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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Putting Things Into Perspective

American Evangelicals have had a difficult time coming to grips with the environmental movement. Conflicting views on politics and economics, overuse of scare tactics, concern over New Age influences and a Cornucopian view of world resources serve to muddy the waters. The ASA 1993 Annual Meeting (held in August in Seattle, Washington) will address ecology once again. It is important that we find ways to communicate the results of this discussion to Evangelicals. Our first paper in this issue, Mark Stanton and Dennis Guernsey's "Christians' Ecological Responsibility: A Theological Introduction and Challenge" offers a keynote for this conference and the Christian in the pew.

Bruce Hedman provides a change of pace with his discussion of Lutheran mathematician Georg Cantor's deep commitment to integrate mathematics and his Christian faith in "Cantor's Concept of Infinity." Hedman examines how Cantor's Christian understanding of the universe as *created* and *contingent* influenced his development of transfinite set theory and, in turn, how transfinite set theory has influenced "an increasingly contingent world view in modern science."

Carl Sagan's popular TV series *Cosmos* and his books on the same theme offer a powerful and enduring contemporary challenge to Christianity. Theologian-pastor Mark G. McKim examines Sagan's world from a Christian viewpoint which seeks to demonstrate the inadequacy of Sagan's philosophy, which characterizes much of Western society.

In our last article, Nancey Murphy takes a critical look at Phillip Johnson's account of the status of evolutionary biology. She suggests that Johnson has "allowed the Evolutionary Naturalists to confuse evolutionary science with something else and, second, that he has used too primitive a view of scientific methodology for his evaluation." I suspect that this will not be the last word on the subject.

Adrian Desmond's *Politics of Evolution* (reviewed in this issue) recounts the often rowdy battles of London's medical community in the early nineteenth century. Two Communications in this issue deal with modern versions. First, Jerry Bergman provides an account of Forrest Mims' struggles with *Scientific American* in his "Censorship in Secular Science: The Mims Case." *Scientific American* also provides the context for Phillip Johnson's "The Religion of the Blind Watchmaker," a response to Stephen J. Gould's highly critical review of *Darwin on Trial*. *Scientific American* has refused to print Johnson's piece.

Clifford Grobstein's views on when life begins are considered defective by F. Earl Fox, due to the fact that the analysis is based on biological grounds alone. Fox argues for the need to look at the psychologist's picture and (ultimately) that of the Bible in considering the nature of life in "Two Kinds of Personhood: A Reply to Clifford Grobstein."

In the closing chapter in the William Hasker/Alvin Plantinga dialogue, Hasker emphasizes the need for Plantinga to articulate an alternative to the "theory of common ancestry" and questions his proposal for a "theistic science." We thank these scholars for an illuminating discussion.

This issue closes with a selection of book reviews and several letters to the editor.

J. W. Haas, Jr.

Christians' Ecological Responsibility: A Theological Introduction and Challenge

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The concept of ecology has gained attention in contemporary society but is frequently neglected by Christians. Some Christians view ecology as a fringe issue, while others have concerns about parallels with New Age ideology, especially the pantheism of secular ecology. This paper assesses the need for an ecological theology and presents an introduction to three elements of such a theology: the immanence of God in creation, the relationship of humans to the remainder of creation, and the role of the church in ecology. The term "stewardship" is shown to relate etymologically to ecology, and a challenge is issued to Christians to fulfill their role as steward-ecologists.

The concept of ecology has gained attention in contemporary society. From nuclear disarmament marches to "Save the Whale" campaigns to the ecological epistemology which is influencing the social sciences, ecology is an increasing concern in our world.

Far too often ecology is considered a fringe issue by Christians. Ecologists are conceived of as scraggly-haired, bearded extremists wearing blue jeans and corduroy jackets, or media moguls spouting New Age ideology. Ecology is seldom preached from evangelical pulpits or discussed in Sunday School classes. Is this legitimate?

In this article we will provide an introduction to an ecological theology, including the need for such a theology and its basic theses, and a challenge to Christians to consider their ecological responsibility.

An Introduction to Ecology

The formal study of ecology is a relatively recent development in the sciences. The term was first used in 1869 by the German biologist Ernst Haeckel, although writings and research which we would now label "ecological" extend back to the classical Greek period (Odum, 1971, p. 3).

Etymologically, the term derives from the Greek *oikos* (house) and may be defined as "the study of 'households' of living organisms together with their interrelationships, and the interrelationship with the environment" (Arny & Reaske, 1972, p. 59).

The ecosystem is the standard descriptive set of analysis. It is an inclusive term, used to describe all the life-support "households" of the earth (Lugo & Snedaker, 1971). At the macro-level, the ecosystem would comprise the totality of interaction and relationship between the living (biotic) and non-living (abiotic) arenas, including all their component subsystems.

It is a basic ecological thesis that all things are related. In this, ecology adopts a General Systems Theory epistemology. Schneider (1976) has a chapter in his book *The Genesis Strategy* entitled "Everything is Connected to Everything Else" in which he illustrates this ecological principle with an account of the effect of human actions on the atmosphere.

He details how the increased burning of fossil fuel has contributed to a substantial increase of carbon dioxide in the earth's atmosphere. This, in turn, has the effect of allowing the surface temperature of our planet to increase. While the increase seems minimal (0.5° C over the last century), he includes dramatic pictures of a glacier near the French Alps town of Argentiere which shows how the mean hemispheric temperature increase (termed the "greenhouse effect") has almost totally melted the glacier. Ecology tells us that we may never look for simple, single cause-effect relationships. Rather, we must understand the complex, interactive relationships which exist within our environment.

The concern of ecologists today is that humans have so distorted the natural ecological process of succession that the system itself may die. They call for a world view which will provide negative feedback to the recent excesses of humanity. As concerned Christians we need to heed this call and seek to establish the theological basis for ecological action.

The Need for an Ecological Theology

The relationship of theology to the modern ecological crisis became an intense issue of debate in 1967, following the publication of the article, "The Historical Roots of Our Ecological Crisis," by Lynn White, Jr., Professor of History at the University of California at Los Angeles.

After detailing aspects of the ecological crisis, White proceeds to fault Christianity for propagating an anti-ecological understanding of the relationship between humanity and the environment. His criticism is two-fold:

> Christianity is the most anthropocentric religion the world has seen ... [it] not only established a dualism of man and nature but also insisted that it is God's will that man exploit nature for his proper ends. (p. 335)

It should be noted that White acceded that his criticism applies to Western Christianity in the post-Scientific Revolution era. In this regard, it may be more accurate to indicate that White is not necessarily criticizing Christian theology *per se*, but Christian thought which improperly imbibed the Cartesian/Newtonian world view. Indeed, White concludes his article with a challenge to theologians to present an alternative Christian view which is ecological: "Since the roots of our trouble are so largely religious, the remedy must also be essentially religious ... " (p. 338).

In 1973, theologian Jack Rogers published an article in which he surveyed the published studies of approximately twelve theologians which had appeared since White's article. They reflect the search for "an appropriate theological model" which adequately assesses the biblical data regarding the relationship of God, humans, and nature.

Using traditional theological categories, the survey establishes a biblical basis for an ecological theology:

A. *God* — God is immanent in His creation. He can involve himself without destroying his own integrity or the freedom and integrity of man and nature. God cares for all the creatures of the earth (Matt. 6:26, Psalm 104: 21-31).

B. *Nature* — The biblical view is congruent with the view of modern science that the world is an integrated ecosystem. Nature is not ruled by "natural law" but is animated, ruled and sustained by the "breath of God"(Rom. 1:20).

C. *Humanity* — Any form of radical dualism between humanity and nature must be rejected; humans are co-creatures with nature. However, humans do seem to have some unique relationship with God. Rogers suggests that humans are to be caretakers within nature.

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D. *Covenant* — This biblical concept clearly expresses relationship between God-humans-nature. The Noahic covenant is an example of a covenant which involves God-nature-humans (Gen. 9:8-17).

E. *Sin* — Nature was subjected to the curse because of the fall of humanity. Human sin continues to wound nature (Gen. 3:17, Rom. 8:20).

F. *Jesus Christ* — Christ created and holds together all things (Jn. 1:3-4, Col. 1:17). The incarnation evidences the goodness of creation.

G. *Redemption* — Christianity is not only "other-worldly," for scripture indicates the entire creation awaits redemption (Rom. 8:19-23). See also John 8:16 *world=Cosmos* and Col. 1:20 (Christ died to reconcile *all* things).

H. *Eschatology* — The end will inaugurate a time when all things will be renewed; biblical descriptions of the eternal state seem to suggest a reconciliation between humanity, animal life, and plant life (Isa. 11:6-9, Ezek. 34:25-27).

The brief overview in Rogers' 1973 article indicates that an ecological theology is possible. Three elements seem to stand out, requiring address: a thorough understanding of the immanence of God in creation, the nature of humans in relation to the remainder of creation, and the role of the church in ecology.

God In Creation

It is interesting that Ernst Haeckel, the German biologist who coined the term "ecology," should have also addressed the relation of God and creation. In advocating a "monistic philosophy" in 1899 he wrote, "Pantheism teaches that God and the world are one. The idea of God is identical with that of nature or substance ... Pantheism is the world-system of the modern scientist" (Quoted in Moltmann, 1985, p. 194).

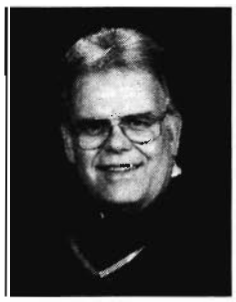
In contrast to this scientific religion of pantheism, Christianity in the last centuries has stressed the transcendence of God. In a standard text like Berkhof's *Systematic Theology*, (1949/1977) a balanced presentation of the transcendence and immanence of God is given, but transcendence is described first, in forceful language:

> God is not simply the life, or soul, or inner law of the world, but enjoys His own eternally complete life above the world, in *absolute independence of it.* He is the transcendent God, glorious in holiness, fearful in praises, doing wonders (p. 134, emphasis added).

Jürgen Moltmann in his work, *God in Creation* (1985), has developed the first full-orbed ecological theology. One of his "guiding ideas" for an ecological doctrine is God's immanence in the world. He indicates that new, ecological thinking about God must no longer center on the distinction between God and the world but on the recognition of the presence of God *in* the world and the presence of the world *in* God.

Moltmann traces the emphasis on transcendence in the Old Testament to the pantheistic, animist environment in which Judaism developed. It was necessary and appropriate to distinguish belief in Yahweh from the idolatrous fertility and field gods of Canaanite culture. Cartesian methodology, however, took these distinctions into an entirely different context and used them to legitimate an anti-ecological, mechanistic world view.

Moltmann argues that an appropriate understanding of the biblical doctrine of immanence is founded on a trinitarian process of creation. Traditionally, theology stressed the role of the Father in creation in a way which resulted in a heightened sense of transcendence. Moltmann proposes that the full trinitarian nature of creation be developed, es-



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pecially the neglected role of the Spirit. He does this by focusing on the understanding of every created thing in terms of the energy infused continually by the Spirit. God is immanent in His creation by virtue of the presence of His Spirit; "God's Spirit acts into and penetrates the world, effecting and fashioning the world's coherence without Himself becoming merged in it"(p. 12).

> There is tension in this understanding of God and creation, but it proceeds from an immanent tension in God himself: God created the world, and at the same time entered into it. He calls it into existence, and at the same time manifests himself through it .... The God who is transcendent in relation to the world, and the God who is immanent in that world are one and the same God. So in God's creation of the world we can perceive a self-differentiation and a self-identification on God's part." (Moltmann, 1985, p. 15)

This is a profoundly ecological theology. God's relationship to creation is not one of simple cause and effect; He relates in complex fashion with all the intricate lines of integration which are characteristic of God as Trinity. Creation has always been, and continues to be, a genuinely contingent order.

This theology is also distinct from the pantheism of contemporary ecological thought. Osborn (1990) notes that there is a tendency among Christian Greens (ecologically-oriented believers) to over emphasize divine immanence at the expense of transcendence. What is necessary is "a doctrine of divine transcendence so radical that it necessitates belief in divine immanence" (Osborn, 1990, p. 59, note 48). Moltmann refers to this as *"parantheism."*

Humanity and Nature

Frederick Elder in *Crisis in Eden* (1970) stated that one's view of the relation of humanity to nature was a crucial theological foundation. He noted two basic views, which he labeled the Inclusionists — those who see humans as part of nature; and the Exclusionists — those who sharply separate humans from nature and are confident that humans have the right and ability to manipulate nature through science and technology.

It is clear that the latter position, facilitated by the Cartesian concept of a mechanistic universe, has in common practice resulted in ecological turmoil. Humanity has shifted from participation in a complex system of equilibrium with a natural cybernetics to a growth-oriented society focused on the acquisition of power and utilizing artificial rather that natural mechanisms to achieve some kind of control of the environment.

This shift led scientist W. I. Vernadsky (1945) to suggest that we think of the "noosphere," a world dominated by the mind of man, as gradually replacing the biosphere, the naturally evolving world. Ecologist Eugene Odum (1971) considers this a "dangerous philosophy" because humanity has not shown itself wise enough to deal with the complex, interactive nature of actions and reactions. Odum suggests that ecological understanding and moral responsibility must keep pace with humanity's power to effect changes so that we may achieve "unlimited ingenuity in perpetuating a cyclic abundance of resources" (p. 36). This can only occur as humans perceive themselves as part of the ecosystem and act responsibly toward the whole of creation.

God's relationship to creation is not one of simple cause and effect; He relates in complex fashion with all the intricate lines of integration which are characteristic of God as Trinity.

An ecological theology supports such a view. It is unfortunate that most "Inclusionists" have been scientists, while most theologians have been "Exclusionists." Theology must reaffirm the human position within creation. Bonifazi (1970) states it well, "We are of the world, and the ontology of man depends upon a general ontology which includes matter" (p. 196). Moltmann (1985) argues in much the same way, "It is important for the way the human being understands himself that he should not see himself initially as subject over against nature, and theologically as the image of God; but that he should first of all view himself as the product of nature and—theologically too—as *imago mundi*" (p. 51). That humans are ontologically one with nature is a primary reality; the relationship between humans and the remainder of creation must proceed from that fact.

Some confusion — and a number of ecologists' condemnation of the Judeo-Christian tradition — has resulted from the perception that the Bible advocates human domination of nature. The exhortation to "Be fruitful and increase in number; fill the earth and subdue it. Rule over the fish of the sea and the birds of the air and over every living creature ... " (Gen. 1:28) has been seen as the theological justification for human exploitation of nature and abuse of the environment. A 1970 study by the Massachusetts Institute of Technology detailed the extent

of such "ecological demand" by illustrating in several spheres of life how much humanity demands today from the environment. (The 1990 world population was 5.3 billion.) Moltmann notes that *The Global 2000 Report to the President* in 1980 forecast that the world population will increase to 6.35 billion by the year 2000 and will total 10 billion in 2030 (p. 323, footnote).

Hall (1986) finds it telling that many have adopted the language of the "conquest of nature" (p. 163). Even the most charitable interpretation includes the element of control and is susceptible to the manipulation and abuse which have been evidenced in our society. Wilkinson (1980) indicates that "all too often throughout history, well-functioning ecosystems have been converted into deserts, dirt bowls, and cesspools"(p. 15). Humans have attempted to replace natural ecosystems with synthetic ones (e.g. farmland "agro-ecosystems" and urban complexes). If care is not given to the principles of natural ecosystem survival, the system itself is threatened by the depletion of resources.

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Did God intend such unrestrained human domination of nature? In what sense has God "given the earth to humanity"? (Psalm 115:16).

Moltmann (1985) compares the command "to rule" to the way in which God relates to His creation.

> The specific biblical concept of "subduing the earth" has nothing to do with the charge to rule over the world which theological tradition taught for centuries as the *dominium terrae*. The biblical charge is a dietary commandment: human beings and animals alike are to live from the fruits which the earth brings forth in the forms of plants and trees. A seizure of power over nature is not intended. A charge "to rule" can be found only in Genesis 1:26: "Then God said, 'Let us make man in our image, after our likeness; and let them have dominion over the fish of the sea, and over the birds of the air, and over the cattle, and over all the earth.'" But here "having dominion" is linked with the correspondence between human beings and God the Creator and Preserver of the world—the correspondence which is meant when the human being is described as being the image of God. Because human beings and animals are to live from the fruits of the earth, the rule of human beings over the animals can only be a rule of peace ... The role which human beings are meant to play is the role of a "justice of the peace." (p. 30-31).

This view is consistent with a humanity which is part of creation. Humanity is not the subject and the world the object; humans act within creation to protect it. In this sense it remains *God's* creation, it "cannot be claimed by men and women. It can only be accepted as a loan and administered as a trust" (Moltmann, 1985, p. 31).

The Church and Ecology

The New Testament has a word for the human administration of creation: "stewardship." Although some find it inadequate, their objections can be passed over when one accepts the systemic nature of the term and its etymology.

In his introduction to ecology, Odum (1971) notes incorrectly, we believe, that the Greeks had no word for ecology. The Greek word, *oikos* (house), which is the root word in ecology, is used frequently in the New Testament. As Goetzmann (1976) has noted, it often takes a metaphorical sense, denoting the family, the property and other things connected with the house itself. The term, *oikos*, is capable of expanded spheres of reference, from the nuclear household (I Tim. 3:5) to the extended family (e.g., house of David, Luke 1:27) or relational group (the church as the "household of God," I Tim. 3:15) or the world (*oikomone*). Consequently, it seems legitimate to equate it with our modern designation for an ecological household, the ecosystem, at whichever level of analysis we choose (micro to macro).

