMAN ORIGINS by Piero and Alberto Angela. Translated from the Italian by Gabriele Tonne. Buffalo, New York: Prometheus Books, 1993. 328 pages, 3 appendices, bibliography. Hardcover; $26.95.

The authors have succeeded in writing a book that reads much like a detective story, as they intended to. The book, originally copyrighted in 1989, provides the reader with a bit of the flavor of trying to unravel a puzzle from rather scant evidence and of squeezing all the information possible from the evidence that is available.

Piero Angela is a well-known journalist and bestselling author in Italy and the host of television programs on science. He is also the founder of Italy's Skepticism Group. Alberto Angela has a degree in natural science from the University of Rome and has participated in paleontological researches in Zaire, with Noel Boaz and in Tanzania with Donald Johnson. Together, the two seem quite well qualified to write a book of this type.

The book basically follows a chronological order, with a slight regression to pick up the evolutionary line again after the extinction of the Neanderthals. There are numerous excursions into an imagined day in the life of the particular hominid being discussed, which enliven the reading and seem quite plausible. The book also includes four appendices that are very helpful, particularly the one on dating fossils.

As one who has always been rather skeptical of the information related to the origin of humans, I must say that this book did little to relieve my skepticism. Throughout the book, the authors clearly indicate just how little evidence exists and why it is so frequently subject to reinterpretation. After estimating that perhaps somewhere between 2 and 20 billion individuals lived in Africa over the last 4 billion years, the authors state (p. 194),

> All the fragments of skulls, teeth, jawbones, etc., found up to now would barely cover the floor of a large room. How can the history of billions of individuals who lived over millions of years in very different places be reconstructed on the basis of such a meager quantity of data?

This is precisely my reason for skepticism. I think this is a strength of the book because, so often, grandiose claims are made about the state of our understanding of human evolution. As a result, things are often presented in popular writing as if there are few questions left to be answered. Furthermore, such claims often violate the boundary between what is legitimate science and what is philosophy.

As one who is involved in a quantitative science, it troubles me that, for example, a skeleton can be reconstructed from a tooth or a piece of a jawbone. What assumptions does one make about the statistical distribution of the size of teeth in the population from which the tooth came? Is it assumed that this tooth represents the mean? What uncertainty should be attached to these assumptions? How does the uncertainty propagate through the reconstruction? How far along does the reconstruction progress before it becomes meaningless, with the uncertainty making any meaningful conclusions impossible? These are some of the thoughts I had while reading this book.

To the extent that it represents the current state of thought in the field of human evolution, the book is very useful for people like me who were unfamiliar with the field. I would recommend it to others in the same category.

Reviewed by David K. Probst, Assistant Professor of Physics, Southeast Missouri State University, Cape Girardeau, MO 63701.

GENESIS, CREATION, AND CREATIONISM by Lloyd R. Bailey. Paulist Press: New York, 1993. 253 pages, index. Paperback; $14.95.

Lloyd Bailey is a biblical scholar and associate professor of Hebrew Bible at the Duke Divinity School in North Carolina. He holds an undergraduate degree in physics and is an author and editor of books and publications in religious studies.

In *Genesis, Creation, and Creationism*, Bailey writes that his purpose "is to investigate the message (agenda, goal) of the biblical story of creation in Genesis 1:1-2:4a, and to compare the result with the interpretation of that same story by "young earth" creationists." His conclusion is that the primary purpose of the Genesis text is "a sustained, although subtle attack upon polytheism. The mythology of surrounding cultures is brushed aside as their divine sources are reduced to mere physical processes." From this premise it follows that scientific creationism is in conflict with the theological purpose of Genesis (as well as with many claims of mainstream science).

Some excellent literature already exists on this subject: Conrad Hyer's *The Meaning of Creation*; Daniel Wonderly's *Neglect of Geologic Data*, and Van Till, Young, and Menningas' *Science Held Hostage*. Indeed, Bailey quotes extensively from these sources. What then does Bailey's book contribute to the dialogue? I found *Genesis, Creation, and Creationism* useful for two reasons, the first being that it contained sixteen appendices with titles such as "Ecclesiastical Statements Concerning 'Creationism' "; "Numbers, Sacred and Symbolic Usage"; "The Cosmology of the Ancient Semites"; and "Anti-Evolutionism and the Courts." The appendices also cover dating topics such as pre-diluvian ages, the date of the second temple, and the elapsed time from Adam to the flood.

The second reason I found Bailey's book to be useful was as a model for the theologian with scientific training who rejects not only "young earth creationism," but also any hint of scientific content in Genesis I. In his preface, Bailey asks the reader to read the Genesis "text carefully and without prior commitment for or against 'the theory of evolution.' " His stated primary purpose is to "let the Bible speak for itself." In that he asks the reader to set aside preconceptions, I was interested to determine what alternate position or positions he would end up advocating for the "Bible believing" Christian.

The first strong clue to his position came in Chapter 6 when he opined (erroneously, in my opinion) that scientists agreed "about the eternality of matter." In Chapter 7, Bailey continues this theme with his version of the scientific creation story taken from his 1984 sermon given in the Duke University Chapel. "It began in a universe that contained huge clouds of formless matter ....About four billion years ago the carbon-based molecule had learned to reproduce itself and an elementary form of 'life' had begun. A billion years later, and the first cellular organisms were on the scene. Another billion years pass, and the organisms had learned 'the joys of sex.' " Following the standard geologic succession of life, we arrive

at "a few million years ago, [when] human creatures emerged on the earth. "The molecules in our bodies are, to quote from *Cosmos*, 'made from star-stuff.' " This sequence is followed by laying our bent toward self-destruction at the evolutionary branch from reptiles.

This 1984 sermon is titled "An Immense Journey: From 'star-stuff' to 'Child of God', " and if some of the language sounds like Carl Sagan's version of evolution, this similarity appears to be deliberate. In fact, Bailey is forthright about his admiration for Sagan, stating near the beginning of the sermon that he will "quote with approval both the astronomer Carl Sagan and the author of the book of Genesis." It was interesting to see a scholar of Bailey's credentials giving an approval rating to Sagan equivalent to that of the author of Genesis and attempting to make their two versions of creation compatible. To my disappointment, he did not deal with how Sagan's creator gods of "natural (non-intelligent) selection" (*Cosmos*, p. 27) and "minor accidents in our immensely long evolutionary history" (*Cosmos*, p. 282) can be accomodated to his biblical assurance that creation "was not a meaningless, accidental, sequence of events, contrary to what some modern people think!"

How can ASA help theologians like Bailey understand that Carl Sagan's antitheistic agenda is incompatible with biblical theism? Our 1991 Executive Council Resolution, "A Voice for Evolution *as Science*," should provide a start toward dispelling confusion, especially if we could teach them to define that ambiguous, protean word "evolution," to separate evidence from inference, and science from scientism. We could also bring them up to date with the latest in cosmology, biochemistry, and paleontology through our *Journal* articles. In addition, we could attempt to teach them that they can reject young earth creationism without buying fully into Carl Sagan's creation story. In my opinion, there is a wide range of far more sound theological and scientific positions available. In any event, *Genesis, Creation and Creationism* should prove useful for its well-organized appendices and for analysis of an uncritical accomodationist position.

Reviewed by John L. Wiester, 7820 Santa Rosa Road, Buellton, CA 93427.

THE IMPACT OF EVOLUTIONARY THEORY: A Christian View by Russell Maatman. Sioux Center, IA: Dordt College Press, 1993. 318 pages, extensive references, indices. Paperback, $12.95.

Russell Maatman is Emeritus Professor of Chemistry at Dordt College, and well known to long-time ASA members, as he himself is a fellow of ASA and has been active for years. Author of *The Bible, Natural Science and Evolution* back in 1969 and *The Unity in Creation* (1978), this third book is the fruit of a lifetime of thinking about the interaction of science and Christianity, particularly in the area of origins.

The title may be somewhat misleading, as the book ranges more broadly. Maatman begins with some basic questions he will address. (1) Given that both creation and the Bible reveal God, how are these two modes of revelation related to the various sciences? (2) What is the Christian way to study science? (3) In what way does a Christian understanding of science differ from the commonly held view of science? (4) How do these different understandings of science result from different world views? (5) How do world views influence questions of origins, and therefore, one's understanding of the world today?

In succeeding chapters, Maatman sketches the rise of evolution from ancient roots and its interaction with Christian theology. He follows with a presentation of the design argument and objections to it, both from Reformed theologians and from an evolutionary perspective. Then comes a survey of the standard evolutionary scenario, followed by two chapters of scientific critique.

At this point Maatman turns to revelation: what is general revelation and how does it fit in with the special revelation of Scripture? What is science? Is the phrase "Bible and science" the proper one to use in this sort of discussion? Finally, in chapters ten and eleven Maatman gets to Genesis 1-2, sketching the importance of control beliefs and looking at seven different approaches to Genesis.

Chapters 12 through 14 actually are closest to the title, giving a brief tour of the influence of evolutionary thought on modern views of human behavior, both individually and collectively; of progress in religion, economics and history; and of how we humans view ourselves.

The last chapter looks at the enormous scope of the evolutionary paradigm and its recent influence in the feminist and animal-rights movements. Evolution posits a closed universe and a very different future than does biblical Christianity.

Maatman's book is well worth reading for its many insights. The scope is somewhat too ambitious for the space available and the treatment uneven in different areas; probably no one on earth has enough expertise in all the academic fields covered. Even if you do not agree with all the positions Maatman takes (Reformed; Christian science different from secular science; natural theology not possible since the fall; old-earth creation; real Adam and Eve; not descended from animals), it would be good to read the book to see how he argues each point and whether or how you can answer it.

Reviewed by Robert C. Newman, Director of the Interdisciplinary Biblical Research Institute, Biblical Theological Seminary, Hatfield, PA 19440.

CREATED FROM ANIMALS: The Moral Implications of Darwinism by James Rachels. Oxford University Press, 1991. Paperback; $9.95.

Many evolutionists, including most Christians who accept evolution as part of God's created order, would agree with Stephen Jay Gould: "Science can no more answer the questions of how we ought to live than religion can decree the age of the earth." James Rachels disagrees. He insists that, if Darwinism has obliterated the biological distinctions between humans and the other animals, then it must also have obliterated spiritual and moral distinctions. If humans are not biologically special, than neither can we be morally special, he insists. His book argues cogently for this viewpoint, and is so brilliantly written that it is even fun to read. Those of us who disagree with him will have our own minds sharpened by it.

Chapter 1 is one of the best short biographies of Darwin and his contemporaries that I have read. In it, you almost feel that you know Charles Darwin as a friend. His ideas about evolution — and later, about the similarities of humans and animals — caused his very religious but faithful wife Emma much distress. To the very end of his life, Charles Darwin grieved that he had brought such trouble on his wife and family.

Rachels' purpose is to demonstrate that Darwin was willing to include not only man's body but his spirituality and morality as products of evolution by means of natural selection — as Darwin wrote privately, the soul is just a secretion of the brain.

Rachels then reviews various unsuccessful attempts to relate ethics and evolution — for instance, Spencer's writings, which were greeted with such enthusiasm in their day but which nobody reads anymore. He reviews sociobiology as one of these less than successful attempts. He says sociobiology fails for the same reason that "mathobiology" would fail. "'Mathobiology,' if it existed, could add nothing to our understanding of [mathematics]. It would be irrelevant to determining whether [a] proof is valid or invalid, because that is something that can be established only within the framework of mathematics itself." Biological heritage may constrain our ethical choices, but does not determine what is right and wrong.

Instead, Rachels focuses on the question of whether Darwinism had destroyed the concept of human dignity. It has, he says, and even T. H. Huxley did not realize this. It did not disprove human dignity, but it took away our reason for believing in human dignity. Rachels reviews the history of the idea of human dominion over the rest of Creation, including the concept of stewardship.

Next, Rachels asks, must a Darwinian reject religion? He, like Gould, notes that many scientists are religious. These scientists (including the entire ASA) are not fools, he says. But, notes Rachels, it would not be the first time a large group of scientists has been wrong. Rachels seems to demolish the Design Argument, in a manner similar to Gould. But he also rejects theistic evolution, precisely because it is unfalsifiable. He is correct that theistic evolutionists will just say "That's the way God did it, I guess," no matter what evolutionary discoveries are made. (He is right that people such as those of us in the ASA will believe that "God did it" no matter what scientific evidence is uncovered!) Rachels says, "This would mean that [God] has created a situation in which his own involvement is so totally hidden that the process gives every appearance of operating without any guiding hand at all. In other words, he has created a situation in which it is reasonable for us to believe that he is not involved ...If religious belief is reduced to this, is it worth having? ...The concept of God that survives is so vague that it is of little use in explaining either nature in general or human nature in particular" (p. 125-6). Can we answer him? It will sharpen our minds.

Darwinism led Darwin to agnosticism, however, primarily because of the "problem of evil." Rachels presents brief and powerful arguments against natural theodicy, rather discomfiting to those of us who have published articles on this subject (see PSCF 39: 150-157). It was the amount, rather than the fact, of evil in the world that made Darwin reject God: "There seems to me too much misery in the world..." both human and nonhuman.

Next, Rachels argues that humans and non-humans are not distinct. The belief that human life is sacrosanct but animal life is expendable is responsible for the meaningless death of thousands of primates, he points out. Darwin demonstrated, however, that nonhuman animals

had what can be called the ability to reason — even earthworms have this ability, in rudimentary form, Darwin wished to demonstrate. In fairness, Rachels also dismisses the way some ethologists impute human feelings to animal behavioral patterns. Rachels further argues, as did Darwin, that humans are not the only moral animals. Rhesus monkeys can be trained to behave compassionately. He dismisses Christian love as an aberration: "If we start with the assumption that humans exhibit a kind of grand, Sermon-on-the-Mount altruism, and we then assume we are trying to explain *that*, then Darwin's suggestion might seem altogether too feeble ... [but] our non-kin altruism is so weak that when an affluent American gives a few hundred dollars to support famine-relief efforts, while spending thousands to send his children to an expensive university, he is judged to be exceptionally generous. Truly disinterested, generalized saintliness might exist in a few people, but it is so rare that it may be regarded, in the naturalist's terms, as a mere 'variation'..." (p. 157-8). I suppose we must agree with Rachels that perfect love cannot be produced by evolution.

Finally, Rachels claims to derive a "morality without humans being special." He begins by pointing out that, even though we claim "all men are created equal," it simply isn't true. But we still assume that we must treat everyone equally, unless there are differences among people that justify their being treated differently. Rachels simply extends this principle to animals. We should treat humans and animals the same, unless there is a good reason to treat them differently. For instance, animals cannot read and write, so it is quite fair to deny animals admission to universities. But animals *can* feel pain, so it is as wrong for us to make animals suffer as to make humans suffer. Chimps are intelligent, so it is wrong to confine a chimp to a boring, bare cage; but shrimp are not intelligent, so it is not wrong to confine shrimp to boring, bare tubs. He answers various objections to his position, for instance, the objection that we have no moral obligations to other animals because they do not treat us in a moral fashion. He bases his ethics on the assumption that "the value of a life is, first and foremost, the value that it has *for the person who is the subject of that life*. Our lives are valuable, not to God or to nature or to the universe, but to us" (p. 198). He uses this argument to conclude that, under some circumstances, suicide is moral. If in the process we lose our sense of duty to God, this may just be "a loss that humans after Darwin must live with." He does not state his opinion about how to apply this principle to every situation, although he clearly does not go as far as some extreme animal-rights activists. He hints at a few applications, however. He says that euthanasia is not as bad as making animals suffer for the safety testing of cosmetics.

Nor does Rachels claim that all species are of morally equal status. He does, however, object to humans having dominion over the other species. He would disagree with Frederick Turner, who wrote:

> We must take responsibility for nature. That ecological modesty which asserts that we are only one species among many, with no special rights, we may now see as the abdication of a trust. We are, whether we like it or not, the lords of creation; true humility consists not in pretending that we aren't, but in living up to the trust that it implies by service to the greater glory and beauty of the world we have been given to look after. It is a bad shepherd who, on democratic principles, deserts his sheep. (*The Rebirth of Value*, SUNY Press, 1991, p. 62)

Rachels would not expect those of us with religious beliefs to agree with him. "Even if every argument in this book were correct, it would be astonishing if readers simply accepted its conclusions," he concedes. But he has done the best job I have seen of drawing Darwinian evolutionary principles to their ultimate moral conclusions. The results are objectionable to the Christian, but not as horrible as we might have feared. It does not lead, as some preachers warn, to totalitarianism and a complete devaluing of human life. Rachels' excellent book gives intelligent readers a chance to sharpen their minds and examine their beliefs.

Reviewed by Stanley Rice, Department of Biology, Southwest State University, Marshall, MN 56258

ANTI-EVOLUTION: A Reader's Guide to Writings Before and After Darwin by Tom McIver. Baltimore: The Johns Hopkins University Press, 1992. 385 pages. Index. Paperback; $15.95.

This is a republication of a 1988 book which was previously reviewed in this journal (*PSCF* 42 (4) 265). The earlier edition was available only in a rather expensive hardcover edition. This new printing, which contains the original text and a new preface by the author, is in a much more affordable paperback form.

The book contains an annotated bibliography of more than 1800 books and other materials in the area of creation/evolution. These include historical works as well as a great variety of published materials up through approximately 1988. This is a fascinating book and an excellent reference for anyone interested in this subject area.

Reviewed by Phillip Eichman, University of Rio Grand, Rio Grande, Ohio.

CLINGING TO A MYTH: The Story Behind Evolution by T.H. Janabi. Indianapolis, IN: American Trust Publications, 1990. 166 pages, Paperback.

Evolution is such a broad topic that there is always room in our libraries for a fresh perspective. *Clinging to a Myth*, however, offers little new. It is rightly classed among the anti-evolution genre, but this is certainly not a typical litany of scientific objections to genetic variation or the fossil record. Although some well-traveled ground

is covered, including a brief refutation of abiogenesis, the author takes on a wide array of issues of obviously personal concern; few recent books on science are more idiosyncratic. The preface describes the writings as "a mere set of ideas derived from disscussions." It might also be summarized as a bizarre ride through Janabi's stream of consciousness.

Janabi is a scientist working in the fields of robotics and artificial intellegence. It is clear that in the author's thinking, evolutionary theory is inadequate in contrast to theism as an explanation for origins and the higher human attributes. There is no indication of any specific religious perspective. As described, Janabi's god is rather impersonal, but with the general sovereign characteristics of our Judeo-Christian Yaweh. The contention with evolutionary theory is supposedly based on mathematical arguments. This approach is only really apparent in some of the chapters. In fact, philosophy (metaphysics in particular) is of primary concern. Among the thirty-five meager bibliographic references, nine are to Bertrand Russell! Argumentation also derives from sources such as Moslem philosophy, psychology, sociology, and general relativity. The train of thought seldom focuses enough attention to develop a coherent argument. Contents of the various chapters are probably more suitable as themes for separate books.

Clinging to a Myth is published by American Trust Publications. Overall, there is the appearance of a vanity product, with poor text editing and no sense of qualified review. Although the book is of rather low quality, it may still provide some readers with stimulation for their own musings on the broader applications of evolutionary theory.

Reviewed by Jeff Greenberg, Professor of Geology and Environmental Sciences, Wheaton College, Wheaton, IL 60187.

BIOLOGY: Principles and Perspectives by John E. Silvius. Dubuque, Iowa: Kendall/Hunt Publishing Company, 1994. 443 pages. $52.96.

This book is intended for students taking an introductory course in biology. It is worthy of mention in the pages of *Perspectives* because it is written by an evangelical Christian. The author is professor of biology at Cedarville College. His previous writings have been on the subjects of biology education and environmental stewardship.

The author states his premise in the preface, where he says "this text is written from a biblical, theistic worldview." In the acknowledgement section, the author thanks Jesus Christ who has given him new life and a new world view. Chapter 1 is entitled "A Scriptural Perspective of Life." Controversial topics covered in this text include creationism, evolution, scientific creationists and zero population growth. Scripture texts and references are liberally sprinkled throughout the volume.