Closely related to the use of *oikos* in the New Testament are the cognate words "steward" (*oikonomos*) and "stewardship" (*oikonomia*). They refer to the person and the task of managing the household. Goetzmann (1976) notes that the terms were used in secular Greek to denote the arrangement of components of a household, such as the stewards responsible for the property, the food, the finances and other specific spheres. These stewards were usually recruited from among the slaves.

In the New Testament, the term is also used to refer to the care for household food (Luke 12:42) and finances (Luke 16:2). In connection with the household of God, Paul refers to himself as a "steward of the mysteries of God" (I Cor. 4:1). This implies a spiritual responsibility for the Gospel.

We believe that an ecological theology includes the understanding that God the Creator has entrusted his creation to the stewardship of humanity. Christians, as the recipients of God's grace, have a special calling to manage well what he has given (I Pet. 4:10). Based on the etymology of the terms and the statements of scripture, it is possible to state our role in this manner: *Christian = Steward = Ecologist*.

An understanding of the ecological implications of the metaphor of stewardship has been in ascendancy in recent years (Wilkinson, 1980; Hall, 1986, 1990; Santmire, 1985). Hall (1990) finds "the steward" a commendable self-designation for Christians. It avoids the most objectionable aspects of some terms by which we designate ourselves (for example, "the elect" or "the saved," which smack of superiority or false security) and communicates a non-authoritarian character which is compatible with the theology of the cross. This is precisely the terminology needed to convey the genuine concern of Christianity for all of God's creation. In fact, the scientific community is already co-opting the term into eco--philosophy (Hall, 1990) and the church must face the challenge of preserving it and presenting it within the context of an ecological theology.

We do not believe that we may take a reductionistic approach to this stewardship, however, such as the common tendency to consider tithing as fulfillment of Christian stewardship. Biblical stewardship is more complex and complete; it involves the responsible care for all God's creation.

Each Christian must consider the implication of an ecological theology for their life. Application of ecological concepts is possible in diverse fields of employment and personal interest. In the social sciences a vast amount of theoretical and practical literature is being written to enable a thorough ecological approach to human issues (Auerswald, 1968, 1986; Bronfenbrenner, 1979; Hartman & Laird, 1983; and Wicker, 1984).

In Jesus' parable of the "Shrewd Steward," he made it clear that the steward is accountable to the Master for his stewardship: "Give me an account of your management .... " (Luke 16:2). The consistent teaching of the stewardship passages is that faithfulness is the essential requirement (Luke 12:42, 16:10; 1 Cor 4:2).

Stanley Hauerwas (1981) has pointed out that nature "seldom tells what we ought to do, but often tells what we are doing is inappropriate" (p. 232). An ecological perspective, in which Christians see themselves as steward-ecologists, challenges us to accurately assess our lives, ministries, and relationships in the social and physical environment in order to see if what we are doing is inappropriate. We must ask ourselves, "Have we been faithful stewards of God's creation?" ❋

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Cantor's Concept of Infinity: Implications of Infinity for Contingence

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Georg Cantor (1845-1918) was a devout Lutheran whose explicit Christian beliefs shaped his philosophy of science. Joseph Dauben has traced the impact Cantor's Christian convictions had on the development of transfinite set theory. In this paper I propose to examine how Cantor's transfinite set theory has contributed to an increasingly contingent world view in modern science. The contingence of scientific theories is not just a cautious tentativeness, but arises out of the actual state of the universe itself. The mathematical entities Cantor studied, "transfinite numbers," he admitted were fraught with paradoxes. But he believed that they were grounded in a reality beyond this universe, not finally determinable by any mathematical system.

Introduction

Contingence

Towards the close of the twentieth century I believe that Christians are finding the climate of science to be more hospitable to our faith than did our forbearers in the nineteenth. I shall refer to Newtonian mechanics as it was developed in the eighteenth and nineteenth centuries as "classical" science. By "modern" science I shall refer to developments since and including Maxwell's electromagnetic theory and Einstein's special and general theories of relativity. Classical science sought to understand all phenomena solely in terms of particle-on-particle interactions, governed by Newton's basic laws of motion and gravitational attraction. So classical science came to regard the universe as self-contained, materialistic, and deterministic. But such a closed universe has no room for revelation, miracles, and salvation. The pursuit of scientific knowledge came to be regarded as antithetical to the Christian faith.

But this conflict was an aberration in the development of science. In this century philosophers of science have become aware that during the Enlightenment experimental science grew out of the Christian doctrine of creation.[1] More recently, the scientific revolutions which reshaped modern thinking were encouraged by Christian notions of contingence. We are indebted to the Very Reverend Professor Thomas F. Torrance for demonstrating how deeply Michael Faraday and James Clerk Maxwell were guided by their Christian belief in the universe as God's free creation, a conviction which also influenced Albert Einstein.[2] Modern science regards the universe as complex, subtle, and as far more open and free than did classical science.

These differences may be summarized using the word "contingent." An "incontingent" world view regards the universe as closed, self-contained, and self-explanatory, that is, not requiring any explanation beyond itself. Such a universe would be deterministic, that is, all that occurs must necessarily have happened according to a system of fixed laws. Such a universe even taken as a whole must necessarily be the way it is, and not otherwise. As such a universe can be explained according to a system of fixed laws, it is essentially simple.

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In contrast, a "contingent" world view regards the universe as open, as ultimately not explainable in terms of itself alone. On this view, no scientific theory can account for all phenomena. Such a universe need not necessarily be the way it is. One cannot understand phenomena through *a priori* reasoning alone, but must study the phenomenon itself.[3] A contingent world view regards the universe as essentially complex, subtle, and mysterious. It believes that an order may be found underlying diverse phenomena, but that this order is itself contingent, that is, always subject to further modification to embrace yet more diverse phenomena. In contrast to classical science's veneration of Newtonian mechanics, modern science regards its theories more tentatively, however beautifully they may now order known phenomena.[4] Most scientists today readily admit the contingence of scientific theories, and increasingly more of them will admit to the contingence of the universe itself.[5]

Cantor's Contribution to a Contingent World View

Georg Cantor (1845-1918) was a deeply religious Lutheran whose Christian convictions consciously shaped his scholarly work, including his mathematics. His biographer Joseph Dauben wrote, "The theological side of Cantor's set theory, though perhaps irrelevant for understanding its mathematical content, is nevertheless essential for the full understanding of his theory and the developments he gave it."[6] Dauben has expressed his surprise that the intentional impact of Cantor's deep Christian convictions has received so little attention from historians of science.[7]

In this paper I propose to examine the following two questions. 1) How did Cantor's Christian understanding of the universe as contingent influence his development of transfinite set theory? 2) How has transfinite set theory contributed to an increasingly contingent world view in modern science? I will examine these questions under three headings, according to the influence of a contingent world view upon epistemology (third section of this paper), cosmology (fourth section), and ontology (fifth section). I am indebted to Dauben's study of Cantor for key points in the discussion.

Cantor's Religious Background

Cantor's father, Georg Woldemar Cantor, was of Jewish descent, but was brought up in a Lutheran mission in St. Petersburg. He married Maria Anna Böhm, an evangelical convert from Roman Catholicism. Their six children, of whom Georg was the eldest, were baptized there in Böhm in the Evangelical Lutheran Church in St. Petersburg.[8] Georg Woldemar was very devout, and gave disciplined religious instruction to all his children. Georg Cantor was confirmed in the Lutheran church at age fifteen.

Throughout the rest of his life Georg Cantor firmly held to the Christian faith his father had instilled in him. During his university studies Cantor felt a deep calling from God to study philosophy and mathematics, rather than more lucrative pursuits. His faith sustained him during long years of rejection when the mathematical establishment dismissed his concept of the transfinite. When weaker men would have abandoned their work, Cantor persevered, not only because he believed that the transfinites had been revealed to him, but moreover because he felt a calling to spread the truth about God's creation for the benefit of both the Church and the world.[9] He wrote in a letter to a Dominican priest in early February 1896, "From me, Christian philosophy will be offered for the first time the true theory of the infinite."[10]

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The Existence of the Transfinite

Cantor's Idea of a Completed Set

Before dealing with the impact of transfinite numbers on the modern scientific world view, I need to discuss their existence. Traditionally Christian theology attributed the characteristic "infinite" to God alone.[11] Thomas Aquinas gave this classical formulation. "Things other than God can be relatively infinite, but not absolutely infinite."[12] A quantity is *relatively* or *potentially* infinite, if it is simply unbounded. The *absolutely* or *actually* infinite contains within itself already an infinite magnitude. Previously, mathematicians had spoken of infinity only as potential, not actual; only as "unbounded." In 1831 Gauss wrote, "The infinite is only a *facon de parler* in which one properly speaks of limits.[13]

Cantor introduced into mathematics the notion of a "completed set," so that the integers, for example, could be considered together as a set in themselves, and so as a completed infinite magnitude. Only by conceiving of the integers as a whole entity, (as a *Ding für sich*) could Cantor define the first transfinite number, which he denoted by a lower case omega (ω), in contradistinction to the familiar "sideways eight" infinity symbol (∞), which had only meant "unbounded." Cantor saw a precedent for this intellectual step in Plato's treatment of the "one/many" problem.[14] More influential was Augustine's argument, often quoted by Cantor, that "all infinity is in some ineffable way made finite to God, for it is comprehended by his knowledge."[15]

Transfinite Numbers in Contrast to Absolute Infinity

The integers considered as a completed set were Cantor's first transfinite number, ω. He went on to construct further transfinite numbers recursively.[16] Thus, the next transfinite number was $\omega + 1 = \omega \cup \{\omega\}$, and next, $\omega + 2 = \omega + 1 \cup \{\omega + 1\}$, etc. Then the sequence $\omega, \omega + 1, \omega + 2, \ldots$ was taken as a completed set, denoted by $\omega \cdot 2$. Similarly, the sequence $\omega \cdot 2, \omega \cdot 3, \omega \cdot 4 \ldots$ was completed as $\omega \cdot \omega$, or ω^2. Similarly the sequence $\omega^2, \omega^3, \omega^4 \ldots$ was completed as ω^ω. Thus, Cantor built up an ever-broadening hierarchy of what he called "ordinal numbers."

Cantor's pivotal discovery, which lends ordinal numbers their interest, was that some ordinals, though infinite in size, are nevertheless smaller than other ordinals. Cantor said two ordinal numbers were of the same "cardinality" (that is, "size," or "power") if they could be put into one-to-one correspondence with each other. Cantor's epochal discovery was that the natural and the real numbers were of different cardinality. More generally, call the set of all subsets of a set S — the "power set" P(S). By his now-famous diagonalization argument,[17] Cantor showed that P(S) was a higher cardinality than S, that is, P(S) was too numerous to be put into one-to-one correspondence with S. Cantor distinguished ordinals of different cardinality as "cardinal numbers," and denoted these by subscripting the Hebrew letter Aleph. Thus, the first cardinal was Aleph-Null ($\aleph_0$), the cardinality of the integers; the second cardinal was Aleph-One ($\aleph_1$), at most the cardinality of the real numbers. Cantor's discovery that the cardinality of P(S) is greater than the cardinality of S guarantees an unending hierarchy of cardinal numbers, $\aleph_0, \aleph_1, \aleph_2, \aleph_3, \aleph_n, \ldots, \aleph_{n+1} \ldots$. Cantor denoted the class of all cardinals by the Hebrew letter Taw ($\beth$).

Note that Cantor built up transfinite numbers "from below," by constructing a larger ordinal out of a smaller. From the beginning of his work he realized that infinity cannot be approached "from above." Cantor was keenly aware of the paradoxes inherent in such constructions as "the set of everything," "the set of all sets," and even Taw. Such totality Cantor called "Absolute Infinity;" it is beyond all mathematical determination, and can be comprehended only in the mind of God. Cantor's distinction between transfinite numbers and Absolute Infinity had a profound impact on our modern contingent world view, which I will examine under "Ontology" below.

Whether Transfinite Numbers Exist

Cantor distinguished three levels of existences: 1) in the mind of God (the *Intellectus Divinum);* 2) in the mind of man (*in abstracto);* and, 3) in the physical universe (*in concreto.)* Cantor believed that Absolute Infinity exists only in the mind of God. But he argued that God instilled the concept of number, both finite and transfinite, into the mind of man. Cantor frequently appealed to their existence as eternal ideas in the mind of God as the basis for the existence of the transfinites in the mind of man.[18] I will pursue the implications of this appeal for our understanding of contingent rationality under "Epistemology" below. Cantor adamantly defended the existence of the transfinites *in abstracto*, even arguing that God had put them into man's mind to reflect his own perfection.[19] Cantor advanced infinite series repre-

sentations of irrationals to claim that their existence was equivalent to that of the transfinites.[20]

Cantor was a realist concerning the relationship between the ideal and physical reality of numbers. The existence of numbers *in abstracto* he called their "intra-subjective" reality, and their existence *in concreto* their "trans-subjective" reality. There was a created correspondence between these two realities which I will discuss under "Epistemology" below. Although he denied that transfinite numbers have a trans-subjective reality in the duration or extent of the physical universe, Cantor did follow Leibnitz in believing that there were a transfinite number of elementary particles ("monads") in the physical universe. I will discuss this further under "Cosmology" below.

Epistemology

Contingent Rationality

Newtonian physics enjoyed tremendous prestige in the eighteenth and nineteenth centuries, as it united under one system both terrestrial and celestial mechanics. The Newtonian world view sought to explain everything in the universe in terms of particle-on-particle interactions governed according to these physical laws. But such a philosophy must struggle to account for the role of the mind in such a mechanistic, deterministic universe. Why should mental, mathematical abstractions correlate with the physical world? This question spurred the developments advanced by Locke, Berkeley, and Hume in the eighteenth century.

The Newtonian system was finally closed in upon itself by Immanuel Kant, who argued that the mind does not experience the physical world itself, the "noumena," but only its own sense perceptions, the "phenomena." Scientific laws are not statements about physical reality itself, but are only the mind's own ordering of its sense perceptions. The mind has innate patterns, the "*a priori*," according to which it orders its perceptions. Kant considered Euclidean geometry, for example, as *a priori* knowledge. Kant lent classical science its final, self-contained, incontingent character by closing it off from not only metaphysics but from physical reality itself.

This Kantian interpretation floundered on the scientific revolutions of the late nineteenth and early twentieth centuries.[21] If science is no more than the mind's projection onto its sense, how could such thorough-going scientific revolutions arise? The first tremors shaking this Kantian foundation came from mathematics, with the discovery of non-Euclidean geometry. In a letter dated 1885 the Swedish mathematician Gösta Mittag-Leffler wrote to Cantor that his transfinites were as revolutionary as non-Euclidean geometry.[22] Maxwell's electromagnetic field introduced a fundamentally non-Newtonian interaction.[23] Einstein's theory of relativity revolutionized Newton's notions of space as a "container" and of time as absolute, and hence Kant's interpretation of space and time as forms of perception.

Thus, modern science has moved away from a positivist toward a realist interpretation of the reciprocity between the mind and the physical universe. I believe that modern recognition of contingent rationality can be described in two movements. First, reason cannot understand nature *a priori*, but must go to nature itself and ask questions that nature may disclose itself. Indeed, the ancient Christian doctrine of contingence is the philosophical basis of experimental science.[24] Out of itself the physical universe suggests patterns to the mind. Second, there is a created harmony between these mental patterns and the physical universe so that later mathematical deductions correlate with further physical phenomena. Modern science simply accepts this correlation without pursuing an explanation.[25] Cantor exemplified both of these movements, and so furthered modern science's grasp on the contingent nature of rationality.

Cantor Grappled With Physical Reality

Kant argued that the mind was not informed by the physical world, but only imposed its own patterns upon its perceptions. Cantor was explicitly opposed to any Kantian interpretation of science, and maintained passionately that the transfinites were not his mind's own invention, but were suggested to him through physical considerations. In 1872 Cantor first demonstrated the uniqueness of the trigonometric series representation of a function. This, then, he generalized over intervals with increasingly infinite points of discontinuity. This led him to consider the nature of the continuum and of continuous motion. In a letter to Mittag-Leffler[26] Cantor wrote that his motive in studying transfinite cardinalities was to address certain applications in chemistry, optics, and biology.[27]In studying continuity Cantor made his epochal discovery of the nondenumerability of the real numbers, from which modern set theory has sprung. The counter-intuitive, even paradoxical, properties of the transfinites argue against a Kantian *a priori*, and suggest that physical reality has impinged upon the mind from outside itself.

I cite Cantor's interpretation of his own work as an example of what I call "incarnational mathematics." There is a created rationality embedded in our minds and within the physical universe. The mathematician possesses not merely a mind, but a mind embedded, "incarnated," if you will, into the physical world through his body. I believe history shows that the most productive mathematics have been suggested by physical considerations. After a period of abstract development, mathematics has often been refocused by physical applications of its abstractions.