This book will appeal to Christian biology teachers, readers interested in biology from a theistic view, and the curious who want to see how biology is dealt with from both a scientific and biblical perspective. This is a second edition, the first having been published in 1985.

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

BIOLOGY AS IDEOLOGY: The Doctrine of DNA by R. C. Lewontin. New York: HarperCollins Publishers, 1991. 128 pages. Paperback; $10.00.

This small volume contains several essays by geneticist Richard Lewontin. All but one of the essays are edited transcripts of radio programs which were broadcast by the Canadian Broadcasting Corporation. The other essay originally appeared in *The New York Review of Books*.

The essays, although written in a popular style, contain a discussion of several issues related to the working of science in general and more specifically of modern biology. Topics in the book range widely from hybrid core to DNA fingerprinting and eugenics to environmental policy. Lewontin is very critical of two all too common trends in biology today — biological determinism and reductionism. He also raises some serious questions in regard to other areas of biology, notably the Human Genome Project and sociobiology, and the philosophy which underlies them.

The author has clearly cut through the rhetoric and has gotten down to the concepts which form the foundations of modern biology. Some scientists will strongly disagree with Lewontin's assertions. However, much of what he says is an accurate representation of modern biology and the "scientific establishment." The major thesis of the book can be summarized in the author's statement that there is " ... a particular ideological bias of modern biology. That bias is that everything we are, our sickness and health, our poverty and wealth, and the very structure of the society we live in are encoded in our DNA." As one might expect from the co-author of another book, *Not in Our Genes*, Lewontin is strongly opposed to such a deterministic viewpoint.

Although not necessarily a work on the philosophy of science, this book could be read within that context. Certainly anyone interested in the philosophical basis of biology today, especially as it relates to reductionism and determinism, would find Lewontin's thoughts worth considering. Those who look upon the universe in a non-reductionist and non-deterministic manner will find this book refreshing.

Reviewed by Phillip Eichman, University of Rio Grande, Rio Grande, OH 45674

THE HUMAN FACTOR: Evolution, Culture and Religion by Philip Hefner. Minneapolis, MN: Fortress Press, 1993. xvii + 317 pages, glossary, bibliography, index. Paperback; $18.00.

According to Hefner (Professor of Systematic Theology at the Lutheran School of Theology in Chicago and Editor-in-chief of *Zygon*) this work is "theological anthropology in the light of the natural sciences" and is designed to provide illumination for "a dangerous confusion in our times about values and the moral life" (p. xiii). He calls it a "conversation between theology and the sciences" (p. xiv), but it might be more accurately described as a scientific philosophy.

Part I sets forth Hefner's theory of mankind as the "created co-creator," with nine auxiliary hypotheses. In his extensive discussion of the nature and purpose of theory, he strongly asserts that it is not necessary for a theory to be adequately substantiated or claim to be "unassailably true" (p. 17). Rather, the theory, to be successful, must be "fruitful" in challenging researchers, providing new insights into old questions, and raising new questions. The "hard core" theory, as in Darwin's and Freud's theories, is not falsifiable; rather, it spawns auxiliary hypotheses which are falsifiable. Parts II through IV take up the three themes of the theory: nature, freedom, and culture. Part V provides the Christian traditions and theology to which he connects his theory.

However, Hefner's philosophy is thoroughly materialistic, grounded upon evolutionary theory with no room for any supernatural (spiritual) elements. "In short, we are indissolubly part of nature, fully natural" (p. 65). His Hypothesis #6, states, "*Homo sapiens* is a two-natured creature, a symbiosis of genes and culture" (p. 45). All knowledge, including "revelation," comes from the study of nature by man, the creature and product of nature. Values, morality, even responsibility and all of culture have arisen as a result of evolution, and man's ultimate purpose on earth will be worked out by the evolutionary process. On page 72 he laments that "...we cannot represent to ourselves how the scientific message of our kinship with nature can qualify as the logos, the word, of God." Myth and ritual are essential to modern humans, but they have been worked out, invented if you will, by mankind to meet the need and must be revised and changed as needed. In most aspects of Hefner's philosophy, God could have as easily been called "Mother Nature."

Criticism should be directed toward his eclectic melding of ideas and the rather fuzzy connections between these ideas, as promised in the preface. Hefner admits that freshmen "may have found me unintelligible at times, while research professors of biology and philosophy found me to be frustratingly simplistic" (p. xv), and he confesses a "predilection for mixing different ways of thinking ... and for methodological opaqueness [stemming] from the context of my work and my discovery" (p. xiv). On page 255, he speaks of the reader traversing" a difficult trail ...(and) entering thickets that were only partially passable, and walking on paths that were often ill-marked." One cannot help wondering if it is, rather, merely fuzzy thinking.

One example will have to suffice: his concept of "what really is." The glossary indicates that it "is employed to denote the most fundamental reality or nature of things" (p. 287). Indeed, it is used in the text as if it were something objective, "out there," yet it seems to be the message of myths regnant for conduct of daily life and morality. Presumedly, if the import of the myth is changed as humanity progresses in knowledge, "what really is," i.e. "fundamental reality," changes as well!

Nevertheless, there are several aspects to this book that merit serious consideration. The stated purpose of his book is to be "fruitful." Judged by this standard, the book is, indeed, successful in opening up many questions for study and promising avenues of thought for this reviewer — even if the results of this study and thought would no doubt be unacceptable to Hefner.

He takes very seriously the biological nature and provenance of humanity as part of creation, yet ruler over creation. Sifting out, refining, and integrating the valid insights into a biblical understanding of man and God would be a very fruitful approach for evangelicals. He also does us a service by insisting that there is no way to separate the content of faith from the symbolic action of ritual and the practical action of everyday life.

This will be a very disturbing book for those on the conservative end of theological tradition, but a critical, thoughtful reading can be quite "fruitful."

Reviewed by Eugene O. Bowser, Reference Librarian, The James A. Michener Library, The University of Northern Colorado, Greeley, CO 80631.

R^x 2000: Breakthroughs in Health, Medicine, and Longevity by the Year 2000 and Beyond by Jeffrey A. Fisher. New York: Simon & Schuster, 1992. Index, bibliography. 228 pages.

Jeffrey Fisher is a pathologist with experience in the basic research of disease prevention. He interviewed seventy men and women involved in medical research and has written a book predicting advances in diagnosis and therapy over the next forty years. He thinks these advances will raise the average life expectancy to ninety within twenty years and the maximum life span to one hundred fifty within forty years.

The longevity increases will be primarily through assaults on cancer and coronary artery disease. Fisher deals with the major cancers individually and finds a variety of answers. Central to many of his predictions for cancer and other diseases is genetic manipulation. Full use of this awaits the results of the Human Genome Project, whose goal is to map the structure of 100,000 human genes by 2005. Once this is done, gene splicing and replacement will be possible for any selected gene. Further-

more, gene mapping at a very early stage of conception will allow undesirable genes to be replaced. Other techniques involve earlier diagnosis, e.g., with monoclonal antibodies, or the use of anti-oxidants to block the action of free radicals, a concept that applies to many diseases.

Fisher predicts that coronary artery disease will be decreased by ninety percent by 2020 through molecular prevention of arteriosclerosis. Until then, the ability to do microsurgery on coronary arteries with tiny stents, flexible instruments, cameras, and holmium lasers will make possible treatment of the disease before significant damage to heart muscle occurs.

The most controversial areas of progress relate to reproduction. There will be more and more separation of the sex act from reproduction, as the in-vitro fertilization and "rent-a-uterus" of today will progress to frozen embryos and eggs, gene selection for sex and physical and mental characteristics, and eventually an artificial placenta. There will be expanded use of surrogates at every stage of the game. Problems with maternal bonding, you say? Not to worry. According to Fisher, oxytocin mediates bonding, so it can be given to the mother, while anti-oxytocins can be given to the surrogate. Equally controversial will be "gardening of the body," where body parts can be grown on specially-produce anencephalic babies, or even a specially cloned twin, created at the four-cell zygote stage and preserved for later use.

Alzheimer's and Parkinson's diseases and strokes will be eventually treated with neuron transplants as well as gene therapy, or prevented by medication after the disease is diagnosed genetically, but before symptoms appear. Allergies, addictions, migraines, dental problems, myopia, baldness, osteoporosis and gall bladder disease are all areas that will become more technically oriented with less doctor-patient contact. Vital signs and blood tests will be measurable at home and transmitted to the doctor's office, so that a visit to the doctor, if even needed, will be a quick prescription of a computer-made decision.

Fisher has organized his book well and writes at a level for the non-medically trained but intelligent layman. He adds interest by created clinical settings for his discussions, even using one or two personal examples. He has made a time-line from 1992-2030 with ten to fifteen expected breakthroughs for each year, which would make for easy browsing. His information is all "on the drawing board" rather than futuristic leaps of techno-faith. Are his prophecies realistic? Anyone who has watched the progress of medicine over the last thirty years cannot doubt that most of his projections will, or can, come true.

Fisher does not intend that his book deal with either the ethics of the advances or how our health care system will be able to absorb them. It's obvious that the more debatable procedures I've mentioned above will make the present abortion controversy seem elementary, and that the costs of these advances cannot be absorbed by a system that just now is having trouble expanding to cover thirty-seven million uninsured people.

If your area of interest is health care planning for the future, or medical ethics problems that will surface soon, or you're just interested in the future of medicine, this book will be valuable.

Reviewed by Edward M. Blight, Jr., Professor of Surgery (Urology), Loma Linda University, Loma Linda, CA 92354.

MAN AND CREATION: Perspectives on Science and Theology by Michael Bauman (Ed.). Hillsdale, MI: Hillsdale College Press, 1993. 306 pages, index. Paperback; $9.95.

Man and Creation is based on lectures presented at Hillsdale College during a 1993 seminar. Michael Bauman is Associate Professor of Theology and Culture and Director of Christian Studies at Hillsdale College. The book includes papers by Bauman, Mark A. Kalthoff, Ronald L. Numbers, Richard H. Bube, J. P. Moreland, Howard J. Van Till, Craig Chester, Phillip E. Johnson, Richard Alexander, Owen Gingerich and Donald. B. Heckenlively. Its primary theme is a debate among Christians over two questions: "What is science?" and "How do science and theology relate?"

The book opens with overviews of the history of relations between science and theology by Kalthoff and Numbers. Kalthoff covers the period from the Middle Ages to the Nineteenth century, while Numbers focuses on the development of modern creationism from the late Nineteenth century to the present.

Next Richard Bube describes seven categories of possible relationships between science and theology. The various categories are distinguished by whether science and theology describe the same or different entities, whether they ask the same or different questions, and in those categories where science/theology conflicts can occur, which is considered to have primacy. In his paper, "The Star of Bethlehem: Science of the Ancients," Craig Chester presents an intriguing example of how ancient records and astronomical knowledge may be used to establish candidate dates for Christ's birth.

The papers by Bauman, Moreland, Johnson, Gingerich and Van Till debate "Theistic Science," which Moreland defines as "A research program committed to these propositions: (1) God, a purposeful agent of great power and intelligence, has purposefully created and designed the world through direct agent causation and indirect secondary causation and has intervened directly in its development at various times; (2) the commitment expressed in proposition 1 can appropriately enter into the very fabric of scientific practice and the use of scientific methodology." Moreland claims theology makes predictions that should guide scientific experimentation. (E.g., purposes will be found for vestigial organs, the fossil record will have gaps, theories such as natural selection operating at the level of macroevolution will be falsified.) Bauman

argues that theology should have greater credibility than science because it has remained rather stable since the days of the early church, while science is constantly rejecting old paradigms for new ones. Differences between the two fields which contribute to this disparity are not discussed. Johnson accepts conventional estimates for the age of the earth, and he accepts microevolution. However, he claims that, "Neo-Darwinian evolution in this broad sense [i.e. macroevolution] is a philosophical doctrine so lacking in empirical support that ... Stephen J. Gould once pronounced it in a reckless moment to be 'effectively dead'." Why then do many scientists hold the doctrine of neo-Darwinian evolution? Johnson believes scientific naturalism demands it: "The problem with allowing God a role in the history of life is not that science would cease, but that scientists would have to acknowledge the existence of something important that is outside the boundaries of natural science."

Gingerich and Van Till believe that God works by formulating the laws of nature so that nature unfolds as he desires, and continues interacting at levels not directly observable. Van Till's "Functional Integrity" concept is the idea that God created a nature capable of executing his commands. Scientists study nature's execution and thus should find natural causes for observable effects — nature is "seamless" and has no gaps that must be filled in by God. Van Till finds support for his views in those of St. Augustine and St. Basil.

Papers by biologists Alexander and Heckenlively discuss the evidence for evolution and show how acceptance of evolution need not conflict with a biblical Christian theology. Alexander shows how some aspects of human nature evident in the human mortality curve can be explained using evolutionary paradigms.

Finally, Art Battson provides some thoughts on an agenda for research by "theistic scientists." He advocates the development of a theory of "macrostasis" — that is, a theory of the processes which prevent macroevolution.

This book is at once refreshing and frustrating. It's refreshing because it mostly avoids the issues creation-evolution discussions get bogged down in: flood geology, the reliability of radioactive dating, the second law of thermodynamics, etc. The debate among Gingerich, Van Till, Johnson, Bauman and Moreland is a debate among Christians, in which the issue under consideration is how should a genuinely biblical theology relate to science. Johnson, Bauman and Moreland seem to recognize that what theologians have to offer scientists is theology and philosophy, not science, and Van Till has shown that a sound Christian theology need not conflict with a truly scientific theory of organic evolution.

The frustrating aspect is the considerable confusion on the part of Bauman, Johnson and Moreland about what science is and what its domain is. Moreland seems to confuse statements about spiritual issues for statements about physical mechanisms when he argues that theology makes predictions that should guide scientific investigation. Johnson rightly chastises some scientists for believing that anything that is not science is irrelevant, but seems to think that even Christians like Van Till and Gingerich fall into this trap. Bauman, in comparing the rapid maturation of Christian theology to the history of paradigm shifts in the sciences, draws the wrong conclusion.

I believe the correct conclusion is that spiritual issues are important enough to God that he spoke very specifically to us about them. He let us investigate issues of physical process and mechanism on our own.

Reviewed by William E. Hamilton, Jr., Staff Research Engineer, GM NAO Research and Development Center, Warren, MI 48090-9055.

TAKING THE WORD TO HEART: Self and Others in an Age of Therapies by Robert C. Roberts. Grand Rapids: Eerdmans, 1993. 315 pages, index. Paperback.

Roberts, a professor of philosophy and psychological studies at Wheaton College, has written this book to make Christians aware of the pitfalls of uncritically adopting secular psychology's view of what it is to become a person. He defines the development of the person, or the self, as being shaped either by the "Word of Christ" or by "some other account of what it is to be a person" (p. xi).

Roberts adopts the usual view of a Christian writer examining psychology and theology. Secular therapies are seen as a mixed blessing. Christians can learn from them, but a good deal of discrimination is required in order to determine what is acceptable and what is not. Since all therapies define what it is to be a person, Roberts believes they are "alternative spiritualities" which must be measured in the light of the revealed truth of the scriptures. Rogers takes the position that a Christian concept of a true self is necessarily different from that of a secular therapist. To the Christian, the self can only really be defined in terms of one's relationship with God and one's neighbor; secular therapies do not take into account man's spiritual development.

The book is divided into two sections. The first section, chapters 1 to 7, concentrates on what Roberts believes to be the essential doctrines of the self and self development therapies of Carl Rogers, Albert Ellis, Carl Jung, Hans Kohut, and Boszormenyi-Nagy. In the second section, eight chapters are used to outline what Roberts suggests are problem areas and methodological considerations which could be adapted into a Christian psychology of human behavior. It is in this section that Roberts draws upon previously published material from journals and magazines, particularly *Christianity Today*. In the concluding chapter, Roberts offers a challenge to Christian psychologists to develop a truly biblically-based Christian psychology.

Roberts is to be commended for undertaking the monumentous task of analyzing the concept of self. The fact that cognitive, analytic, and family systems are all rep-

resented poses some problems in the book as it is not made clear why and how each school of thought has developed its own distinct way of dealing with human behavior. Roberts chose these systems because they have made inroads into Christian thinking with a potentially detrimental effect. To prove his point, Roberts cites conversations with pastors and church workers who have used the concepts of secular therapists as a foundation for worship, rational living seminars or encounter groups. The adaptation of Rational Emotive Therapy by William Backus to a Christian setting also comes under scrutiny and receives mixed reviews, as does Martin Kelsey's use of Jung. Nagy's "contexural therapy" was considered to be useful in the development of a Christian psychology since it uses the "sovereignty of justice," a concept Roberts considers to be in tune with Christianity. Nagy's therapy also incorporates other virtues such as loyalty, justice, gratitude, trust, accountability, all of which play a role in Nagy's concept of how the self is developed. However, as with the other therapies, certain aspects of Nagy are unacceptable to the Christian. Loyalty to the intergenerational family, for example, must be replaced with loyalty to God. Roberts' treatment of Rogers, Jung and Nagy, raises few problems for this reviewer.

Questions do arise concerning his interpretations of Ellis and Kohut. Roberts' evaluation of Ellis' views on self-esteem and self-acceptance (pp. 48-9) is questionable. Roberts believes that Ellis is not clear on the relationship between feelings and beliefs concerning self-worth and self acceptance (p. 49). But in Ellis' scheme of things, self-acceptance is not an emotion or a rational feeling but a cognitive exercise. While Roberts recognizes that the goal of Rational Emotive Therapy is to change absolutist "musts" into "shoulds" and thereby enable the client to begin to accept himself as a valuable person, he believes Ellis rejects the aspect of "global self-assessment" as an important part of self development. A perusal of the thirteen criteria of psychological health which Ellis and Dryden outline in their latest book indicates that Ellis did take into account the concept of "global evaluation" of self-worth but not at the expense of creating a pathological way of functioning.

Similarly, I would question Roberts' treatment of Kohut. According to Roberts, Kohut's aim is to develop a sense of healthy narcissism in the client, and in this manner become a true self. Roberts suggests that "healthy narcissism" ultimately prevents the client from adopting a proper relationship with God. But Kohut's view of healthy narcissism accomplishes just the opposite to denying "Christian humility" (p. 143). The healthy narcissist is able to see himself in a realistic way, and to know where he fits into the scheme of things. His view of himself is one of humility, which would enable him to react empathically with others, and would not necessarily hinder him from developing a proper relationship with God.

The second section of the book is the least controversial. Roberts outlines problematic issues which Christian therapists could treat with a cognitive strategies. These include dealing with the problems of encouraging competition in children, using Christian hospitality to encourage the lonely, the use of forgiveness as therapy, the disruption of envy and pride in relationships, and the spiritual lessons to be learned from children. Therapists and counsellors may question, however, whether these issues can be dealt with in highly disfunctional families or disturbed individuals without their first being restored to a healthy concept of self or to a reasonably healthy family system. This is a key issue. The use of a cognitive strategy, such as Rational Emotive Therapy, to deal with "masturbatory" irrational thinking, or the use of Kohut's "restoration of the self as a psychoanalytic strategy for dealing with personality disorders in an effort to restore these clients to some semblance of mental health, is a precursor in most instances to achieve the goals Roberts suggests.

Another criticism of the book is the lack of a bibliography. The only references to the writers Roberts analyzes are in the footnotes. One would expect a more detailed list of source material.

Roberts has, however, written an interesting book and it does achieve the aim he intended. He has raised significant questions, which deserve consideration, concerning the relationship between secular therapies and Christian views of personhood. Christian pastors and church members need to take care that they do not adopt therapies for uses for which they are not intended. The book would appeal to ASA readers who are interested in the relationship between psychology and theology. However the book is more philosophical than practical, and would offer little help to therapists in their private practice.

Reviewed by E. J. Noble, a psychotherapist in private practice in Collingwood, Ontario, Canada.

TELLING TALES OF THE UNEXPECTED: The Organization of Factual Discourse by Robin Wooffit. Savage, MD: Barnes and Nobles Books, 1992. 217 pages, bibliography, index. Hardcover.