The Applicability of Mathematics

As mentioned above (page 11), Cantor distinguished between the "intra-subjective" and the "trans-subjective" existence of all numbers, finite and transfinite. But Cantor believed these dual realities were always found together. This correspondence between the physical and ideal aspects of numbers Cantor believed came from "a unity in the universe itself."[28] Cantor believed in a created harmony between the mind and the physical world, so that mathematical deductions from patterns first suggested by the physical world should reapply to further phenomena. He thought that the transfinites would shed light on the ultimate constitution of matter, which would benefit physics, chemistry, and biology. History has vindicated his expectations, though along different paths. Cantor's set theory laid the foundation for analysis. His discovery that n-dimensional space is of the same "size" for all n spurred the study of topology, which has given us fiber optics, to name one benefit.

But this created harmony is contingent. In contrast to Hellenistic philosophy, the human mind is not a "divine spark," or an actual piece of God's own mind. This rationality in our minds and in the physical world is not absolute and self-dependent, but is only a created reflection of an Ultimate Rationality upon which it depends. So no scientific deduction must necessarily be so, nor is any scientific theory beyond revision. Cantor produced a classic example of contingent rationality when he drew the distinction between transfinite numbers, which exist in the human mind, and Absolute Infinity, which is beyond all human determination, and exists only in the mind of God.

Cosmology

Creation

Classical science regarded the physical universe as incontingent, as self-contained and self-explanatory. An incontingent universe must, therefore, be necessarily infinite in duration and extent. Otherwise, the questions as to what came before and what lies beyond have no answer within that incontingent universe itself. The eternity of the universe has been called the "first article of the secular faith."[29]

Cosmology is the bellwether of major paradigm shifts in a culture.[30] Modern science has returned to a more contingent world view of the universe as finite in duration and extent. Steve Hawking has called "Big Bang" cosmology one of the "great intellectual revolutions."[31] Furthermore many modern cosmologists seriously doubt that only one type of universe was logically possible, but rather argue that there were arbitrary elements in the composition of both the structure of the universe and its fundamental constants.[32] The ancient Christian doctrine of *creation ex nihlio* regards the physical universe as God's free creation whose structure is determined by no necessity nor constraint, but is contingent only upon God's will. Cantor's thinking was shaped by his Christian belief in the universe as *created.*

Cantor's Universe Finite in Duration and Extent

Cantor was explicitly opposed to the prevailing materialism of his scientific community, which regarded the physical universe as eternal and unbounded. From his earliest papers Cantor stressed that transfinite numbers were of no aid to the materialist, positivist, or pantheist.[33] In a letter to K.F. Heman dated 1887 Cantor promised to show that in fact transfinite numbers could demonstrate the impossibility of eternal time, space, and matter, though such arguments, if ever written out, have not survived.[34] Cantor was proud to be the only indeterminist on faculty at the University of Halle. Interestingly, Cantor challenged the existence of objective or absolute time in advance of relativity theory.[35]

For many years the only encouragement Cantor received for his work on the transfinites was from Roman Catholic scholars. Their support was at first tentative, until Cantor made certain basic distinctions. Christian theology had taught that infinity was an attribute of God's alone.[36] Hellenistic cosmology identified God as the soul of the world and the world as the body of God. These pantheistic notions were reintroduced by Spinoza, whose monistic philosophy of substance conceived of God as the infinite self-generating substance *(natura naturans)* from which the world *(natura naturata)* is derived. Any concrete, temporal infinity was pre-

sumably identified with God's infinity, and so suspected of pantheism.

The first theological paper to appeal to Cantor's transfinites was written in 1886 by a neo-Thomist, Fr. Constantin Gutberlet.[37] Gutberlet was concerned to show that actual, completed, mathematical infinity did not challenge the unique, absolute infinity of God's existence. Yet he disagreed with Cantor as to admitting the actual infinite into the created order. Whereas Cantor denied the infinity of the universe in duration and extent, he did believe, following Leibnitz, that there were an infinite number of elementary particles ("monads"), and so that the transfinites were realized *in concreto*. In a letter dated 1886 to Cardinal Johannes Franzelin, Gutberlet's teacher, Cantor made the distinction between Absolute Infinity, as eternal and uncreated, reserved for God and his attributes, and the *Transfinitum* (the transfinite numbers), as created *in abstracto* and *in concreto*.[38] Franzelin approved of this distinction as removing any threat to orthodoxy. As Franzelin was a leading Jesuit philosopher and papal theologian to the Vatican Council, Cantor took his approval as an imprimatur for his work. Cantor further argued that the real existence of transfinites in the created order reflects the perfection of the infinite nature of God's being.

Cantor's Universe Not Necessitarian

An incontingent world view regards the universe as having a necessary structure, as being uniquely determined by just the requirement of self-consistency. All phenomena in principle could be deduced from its system of basic laws. A contingent universe does not contain within itself a sufficient explanation of itself, and so cannot be understood simply by a priori reasoning. In his writings about the nature of the universe Cantor was deeply conscious of its contingent character. Following Leibnitz, Cantor thought of the universe as being built up from two kinds of elementary units: corporeal ("matter") and ethereal ("ether") monads. Cantor held that transfinites exist in concreto in a nevertheless temporal, bounded universe, because there are a transfinite number of such monads. Cantor further believed that the cardinality of the corporeal monads was Aleph-Null, and of ethereal monads was Aleph-One, his "First World Hypothesis." But in spite of his philosophical investment, Cantor was careful to stress that God did not necessarily have to create the universe in this or any other way.[39] The existence of the transfinites in the mind did not even necessarily depend upon their realization in the physical universe.

Ontology

Contingent Order

Classical science regarded the universe as self-contained, and hence as self-explanatory. It had to be understood out of itself, and had to contain within itself a sufficient explanation of itself. Many believed that all phenomena could ultimately be explained by the Newtonian laws, which were highly esteemed as expressions of the fundamental structure of physical reality. The revolutions of modern science, particularly the electromagnetic field and relativity theories, showed the naivete of this interpretation. Newtonian mechanics was not simply falsified, but came to be seen as a limited case of a far wider understanding. Modern science regards the universe as far more complex than ever imagined. Albert Einstein said, "God does not wear his heart on his sleeve."

Therefore, modern science regards its theories more provisionally than did classical science. No matter how true to known data, any scientific theory is considered as tentative, as a limited case of a wider reality yet to be discovered. The enterprise of modern science may be thought of as a sequence of concentric circles, like ripples radiating out from a pebble thrown into a pond, embracing a yet larger understanding of reality, but never all of it.

I believe that this interpretation of scientific theories illustrates an ontological conclusion as to the nature of reality itself. All theories are provisional, because the universe cannot be understood out of itself, and depends upon an explanation beyond itself. In other words, the contingence of scientific theories arises from the contingence of the universe itself. Since the existence of the universe depends upon a reality beyond it, no scientific theory, which is of course couched only in terms taken from within the universe itself, can finally explain everything in that universe. Thus, the order we find in the universe in contingent. I want to argue that not only did Cantor exemplify this attitude, but that his transfinites have consequently stimulated this understanding of the contingent order within the universe.

Contingence of Scientific Theories

Cantor's transfinite set theory changed the way mathematics thinks about itself. Joseph Dauben wrote, "Cantor's infinite had shaken the traditional faith in mathematics' everlasting certitude."[40] Cantor believed that he was studying mathematical entities which existed apart from and beyond any

mathematical system. He thus had no qualms about embracing the paradoxes which arise in transfinite set theory. Although Cantor did not explicitly write about these paradoxes until 1895, he seems to have been aware of them in his first book devoted solely to set theory, published in 1883. There he defined a "set" as a collection which could be taken as a completed whole *(Ding für sich)*. This requirement of completion precluded self-generating sets like the set of all ordinals ("Omega"), the set of all cardinals ("Taw"), or the set of sets. Cantor accepted the impossibility of analyzing mathematically the entire succession of the transfinite.

Yet Cantor was absolutely convinced about the real existence of the transfinites. I believe that Cantor would not have sympathized with the formalists of the next generation of mathematicians, who sought to reduce all mathematics to a logical system. He believed mathematics was simply too large for that. In contrast to these formalists, the spirit of Cantor's approach was vindicated by Gödel's work on incompleteness in 1931.

Cantor would not have been surprised, I think, to learn that any system large enough to include the integers would contain propositions whose truth was undecidable within that system. From a realistic point of view, Gödel vindicated his conviction that mathematics itself is far richer than any formal systemization of it. As mathematics is the model for other scientific disciplines, I believe that this harbingers the incompleteness, and hence contingence, of any scientific theory.

One specific case is worthy of note. Cantor spent years unsuccessfully trying to prove his "Continuum Hypothesis," that the cardinality of the geometric continuum is the smallest uncountable cardinal number, that is, P(Aleph-Null) = Aleph-One. In 1936 Gödel showed that Cantor s Continuum Hypothesis was at least consistent with set theory, and in 1963 Paul Cohen showed it was in fact independent. Thus, Cantor's prize conjecture turned out to be far richer than he had ever guessed. Cohen has suggested that the continuum may be larger than all Alephs.[41] In analogy with the Fifth Postulate, I suggest that someday different physical situations may be found, one of which will be described by Cantor's Continuum Hypothesis, and the other by a richer continuum.

Contingence of the Universe Itself

The contingence of scientific theories is not just a cautious tentativeness, but arises out of the actual state of the universe itself. The mathematical entities Cantor studied, which existed apart from any mathematical system, were themselves grounded in a reality beyond this universe. The transfinites were fraught with paradoxes which Cantor believed the finite mind could never understand. But he relied on the Divine Intellect as "the certain repository of the *Transfinitum*."[42] This Absolute Infinity was the ground for the transfinites, but was itself mathematically indeterminable. Were it determinable, it would have then been limited.

The character of infinity forced the contingence of the universe onto Cantor's thinking. Joseph Dauben considered the influences of Cantor's religious views upon his creative process in discovering the transfinites. He wrote, "One is tempted to wonder if this view of God's role in ensuring the reality and existence of Cantor's *Tranfinitum* was responsible for his discovery of the contradictory nature of that very concept."[43] I want to argue further that Cantor's discovery of the paradoxical character of the transfinites points to the contingence of the universe itself. That the transfinites cannot be completely understood out of themselves is a specific example illustrating that the universe cannot be understood out of itself. Cantor thought of the infinite ascent of ever-increasing transfinite numbers as an appropriate symbol for the absolute. Likewise, I think such a picture is a fit analogy for the scientific enterprise in a contingent universe. In the words of Ecclesiastes, "I have seen the business that God has given the sons of men to be busy with. He has made everything beautiful in its time; also he has put eternity into man's mind, yet so that he cannot find out what God has done from the beginning to the end."[44]

Open Questions

Anselm's Ontological Argument

Anselm argued that God is that of which nothing greater can be conceived. Can this be reworded more pointedly using Cantor's transfinites? Gutberlet used a similar argument. "But in the Absolute Mind the entire sequence is always in actual consciousness, without any possibility of increase."[45] Again, this is parallel to the Reflection Principle, which says that the Absolute should be totally inconceivable. Otherwise, if the Absolute is the only thing having a certain conceivable property, then the Absolute can be conceived as the only thing with this property.[46]

Applying Gödel's Theorem

Stanley Jaki appears as the first to have developed Gödelian implications for cosmology.[47] Yet, Gödel's Incompleteness applies only to systems large enough to contain the integers. So to apply Gödel's Theorem in this context one must assume the integers are included in the universe at least *in abstracto*. This argument should be developed for finitists like Prof. Torrance[48] who nevertheless wish to appeal to Gödelian results.

Zeno's Paradoxes

Cantor was motivated by the nature of the continuum and continuous motion. In short, continuous motion is possible because there are more real numbers than rational, that is P(Aleph-Null) 〉 Aleph-Null. This should relate to Zeno's paradox of "The Arrow in Flight."[49]

Disproving the Eternity of Space, Time, and Matter

Cantor claimed that he could use transfinite numbers to argue against the eternity of space, time, and matter, but apparently he never wrote the arguments down.[50] It would be interesting to try to reconstruct them, along the lines of his arguments against infinitesimals.[51]

Artificial Intelligence

Devotees of artificial intelligence model human thinking after Turing machines. Yet such can involve even potentially only a countable number of steps. Can one argue that from the uncountability of the real numbers that the human mind can fathom a reality larger than Turing machines can accommodate?

Kantian Philosophy

As suggested by a referee, another interesting direction would examine the effect Canton's mathematics of infinity, along with non-Euclidean geometry, had on the interpretation of Kantian philosophy in the twentieth century. ❋

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NOTES

[1]Seminal articles were written by M. B. Foster in *Mind*, xliii (1934), pp. 446 ff.; xliv (1935), pp. 439 ff; xlv (1936), pp. 1 ff; also, M. B. Foster, *Mystery and Philosophy*, (1957), pp. 87 ff; John Baillie, *Natural Science and the Spiritual Life* (1950), pp. 20 ff; W. A. Whitehouse, *Christian Faith and the Scientific Attitude*, (1951), p. 60 f. Also A.N. Whitehead, *Science and the Modern World* and Ian Barbour, *Issues in Science and Religion*.

[2]Thomas F. Torrance, *Christian Theology and Scientific Culture* (New York: Oxford University Press, 1981); also *Transformation and Convergence in the Frame of Knowledge*, (Grand Rapids, Eerdmans, 1984).

[3]In the history of science the Christian doctrine of the contingence of the universe, as a free creation by God, separate from yet dependent upon him, spawned experimental science in a way that speculative Greek philosophy never could. For an excellent account of the doctrine of contingence, see Thomas F. Torrance, *Divine and Contingent Order*, (New York: Oxford University Press, 1981).

[4]An example of modern physics' more humble approach to its own understanding of the universe is Einstein's reply to Helmholtz. Concerning the latter's conviction that the universe could be explained entirely in terms of one theory, Newtonian mechanics, Einstein replied, "The view appears dull and naive to a twentieth-century physicist. It would frighten him to think that the great adventure of research could so soon be finished, and an unexciting if infallible picture of the universe established for all time." Albert Einstein and Leopold Infeld, *The Evolution of Physics*, (New York: Simon Schuster, 1938), p. 58.

We have Thomas Kuhn to thank for making us aware of the progressive nature of scientific revolutions. T. S. Kuhn, *The Structure of Scientific Revolutions*, (Chicago, 1962).

[5]For a discussion of contingent world views among modern cosmologists, see Bruce Hedman, "Mathematics, Cosmology, and the Contingent Universe," *Perspectives on Science and Christian Faith*, vol. 41, no. 2 (June 1989), p. 99-103.

[6]Joseph Warren Dauben, *Georg Cantor: His Mathematics and Philosophy of the Infinite*, (Cambridge, MA: Harvard University Press, 1979), p. 291.

[7]Dauben, op. cit., p. 232.

[8]Dauben corrects numerous errors in E.T. Bells' popular biography of Cantor, the chief being that Cantor was not Jewish but Lutheran. Dauben also treats more sympathetically the nervous breakdowns Cantor suffered later in life. He apparently suffered from manic depression, and his first brief bout occurred when he was 37, and his second at 53. He was frequently in Halle's *Nevenklinik* towards the end of his life. Dauben points out that Cantor died in hospital only because his family was unable to take him home due to the exigencies of the First World War. cf. E. T. Bell, *Men of Mathematics*, New York: Simon & Schuster, 1937).

[9]Dauben, op. cit., p. 291.

[10]From a letter dated February 15, 1896, from Cantor to Esser. In Herbert Meschkowski, "Aus den Briefbüchern Georg Cantors," Archive for History of Exact Sciences, 2 (1965), p. 503-519.

[11]To offer an autobiographical footnote, I became interested in the Christian interpretation of the transfinite after a conversation with Prof. Torrance in April 1987, when he expressed his view that infinity simply cannot exist in a contingent universe. As a mathematician, I was convinced nevertheless that the concept of infinity played a key role in shaping the world view of modern science.

[12]Thomas Aquinas, *Summa Theologicae*, (ed. Anton Pegis), (New York: Random House, 1945), Ia, Q.7, a.2.

[13]K.F. Gauss, *Briefwechsel zwischen C. F. Gauss und H.C. Schumacher* (C.A.F. Peters, ed.) (Altona, G. Esch) vol II, p. 269.

[14]This wholeness Plato called *mikton* in the *Philebus*. "All things that are even said to be consist of a one and a many, and

have in their nature a conjunction of limit and unlimitedness." (16d) *The Collected Works of Plato* (eds. E. Hamilton, H. Cairns) (Princeton, Princeton University Press, 1961), p. 1092 .

[15]*City of God* Book 12, chapter 18, quoted from *The Nicene and Post-Nicene Fathers* (ed. Philip Schaff) (Grand Rapids: Eerdmans, 1979) vol. 2, p. 238.

[16]I can only sketch here the briefest description of Cantor's work. For more detail accessible to the general reader I recommend the following two essays:

"Infinity," by Hans Hahn, in *The World of Mathematics*, edited by James R. Newman (New York: Simon Schuster, and 1956), vol. 3, p. 1593-1611.

"Beyond the Finite," *Great Moments in Mathematics (after 1650)*, Howard Eves (MAA: 1981), p. 159-170.

[17]That the power set of a set even exists requires a special axiom, as set theory has come to be formulated in modern times. See Paul Halmos, *Naive Set Theory*, (New York: Van Nostrand Reinhold, 1960) p. 19.