Wooffit notes a lack of progress in scientific research of paranormal experiences. After all, paranormal appearances are hardly repeatable in a laboratory. The author uses conversation analysis to study stories about unexpected (parapsychological) appearances: organization, language, content, etc. The writer taped the stories, then transcribed them and noted pauses, hesitations, etc., including interruptions and encouragement of the interviewer. He recorded most of these stories in England, in York and Bristol. The "factual status" of these accounts is to be found by conversation analysis.

Is parapsychology a "science"? The book claims it is, but says: "Despite the evidence accrued from a massive number of experimental studies, orthodox scientists are reluctant to accept the claim that psychic events exist and that parapsychology is a 'proper' science" (p. 26).

This book may be of interest to psychologists, linguists, and to people writing and reading reports. I had trouble reading the book because of its repetitiveness. For example, transcribed tapes are reprinted any time the writer discusses them. The reason given by the author for repeating the transcripts is that she wanted to prevent going back and forth in the book. The discussion is often not on the same page so that paging back and forward must be done anyway. It would have been better if the transcribed tapes had been together in the back of the book. Once the same conversation is twice on the same page (p. 175). I noticed several times words which I could not find in the Unabridged Oxford Dictionary. Sometimes the writer explained the word, sometimes Latin would help me find the meaning.

The author concludes on p. 198 that the research does not want to "...provide an arbitration on the ontological or factual status of the phenomena..." but "Rather, it seeks to explicate the communicative practices by which the factual character of those phenomena, and the nature of people's experiences of them, are pragmatically constructed in language." Does that mean it is a course in lying?

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

CHRISTIAN PERSPECTIVE ON HUMAN DEVELOPMENT by Leroy Aden, David G. Benner & J. Harold Ellens (Eds.). Grand Rapids, MI: Baker Bookhouse, 1992. 274 pages, bibliography, index of authors and subjects, index of Scripture. Paperback.

The book is number seven in the series "Psychology and Christianity." It is divided into three parts: Developmental Theory and Faith, Developmental Theory and the Mature Self, and Developmental Theory in Specific Situations. Sixteen writers contributed to the book. I recommend the book not only to psychologists but also to anyone who is involved in teaching, counselling, or pastoring. The writers want to use psychology's life cycle theories to show how one passes through the stages of life. They want to do so from a Christian perspective. The back cover says that the writers represent a variety of theological and psychological backgrounds.

To most writers I feel close, with some I have trouble. For example, does the last essay, John W. Miller's, on "Jesus and the Age Thirty Transition," belong in this book? I have trouble recognizing my Savior. In a Christian book I do not expect to find sentences like the one in note 10 on page 245: "While it is difficult to imagine who in the early church might have invented stories of Jesus being tempted by Satan in this manner, an analysis of Jesus' mission points to a victorious battle over 'satan' as one of its presuppositions." Or on page 246: "It is worth noting that Satan in these narratives represents patricidal ambition." I could mention more. For me, these sentences (and the whole article) diminish the real power of the real Satan, which Jesus had to overcome. Stories did not have to be "invented."

Generally speaking I enjoyed the book. I believe that non-psychologists can benefit from it in their understanding of people they meet.

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CREATING MINDS by Howard Gardner. New York: Basic Books, 1993. 464 pages. Hardcover; $30.00.

The problem of creativity has always been a challenging topic for scientific research since it does not lend itself easily to quantitative or qualitative characterization. Nevertheless, Gardner tries to characterize creativity and his "focus takes the form of a search for patterns — for revealing similarities and for instructive differences" (p. 7). The framework is characterized by three components: a creator, a project, and others. All creativity results from ties between an individual and a project on the one hand, and between the individual and others on the other. To discover some patterns in discoveries, Gardner uses biographies of seven creative minds representing very diverse disciplines: Freud, Einstein, Picasso, Stravinsky, Eliot, Martha Graham, and Gandhi. In his analyses, Gardner attempts to draw on two approaches to the phenomenon of creativity: Gruber's "evolving system approach" in which evolution of certain systems is simultaneously traced, and Simonton's historiometric approach. What is interesting in Gardner's specification of creativity is an emphasis of the fact that personal creativity is not sufficient to be a creator; the work has to be accepted, i.e., filtered through "a judgment of a competent field" (p. 40), in order to be considered creative.

The bulk of the book is a presentation of the seven biographies. In the concluding chapter the author outlines some generalizations, although "an exception can be found to each of the emerging generalizations." (p. 360). He gives a portrait of a creator, although for each element of the portrait a creative mind can be shown who contradicts it. This shows that no single factor can explain creativity (or no single factor taken into account so far by the researchers). Thus, some creators have support of families, some experienced isolation, some "experienced very powerful feelings." Creators have mentors, but there are "anomalous" creators who have none. All creators were active through lifetime, but there are some "meteoric" exceptions also with few exceptions. With all these alleged patterns, numerous exceptions, and exceptions to exceptions the composite portrait Gardner draws resembles very much a composite portrait of a perpetrator constructed from descriptions of people who witnessed a misdeed in different countries in different times and situations.

The phenomenon of creativity remains as elusive as ever and Gardner's book is of very little help in giving more insight into this problem. Unconditional generalizations he proposes, such as a "notable characteristic of creativity ... is its special amalgam of the childlike and the adultlike" (p. 365) and the fact that all creators rebelled against control (p. 367) are hardly informative or specific to creativity. The book is, however, not without value. Biographies of the seven creators are very well written and very informative. The author has a flair for historical writing (his excellent *The Mind's New Science* is another example), and the reader will certainly benefit from reading this part of the book.

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

NATURE, GOD, AND PULPIT by Elizabeth Achtemeier. Grand Rapids, MI: Eerdmans, 1992. 206 pages. Hardcover; $12.95.

The dialogue between science and theology will ultimately be of value for the Church only if it has a healthy impact on the Church's ministries of proclamation and education. Elizabeth Achtemeier, an adjunct professor of Bible and Homiletics at Union Seminary in Virginia and author of a number of books on homiletics, provides here some theological background for preaching on concerns related to humanity's relationship with nature and environmental issues. This is accompanied by examples of sermons which she has preached over the past years on various texts and themes.

Achtemeier's discussions and her sermons are based upon, and permeated by, the Scriptures of the Old and New Testaments. She begins by noting that the Church has a fully developed doctrine of redemption in Christ, a doctrine which underlies most preaching. But, she argues, the centrality of Christ also has important implications for our understanding of creation. Implication, which are often not worked out properly, and which seldom arise in sound preaching about creation and the human role in the world. Although she does not go into great detail on scientific questions or a theological view of science, those familiar with the science-theology dialogue will see some similarities between Achtemeier's approach and that of Thomas Torrance: in order for our scientific understanding of the world to be of any theological significance, it must be viewed in the light of God's historical revelation, which is centered on Christ.

The book's discussion begins with that basic grounding of our knowledge of God. Chapter 3, "The Reserved Room," develops the theme that God, in creating the universe, has given the possibility of human life. Succeeding chapters deal with the biblical picture of humanity's role, contingency and providence, the problem of evil, and eschatology. Each chapter is accompanied by one or two textually based meditations or sermons which indicate how the chapter's theme can be given homiletic application. The final chapter, "The Preacher's Opportunity," summarizes some of the book's basic ideas specifically for preaching on God, nature, and humanity.

Of course, a considerable amount of attention has been given to religious dimensions of current environmental concerns. Many feminist writers, process theologians, and partisans of "deep ecology" have been critical of traditional Christian views of God and the relationship between God and the world. Such traditional views are, some have argued, largely responsible for the present environmental crisis. The brief 1967 article by Lynn White Jr., is perhaps the best known of such analyses. Achtemeier is not at all hesitant about taking on such critics, opposing them with biblically based arguments that the traditional understanding of the difference between God and the world, the human commission to have responsible dominion over the earth, sin, and an eschatology which transcends the working out of natural processes provides the only adequate framework for an environmental theology.

Such a competent defense of biblical theology in this area, especially when intended to support the work of proclamation, is welcome. It has to be said, however, that the author does sometimes seem too defensive. While the Bible itself supports a healthy attitude toward nature, Christians often have in fact interpreted the "dominion" of Gen. 1:26-28 to mean simply a right to exploit the world. And some traditional theological views may at least need to be expanded. For instance, while Achtemeier seems to have no problem with the idea of biological evolution itself, her chapter on suffering and evil does not come to grips with the idea of natural selection: that competition and extinction play crucial roles in the evolutionary process.

These and some other points can be criticized. But *Nature, God, and Pulpit* can be an excellent resource for a pastor who feels that he or she should do some preaching on environmental concerns but isn't sure how to go about it. Achtemeier should be thanked for making a contribution to environmental theology which can be used in this essential ministry of the Church.

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

AGING IN GOOD HEALTH by Florence Liebermann and Morris F. Collen, (Eds.). New York: Plenum Press, 1993. 337 pages. Hardcover; $26.95.

This book will be of interest to members of the American Scientific Affiliation because all of them are (1) aging and (2) want to continue to do so. The information in this tome will be especially useful to the 31 million Americans over the age of 65. For the rest of us, it will provide advice on how to prepare for the inevitable. *Aging in Good Health* is based on information presented at forums or-

chestrated by the National Academies of Practice, an organization devoted to optimum patient care through interdisciplinary communication. The physiological, psychological, ethical, social and financial situations facing the elderly and their families are considered by these nine health professions: dentistry, medicine, nursing, optometry, osteopathic medicine, podiatric medicine, psychology, social work, and veterinary medicine.

Subjects discussed include chemical dependency, the aging eye, dementia, and the therapeutic effects of relating to animals. Interesting facts: 13 percent of the population will be over 65 years of age in 1995; half of medical cost result from treating persons in the last year of life; the majority of patient care of the elderly is rendered by nurses; two-thirds of the visually impaired are over 65 years of age; the most common ailments of those over 55 are hypertension, diabetes, and heart disease. Unfortunately, this book contains no discussion of the role religion and spirituality play in the health of the elderly. This is a glaring omission since there is a section devoted to elderly social and psychological issues.