The relation between the natural and real numbers poses a thorny problem in modern mathematics. The real numbers at least contain the power set of the naturals, but how much richer they may be is a question of the "continuum Hypothesis." For a more detailed discussion of power sets and the Continuum Hypothesis, see Halmos, op. cit, p. 92, 102.

[18]Dauben, op. cit., "Cantor's Correspondence with Hermite Concerning the Nature and Meaning of the Transfinite Numbers," p. 228-232.

[19]Dauben, op. cit., p. 146.

[20]Dauben, op. cit., p. 126.

[21]For an excellent discussion see "Christianity in Scientific Change," in Thomas F. Torrance, *Christian Theology and Scientific Culture*, op. cit., p. 11-39.

[22]Quoted in Dauben, op. cit., p. 138.

[23]Newtonian mechanics understood force as action along a line though the centers of interacting bodies. Maxwell's fields acted perpendicularly to this direction. Despite early prodigious efforts, this could not be explained satisfactorily in terms of Newtonian dynamics. The history of this attempt is well chronicled by William Berkson in *Fields of Force: The Development of a World View from Faraday to Einstein*, (London: 1974). An impeccable witness to the revolutionary non-Newtonian character of the Maxwellian field is Einstein himself, "The Reality of the Field," in A. Einstein and L. Infeld, op. cit., p. 148-156.

[24]For an excellent discussion of this, see "Theological and Scientific Worldviews," in Thomas F. Torrance, *Divine and Contingent Order*, op. cit., p. 62-84.

[25]A classic statement of this inexplicable correlation between mathematics and the physical sciences is Eugene Wigner, "The Unreasonable Effectiveness of Mathematics in the Natural Sciences," *Communications on Pure and Applied Mathematics*, vol iii (190), 1-14.

[26]quoted in Dauben, op. cit., p. 294.

[27]Dauben, op. cit., p. 292-294.

[28]Dauben, op. cit. p. 132.

[29]Jaki, Stanley L., *Cosmos and Creator*, (Edinburgh Scottish Academic Press), p. 108.

[30]See note 5.

[31]Hawking, Stephen W., *A Brief History of Time* (New York: Bantam, 1988) p. 39.

[32]Barrow, John D., *The World Within the World*, (London: Oxford University Press, 1988), p. 323.

[33]Dauben, op. cit., p. 295.

[34]Dauben, op. cit., p. 360.

[35]Dauben, op. cit., p. 108.

[36]See note 12.

[37]Gutberlet, Constantin, "Das Problem des Unendlichen," *Zeitschrift für Philosophie und philosophische Kritik*, 88 (1886), p. 179-223.

[38]Dauben, op. cit., p. 145.

[39]Dauben, op. cit., p. 295.

[40]Dauben, op. cit., p. 270.

[41]Paul Cohen, *Set Theory and the Continuum Hypothesis*, (New York: W.A. Benjamin, 1966), p. 151.

[42]Dauben, op. cit., p. 349.

[43]See note 42.

[44]Ecclesiastes 3: 10, 11 RSV.

[45]See note 37.

[46]Rudy Rucker, *Infinity and the Mind* (Boston: Birkhauser, 1982).

[47]Stanley L. Jaki, *The Relevance of Physics*, (Chicago: University of Chicago Press, 1966), p. 127-130.

[48]See note 11.

[49]Also see Rucker, op. cit., p. 117.

[50]See note 28.

[51]Dauben, op.cit., p. 296.

Dot to Dot

It's simply dots
upon a printed page
(as anyone who's watched
a printer print's observed).
For techno-nerds,
one hundred twenty seven
dots per inch; for me
connected dots are even
lines of dotless letters;
only i-dots to denote
the minuscule matrix.
Beyond this font of wisdom,
letters are subsumed in prefix,
suffix, roots, declensions,
words and phrases: meaning.
Even lines of text not mentioned
when discussing grand ideas
riding on connected dot to dot.
Here, specifically, atomic physicist
transforms his minuscule thought
and research into unity of all
he does not understand,
but merely comprehends.
The only sign of just how small
this is: the minuscule i-dot
disconnected from the net he's drawn
to gather in his thought.

James E. Nelson

The Cosmos According to Carl Sagan: Review and Critique

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The writings and television appearances of Carl Sagan have done much to popularize the scientific enterprise and to fire the popular imagination. A careful examination, however, shows that Sagan is highly critical of religious frames of reference, especially the Christian one. This article sets forth Sagan's major criticisms and maintains that he is operating from a clear world view, which itself verges on being a religion. A critique of the major points of that world view and a response to the criticisms which Sagan levels towards Christianity are also provided.

Carl Sagan's widespread popularity, which began with the television series *Cosmos* and the book by the same title, should of itself provide sufficient justification for a serious consideration of the personable Cornell professor's views, which have captured the imaginations of millions. But if additional reasons for such a consideration are needed, one can cite such factors as the continuing popularity of Dr. Sagan's writings and his very considerable influence in shaping the views of many in the English-speaking Western world, not only through the medium of the printed word, but also by means of his frequent television appearances, in productions ranging from news programs to late-night American talk shows. In addition, one would hope that the benefit of historical perspective should attend any consideration of Sagan's views today, seeing that *Cosmos* (both text and television series) and the acclaim and controversy they created are almost a decade old.

It is widely conceded that Sagan's magnum opus, *Cosmos*, is critical toward religious frames of reference, especially the Christian one, and this perception is easily confirmed by a cursory reading of the *Cosmos* text.

In this paper a wide-ranging review and critique of Sagan's writings will be undertaken. I intend to elucidate Sagan's major criticisms of religion in general and Christianity in particular; to determine the major components of the *Weltanschauung* which stands behind Sagan's criticisms; and to provide a brief running commentary on, or critique of, each of the components of that world view.

This paper will limit itself to four volumes published by Dr. Sagan: *Cosmos*,[1] undoubtedly Sagan's best known work; his popular novel *Contact*;[2] his Pulitzer Prize-winning work *The Dragons of Eden: Speculations on the Evolution of Human Intelligence*;[3] *Broca's Brain: Reflections on The Romance of Science*.[4] In addition, we will consider two particularly enlightening interviews with Sagan. The first interview was published in U.S. News & World Report[5] in December 1980, the second in the U.S. Catholic[6] a few months later.

Let us begin with a systematic examination of Sagan's major criticisms of religious frames of reference. These criticisms seem to divide into four parts.

"Religion is Anti-Intellectual"

The first of these criticisms is that Dr. Sagan believes that religion (at least in its institutional Christian form) is anti-intellectual. It does not make use

of the cerebral matter, believing things instead on the basis of tradition, authority and the like. Sagan writes: "The suppression of uncomfortable ideas may be common in religion ... but it is not the path to knowledge; it has no place in the endeavor of science."[7]

This viewpoint becomes, if anything, much more pronounced in Sagan's novel Contact. The protagonist, Ellie, clearly mouths Sagan's own notions about religion. She says:

> Around Santa Fe, the faintest glimmerings of dawn might be seen above the Sangre de Cristo Mountains. (Why should a religion, she asked herself, name its places after the blood and body, heart and pancreas of its most revered figure? And why not the brain among other prominent but uncommemorated organs?)[8]

Later, Ellie says:

> Anything you don't understand, Mr. Rankin, you attribute to God. God for you is where you sweep away all the mysteries of the world, all the challenges to your intelligence. You simply turn your mind off and say God did it.[9]

In his comments in the *U.S. News & World Report* interview, Sagan posited that in "... the traditional approach of religion ... many assertions are never challenged."[10]

Richard A. Baer, Jr., adequately summarizes Sagan's position in this way. "Science gives us reliable knowledge, [Sagan] suggests, whereas religion is connected with ... narrowness of mind, and bigotry."[11]

In response to Professor Sagan, one must admit that some Christians have sometimes adopted anti-intellectualist, obscurantist stances. This attitude is still dominant within some forms of Protestant fundamentalism.

But Sagan overplays his hand. Historically, there have been many instances of Christians who were not by any stretch of the imagination anti-intellectualist! Was it not the Christian church which preserved and protected the remains of the ancient world's best writings, established and nurtured some of the greatest universities in Europe and North America, and had among its adherents a number of the giants in the development of modern science?

Additionally, Sagan fails to take any notice whatsoever of the fact that the New Testament records give scant support to obscurantism. The apostle Paul held public debates about his new faith.[12] Jesus *demanded* the active employment of the mind![13] Surely it would have been reasonable for Sagan to note that obscurantism is a deviation from the intentions of primitive Christianity and its founder.

"Religion Opposes Scientific Advancement"

Sagan's second major point of conflict with religion is the accusation that religion, especially in its institutional Christian expression, has tended to oppose the advance of scientific knowledge even to the point of persecuting scientists. *Cosmos* is replete with numerous examples and comments intended to prove this. With reference to Copernicus, Sagan writes:

> Nicolaus Copernicus' proposition that the sun, not the earth, was at the center of the universe upset many people including the Catholic Church, which put his work on the index, and Martin Luther, who called Copernicus "an upstart astrologer ... this fool..."[14]

Of Giordano Bruno, Sagan notes:

> Giordano Bruno, a sixteenth century Roman Catholic scholar who held that there are an infinity

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of worlds and that many are inhabited, was burned at the stake in 1600 for his views.[15]

Sagan again simplifies history to the point of distortion and omits key points.

And, with an almost malicious glee, Sagan comments on Kepler:

> He (Kepler) lived in a time when the human spirit was fettered and the mind chained; when the ecclesiastical pronouncements of a millennium or two earlier on scientific matters were considered more reliable than contemporary findings made with techniques unavailable to the ancients.[16]

Once again, Sagan is partly correct, but only partially. There is no question that Christians and the institutional church have sometimes acted in irrational ways toward scientists and their studies. Sagan's examples are certainly not the only ones which could be brought forward as instances of opposition to scientific progress, persecution of scientists, or legal pressures to insure conformity. Some great scientists only avoided becoming additional examples for Sagan's list by hiding their views from public scrutiny. Isaac Newton, for instance, had to conceal his rejection of Trinitarian teaching to keep his university post.

As Bernard Ramm notes,

> Some theologians are unsympathetic with, or suspicious of, science, and fail to understand it and while being censorious of the scientist who makes amateurish remarks about theology, they themselves fail to learn a little science before they speak of the scientific issues. They view science as the work of scheming atheists, iconoclasts, or plotting infidels.[17]

In his discussion of this subject Sagan again simplifies history to the point of distortion and omits key points. As Dr. Clark Pinnock of McMaster University remarks:

> Without wishing to deny that institutional religion has often times opposed new ideas in science in the fear that they might upset theological convictions, I think it only fair to state somewhere in the course of a long book that modern science was born on Christian soil and in connection with a Christian understanding of the world. [18]

William J. O'Malley notes: " ... he (Sagan) makes the scientific community sound universally and immediately tolerant .... "[19] Furthermore, O'Malley notes that Sagan fails to mention that some prominent scientists like Gregor Mendel and Copernicus were clerics![20] Sagan's treatment of the matter gives the historically inadequate impression that there has been a virtually unanimous opposition by Christians to scientists and their researches, the former being the clear villains, the latter the clear heros in the piece.

"Religion is Provincial"

Sagan's third criticism is summarized by his comment:

> Fanatical ... religious ... chauvinisms are a little difficult to maintain when we see our planet as a fragile blue crescent fading to become an inconspicuous point of light against the bastion and citadel of the stars.[21]

In *Contact*, a similar strain of thought is found.

> It is hard to imagine ... extraterrestrials taking seriously a plea for preferential parley from representatives of one or another ideological faction.[22]

What does the size of the universe and earth's physical smallness in that universe have to do with the importance, significance, truth or falseness of views held by humans? Would a universe half or a quarter the size it is make the views held by humans more or less significant? If a view held by any given group is shown to be correct, then the size of the universe has nothing to do with the matter.

"Religion Has Suspect Origins"

Sagan's fourth criticism may be termed his "theory of the origin of religion." The theory bears remarkable likeness to the views expressed by Freud in his *The Future of An Illusion*.

In *Cosmos* Sagan writes:

> The idea that every organism was meticulously constructed by a Great Designer *provided* a significance and order to nature, and *an importance to human beings that we crave still.* A Designer is a natural, appealing ... explanation of the biological world. [Italics added.] [23]

In *Contact*, this line of thought continues, as illustrated by this conversation between Ellie and the clergyman, Palmer:

> Don't you ever feel ... lost in your universe ....?

> You're not worried about being lost, Palmer. You're worried about not being central, not the reason the universe was created ....
>
> * * *
>
> Your religion assumes that people are children and need a bogeyman so they'll behave. You want people to believe in God so they'll obey the law.[24]

Religion originates, in Sagan's view, from a combination of wish fulfillment and attempted societal control.

"Your religion assumes that people are children and need a bogeyman so they'll behave. You want people to believe in God so they'll obey the law."

There is no doubt that for some persons the notion of a god is wish fulfillment. One does sometimes hear Christians comment that God must exist, for if he did not, how could sense be made of life? And by such a comment is intended as nothing more or less than a wish. It is not hard to see how such a wish could be in some cases transformed into a virtual proof of God's existence. And there can also be little doubt that there are historical examples of institutional religion being used as an oppressive means of societal control. For examples, consider 17th century Anglicanism, the Roman Catholic Church in Quebec from 1760 until the "Quiet Revolution" of the 1960s, the early Puritan churches of Massachusetts, or the Roman Catholic Church in Spain under Franco.

But such examples do not of themselves actually demonstrate the origin of the idea of God. As Richard Baer notes:

> Throughout *Cosmos* Sagan presents his speculations about the origin of religion and belief in the gods (or God) as facts, with no discussion of alternative possibilities. He simply assumes that the gods (or God) is a human creation, a primitive attempt to explain natural phenomena that science later helped us to understand correctly.[25]

Sagan's notions about the origin of the idea of God are not encompassed by detailed historical analysis and reference to ancient texts to demonstrate the point. One is simply presented with Sagan's view, apparently to be taken on faith. This is a most unusual proceeding for one who says:

> You must be skeptical; you must ask for verification. If someone claims a thing happens in a certain way, you do the experiment to check it out, to see if, in fact, it works as claimed. You examine the internal coherence of the idea. You test its logical structure. You see how well it agrees with other things which are reliably known, and only then do you start accepting new ideas. This is standard practice in science. I wish it were more widely applied.[26]

Furthermore, although in *Contact* religion is said to "... sell human beings short,"[27] intellectually and in terms of their abilities, one must consider whether in fact Sagan himself gives insufficient credit to humans. His theory of the origin of religion assumes that human beings want consoling notions about God even if such notions are untrue, and seems to further posit that humans can in large degree find even notions which are known or suspected to be untrue to be consoling!

Sagan's Religion

If one were to end the consideration of Sagan's views at this point, the impression would be that, while more than a little irritated by conventional expressions of religious belief (notably Christian), Dr. Sagan is, however, only taking random "potshots." Actually, while the four major criticisms outlined above do indeed have the character of isolated volleys, Sagan is operating with a discernable world view which in fact has features remarkably similar to a religion. It is important, then, to set forth the major components of this "religion."

In considering the existence of a virtual religion (or at the very least the existence of a clear world view), it seems appropriate to be guided by the use of the traditional theological terminology and categories, chiefly because they seem to apply so well!

Sagan's Ultimate Concern

Every world view has some concept of what Paul Tillich called "ultimate concern." Sagan rejects the usual religious "ultimate concern" (God), saying:

> To be certain of the existence of God and to be certain of the nonexistence of God seem to me to be the confident extremes in a subject so riddled with doubt and uncertainty as to inspire very little confidence indeed.[28]

Sagan's belief is that the evidence for the existence of God, particularly the Christian God, is insufficient, as evidenced from *Contact*:

> ... if God wanted to send us a message, and ancient writings were the only way he could think of doing it, he could have done a better job. And he hardly had to confine himself to writings. Why isn't there a monster crucifix orbiting the Earth? Why isn't the surface of the Moon covered with the Ten Commandments? Why should God be so clear in the Bible and so obscure in the world?[29]

In *Cosmos*, Sagan goes even further and turns the universe into his "ultimate concern."

> In many cultures it is customary to answer that God created the universe out of nothing. But this is mere temporizing. If we wish courageously to pursue the question, we must of course ask next where God comes from. And if we decided this to be unanswerable, why not save a step and decide that the origin of the universe is an unanswerable question? Or, if we say that God has always existed, why not save a step and conclude that the universe has always existed.[30]

And, in a statement which echoes the prologue to John's gospel, Dr. Sagan claims, "The Cosmos is all that is, or ever was, or ever will be."[31]

Richard A. Baer, Jr., summarizes like this: "Sagan presents much more than science ... He also shares his religious testimony, his witness to a strange and beautiful cosmos that for him is the ultimate reality."[32]

In a statement which echoes the prologue to John's gospel, Dr. Sagan claims, "The Cosmos is all that is, or ever was, or ever will be."

A Christian response to Dr. Sagan, of course, must reject his "ultimate concern" as not being identifiable with God. But additionally, one can wonder about Sagan's apparent failure to deal with certain historical issues. While Sagan paints his reasons for rejecting a traditional "ultimate concern" (i.e. God) on an immense canvas — the whole universe — he apparently does not deal with the more mundane history of humankind, which might furnish the evidence he says is lacking. Indeed, Dr. Sagan is convinced that the universe is a closed system, so to speak, that in point of fact "... we live in [a] ... universe, where things change ... according to patterns, rules, or as we call them, laws of nature"[33] This being the case, it is not surprising to be informed that:

> The gods don't drop in on us to fix things up when we've botched it. You look at human history and it's clear we've been on our own.[34]

Sagan fails to address the fact that the Christian assertion is *precisely* that God did intervene dramatically, clearly, and bodily, in *human history*, and that its primary contention is that we have *not* "... been on our own."[35]

Sagan's Anthropology

Sagan's world view is also replete with an anthropology which defines the human in these terms:

> I am a collection of water, calcium and organic molecules called Carl Sagan. You are a collection of almost identical molecules with a different collective label. But is that all? Is there nothing in here but molecules? Some people find this idea ... demeaning to human dignity. For myself, I find it elevating that our universe permits the evolution of molecular machines as intricate and subtle as we are.[36]

Sagan provides this definition of "human" in an utterly materialist and reductionist fashion, and puts it forward for acceptance without any serious consideration of other definitions, and without suggesting any reasons for accepting the posited definition.

But there is considerably more to Sagan's anthropology than this definition of a human. The question of what constitutes the essence of a human being has a long history of discussion among theologians, philosophers, ethicists, and, more recently, with the advances in medical technology, among politicians and even average citizens.

Sagan in one deft stroke defines from his perspective what constitutes our humanity. He writes: "The cortex regulates our conscious lives. It is the distinction of our species, the seat of our humanity."[37] In *The Dragons of Eden*, Sagan says something quite similar: "This essential human quality, I believe, can only be our intelligence. If so, the particular sanctity of human life can be identified with the development and functioning of the neo-cortex." [38] In *The Dragons of Eden*, Sagan takes this view, found in brief form also in *Cosmos*, to its logical extreme. Regarding the abortion issue, he writes:

> The key practical question is to determine when a fetus becomes human. This in turn rests on what

> we mean by human ... The reason we prohibit the killing of human beings must be because of some quality human beings possess, a quality we especially prize, that few or no other organisms on earth enjoy ... This essential human quality, I believe, can only be our intelligence. If so, the particular sanctity of human life can be identified with the development and functioning of the neo-cortex ... We might set the transition to humanity at the time when neocortical activity begins . . .[39]

The reader is faced with a view which is reductionist in the extreme: humanity is reduced to a biological/chemical level.

At first glance, Sagan's opinion is exceedingly attractive. It apparently would put a swift and decisive end to agonizing over when life exists — and when it does not.

Several points, however, should be made. To begin with, the reader is once again faced with a view which is reductionist in the extreme. Humanity is reduced to a biological/chemical level. In addition, Sagan does not offer further support for his position. Finally, it should be made clear at this point that a theology developed with a traditional respect for the Scriptures must reject Sagan's view outright.

It is true that traditional Roman Catholic theology has often posited that the essence of the human being (i.e., that which makes a being human) is the reasoning capacity. It is also true that such a view is not unknown in Protestant circles. It is to be noted, however, that Roman Catholic thought seems to be moving away from such a position,[40] and that a strong case can be made that the true essence of humanity is not a matter of intellect.

The whole thrust of the biblical witness seems instead to be that the *Imago Dei* consists to a large degree in the human potential to have a unique relationship with the Creator, a relationship which is personal, constituted by an offering by God of love, and human acceptance and reciprocation of that love, and a relationship in which the human finds true humanity and ultimate freedom in complete dependence upon God. This view is very well articulated by Emil Brunner, who wrote:

> True humanity does not spring from the full development of human potentialities, but it arises through the reception, the perception, and the acceptance of the love of God, and it develops and is preserved by "abiding" in communion with the God who reveals himself in Love.[41]

While it is true that the image was marred at the Fall, it cannot be said to have been lost, or else Scripture would be in error in continuing to refer to humans as human. Thus, the biblical thrust is that the image of God consists of the potential to have a unique relationship with God and the realization of that relationship. But though humanity lost the relationship, and in a sense "full" or "true" humanity at the Fall, the potential for the relationship, and the claim to still be human, remains. This potential must be said to exist in all the offspring resulting from human mating, no matter how limited intellectually, physically, or otherwise such offspring may be.

Sagan's Ethic and Soteriology

As world views normally contain some notions about right and wrong behavior, variously termed "ethics," "morality," and so forth, it is not surprising to find such an element in Sagan's world view. Sagan's ethic centers on one "commandment" which appears several times in *Cosmos*. Sagan writes, "*Our obligation to survive* is owed not just to ourselves but also to the Cosmos, ancient and vast, from which we spring." [Emphasis added.][42] As Norman L. Geisler summarizes:

> So the Cosmos has created man in its own image, endowed him with life, and sustains his very existence. For all of this man has a moral obligation to perpetuate life in the Cosmos.[43]

This ethical imperative to survive is so closely tied to Sagan's soteriology that the two should be placed together for purposes of commentary.

Throughout *Cosmos*, but particularly in its last chapter, Sagan argues that the great threat facing humankind is its own self-destruction, most likely through nuclear warfare, and that it is from such a threat that mankind needs "salvation."[44]

And how is such "salvation" to be accomplished? Dr. Sagan describes the human dilemma and his rather unique solution:

> There are some who look on our global problems here on earth — at our vast national antagonisms, our nuclear arsenals, our growing populations, the disparity between the poor and the affluent, shortages of food and resources, and our inadvertent alterations of the natural environment — and con-

clude that we live in a system that has suddenly become unstable, a system that is destined soon to collapse. There are others who believe that our problems are soluble, that humanity is still in its childhood, that one day soon we will grow up. The receipt of a single message from space would show that it is possible to live through a technological adolescence; the transmitting civilization, after all, has survived. Such knowledge, it seems to me, might be worth a great price .[45]

But, in case there is no response from space, Sagan notes:

> And what if we make a long-term dedicated search for extraterrestrial intelligence and fail? Even then we surely will not have wasted our time ... For if intelligent life is scarce or absent elsewhere, we will have learned something significant about the rarity and value of our culture and our biological patrimony . . .[46]

Given Sagan's "ultimate concern" and anthropology, his soteriology and ethic do make some sense. But what if humans are more than Sagan defines them as, and what if his "ultimate concern" is incorrect? Neither assumption was adequately defended by Sagan, leaving the ethic and soteriology presented by him resting on shaky ground.

Sagan's Worship

The last major element in Sagan's world view can be termed the component of worship, the experience of the numinous. Sagan speaks of this when he says:

> It is very hard to look at the beauty, intricacy, and subtlety of nature without feeling awe. I don't think even the word reverence is too strong.[47]

But experiences of the numinous are limited indeed.

> She asked Eda if he had ever had a transforming religious experience.
>
> "Yes," he said.
>
> "When?" Sometimes you had to encourage him to talk.
>
> "When I first picked up Euclid. Also when I first understood Newtonian gravitation. And Maxwell's equations, and general relativity. And during my work on superunification. I have been fortunate enough to have had many religious experiences."
>
> "No," she returned. "You know what I mean. Apart from science."
>
> "Never," he replied instantly.[48]

This all leads to the conclusion that:

> If we must worship a power greater than ourselves, does it not make sense to revere the Sun and stars? Hidden within every astronomical investigation, sometimes so deeply buried that the researcher himself is unaware of its presence, lies a kernel of awe.[49]

A comment by Dr. Clark Pinnock provides a pointed rejoinder:

> ... [W]hy would anyone celebrate nature if in fact it is the product of blind chance and part of a pointless process? Sagan appears to think that people ought to imitate his own loyalty to evolution and reverence for life. But why should they do such an irrational thing? Surely a more sensible response to the cosmos as Sagan presents it would be to adopt a nihilistic outlook and try to derive as much pleasure from life as possible before it is snuffed out.[50]

An Appropriate Response to Sagan: A Mission of the Church

Sagan's works are replete with criticisms of Christians and institutional Christianity. These criticisms are not entirely invalid, but they frequently paint only a partial and therefore distorted picture, and rarely, if ever, distinguish between the intentions of Christianity's founder and the way things have sometimes been worked out in a manner not in accord with those intentions. This is akin to arguing that the scientific method is invalidated, because some scientists have used its premises to develop terrifying weapons of mass destruction! But in addition, Sagan is operating with, and promoting the acceptance of, a discernable world view, which is in large part opposed to the Christian world view. In fact, as Baer says:

> Throughout *Cosmos* Sagan goes far beyond the traditional descriptive and interpretive role of science. His presentation involves a host of metaphysical and value statements that are *not* a part of science as ordinarily understood and practiced ... He transforms a very fruitful method for understanding the world into an all embracing metaphysic or world view.[51]

Much of Sagan's writing propagates his particular world view and attacks other views as much as it popularizes science. Because of this fact, the church needs to make a clear and adequate answer to Sagan. This reply should consist of a careful analysis and a response which meets Sagan's position on the grounds of scientific history, and provides clear, adequately supported philosophic positions. Since

Sagan's views are so well known, and since they are not ill-representative of a philosophy which pervades much of contemporary Western society, a response to Sagan constitutes an important part of the mission of the church. ❄

NOTES

1 Carl Sagan, *Cosmos*, (New York: Ballantine Books, 1985).
2 Carl Sagan, *Contact*, (New York: Simon and Schuster, 1985).
3 Carl Sagan, *The Dragons of Eden: Speculations on the Evolution of Human Intelligence*, (New York: Random House, 1977).
4 Carl Sagan, *Broca's Brain: Reflections On The Romance Of Science*, (New York: Random House, 1979).
5 Carl Sagan, "A Conversation with Carl Sagan — Science and Religion 'Similar Objective, Different Methods,'" interview by Alvin P. Sanopp, *U.S. News & World Report* (December 1, 1980), 62, 63.
6 Carl Sagan, "God and Carl Sagan: Is The Cosmos Big Enough for Both of Them? Edward Wakin interviews Carl Sagan," interview by Edward Wakin, *U.S. Catholic*, No. 5 (May 1981), 19-24.
7 *Cosmos*, 74.
8 *Contact*, 61.
9 *Ibid.*, 172
10 *U.S. News & World Report*, 62.
11 Richard A. Baer, Jr., "*Cosmos*, Cosmologies and the Public Schools," *This World*, No. 5 (Spring/Summer 1983), 7.
12 For examples, see Acts 17: 16-34, 19: 8-10.
13 For examples, see Matthew 22:37 and parallel passages Mark 12:30 and Luke 10:27.
14 *Cosmos*, 39-41.
15 *Ibid.*, 70.
16 *Ibid.*, 41.
17 Bernard Ramm, *The Christian View of Science and Scripture*, rpt., (Grand Rapids: William B. Eerdmans Publishing Company, 1978), 36.
18 Clark Pinnock, "Sagan's Humanist Metaphysic: Fantasy, Not Fact," *Christianity Today*, (November 6, 1981), 98.
19 William J. O'Malley, "Carl Sagan's Gospel of Scientism," *America*, (February 7, 1981), 96.
20 *Ibid.*
21 *Cosmos*, 264.
22 *Contact*, 265.
23 *Cosmos*, 18.
24 *Contact*, 254.
25 Baer," *Cosmos*, Cosmologies and the Public Schools," 8.
26 *U.S. Catholic*, 24.
27 *Contact*, 254.
28 *U.S. Catholic*, 20.
29 *Contact*, 170.
30 *Cosmos*, 212.
31 *Ibid.*, 1.
32 Baer, "*Cosmos*, Cosmologies and the Public Schools," 6.
33 *Cosmos*, 32. Sagan here seems to be using the model of the Newtonian universe, which is somewhat too rigid, and should be modified according to the theories of Einstein. Nevertheless, since Sagan apparently is dealing with this model, this is the model to which we will respond. For a more popular exposition of the notion of randomness in the universe, particularly on the micro level, consult A.R. Peacocke's *Creation and The World of Science*.
34 *Contact*, 287.
35 *Ibid.*
36 *Cosmos*, 105.
37 *Cosmos*, 229.
38 *The Dragons of Eden*, 197.
39 *The Dragons of Eden*, 196, 197.
40 The reader is referred to the document *Gaudim et Spes* (*Pastoral Constitution on the Church In The Modern World*) promulgated on December 7, 1965, by the Second Vatican Council, especially Chapter I, sections 12 - 17.
41 Emil Brunner, *The Christian Doctrine of Creation and Redemption*, Vol. II of *Dogmatics*, trans, Olive Wyon (Philadelphia: Westminster Press, n.d.), 59.
42 *Cosmos*, 286.
43 Norman L. Geisler, Cosmos: *Carl Sagan's Religion for the Scientific Mind* (Dallas: Quest Publication, 1983), 31.
44 *Cosmos*, especially the last chapter, "Who Speaks for Earth?"
45 *Broca's Brain: Reflections On The Romance Of Science*, 275.
46 *Ibid.*, 277.
47 *U.S. Catholic*, 19.
48 *Contact*, 315.
49 *Cosmos*, 199.
50 Pinnock, 99.
51 Baer, "*Cosmos*, Cosmologies, and the Public Schools," 6.

In the end

it will not matter to us whether we wrote well or ill;
whether we fought with flails or reeds.

It will matter to us greatly
on what side we fought.

G.K. Chesterson

Phillip Johnson on Trial: A Critique of His Critique of Darwin

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Phillip Johnson's recent book, Darwin on Trial, *claims to show that the reasoning presented in favor of evolutionary biology is defective. Such a book, being one of so many, would excite little attention were it not for the fact that the author is an expert in legal reasoning, and has contributed his particular skills to the debate. However, the canons of scientific argument are quite different from those of the courtroom, and it can be shown that Johnson's critique of Darwinian thought falls far short of the mark in that it does not fully appreciate the special requirements of scientific argumentation.*

Introduction

Phillip E. Johnson's recent book, *Darwin on Trial*[1] has attracted a fair amount of attention among conservative Christians. Yet it may create an inaccurate impression of the status of evolutionary biology — an impression that I hope to correct in this article. On the book's dust jacket it is said that Johnson, a professor of law at the University of California at Berkeley, took up the study of Darwinism because he judged the books defending it to be dogmatic and unconvincing. I, at least, find Johnson's own arguments dogmatic and unconvincing. The main reason is that he does not adequately understand scientific reasoning.

Many readers will be impressed, even overawed, by Professor Johnson's credentials. He is not a scientist but a lawyer, who claims that his law career, with "a specialty in analyzing the logic of arguments and identifying the assumptions that lie behind those arguments" well qualifies him for the task (p. 13). The fact that he is a professor at U.C. Berkeley certainly adds to his credibility in the eyes of many. But I wish you would bear with me in a little foolishness (cf. 2 Cor. 11:1). Is he from Berkeley? So am I. One of my doctorates was earned in the philosophy department at U.C. Berkeley, where I specialized in philosophy of science. Is he an expert in critical reasoning? So am I. I teach critical reasoning to seminary students (now at Fuller Theological Seminary) and have just completed a textbook on the subject. Most of my other research and writing deals with methodological issues in theology, science, and the relations between the two.[2]

My plan is to describe some of the basic moves in scientific reasoning, and then examine in detail an important (and typical) passage in Johnson's book, explaining why it appears fallacious to one trained in scientific reasoning. Next, I shall describe some recent refinements in philosophers' understanding of scientific reasoning, and use them to describe the sort of study that would be required to make a fair assessment of the scientific standing of evolutionary biology.

Another issue that needs to be addressed is the very nature of science, and how it relates to religion. A bit of history will help us understand some of the positions taken by evolutionary biologists and excuse them from some of Johnson's criticisms.

I shall end with a few remarks on what I take to be the proper attitude for Christians toward evolutionary biology.

Before I proceed to the attack, however, I must say that Johnson's book has many good features. Johnson describes some of the failures and problems faced by evolutionary biology, and provides a valuable critique of popular writings that turn the science of evolutionary biology into an atheistic metaphysical system with many of the trappings of religion.

Basic Scientific Reasoning

Francis Bacon's description of scientific reasoning has been influential for many years. In brief, he claimed that scientists must first rid their minds of all prejudice and preconceptions, then collect all the facts relevant to the issue at hand, and finally draw inductive inferences from the facts.[3] This view of scientific reasoning is inadequate, however, since it only accounts for our knowledge of observed regularities. An important advance in the philosophy of science of this century was the recognition of what has been called "hypothetico-deductive" reasoning.[4] This kind of reasoning frees science from dependence on direct observation, and accounts for all of our theoretical knowledge. It is called "hypothetical" because it relies on the formation of hypotheses to explain a given set of data or observations. It is called "deductive" because hypotheses must be tested by drawing conclusions from them and seeing if they are corroborated by further observation or experiment. So the test of a hypothesis is not by direct observation (most scientific hypotheses postulate unobservable entities or processes), but by asking what observable consequences follow from the hypothesis, and by testing these instead. Another way of putting the matter: a hypothesis is accepted on the basis of its ability to explain observations and results of experiments.

Consider the following analogy drawn from everyday experience. You come home from work and find the front door ajar and muddy tracks leading into the kitchen. You form a hypothesis: the kids were here. But of course, there could be other explanations, such as a prowler. To test the hypothesis, you make predictions based on your knowledge of the children's behavior. For example, you check to see if anyone has been into the cookies, or if their school clothes are on the floor upstairs. If your predictions are confirmed you do not need to see the children to know that your original hypothesis was correct.