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

THE CULTURE OF DISBELIEF: How American Law and Politics Trivialize Religious Devotion by Stephen L. Carter. New York: Basic Books 1993. 328pp, notes, index. Hardcover: $25; Paperback: $15.

Ours is a culture that does not value religion, and in public life the consequences range from our willingness "to let a court, of all things, settle many of our toughest moral dilemmas"to a climate that compels religious people to deny their most fundamental selves upon entering the public square. In *The Culture of Disbelief*, Stephen Carter, a professor of law at Yale, shows how our public culture trivializes religion, and argues that this is a grave mistake.

Carter is very careful not to claim (though critics like the reviewers for *The Humanist* gleefully pretend he has) that our public life is devoid of all semblance of religion. It may be acceptable, even important, for politicians to mention God or make statements that sound like quotes from the Bible, something many of us find reassuring in the candidates we intend to vote for anyway. But when there is conviction behind the talk and religion begins to actually affect things — important things like making laws and running businesses — we have gone too far. This, Carter says, is to trivialize religion, and his fascinating, though at times infuriating book,offers many well-argued examples, from fundamental concepts like the separation of church and state, to specific issues like school prayer, abortion law, and creation science. Carter is not opposed to courts or to politics, but to what they become when religion is devalued, when the tacit rules of public discourse require us to justify our beliefs in the mold of enlightenment rationalism — excluding as absurd and fanatical, for example, appeal to the Word or the will of God as reasons for belief and action. And he is concerned with what he himself must become, for Carter is a committed Christian, one for whom God is not just a hobby, and one who is concerned about our public life. It is not his purpose, though, to defend Christianity as the basis for political life, and he often uses (to great effect) the experience of people of other faiths. He also devotes a profoundly insightful chapter and more to showing that religious people are in part responsible for religion not being taken seriously. Religions can be very important to a democracy, as independent centers of power with claims on the allegiance of members often different from — and more powerful than —claims of the state. But though we speak most often of freedom, this requires autonomy of religions, something quite different. And Carter argues that for many reasons, including tax exempt status, autonomy "is often the missing element in America's confused relationships with its religions."

In one interesting section he relates how, inspired by his childrens' fondness for *The Sound of Music*, they read Maria's autobiography. There Maria recounts that after falling in love with Captain Von Trapp, she visited Mother Superior — not for advice but for permission to marry. Her answer was, in effect, a command from God communicated through Mother Superior. There is much here from which to expound the distinction between someone like Maria, who takes faith seriously, and those who do not.

But Carter instead asks us to imagine Maria not as a Roman Catholic but as a member of the Unification Church, consulting not the wise and holy Mother Superior but the Reverend Sun Myung Moon. "All at once her decision to consult with her religious superiors before marrying takes on a cast either sinister or amusing...At that point, Maria Trapp believes too deeply; she becomes a weirdo." This brought home to me a sense of the difficulty others must have in taking me seriously when my views arise from Christian conviction. Asking a secular person to take my Christianity seriously in public life must surely have something in common with asking me to take the Rev. Moon seriously. It is one of Carter's strengths that he so ably conveys an appreciation for the complexity of these issues, but this complexity is also, at times, his undoing.

Some Christians, he observes, say it is important to tolerate people of different religions, yet Jewish citizens will "rightly object to language suggesting that Christians...should 'tolerate' them," for the First Amendment is meant to establish religious equality. True enough, but are we talking about personal conviction or legal status? Does the fact — the important fact — of legal equality require the deeply religious to honor the convictions of others as being as true as their own? I think not — I hope not — but then what does it mean to take religion seriously? How, that is, can I expect non-religious people to take me seriously if I do not, if because of my religion I cannot accept their view of the matter as equal to my own? If Carter offers a fine exposition of how we trivialize religion, he leaves us wondering just what it could mean

to take others seriously without each trivializing our own religious convictions.

The trivializing of religion is deeply ingrained in our thought, and as Philip Johnson notes (*First Things*, Dec. 1993) this book is no exception. Carter is distinctly squeamish at the prospect of religious people influencing public affairs when they oppose his own political convictions. Consider the strikingly censorious terms he reserves for the 1992 Republican National Convention, and for Pat Robertson's "sinister" political activism. He seems unaware of the irony in speaking of "the frighteningly antidemocratic...character of the push by a national political party to replace secular politics with an appeal to religiosity"in a book meant to convince us that religion's place in public life should reflect its importance in people's lives. Yes, he patiently explains that these ideas should not be rejected because they are religious but because they are wrong. But while this may seem only reasonable, is it not a claim that we can judge the rightness of a view quite apart from the religious reasons people give for holding it?

It is another irony — but this time a true sign of hope — that a book which so ably documents a culture of disbelief should be so widely discussed among those who participate in or experience that culture. It does appear to have struck a responsive chord. It is also my hope that we can move on to discover practical means of taking religious conviction seriously in our pluralistic public square. Carter offers a profound and elegant diagnosis of a national illness, but my fear is that if we do not find a cure it will be too easy for those satisfied with religion's exclusion ultimately to ignore Carter despite the momentary high profile of this book. And what he has to say is far too important for that.

Reviewed by Paul K. Wason, Bates College, Lewiston, ME 04240.

INTELLECTUALS DON'T NEED GOD: Building Brides to Faith Through Apologetics by Alister E. McGrath. Grand Rapids: Zondervan Publishing House, 1993. 241 pages, index. Paperback.

The Enlightenment was an intellectual movement which swept through 18th century Europe. While impacting culture and ideas in general, the movement had a most pernicious effect on orthodox Christianity. Using tools acquired from the Renaissance, thinkers such as Voltaire attempted to move authority from the purview of Scripture to a dependence on pure reason.

Certain segments of the Church, in reaction to this threat, made a fatal mistake; they moved the data of Christianity from the area of reason to that of "faith." The careful theological formulations of St. Augustine, Bishop Anselm, and Thomas Aquinas, which had been based on reason and Scripture, were discarded.

The extent that this approach has grown and permeated our present culture can be illustrated by a remark made on national TV a few years ago. The then wife of a well-known televangelist, in a burst of religious ecstasy, exclaimed, "I'd love Jesus even if he wasn't real!" (A brilliant analysis of the situation has been undertaken by James Turner in his work, *Without God, Without Creed: The Origins of Unbelief in America.* Turner claims that religion caused unbelief by adapting beliefs to socioeconomic changes.)

Fortunately, there are some in the church who value the need for a rational defense of the Christian faith. Such evangelicals as R. C. Sproul, Stuart Hackett, John Warwick Montgomery, and Normal L. Geisler come to mind. On the Roman Catholic side, Garrigou-Lagrange, Jacques Maritain and Ralph McInery could be mentioned. Add the author of the book under consideration to this illustrious group.

Alister McGrath is Research Lecturer in Theology and Ethics, Wycliffe Hall, Oxford. In addition to being a theologian, he is a scientist with a Ph.D. in microbiology, which makes his observations of particular interest to readers of this journal. (The back cover of *Intellectuals* lists a number of "popular" books McGrath has written, but unfortunately doesn't mention his magnum opus, *Iustitia Dei: A History of the Christian Doctrine of Justification*, 2 volumes.)

The book divides itself into three parts: "Creating Openings for Faith," "Overcoming Barriers to Faith" and "Apologetics in Action." Each part is further sectioned into subjects relevant to the general topic. McGrath sets his agenda in the introduction: "This book does not seek to discard or discredit traditional approaches to apologetics; it seeks to supplement them" (p. 11). Further, "Effective apologetics demands both intellectual rigor and pastoral concern, for when all is said and done, apologetics is not about winning arguments — it is about winning people" (p. 12).

Chapter one develops the theological foundations for Christian apologetics. Paul's Areopagus sermon (Acts 17:22-31) serves as a model for apologetics (p. 28). The Apostle begins where his audience is.

McGrath is comfortable with Thomas Aquinas' "Five Ways" arguments, which provide points of contact. Christianity is not irrational — "Reason, then, provides an important point of contact for the gospel. Through fallen, reason still possesses the ability to grasp and point, however darkly, toward the reality of God" (p. 37).

Chapter Three has an interesting discussion of the components of faith. Chapter Four contains valuable information concerning things which keep people from coming to faith in Christ. Contemporary situations are examined and compared with classic examples such as Augustine's journey of faith and his encounter with Manichaeism.

Intellectual barriers to faith (such as Freudian theory, religious pluralism and miracles) and a discussion of dif-

ferent world views are presented in Chapters Five and Six. The material on feminism is rather limited. For example, the feminist attack on God-language (See Donald G. Bloesch, *The Battle for the Trinity*, Ann Arbor: Servant Publications, 1985) is not covered, nor is the hierarchal vs. egalitarian dispute within orthodox Christianity mentioned.

Chapter Seven brings the practice of apologetics from the theoretical to the practical. McGrath is at his best here. Appendix A deals with the apologetical approach of John Calvin (which interestingly is very similar to that of Thomas Aquinas). A very incisive critique of the presuppositionalism of Cornelius van Til is found in Appendix B.

A first-rate thinker is at work here. This book is highly recommended.

Reviewed by Ralph E. MacKenzie, Biblical Cornucopia Ministries, 5051 Park Rim Drive, San Diego, CA 92117.

I HAVE MY DOUBTS: How to Become a Christian Without Being a Fundamentalist by H. M. Kuitert. Valley Forge: Trinity Press International, 1993. 288 pages. Paperback.

The back cover of this volume reveals that the author is Emeritus Professor of Ethics and Dogmatics in the Free University of Amsterdam and a well known speaker on religious subjects in the Netherlands. This book is a best seller in the Netherlands, reprinted 12 times and almost 50,000 copies sold, more's the pity.

The state of Christianity in Europe has been reported to be less than robust. If Kuitert and his book are indicative of the reigning theological perspective in the Netherlands then the Church there is indeed in dire straits.

The volume has 22 parts, each of which is further subdivided. The individual parts address a different theological subject. However, in the introduction (p. xiii) Kuitert claims that he is not writing about theology. He then proceeds to discuss theology, though not the classical variety that would appeal to evangelicals. The book's subtitle is misleading; it should be called *How to Be a Christian Without Believing Anything Christian.*

On page 8, concerning the centrality of the Gospel, we are told, "...this whole approach derives from a particular view of Christian religion as being revealed by God and therefore unassailably right. Quite apart from its pretentiousness, it's too simplistic to be true." So much for the early Church martyrs not to mention such Christian leaders as St. Augustine, Anselm of Canterbury, Thomas Aquinas, Luther, Calvin, and others.