So the form of hypothetico-deductive reasoning is as follows:

- We observe O_1.
- We formulate a hypothesis (H), which, if true, would explain O_1.
- Then we ask, if H is true, what additional observations (O_2 ... O_n) ought we be able to make?
- Finally, if O_2 through O_n are observed, H is confirmed.

It is important to note that O_2 through O_n are not equivalent to H; they are observable consequences that we deduce from H with the aid of additional assumptions — nibbled cookies and strewn clothing are not children.

Because the hypothesized entities or processes are unobservable, scientists often make use of *models* — observable entities or processes that are similar in important respects to the theoretical entities. A famous example is the billiard-ball model used to understand and account for the behavior of gasses in a closed container. Models are often helpful in deriving testable predictions from hypotheses (theories).

It is also important to note that hypothetical reasoning (like all reasoning about matters of fact) can never amount to proof. The best that can be hoped

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for is a high degree of confirmation. Much of what philosophy of science is about is examination of the conditions under which a scientific theory can be said to be well-confirmed. So objecting that *any* scientific theory is "not proved" is empty — none can be.

The foregoing provides enough terminology to analyze some of Johnson's arguments, so we turn now to these.

Johnson on Natural Selection

Chapter Two of *Darwin on Trial* is an examination of the thesis that natural selection, or survival of the fittest, (when combined with natural variation) provides an adequate account of macroevolution — that is, the evolution of all known species of living things from one or a few primitive ancestors. A crucial step in Johnson's overall criticism of evolutionary biology is his assessment of evidence for the efficacy of natural selection, so we must examine this short passage (pp. 17-20) with care. Johnson begins by noting that Darwin could not point to examples of natural selection in action, and so he had to rely heavily on an argument by analogy with artificial selection by breeders of domestic plants and animals.

However, Johnson replies to Darwin's argument as follows:

> Artificial selection is not basically the same sort of thing as natural selection, but rather is something fundamentally different. Human breeders produce variations among sheep or pigeons for purposes absent in nature, including sheer delight in seeing how much variation can be achieved. If the breeders were interested only in having animals capable of surviving in the wild, the extremes of variation would not exist ....
>
> What artificial selection actually shows is that there are definite limits to the amount of variation that even the most highly skilled breeders can achieve. Breeding of domestic animals has produced no new species, in the commonly accepted sense of new breeding communities that are infertile when crossed with the parent group ....
>
> In other words, the reason dogs don't become as big as elephants, much less change into elephants, is not that we just haven't been breeding them long enough. Dogs do not have the genetic capacity for that degree of change, and they stop getting bigger when the genetic limit is reached (p. 18).

Next, Johnson turns to evidence cited by contemporary evolutionists:

> Darwinists disagree with that judgment, and they have some points to make. They point with pride to experiments with laboratory fruitflies. These have not produced anything but fruitflies, but they have produced changes in a multitude of characteristics. Plant hybrids have been developed which can breed with each other, but not with the parent species, and which therefore meet the accepted standard for new species. With respect to animals, Darwinists attribute the inability to produce new species to a lack of sufficient time .... In some cases, convincing circumstantial evidence exists of evolution that has produced new species in nature. Familiar examples include the hundreds of fruitfly species in Hawaii and the famous variations among "Darwin's Finches" on the Galapagos Islands ....
>
> Lack of time would be a reasonable excuse if there were no other known factor limiting the change that can be produced by selection, but in fact selective change is limited by the inherent variability in the gene pool. After a number of generations the capacity for variation runs out. It might conceivably be renewed by mutation, but whether (and how often) this happens is not known (p. 19).

And now Johnson's conclusion, drawn from the above considerations:

> Whether selection has ever accomplished speciation (i.e., the production of a new species) is not the point. A biological species is simply a group capable of interbreeding. Success in dividing a fruitfly population into two or more separate populations that cannot interbreed would not constitute evidence that a similar process could in time produce a fruitfly from a bacterium. If breeders one day did succeed in producing a group of dogs that can reproduce with each other but not with other dogs, they would still have made only the tiniest step towards proving Darwinism's important claims.
>
> That the analogy to artificial selection is defective does not necessarily mean that Darwin's theory is wrong, but it does mean that we will have to look for more direct evidence to see if natural selection really does have a creative effect (pp. 19-20).

Analysis

What are we to make of this set of arguments? Before I begin a serious analysis, permit me another bit of foolishness: The series of steps in Johnson's argument recalls an old lawyer's joke about a defendant in a murder trial: "Your honor, I didn't kill him, and besides, it was an accident, and on top of

that he really had it coming!" Similarly: artificial selection is not analogous to natural selection, and besides, selective breeders have not produced any new species, and on top of that they have only produced new plant species, but no new animal species.

***We must ask what observations or results are required to confirm (not prove) the scientific hypothesis that natural selection is capable of producing* radically different new species**

More seriously, we must ask what observations or results are required to confirm (not prove) the scientific hypothesis that natural selection is capable of producing *radically different new species.*[5] Since we cannot directly observe natural selection at work, we need an observable model. Selective breeding has been proposed. (We will come back to the issue of the suitability of this model below.) What is at stake in testing the power of natural selection, then, is that our analogue to natural selection be shown to accomplish two things: First, we need to see that selection can produce *radical differences* within a population. Second, we need to see that selection can result in *speciation* — the development of one species out of another. The criterion here is incapacity to breed with the parent species.

Johnson seems to believe that both of these effects need to be observed in the same instance. He would have a point if there were something about one effect that precluded the other or made it less likely; for example, from the fact that you can pat your head and can also rub your stomach, I cannot infer with much confidence that you can do both at once. However, this does not appear to be such a case. The splitting of a population into two species isolates the gene pools, allowing them to diverge, and ultimately to manifest different physical characteristics. We can also imagine that a wide enough physical variation within a species would tend to isolate two or more gene pools and provide a necessary though not sufficient condition for speciation. Johnson notes, for example, that while dogs are all theoretically capable of interbreeding, size differences make it practically impossible.

Now, Johnson admits that we have examples of both of these changes as a result of intentional selective breeding. Regarding the first, he would like to see dogs as big as elephants, but the difference between a toy poodle and a great dane seems adequate to me. Regarding the second, there are instances from plant breeding and, he says, circumstantial evidence that many species of fruitflies have developed from one or a few species originally introduced to Hawaii. Yet his conclusion is that none of this is adequate evidence for the Darwinian thesis. In effect, he is claiming that because plant speciation and intra-species variation *are not equivalent to* macroevolution they provide no evidence for the power of natural selection. But recall that we never hoped to *observe* a case of macroevolution by means of natural selection. We were about the more modest task (and the only realistic task) of providing confirmatory evidence by means of a model — an analogous process — that macro-evolution by means of natural selection is possible (given sufficient time and enough environmental pressure).

The form of the Darwinian reasoning is as follows:

- O_1 is observed (here, the patterns of speciation in existence today).
- A hypothesis (H) is formulated which, if true, would explain O_1 (here, the correlative hypotheses of variation, natural selection, and geographical isolation).
- If H is true, what additional observations (O_2 ... O_n) ought we be able to make? (here, O_1: radical change within a population, and O_2: speciation).
- Finally, O_2 and O_3 have been observed, so H is confirmed.

Again, O_2 and O_3 are not equivalent to H; they are observable consequences that can be deduced from H with the aid of additional assumptions.

In effect, Johnson is claiming that because plant speciation and intra-species variation* are not equivalent to *macroevolution they provide no evidence for the power of natural selection.

One of the crucial assumptions here is that selective breeding is like natural selection in relevant respects. It *is* like natural selection in that it operates by means of differential reproduction rates and within the variation that nature supplies. These seem to

me to be the relevant factors. Johnson's claim that the characteristics breeders look for are different from the ones for which "Nature" selects seems to me beside the point. The issue is whether selective breeding can produce radical changes, including speciation; not the particular nature of those changes.

I believe it could be shown by examining other arguments that Johnson *consistently* fails to distinguish between evidence confirmatory of a hypothesis and a set of observations that together are equivalent to the hypothesis. For example, on pp. 25-7 he first lists six pieces of evidence that have been offered in support of the power of natural selection, then concludes *without explanation* that "none of these 'proofs' provides *any* persuasive reason for believing that natural selection can produce new species ... (p. 27, emphasis mine). In Chapter 8, discussing theories about the origin of life, he concludes that because the synthesis of some of the components of living organisms does not actually amount to the production of life in the laboratory there is "*no reason* to believe that life has a tendency to emerge when the right chemicals are sloshing about in a soup" (p. 103, emphasis mine).

Recent Philosophy of Science

I shall introduce in this section some of the refinements contributed by recent philosophers of science by commenting on further aspects of Johnson's arguments.

In the section quoted above, Johnson has said that there are definite limits to the amount of variation that even the most highly skilled breeders can achieve; that dogs do not get as big as elephants because they do not have the genetic capacity for that degree of change (p. 18); and that after a number of generations the capacity for variation runs out (p. 19). He then admits that *mutation* might renew the capacity for change, but claims that whether and how often this happens is not known (p. 19).

When Darwin proposed his theory of evolution, he speculated that there must be a mechanism that works predominantly to maintain the characteristics of a population from one generation to another, but that also allowed for some degree of fluctuation and for genuine novelty. At that time, of course, he did not know what that mechanism was. A great triumph for evolutionary theory, but one Johnson does not mention, came from the discovery of the role of genes in reproduction. The gene pool provides for variation within overall stability in most instances, but mutations allow for genuine novelty.

Johnson mentions mutation as though it is scarcely important at all, but in fact it is an essential "auxiliary hypothesis" for the evolutionary program, and it is simply not possible to draw Johnson's strong conclusions about the limits of variation without considering the frequency and kinds of mutations, and their potential contribution to viable changes in a population.[6]

Johnson mentions mutation as though it is scarcely important at all, but in fact it is an essential "auxiliary hypothesis" for the evolutionary program.

This fact illustrates an important point stressed by philosophers of science. Theories (hypotheses) rarely or never face the test of experience standing alone. We are (almost) always faced with the testing of whole networks of theories and auxiliary hypotheses. This makes the falsification of a major theory very difficult — when negative evidence comes along, it can often be reconciled with the central theory by adding or changing lower-level (auxiliary) theories. If positive evidence is lacking, its absence can often be explained by the same strategy.

Johnson's book is full of examples of changes of this sort to make evolutionary theory consistent with the evidence (or the absence of evidence). For example, Darwin expected that the fossil record would soon provide evidence of species intermediate between known species and their ancestors (the "missing links"). When few such intermediates were found, later theorists proposed auxiliary hypotheses to explain their absence: for example, the fossil record is still only a small sample of all of the creatures that have existed, and it is to be expected that the intermediate species, being in between well-adapted forms, would not last long and would therefore leave little evidence behind in the form of fossils.

Theorizing of this sort is extremely common in science. Since major theories come along only rarely, most of scientific advance consists in the careful elaboration and qualification of major theories, fine-tuning them to fit the evidence. Several philosophers of science have noted, though, that there is a kind of fine-tuning that represents genuine improvement and growth in scientific knowledge, and another kind that is a mere face-saving device — linguistic tricks to protect a theory from falsification. So the important question is how to tell the difference.

Imre Lakatos (d. 1974) made a major contribution to philosophy of science by providing a criterion for distinguishing "progressive" from "degenerative" or "*ad hoc*" refinements of a network of theories.[7] The essence of his criterion is this: if a hypothesis that is added to the network not only explains the problems for which it was designed, but also leads to the prediction and corroboration of new facts of a different sort, then the modification is progressive. On the other hand, if it only takes care of the problem and is not independently confirmed by the successful prediction of novel facts, then it is a degenerative move. Lakatos made a double claim about this criterion. First, he claimed that it could account for the history of science better than other views,[8] in that history would show that scientists generally abandon research programs that are making mostly degenerative moves in favor of a more progressive rival. His second claim is that scientists *should* accept progressive programs and abandon degenerative ones — that this is what scientific rationality consists in.

Application to Darwinism

Now, what consequences does this criterion of "progressiveness" have for evaluating evolutionary theory? It shows, first of all, that the only fair way to assess the program is by examining the auxiliary hypotheses that have been added to it to see whether each is a progressive or degenerative modification.

It is clear that Johnson is aware of the problem of *ad hoc* developments of a theory, as the following passage indicates:

> Darwinists have evolved an array of subsidiary concepts capable of furnishing a plausible explanation for just about any conceivable eventuality. For example, the living fossils, which have remained basically unchanged for millions of years while their cousins were supposedly evolving into more advanced creatures like human beings, are no embarrassment to Darwinists. They failed to evolve because the necessary mutations didn't arrive, or because of "developmental constraints," or because they were already adequately adapted to their environment. In short, they didn't evolve because they didn't evolve.
>
> Some animals give warning signals at the approach of predators, apparently reducing their own safety for the benefit of others in the herd. How does natural selection encourage the evolution of a trait for self-sacrifice? Some Darwinists attribute the apparent anomaly to "group selection." Human nations benefit if they contain individuals willing to die in battle for their country, and likewise animal groups containing self-sacrificing individuals may have an advantage over groups composed exclusively of selfish individuals.
>
> Other Darwinists are scornful of group selection and prefer to explain altruism on the basis of "kinship selection." By sacrificing itself to preserve its offspring or near relations an individual promotes the survival of its genes. Selection may thus operate at the genetic level to encourage the perpetuation of genetic combinations that produce individuals capable of altruistic behavior. By moving the focus of selection either up (to the group level) or down (to the genetic level), Darwinists can easily account for traits that seem to contradict the selection hypothesis at the level of individual organisms.
>
> Potentially the most powerful explanatory tool in the entire Darwinist armory is *pleiotropy*, the fact that a single gene has multiple effects. This means that any mutation which affects one functional characteristic is likely to change other features as well, and whether or not it is advantageous depends upon the net effect. Characteristics which on their face appear to be maladaptive may therefore be presumed to be linked genetically to more favorable characteristics, and natural selection can be credited with preserving the package.
>
> I am not implying that there is anything inherently unreasonable in invoking pleiotropy, or kinship selection, or developmental constraints to explain why apparent anomalies are not necessarily inconsistent with Darwinism. If we assume that Darwinism is basically true than it is perfectly reasonable to adjust the theory as necessary to make it conform to the observed facts. The problem is that the adjusting devices are so flexible that in combination they make it difficult to conceive of a way to test the claims of Darwinism empirically (pp. 29-30).

This passage indicates that Johnson sees no difference between auxiliary hypotheses that are testable and those that are not.

However, this passage also indicates that Johnson sees no difference between auxiliary hypotheses that are testable and those that are not. It is difficult to conceive a test for the hypothesis that the living fossils failed to evolve because they were already adapted to their environment — or to be more precise, it is hard to conceive of a way of showing this claim *false*. This seems to be an instance of a "linguistic trick" to protect the theory from falsification.

But not so with all of the examples Johnson has cited here. For example, kinship selection is testable: if it is true, then there should be a direct relationship between the percentage of genes shared with another individual and the degree of "altruism" exhibited toward that individual — a prediction that has in fact been confirmed. In addition, genetic mapping makes the concept of pleiotropy empirically testable.

It must be emphasized, though, that the mere existence of problems does not disqualify a theory — good theories are always in process, and the question is whether they are progressing, overall, or degenerating.

So it is clear that Johnson has failed to see the import of such cases. He does not understand their role in demonstrating that there are in fact ways "to test the claims of Darwinism empirically" (p. 30).

In general Johnson has given too little attention to the role genetic theory has played in the history of evolutionary biology. Genetics arose as a major new theory in complete independence of evolutionary biology. Initially there was strong antagonism between workers in the two fields. However, with the advent of population genetics under Fisher, Wright and Haldane, the two fields were reconciled. In Lakatos's terms, the entire genetic program came to function as an "auxiliary hypothesis" within the evolutionary program, providing a tremendous amount of fresh empirical evidence — evidence of exactly the sort that Lakatos has led us to expect from a progressive program. Another instance is "neutral allele" theory, with its associated phenomenon of molecular clocks.

Much remains to be done to provide an adequate assessment of the evolutionary program. There are a number of problems with the theory, but whether there are more than with other major theories, such as Big-Bang cosmology, remains to be seen. It must be emphasized, though, that the mere existence of problems does not disqualify a theory — good theories are always in process, and the question is whether they are progressing, overall, or degenerating. So the important question is *how* the evolutionary program deals with its problems; whether the auxiliary hypotheses needed to account for anomalies — for the absence of certain kinds of expected confirmatory evidence — can be independently tested and confirmed. Johnson does not pursue this question; nor can I do so here. Adequate treatment would require another book. But this is where the battle must be joined if we are to have a fair assessment of the evolutionary program.

It has been noted[9] that the kind of "novel facts" needed to provide independent confirmation of auxiliary hypotheses are usually rare, and get harder rather than easier to find as a program progresses. This suggests that the crucial evidence for evolutionary theory, if it can be produced, will not be massive. It will consist in a few confirmed predictions here and there. In this way, evolutionary biology will be entirely in line with many well-respected programs such as Big-Bang cosmology.

A major problem for anyone undertaking an assessment of the evolutionary program is that philosophy of science provides criteria for relative rather than absolute assessment. That is, the criteria we have been discussing are only capable of telling us which of two or more competing programs is the most acceptable. While there is competition within the evolutionary program, between punctuated equilibrium and gradualist theories of change, for instance, there is no major scientific competitor for the program as a whole. This being the case, there are limits to what critics of Darwinism can hope to accomplish. When a theory is the only one available, the burden of proof falls on those who wish to do away with it. It is simply a fact of the history of science that a theory is seldom — perhaps never — abandoned when there is no competitor to take its place. If criteria for rational choice are necessarily comparative, then this is a rational way to proceed. Beyond that, there is the practical question: what would evolutionary biologists *do* if there is no other conception of the field to guide their research?

The Nature of Science

In this section I shall take up three issues raised by Johnson:

1. Evolutionary biology is not scientific because (according to Karl Popper) science is characterized by falsifiability, and the central ideas of Darwinism are held dogmatically.
2. Evolutionary theory is held dogmatically because it is the only account of life that fits with a naturalistic philosophy.
3. Evolutionary biologists ought to consider the possibility that life is the product of creative intelligence.

Science and Falsifiability

In his final chapter Johnson adopts Karl Popper's criterion for distinguishing science from pseudoscience. Popper argued that what made science scientific was not its subject matter but the willingness of its proponents to allow their theories to be falsified.[10] In Johnson's words: "Progress is made not by searching the world for confirming examples, which can always be found, but by searching out the falsifying evidence that reveals the need for a new and better explanation" (p. 147).

Imre Lakatos was a colleague of Popper's at the London School of Economics. Lakatos treated Popper's claims about the nature of science as an empirical theory and argued that, as such, the history of science *falsified* Popper's account. His own theory, introduced above, was proposed as a "new and better explanation" of the course of the history of science. We have already seen his proposed criterion for distinguishing between acceptable and unacceptable (progressive and degenerating) research programs. Here it is relevant to introduce another feature of his account of science.

All scientific research programs, he concluded, include a central idea, called the hard core, which is usually too vague to be tested directly. In addition, there are the auxiliary hypotheses that mediate between the core theory and empirical data. Lakatos's study of the history of science convinced him that a certain amount of dogmatism with respect to the core of a program was both a regular feature of good science and a necessary strategy to allow for the development of scientific thought. His new version of falsificationism allows researchers to protect their core theory "dogmatically" so long as the program is progressive overall.[11]

From what has just been reported,[12] it follows that Johnson's criticism in the following quotation shows *not* the unscientific character of evolutionary biology, but rather that Johnson approaches it with an inadequate understanding of the philosophy of science:

> The central Darwinist concept that later came to be called the "fact of evolution" — descent with modification — was thus from the start protected from empirical testing. Darwin did leave some important questions open, including the relative importance of natural selection as a mechanism of change. The resulting arguments about the process, which continue to this day, distracted attention from the fact that the all-important central concept had become a dogma (p. 149).

That is, the usual strategy in science is to hold on to a central idea — hold it "dogmatically," if you will — so long as the theoretical elaborations and additions that are necessary to reconcile it with the evidence lead to new discoveries rather than to blind alleys.

Evolution and Naturalism

Johnson explains the evolutionists' dogmatism by attributing it, not to the usual processes of scientific development, but to an atheistic philosophical naturalism. Johnson is quite right about this in some cases, and perhaps in most of the cases of *popular* books written in defense of evolution.

However, a subtle distinction needs to be made here. On the one hand there are the proponents of "a religion of scientific naturalism, with its own ethical agenda and plan for salvation through social and genetic engineering" (Johnson, p. 150). This religion is fair game for criticism by proponents of other religions, and ought not be allowed *establishment* in the curriculum of the public schools. On the other hand, there is what we might call *methodological atheism*, which is by definition common to all natural science. This is simply the principle that scientific explanations are to be in terms of natural (not supernatural) entities and processes.

Johnson is critical of biologists and philosophers who define science in this way. However, it is a fact of history (perhaps an accident of history) that this is how the institution of *natural* science is understood in our era. It is ironic, perhaps, that Isaac Newton and Robert Boyle, two of the scientists who led the move to exclude all natural theology from science (then called "natural philosophy") did so for *theological* reasons. Their Calvinist doctrine of God's transcendence led them to make a radical distinction between God the Creator and the operation of the created universe, and hence to seek to protect *theology* from contamination *by science*. The metaphysical mixing of science and religion, Boyle and Newton believed, corrupted true religion.[13]

So, for better or for worse, we have inherited a view of science as *methodologically* atheistic — meaning that science *qua* science, seeks naturalistic explanations for all natural processes. Christians and atheists alike must pursue scientific questions in our era without invoking a creator. The conflict between Christianity and evolutionary thought only arises when scientists conclude that if the only *scientific* explanation that can be given is a chance happening,

then there is no other explanation at all. Such a conclusion constitutes an invalid inference from a statement expressing the limits of scientific knowledge to a metaphysical (or a-religious or anti-religious) claim about the ultimate nature of reality.

This is a subtle difference — one beyond the grasp of a fourth-grade science class (and perhaps beyond the grasp of some outspoken scientific naturalists as well?). For this reason I am sympathetic with Christians who object to the teaching of evolution in the public schools. But the answer is to help educators make the distinction, not to cooperate in blurring it as Johnson has done.[14]

Creative Intelligence as a Scientific Hypothesis

Johnson writes:

> Why not consider the possibility that life is what it so evidently seems to be, the product of creative intelligence? Science would not come to an end, because the task would remain of deciphering the languages in which genetic information is communicated, and in general finding out how the whole system *works*. What scientists would lose is not an inspiring research program, but the illusion of total mastery of nature. They would have to face the possibility that beyond the natural world there is a further reality which transcends science (p. 110).

The answer to Johnson's question is that anyone who attributes the characteristics of living things to creative intelligence has by definition stepped into the arena of either metaphysics or theology. Some might reply that the definition of science, then, needs to be changed. And perhaps it would be better if science had not taken this particular turn in its history. Could the nature of science change again in the near future to admit theistic explanations of natural events? There are a number of reasons for thinking this unlikely. A practical reason is the fact that much of the funding for scientific research in this country comes from the federal government. The mixing of science and religion would raise issues of the separation of church and state.

A second reason for thinking such a change unlikely is that many Christians in science, philosophy, and theology are still haunted by the idea of a "God of the gaps." Newton postulated divine intervention to adjust the orbits of the planets. When Laplace provided better calculations, God was no longer needed. Many Christians are wary of invoking divine action in any way in science, especially in biology, fearing that science will advance, providing the naturalistic explanations that will make God appear once again to have been an unnecessary hypothesis.

Concluding Remarks

What, then, of the relation between Christianity and Darwinism? I hope I have made it clear that this question is ambiguous. One question is: How ought Christianity be related to evolutionary biology — the pure science? The other is: How ought Christianity be related to evolutionary metaphysics? The latter system of thought involves the use of scientific theory to legitimate a metaphysical-religious point of view, and it has been so successful that many cannot imagine Christian thought making its own, different use of biology. Nonetheless it can be done, and it has been done by the likes of biochemist-theologian Arthur Peacocke.[15]

Peacocke notes that the sciences can be organized in a hierarchy, with higher sciences studying more complex levels of organization in reality. For example, chemistry studies more complex organizations of matter than does physics; biochemistry more so than inorganic chemistry; within biology alone there is a hierarchy as we move from biochemistry to the study of cells, to tissues, organs, and finally to the functioning of entire organisms within their environments.

Each science has its recognized domain, and concepts and theories appropriate to its own level of interest. Yet each science is conditioned by the levels above and below. Lower levels set limits on the behavior of entities at higher levels — for example, chemical processes in nerves and muscles set limits on how high or fast an animal can jump. However, lower levels do not uniquely determine the behavior of entitles at higher levels — here one also has to take account of the environment. Thus, the animal's particular movements within the range permitted by chemistry and physics will be to some extent conditioned by ecological factors as well.

So any science alone provides an incomplete account of reality; it finds limits above and below, beyond which its explanatory concepts cannot reach. But what about the limits of the highest (or lowest) science in the hierarchy? Peacocke proposes that at the top of the hierarchy of the sciences we reach theology, the science that studies the most complex system of all — the interaction of God and the whole of creation.[16]

Peacocke's suggestion provides the groundwork for an exciting account of the relations between the sciences and theology. We can examine the kinds of relations that hold between two hierarchically ordered sciences, and then look for analogous relations between theology and one or more sciences. One relation we may expect to find is that when a science reaches an inherent limit, there may be a role for theology to play at that point. For example, it *may* be inherently impossible for science to describe what happened "before" the Big Bang.

Peacocke's understanding of the relation between science and theology means that we need not turn biology into theology, but we may and must bear in mind that there is a discipline "above" biology that answers questions that biology alone cannot answer. Is this discipline to be an atheistic metaphysic that elevates "Chance" to the role of ultimate explanation, or is it to be a theology of benevolent Design? The question calls for a careful comparison of the explanatory force of these two competing accounts of reality. The former has to explain (or explain away) all appearances of order and purpose; the latter has to explain a number of features of the world that (as biologists correctly point out) appear inconsistent with intelligent design.[17]

It looks to many as though these two explanatory systems are at a stand-off. For every feature that appears to be the product of design, there is another that appears to be the product of chance. However, I suspect that the design hypothesis, as the core of the theological research program, could be shown to be *more progressive* (in Lakatos's sense) than a research program based on chance. My guess is that while the atheistic program could explain (or explain away) all the evidence for design, it will have to do so by means of an assortment of *ad hoc* hypotheses. Besides this, the Christian program has at its disposal additional supporting evidence from a variety of domains: religious experience, history, the human sciences.

So there are two issues before us, both of which cry out for much more extensive and careful treatment than I have given them here: First, what is the true standing of evolutionary biology *as a science* and measured against the best criteria that have so far been proposed for evaluating scientific acceptability (truth). I make two claims with regard to Johnson's book: first, that he has allowed the Evolutionary Naturalists to confuse evolutionary science with something else and, second, that he has used too primitive a view of scientific methodology for his evaluation. I do not claim to have definitively refuted his claims against evolutionary science, but I hope to have undermined them, and to have shown the direction a definitive evaluation of evolutionary biology would have to take.

The second big issue is the clash of world views: evolutionary naturalism versus Christianity; Chance with a capital "C" versus Design. Settling this controversy is well beyond the capability of any single scholar on either side, but we do educators, school children, and perhaps even evolutionary biologists a great favor by carefully distinguishing this issue from the first.

An important effect of separating the theological-metaphysical issue from the scientific one may be to lessen the anxiety and heat of controversy that surrounds the latter. We want scientists to stop their attacks on Christianity, but all Bible-readers should know that the cessation of hostilities is not to be left to our opponents. Better to turn away wrath with a gentle word.[18] ❄

NOTES

[1] InterVarsity, 1991.

[2] This sort of credential swapping is quite out of place in academic writing, but nonetheless it deserves a name. In practical reasoning, some arguments are called *ad hominem* (to or against the man); this argument I shall dub an *ab femina* argument (from the woman).

[3] This view of science has been particularly influential in conservative American Christian circles. John Witherspoon promoted Bacon's views among the Princeton theologians, such as Charles Hodge, who have influenced American Fundamentalism. It is described and criticized at somewhat greater length by Johnson, pp. 146-47.

[4] This term was coined by Carl Hempel. See his *Philosophy of Natural Science* (Prentice-Hall, 1966).

[5] Actually, we are asking more of natural selection here than is required by the theory. Darwinian theory does not require that natural selection be directly responsible for reproductive isolation. The classical theory is that geographical isolation, followed by differential adaptation to different conditions, is the principal agent of speciation.

[6] Johnson does take up this issue in the following chapter. My point is that the conclusions he draws in this chapter regarding the limits of variation are quite unwarranted because they cannot be made *independently* of the assessment of the possibilities for mutations.

[7] See "Falsification and the Methodology of Scientific Research Programmes," in J. Worrall and G. Currie, eds., *The Methodology of Scientific Research Programmes: Philosophical Papers, Volume 1* (Cambridge University Press, 1978), pp. 8-101.

[8] Such as Karl Popper's falsificationism.

[9] By Alan Musgrave, in "Logical vs. Historical Theories of Confirmation," *British Journal for the Philosophy of Science* 25 (1974): 1-23.

[10] Popper first elaborated this thesis in *Logik der Forschung* (Vienna, 1935); English translation, *The Logic of Scientific Discovery* (Harper, 1965).

[11] There is insufficient space here to show that Lakatos's understanding of science is superior to Popper's. See my *Theology in the Age of Scientific Reasoning* (Cornell University Press, 1990), chapter 3; as well as Lakatos's "Falsification and the Methodology of Scientific Research Programmes," op. cit.; and

especially his "History of Science and Its Rational Reconstructions," also in *The Methodology os Scientific Research Programmes*, op. cit., pp. 102-138.

[12] The same point is made by Thomas Kuhn in *The Structure of Scientific Revolutions* (University of Chicago, 1970); Paul Feyerabend in *Against Method* (New Left Books, 1975); and Larry Laudan in *Progress and its Problems* (University of California Press, 1977).

[13] See Eugene Klaaren, *Religious Origins of Modern Science* (Eerdmans, 1977); and Frank Manuel, *A Portrait of Isaac Newton* (Harvard University Press, 1968).

[14] For an excellent discussion of this and other issues, see Howard Van Till, Robert Snow, John Stek, and Davis Young, eds., *Portraits of Creation* (Eerdmans, 1990).

[15] See *Creation and the World of Science* (Clarendon, 1979); *Intimations of Reality* (University of Notre Dame Press, 1985); or *Theology for a Scientific Age* (Basil Blackwell, 1990).

[16] I elaborate and apply this view of the hierarchy of the sciences and their relation to theology in "Evidence of Design in the Fine-Tuning of the Universe," in Robert Russell, Nancey Murphy, and Chris Isham, eds., *Quantum Cosmology and the Laws of Nature: Scientific Perspectives on Divine Action* (The Vatican Observatory, forthcoming).

[17] Peacocke's view is that God creates through exploration of the possibilities provided by chance as well as through law-governed design.

[18] I wish to thank Philip Spieth at the University of California, Berkeley for helpful comments on an earlier draft of this paper.

Communications

Censorship in Secular Science: The Mims Case

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More and more frequently, those in science who are vocal about their objections to evolutionary naturalism as a universal explanation for the living world will be likely to experience employment problems in the field, as documented elsewhere by this author (Bergman, 1984; 1991). One of the latest in a recent string of cases involves *Scientific American*, the nation's oldest and most well-known popular science publication. The monthly magazine has an international circulation of more than 650,000 subscribers and has been publishing since the middle 1800s.

This particular affair began in May of 1988 when Forrest Mims, III, a veteran science writer from Seguin, Texas, proposed to write the magazine's popular amateur science column. Mims' background includes the authorship of over sixty books on science and hundreds of magazines articles published in journals including *Science Digest*, *Popular Mechanics*, *Modern Electronics*, and *National Geographic* (Mims, 1990a). Mims' science books have been published by Prentice-Hall, McGraw-Hill, Radio Shack and other mainline, respected firms (Eastland, 1991, p. 32; Mims, 1992c). He is also a regular columnist for several science magazines and is now the editor of a highly successful science magazine *Science Probe!* (Sidney, 1990, p. 56). Of this new magazine, a review in *Nature* said:

> *Science Probe!* is a cornucopia of delights for the amateur scientist and, I suspect, of real value also to the professional. It bears such treasures as the telephone number through which to obtain graphic images, in a format compatible with your personal computer, from the Hubble telescope; how to make an electrocardiogram; and how to encounter slime moulds in their natural habitat. It is transdisciplinary and regards all science as open to the amateur.... Science is criticized by some philosophers as soulless and damaging. This may be true of that part of science which has become too serious, narrowly specialized and subject to the strictures of scientific correctness; .... How did we allow dogma to become respectable and speculation pejorative? I grew up in a science thinking that our task was to reduce science fiction to practice and have done my best to do so. I hope that *Science Probe!* flourishes and brings back science as something interesting that can be done at home (1992, p. 436).

The History of the Case

Forrest Mims first submitted a proposal to write *Scientific American*'s column, "The Amateur Scientist," in 1988 (Hartwig, 1990, p. 6). He approached the magazine only after University of Cincinnati physics professor Jerl Walker gave notice that he could no longer author the column (Gardner, 1991, p. 356). Mims' great interest in this column stems from his love for science which was originally awakened by this column. While still a young man, Mims dreamed that he would someday be its author. Later, C.L. Strong, the column's long time author, told Mims before he died that Mims would someday be in charge of the column (Eastland, 1991, p. 32). It soon seemed that his dream would come true: the Editor, Jonathan Piel, phoned in late July, 1989, asking Mims if he wanted to take over "The Amateur Scientist" column (Eastland, 1991, p. 32). In late August 1989, Piel asked Mims to write several sample

columns—and in three weeks, three 3000 word pieces were submitted (Mims, 1991a; 1990; 1990b; 1990c).

Piel then invited Mims to come to New York to discuss the details of doing the column. Things went extremely well, Mims recalls, until Piel asked what other publications he had written articles for. Only then did the Christian magazines that Mims once wrote for come up, provoking the question: "What did you write about for these magazines?" The answer was, "Bicycling trips and aerial photography" (Eastland, 1991, p. 34). Mims did not then know the repercussions that would ensue from the serious mistake that he made in mentioning these articles. Nothing that he had written was even remotely related to the topic of creationism, but the fact that Mims had written for Christian magazines obviously disturbed Piel (Kincaid, 1990). After the Editor inquired as to *exactly what* he had written for Christian magazines, Piel pointedly asked him his major concern: "Do you accept Darwin's theory of evolution?" (Hartwig, 1990, p. 6). Mims responded that he did not, an answer that was the beginning of the end.