Page 12 says that the determinative factor in fashioning our belief system should be experience. The Bible is insufficient for leading us to faith: "So I shall drop revelation as a foundation for the Christian tradition of faith; I prefer to give it a quite different substructure." Kuitert certainly does.

The volume continues to treat such doctrines of the faith as God as Creator, Christology, the Resurrection, the Church and the Bible in the same revisionistic fashion. The noise you hear is the illustrious founder of the Free University of Amsterdam, Abraham Kuyper, turning over in his grave.

When reviewing books, I strive to find something of redeeming value. On page 31, the author states: "Christianity is inconceivable without the faith of Israel, which preceded it." At least Kuitert may not be charged with anti-Semitism.

This is a dreary book; the Church in the Netherlands is asking for bread and fish but Kuitert offers stones and serpents (Matt. 7:9,10). The last sentence in the work reflects on the Scriptures and sums up the author's viewpoint: "The Bible is there to reflect on, not to prescribe what we must think." If you have been living in a time warp and have not been appraised of the deteriorative effect that "progressive" theology has had on Christianity in the 20th century, then this book may be of some value. If not, skip it; save your money.

Reviewed by Ralph E. Mackenzie, Biblical Cornucopia Ministries, 5051 Park Rim Drive, San Diego, CA 92117.

UNDERSTANDING THE NEW AGE by Russell Chandler. Grand Rapids, MI: Zondervan Publishing House, 1993. 367 pages. Paperback.

The author, Russell Chandler, has served as a journalist covering religion for the *Los Angeles Times* and other media for more than 25 years. Living and working in southern California gave him numerous opportunities to observe a smorgasbord of pseudo-religious movements and leaders. Also, theological studies at Edinburgh and Princeton helped prepare him for the formidable task of sorting out hundreds of innovators, beliefs, and spokespersons.

In 1987 Chandler first thought seriously of sharing information about the New Age with two groups: "those who are curious or searching, and those who are concerned for family members or friends 'caught up' in the mystique of some alternate spiritual lifestyle."

The book has 33 chapters, including "The Mind of the New Age," "Choosing a Channel," "Harmonic Convergence," "Holistic Health and Healing," and "Satan and the Problem of Evil." The final chapter is entitled "The Man for All Ages." To help the uninitiated comprehend this complex subject, Chandler has provided eight pages of definitions of such terms as akashic records, channeling, dharma, karma, paranormal, and tarot. He also provides 35 pages of notes which reveal a surprising number and

variety of books and articles on the subject. Finally there is a discussion guide divided into 12 sessions.

The main point of the book is communication and clarification. Chandler hopes that the reader will have a better idea of the true character and universal penetration of New Age. The reader should learn that "New Age" is a blanket term covering hundreds of different individuals, groups and dogmas. One leader is quoted as saying that New Age consciousness is a transformation going on everywhere. For example, roughly one in four Americans are said to believe in reincarnation, one of the basic New Age tenets.

Many New Age concepts of the nature of God are dealt with in this book. One definition of God, according to the author, comes from Star Wars: the "Force, [which is] ...an energy field generated by living things." One chapter is dedicated to the mind of the New Age, a reference to the two hemispheres of the brain. In one example, Shirley McLaine talks about left-brained Westerners and right-brained Easterners, making it obvious that Easterners are not grounded by elementary and unimaginative logic, as are the left-brainer Westerners.

Chapter four, "Historical Roots," traces the New Age movement back to cults which existed long before the birth of Christ. In modern times, transcendentalism was the first important religious movement in this country with a major Asian component. One reason for its growing influence, according to Chandler, is the immigration of several hundred thousand Asians into the U.S. each year.

After a very extensive treatment of the New Age movement, the book presents the biblical view of Christianity and points out the incompatibility of Christianity and New Age concepts.

The book is certainly informativem, and should be very helpful to the person who needs to understand what friends and family might be getting into. It also exposes the threat to the Judeo-Christian way of life. A chapter on religion and churches is especially recommended to the reader.

Understanding The New Age appears to be well documented, and it is written in a readable style, although the content is so compressed that most readers will want to digest it over a period of time. Even one who is well informed on the New Age movement will value this compendium of information. For those who are interested in specific topics, the index provides ready access.

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DEFENDING YOUR FAITH: How to Answer the Tough Questions by Dan Story. Nashville, Tennessee: Thomas Nelson, 1992. 233 pages. Paperback.

In the introduction to this book, the writer says that he wrote it to show that "Christianity is a reasonable and intelligent faith grounded on objective, verifiable evidence." To *prove* that God exists and that the Bible is true, Story points out that the Bible often agrees with other ancient documents and archeological findings. Furthermore, younger and older manuscripts of the Bible are almost identical. These two facts force us to accept the Bible as true in all respects. Clearly his "proofs" are not mathematical ones. Later in the book Story admits that absolute proof that Jesus is Lord and Savior is not possible (p. 14). "Even if we didn't have all the objective evidence currently available, the Bible would still be validated by the inner witness of the Holy Spirit" (p. 67). Those who say "God tells us that Jesus is our Savior, and that the Bible is true," without depending on evidence Story calls presuppositionalists. This reviewer is one of them!

Story states: "The belief that the Bible is scientifically inaccurate often has its source in the fact that the Bible used pre-scientific and phenomenological language" (p. 134). In other places Story wants to read Scripture "literally" because Scripture is inerrant. For example if Gen. 1-11 is "true" then evolution cannot have taken place since creation is the opposite of evolution. My question to Story here is: "Why can't the chapters of Gen. 1-11 be pre-scientific and phenomological language? Is the word "phenomological" a good description? If so, why?" Story claims that being created in God's image means that our ability to think is the God-given attribute that separates human beings from all other creatures (p. 14). But I would ask: "Is being created in the image of God limited to our rationality?" Such a view of man is far too limited, even when I fully agree that faith and knowledge cannot be separated. After all, faith, Christian or non-Christian, is the foundation of our life on this earth. Life includes much more than factual knowledge.

Story wants to reach thinking people, but the research he did is insufficient. He will have difficulty convincing anyone. An example: Story states that the second law of thermodynamics says that entropy *always increases* in a closed system. His conclusion is that the entropy of the universe is increasing. Contrary to that, P.C.W. Davies, in *Space and Time in the Modern Universe* (Cambridge, 1977) is more careful when he summarizes his point of view (p. 65): "Entropy of the universe can *never go down* ... equilibrium can be identified as maximum entropy." Also: in *The Cambridge Quarterly* Winter 1965/6, page 64-65, M.L.McGlashan writes:

> Thermodynamics is incredibly badly presented, for the most part by people who do not understand it. The usual undergraduate course consists more of pretentious pseudo-philosophy than of anything relevant to experimental science.

Another example: The distinction the writer makes in the beginning of the book between evidential and pre-

suppositional apologetics is too simplistic. As stated above I am a presuppositionalist, according to Story's definition. Yet I cannot find myself in the description Story gives (p. 4). A look at the Belgic Confession of the Christian Reformed Church Art. 2 shows that God is known in the first place by " ... the creation, preservation, and government of the universe ... " Art. 2 states too that we *know* God, not just "assume" that God exists and that the Bible is true. "Presuppositional" evangelists fully underwriting the creed I just quoted can point to many churches started because of their work, contrary to Story's statement that their view takes the steam out of evangelism.

A different kind of objection to this book is that it gives the impression that God could not have used evolution as a tool. Creation and evolution are opposites says Story. Contrary to Story, I think that God *could* have used evolution as a tool in creation, without taking away the basic statement in the letter to the Romans, that through man sin entered the world and that reconciliation is only possible through Jesus Christ, the God-given Son of Man, who takes away the results of our sins. Contrary to Story I believe that we should use the word "evolutionist" only to describe people who believe that evolution is operating independently from an external, higher force. I must admit that on page 135 we read that there are people who believe in creation *and* evolution: " ... there is no reason for anyone to allow evolution to interfere with his acceptance of the God of Scripture and the Lord Jesus Christ." Story contradicts that view on the next page, where we read: "It is not just a matter of conflicting interpretations of facts but of conflicting faiths."

After reading this book, I feel that it is not out of place to discuss the philosophy hiding behind the use of words like "science," "facts," "true," "truth" etc. Did we accept an unchristian view of life, taking these words in the sense the secular world uses them? A minor difficulty, for example, is that "science" means different things for different people. Some want to restrict science to subjects where experiments are done, and verified by repeating the experiments. Others have a wider understanding, and include subjects where calculations are made, and statistically verified. It seems to me that Story wants to set up theology on a "scientific" basis in the last sense. I have trouble with that. I believe that each discipline has its own particular methods and laws.

The temptation is great to go back in philosophical history to show that an approach like Story's is an approach which takes its starting point not in God the Creator, but in man a creature. Our reasoning decides then what is truth, contrary to the teaching our Lord, who said "I am the Truth." We acknowledge the fact of Adam's fall in sin, and the coming restoration of the Cosmos through Jesus Christ. From these facts we know that our knowledge here on earth is only a beginning. We should not trust our reason too much. However, a book review is not the place to go deeper into these philosophical and theological questions.

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Letters

Method and Miracle — A Reaction

In the recent exchange between Moreland, Meyer and Bube, (*Perspectives*, March 1994, pp. 2-25) I find myself in substantial agreement — with everyone. So why do they disagree? There seem to be two minor unresolved issues — the methodology of science and the law it investigates.

First, let us consider methodology. Let us term science a freely chosen cultural "game" in which we are involved. In a game, the players have the right to set the rules. Thus, responding to Moreland and Meyer, it seems perfectly legitimate for the "players" to go with "methodological naturalism," in the sense of only considering "law-bound" theories. Thus, *science* would be defined as the study of natural law, and intrusive acts would be excluded from the game.

It is true that this makes science a *self-limited* investigation of only part of reality, as Bube suggests, but after all, "Monopoly" does not *have* to use real money. However, it *does* mean that science must lay down its expectation of explanatory completeness, for the likelihood of "singularities" can not be determined from within the game. This limited view is what Bube calls "authentic" science. Now it may be legitimate to so limit science, but as Gillespie documented (1979), such limits to possible explanation (termed nescience) have been rejected by the scientific enterprise since the Naturalism movement of the mid-nineteen century. Thus we find the sort of "exclusion" act which removes divine acts blocks one group of "second-order" assumptions, while leaving the field open for another group (the legitimation of law-limited explanatory completeness). Thus, what Bube considers defective science is unfortunately the way the discipline has been done — the way the game has been played — for a long time. Creationists want a piece of the action.

On the other hand, Moreland and Meyer also have a blind spot. They suggest that creationists "deny the adequacy of theistic evolution," instead proposing the intervention of "a personal agent of great power and intelligence" (Moreland). They contrast "intelligent design" and "naturalistic descent" — or more specifically, oppose "design and descent" (Meyer). Clearly, design implies intelligence, and thus refers to final and formal causes (Aristotle). On the other hand, "descent" refers to material and efficient causes. The terms can only be directly opposed if one term is carrying a hidden weight of meaning

of the other sort of causes. For Meyer, that seems to be descent — which has been given formal and final power as well. But clearly, that need not be so. Consider the "creation" of a new breed of dog. "Descent" describes the material and efficient causes which produce the new breed, but the *breeder* provides the formal and final cause. Thus, to argue that natural descent means absence of design is to assume that law-governed events are not directed. This is the same error for which Charles Hodge critiques Darwin, that by the use of "natural" selection, Darwin intended to exclude "supernatural" selection and thus the possibility of design through the natural order.

Bube speaks of "recognizing beyond the scientific description the activity of God." This implies that God *directs and determines* the outcomes of the lawful events of nature. He *governs* nature. However, Meyer does not seem to allow for that. In his postscript, he differentiates "Potentia Ordinaria" and "potentia Absoluta," but even here, the "potentia Ordinaria" is viewed as sustaining only, *not* as directive governance. Thus, nature remains semi-autonomous, and Meyer's view remains semi-deistic, i.e., the form which I previously termed "legal deism" (Wilcox, 1986). *Theistic* evolution by definition means the *directed* realization of God's eternal decrees by his absolute control of *all* natural processes (Wilcox, 1987). Unlike Meyer's view, theism denies autonomy to natural law, even in its direction. God is free to make and direct the world any way he likes. He can not be boxed to fit neatly into our debates — or kept from mucking about in our laboratories. Theistic evolution (governed cause) is a possibility, and so are theistic singularities (governed absence of cause). In both cases, equally, *God is the Primary Causal Agent!!*

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Bube, Meyer and Moreland: A Middle View

J. P. Moreland, "Conceptual Problems and the Scientific Status of Creation Science" (*Perspectives*, 45:1, pp. 2-13) and "Response to Meyer and Bube" (*ibid.*, pp. 22-25) takes the position that divine creation is acceptable in a valid scientific theory. Stephen C. Meyer, "The Use and Abuse of Philosophy of Science: A Response to Moreland" (*ibid.*, pp. 14-18) endorses this view on the grounds that no line of demarcation has been successfully drawn between acceptable and illegitimate concepts for scientific theories. Richard C. Bube, "Is Creation Science an Oxymoron?: A Response to Moreland") *ibid.*, pp. 19-21) rejects their contention.

I understand Bube. In his basic discipline, physics, every acceptable theory has a logico-mathematical model as its core. Every such model has to make predictions which can be empirically tested, at least in principle. When it was proposed in 1948, Gamow's Big Bang cosmology could not be confirmed. Its predicted isotropic 3 K radiation was not measurable. Wilson and Penzias detected this radiation in 1965, confirming the theory. Most physical theories are more easily tested, often experimentally. The need for auxiliary theories does not essentially alter this requirement. For example, Newton depended on the earth and moon to confirm his gravitational theory, and was at first put off by erroneous data. Eötvös, more than two centuries later, measured the minute attraction between two masses in the laboratory.

A physicist may posit an unobservable entity or quality, but it has to make an observable difference. Further, it must be quantitative, not qualitative. Thus there are no designer nuclei, though elements have been produced artificially. Esthetics enters physics only as applied to theories. Yukawa, for example, declared Einstein's General Theory of Relativity beautiful. This parallels the mathematicians' recognition of elegant proofs. Consequently, one may consider discounting Bube's view as biased.

Moreland and Meyer approach the matter philosophically. They properly note the distinct nature of historical science, including Gamow's cosmology. While historical science may call on experimental evidence, it ultimately cannot be tested by experiment. This was not recognized when logical positivists set out to develop a purely scientific language, one free from metaphysics. Their expectation was jolted by Carnap's 1956 declaration that any such language was too restricted for scientific theory construction. Now our authors note that no demarcation between acceptable scientific concepts and non-scientific language can be drawn. So they add notions of miracle, creation and design to the vocabulary of "normal" science.

I would be more impressed with their approach if philosophers were able to demonstrate more. For example, as Augustine noted, and Descartes emphasized, I have irrefutable internal evidence that I exist. But I cannot demonstrate it to another, nor can I get such evidence from another. Solipsism is a logical possibility. Philosophical demonstration is impotent to defend what we all assume, that we exist together and that communication is not talking to oneself. Again, there are philosophical arguments for strict determinism which some people find compelling. One such person importuned one of my colleagues day after day. Finally, frustrated, he asked, "Why won't you accept it?" "Do I have a choice?" was the rejoinder. My friend recognized what determinists overlook, their assumption that everyone is free to choose to believe determinism. This inconsistency is not demonstration, for we may still be automata with the delusion of freedom. Only uninformed dogmatists are sure they have unconditional proof in this area.

In preparing my dissertation, I found no comprehensive criteria for declaring an observed sequence causal. But there are grounds for declaring that Aristotle's "First Cause" is not univocal with "cause" in cause-effect contexts. So, if a designing or originating deity is to be included in science, it will be with a telling difference. Is this change so great as to transform science into something abnormal? This question is not addressed by our authors.

Virtually everyone makes a distinction between historical scientific explanation and other explanations. For example, Exodus 14:19-31 describes Israel's passage through the Red Sea and the drowning of Pharaoh's pursuing army. Nof and Paldor explained how this could happen. They modeled the floor of the Gulf of Suez, a northern extension of the sea, and showed that a strong wind will uncover a ridge, leaving water on either side. When the wind stops, the water surges back. This model is unquestionably scientific. But the declaration that the Lord caused the wind to blow is not normally considered a scientific statement. A scientific explanation of the wind would have to be in terms of the placement of meteorological highs and lows. Ascribing the action to God is, in contrast, a theological explanation.

If we turn to cosmology, we have a scientific explanation back to 10^{-43} second after the Big Bang. Is it scientific to extrapolate back that fraction of a second to declare the Big Bang *creatio ex nihilo* by God? Most people will say "No." If "quantum fluctuations in the vacuum" are shown to be relevant, the extrapolation to divine origination will surely be seen as a "God of the gaps" move.

Despite our authors' protestation that all demarcation arguments fail, it seems to me that we have a fairly clear idea of the distinction between scientific and non-scientific constructions. The simple rule asks: Does the factor make an observable difference? Einstein thought his cosmological constant did, though it later was judged superfluous. But the claim that the world was brought into existence ten minutes ago with all the appearance of age is not a scientific claim. Changing minutes to millennia does not alter this judgment. This is one reason why most young-earth creationists have abandoned it, opting for the Flood or a gap to explain the current state of the earth.

Do Moreland's and Meyer's demarcation arguments counter this traditional attitude? Clearly, the lack of a criterion to exclude any concept from scientific contexts provides that references to God, creation, design, miracle, etc., cannot be arbitrarily proscribed. Does this establish that their inclusion is relevant? Moreland tacitly assumes that the answer is "Yes."

Let's look again at the crossing of the Red Sea. What difference does claiming that God caused the wind make? How, apart from the biblical statement, can I determine that it was God, rather than Satan or Caicas, who sent the wind? Further, what changes when we make God the source of the Big Bang? What would alter if, pantheistically, we insert god as the ylem, identifying him (it ?) with the expanding universe? Is not such an insertion of a supernatural actor essentially parallel to the ten-minute universe? It seems evident that, even though we may not have a defensible criterion for language in general, we have a robust criterion for the utility of concepts within scientific explanations. This argument is strengthened by another consideration. "Atom" is a useless term in psychology, as "emotion" is in physics. Reverse the disciplines and both terms are relevant, indeed, vital. This clearly suggests that there can be concepts which have no place in any science. Perhaps the failure to establish a demarcation springs from the attempt to cover all the sciences simultaneously. Would a search for criteria limited to one discipline be successful?

Because Moreland and Meyer have assumed that demarcation is the only relevant criterion, they have come up short. Moreland needs to establish empirical relevance in order to establish that creation science is *science*. It thus appears that Bube, far from pushing an outdated view of science, is onto something.

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More on the Big Bang/Big Crunch

Recently, in referring to the universe in terms of its origin at the Big Bang, I was criticized for referring to the center of the universe. Knowledgeable advocates of relativistic cosmologies, it was said, deny that the universe has a center. While of course I have been familiar with that denial, I do not at all accept it that the universe has no center.

According to the Big Bang model, the universe initially exploded in all directions outward from a single point. That point remains the central point from which expansion continues in all directions outward, and so that point is the center of the universe.

Reasonably, the term "universe" must include both material objects and the space between material objects. If extended in imagination far enough through that point at which the universe exploded, eventually both ends of a straight line would overtake material objects moving in opposite directions, and the straight line would represent the diameter of the universe. Obviously it would also represent space between material objects, therefore reasonably that space must be considered part of the universe, and reasonably the center of that line of diameter must be regarded as the center of the universe.

I contend that, at death of the physical body, each intangible soul begins a journey of allurement to the center of the universe the Alpha Point, where the universe exploded into existence a point which to approaching souls eventually becomes the Omega Point, the end-point where, gathered into vast civilizations, souls will live endless aeons of wonderfully fulfilling episodes of life.

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