From then on, "Piel's attitude toward him changed dramatically" (Hartwig, 1990, p. 6). Piel informed Mims that he would not be allowed to write *anything* for *any publication* that *Scientific American* objected to. Piel was specifically concerned about articles on the subject of creation or against evolution or anti-abortion pieces. Mims was warned that if an outside article was published without *Scientific American*'s prior review and permission, he would face a pay cut or dismissal (Sidey, 1990, p. 56). Mims pointed out in response that he has *never* used his writing to promote his creationist beliefs, nor would he do so in the future (Mims, 1992a). To insure that he conformed to this demand, Piel continued to insist that *all* of Mims' outside writings must be reviewed by *Scientific American* prior to their publication elsewhere.

Soon after he returned home, Mims submitted his initial three columns. Several months later, however, Mims was again questioned by Piel and another editor about his views on abortion and related topics. Actually, Mims notes, abortion and his Christianity were also major issues. He writes:

> Gardner's defense of his former employer, *Scientific American*, is misplaced. He knows that to this day the magazine's staff remains divided over the issue ... [of if I should have been terminated and] that I was asked more about abortion and my Christian faith than about evolution. He also knows about the duplicity of the magazine's editor, who denied his promise to buy and publish three of my columns. The columns were published only after the magazine's president intervened. Moreover, in Gardner's first report about this unfortunate matter, even he cited the transcript in *Harper's* (March 1991) in which the following exchange appears:
>
> MIMS: Prior to the visit to your offices, there was never even a hint that religion would become an issue.
>
> PIEL: Forrest, come on, that's why I had the meeting with you (Mims, 1992b, p. 444).

Piel again expressed his concern that the reputation of *Scientific American* could suffer if Mims openly supported in some way the views of the anti-abortion movement or was critical of evolution. When Piel specifically asked, "Are you a fundamentalist Christian?" (a label he does not accept) — Mims objected to the obviously illegal question. He responded, "I will not be discriminated against" (Sidey, 1990, p. 56).

Scientific American then published the three columns that Mims had prepared, but only after the magazine's president intervened and on condition that Mims signed a written agreement waiving all of his rights to obtain legal redress from the magazine for religious discrimination (Truehart, 1990; Mims, 1992b, p. 444). The agreement with *Scientific American* specifically stated that Mims would not pursue legal action to rectify the religious discrimination he experienced. Mims was then dropped as a writer, and rather than risk a law suit, the editors then decided to permanently drop the column which, with the threat of a lawsuit past, has since been resumed. They probably reasoned that, in order to win a discrimination suit, Mims must show only that someone less qualified who is not of his religious persuasion was hired—and if no one was hired, a suit would not have much chance in the courts (Eastland, 1991, p. 32). The column began in 1952 when Mims was eight years old, and it seemed for several months that Mims would have the honor of having the last byline in the column's long history.

A concern over the blatant discrimination that was occurring caused Mims to surreptitiously record one of his conversations with Piel, who stated on tape, "what you have written is first rate ... it's the public relations nightmare that's keeping me awake" (B. Davis, 1990). Excerpts of the transcript of much of this now famous thirty minute call were published in *Harper's Magazine* (March 1991, pp. 28-332). The editor's concern was not Mims' writing, but primarily the reaction of the scientific community to *Scientific American* employing a non-believer in megaevolution and that the critics of evolutionism

could use Mims to advance their position (Eastland, 1991, p. 34; B. Davis, 1990). In a phone call the next day and later formally in a letter, Piel then terminated all further discussions of the possibility of Mims ever being a contributor to the pages of the magazine.

Few if any of the events in this case are in dispute. However, when contacted by various reporters, Piel actually stated, "*Scientific American* does not discriminate on any basis. We have not and never will." Both Piel and two former editors have openly stated that the reason Mims did not continue in the assignment was not because of his qualifications, but his personal religious conclusions and beliefs. Tom Appenzeller, currently science editor of *The Sciences*, said that there was, "no question about [Mims'] competence." At issue was the "public relations" aspect of a creationist being connected with the magazine (Sidey, 1990, p. 56). Appenzeller stated that the magazine's concern "was specifically his beliefs about evolution and his rejection of Darwinian selection" (Sidey, 1990, p. 56). And as Jukes (1991c, p. 12) noted, in view of this conflict due to religion, might Mims "not feel at home as a member of the staff of *Scientific American*?" The blatant bigotry that this statement evidenced was not perceived by Jukes: would *Scientific American* condone not hiring a Jew, giving the reason that he might "not feel at home as a member of the staff?"

Because he still would like to do the column, Mims has since tried to discuss this situation with *Scientific American*, but the magazine's attorneys have responded in writing, stating that "the publication has ended all business contacts" with him (Sidey, 1990, p. 56). They have even reportedly written to his other editors and tried to persuade them not to publish Mims' work. (Fortunately all of these editors refused to cave in to this bigotry.) As Eastland, (1991, p. 34) notes:

> Mims knows that if had never volunteered that he'd written a few pieces for Christian magazines—on some awfully tame subjects—he'd be writing the "Amateur Scientist" today .... Even more striking than Mims telling the editor of *Scientific American* that he is a Christian was his failure to confess, when asked about it point blank, to the theory of evolution. This was more than a breach of etiquette — it was heresy.

Mims does not describe himself as a fundamentalist, but as an evangelical Christian (Truehart, 1990; 1990a). His views on evolution and creation are not clear cut: he accepts microevolution and his definition of creationism is simply "the doctrine that God created the world or universe" (Denini, 1990, p. 2b; Weisberg, 1990, p. 47). In his own words, he believes only that the universe was designed by God, and he has not published any details about his beliefs. In personal conversations Mims has made it clear that his interests and knowledge is in the amateur science field, not the nuances of creationism (Mims, 1990e; 1991a). Gardner (1991, p. 357) concluded that Mims "is not a 'young earther' who thinks the universe was created about 10,000 years ago. He allows that individual species were created at intervals over long periods of time, [and] the 'days' of Genesis are not to be taken as 24-hour-time-spans." Those that I have talked to conclude that he would probably be more at home in ASA than either the Institute for Creation Research or the Creation Research Society.

Of course his actual beliefs are in fact largely irrelevant; what is relevant is the label forced upon him. Many have charged that he cannot do science and is trying to inject pseudoscience in his work, a charge to which Mims responds as follows:

> The editorial then purports to explain "the firing of Mims" by contending that "the real reason was that creationists substitute what they call 'creation science' for conventional science." This conclusion completely contradicts explanations given by Piel (*Harper's* 1991) and former editors at the magazine, ... all whom expressed great interest in my work and who were more than pleased with the columns I wrote for them (e.g., Abernathy 1990; National Public Radio 1990; Sharpe, 1990; *The New York Times* 1990; Weiman, 1990; *Harper's Magazine*, 1991). Moreover, the editorial fails to identify a single example in my published writings, including my three columns for *Scientific American* (Mims, 1990a), in which I have not practiced conventional science (Mims, 1992a, p. 1).

Stereotyping and Mislabeling

That the problem was less his beliefs than the labeling process—which can be vicious and is usually applied to a wide variety of positions, often to anyone in science who does not with wholesale enthusiasm embrace atheistic evolution—is clear from the general studies on this subject (Numbers, 1992; Eve and Harrold, 1991; Smith, 1990). The crux of the matter, in Eastland's (1991, p. 34) words, is that "the beliefs of evolutionary biologists imply a philosophical system that excludes a creator. Thus, for them, theistic evolution is a contradiction in terms; the alternatives are two and only two: creation or evolution, God or not God." Most of those who label themselves creationists and have been active publishing in the controversy do not identify with the Institute for Creation Research or the other

groups which have been stereotyped as representing creationists (Morris, 1984; Numbers, 1992; P. Johnson, 1991). As Mims notes, critics often cite a "mock inquisition that demonstrates a stereotypical, prejudiced view of what creationists believe" (1992a, p. 2).

Many scientists have openly and actively supported the actions of *Scientific American* has taken in regards to Mims. (Lewis, 1992; King, 1991; Weinberg, 1991). As Arthur Caplan concludes:

> Forrest Mims is a competent writer and amateur scientist. But his personal beliefs about creation limit what he can and cannot tell his readers about all the nooks and crannies of science. They also distort the picture he conveys regarding what science methodology is all about. It is a hard line to draw, but Forrest Mims and others who espouse a belief in creation and reject the scientific standing of evolution are on the wrong side of the line (1991, p. 13).

In response to this line of reasoning, Eastland (1991, p. 34) notes "The Forrest Mims story ultimately comes down to the remarkable influence that Darwinian fundamentalism has on institutions of science like *Scientific American*. The doctrine of evolution is what's 'politically correct,' and woe betide those who express dissent." As P. Johnson put it:

> Mims was sent packing because his very presence was perceived as a threat to Darwin's theory of evolution. Even if he never published a word about evolution, creationists might have cited him as a well-informed skeptic. If they did, angry Darwinists would cancel their subscriptions—and *Scientific American* knows who butters its bread. So Mims became a casualty in a religious war. Many Darwinists insist that people like Mims have to be kept out of science because their skepticism about evolution is inconsistent with scientific objectivity. One biology professor who defended the magazine's action reasoned that "I would be against having such a person writing a column, because at the base, this philosophy could enter everything one does in science (1990, p. B7).

A major difference between the Mims case and the many others in this modern religious battle between scientists and Christian theodicy is the enormous amount of favorable publicity that Mims has received. Most cases of this type—and there are thousands—receive either no publicity or extremely limited publicity. The many mainline, respected publications that have run articles about the Mims imbroglio range from the *Wall Street Journal, New York Times,* to *The Washington Post,* and scores of others (Holden, 1990). Mims has also been on numerous talk shows and has given scores of radio interviews and television and personal appearances, including on CNN and national television. The wire services picked up the story, and "some one-thousand radio stations amplified Mims' complaint" Eastland (1991, p. 34). Mims also stated to me that he found the secular press far more supportive than the Christian news media.

Part of the reason that this case has generated so much publicity is that, according to Mims, "virtually all" of the reporters he talked to are "very sensitive" to the freedom of press issues involved. Eastland (1991, p. 34), concludes that a major reason for the support by reporters is because of the obvious fear that "this could happen to them too."

Support for Mims From the Academic Community

What is also unusual is the support that he has received from mainline scientists (Keleher, 1991; R. Johnson, 1990). The *American Association for the Advancement of Science: Committee on Scientific Freedom and Responsibility* headed by Sheldon Krimsky, compiled a report on the Mims case, which stated in part that

> ... articles submitted for publication to journals devoted to science, technology and medicine should be judged exclusively on their scientific merit ... a person's private behavior, religious or political beliefs or affiliations should not serve as criteria in the evaluation of articles submitted for publication. We emphasize in particular, the consensus of the committee that even if a person holds religiously derived beliefs that conflict with the views commonly held in the scientific community, those beliefs should not influence publication of science articles unless the beliefs are reflected in the articles (Krimsky, 1990; Truehart, 1990).

Lemar Hankins, acting director of the Texas ACLU, likened the magazine's treatment of Mims to McCarthyism (Abernathy, 1990, p. 2; 1990a, 1990b). Admittedly, *Scientific American* possessed a genuine concern: a realistic fear of the effects on the magazine due to the intolerance commonly found in the scientific community to a theological world view (P. Johnson, 1990). According to Abernathy (1990, p. 2) "former *Scientific American* editors Timothy Appenzeller and Armand Schwab, Jr. told the *Chronicle* earlier that Piel feared Mims' hiring could create ill will among biologists and other scientists who believe in evolution." Potjewyd compared Mims to other religious scientists, concluding:

> We have been raised to believe that we are free to practice our beliefs and still be allowed to work

together, at least within science, with people whose belief systems are different from our own. The system is not supposed to enforce a litmus test of beliefs, nor can it force Mims to score a passing grade on a test of correct scientific opinions. Imagine what would have happened to Isaac Newton if he had been forced to accept the current opinion about what influences planetary motion as a condition of acceptance of the post of mathematics professor at Cambridge.

Most of Newton's manuscripts on religion were long concealed from the world's notice. Of the major nonscientific works now in print, only one, the *Chronology of Ancient Kingdoms Amended*, was prepared for the press by Newton himself. For 200 years, most of Newton's religious manuscripts were suppressed because it was believed that Newton's beliefs would tarnish his image as a scientific genius. Would Newton's personal beliefs have prevented him from working as a science writer at *Scientific American*?

I, as a scientist, know that I do not have to judge the worth of another person's value system as an indication of his or her knowledge of science or skill at handling the job of science writer, as was Mims' lot. Scientists leave this to a "Higher Authority." *Scientific American* cannot afford to. What this should tell us is that *Scientific American* is not very scientific and not very American (1991, p. 12).

Piel himself specifically stated that the association of an evolutionism non-believer with the magazine "could harm the cause of science and alienate crucial groups of authors or readers" (Truehart, 1990, p. 6). Piel correctly recognized that the scientific community would not take lightly to them allowing a non-believer in evolutionism to author articles for the magazine, and many would be likely to boycott it (Nutting and Nutting, 1991). Jukes openly stated "the actual reason" Mims was released by *Scientific American* "was because he was a creationist" (1991a, p. 1).

As Gardner, another *Scientific American* editor, adds, "from a PR standpoint, having a creationist write regularly for the magazine would become increasingly embarrassing" (1991, p. 357). To explain his position he uses the example of medical journal considering someone to write a column about nutrition, then discovering that the person is a naturopath who did not believe that germs cause disease, or *Sky and Telescope* assigning someone to write a column on how to make or buy telescopes, and then finding that the author did not believe that the Sun revolves around the Earth. Gardner (1991, p. 358) concludes that in both of these cases the writer might be well informed about nutrition or telescopes, but the magazine would be fully justified in not allowing them to write to avoid facing ridicule. While these examples may be somewhat strained if not unrealistic, no world view is fully objective, and as a University of California at Berkeley law scholar notes, science has today been strangled by naturalistic Darwinism:

In Darwinist hands, however, science includes a philosophical bias that is essentially religious in character. Darwinists begin by assuming that science excludes the possibility of a creator. They conclude that purely material processes (like random mutation and selection) must have created all the wonders of the living world, because nothing else was available to do the job. (P. Johnson, 1990:B7)

For this reason many of Mims' supporters feel that Gardener's analogy is not only invalid, but that it is an unethical "guilt by association" ploy. Gardner quotes University of Maryland physicist Robert Park, who stated that Mims has "established that he doesn't have credibility to write about science" if he rejects evolutionism. This illustrates the common attitude among scientists on the subject of origins (Truehart, 1990; 1990a). Poll after poll finds about half of all Americans are conservative creationists, and further over 20% of all biology teachers and professors do not accept evolutionism. As Milner notes:

According to a 1982 Gallup Poll, the American public is almost evenly divided between those who believed that God created man in his present form in a single act of creation in the last 10,000 years and those who believe in evolution or an evolutionary process involving God. Although the Gallup organization did not conduct a follow-up study, a more recent survey of beliefs among a collegiate population was made in 1986 by social scientists at the University of Texas. Nearly 1,000 students at five colleges were asked whether they accepted certain propositions as true, including the story of Adam and Eve. A surprisingly large majority, 60 percent, of the students in the survey said they do believe that "Adam and Eve were created by God as the first two people." If the study is accurate, a higher proportion of the college-educated Americans believe the Adam and Eve story than the general population polled by Gallup four years earlier (1990, p. 100).

Gardner assumes his analogy is valid because he believes that naturalism evolutionism is a fact, and, as an Eric Hofferian true believer, he refuses to consider any other world view. Gardner, who was "raised a fundamentalist," evidently had a bad experience with religion or religious people, and now calls himself a "philosophical theist" (1991, p. 357).

He concludes that God had nothing to do with the creation of the universe or anything in it, including humans. God is presumably like an army general who takes over a thriving village and claims the village's successes as its own. Likewise, after the universe evolved by its own forces, God decided to steal the credit for its many wonders.

The Central Role of Religion in the Case

Ironically, Gardner steadfastly claims that it was not Mims' religion that ruined his career at *Scientific American*, but only his beliefs about evolution. Yet he states:

> "... it would be interesting to see if Mims ever has the courage to write an article on say, how amateur scientists can build equipment for testing (by any of several different techniques) the ages of fossils and human artifacts, or will he, *like a good Southern Baptist*, carefully avoid any topic that might provide support for the theory that fundamentalists believe to be the work of Satan?" (Emphasis added).

And Gardner adds, "although he [Mims] prefers to call himself an evangelical, Mims is a Southern Baptist fundamentalist" (1991, p. 358; 357). Gardner here makes it clear that Mims' beliefs about evolution are an integral part of his religion, and that he was not hired *because of those beliefs*, then makes the astounding claim that "it was not Mims' religion" that caused his problems (1991, p. 357). Mims, in response to Gardner, insists he is not a fundamentalist, but an evangelical and that there is a "significant difference between the two" (Mims, 1992b, p. 444). Gardner then concludes that "it is unlikely that either Cal Thomas or Forrest Mims will ever go back to college — fundamentalist colleges like Jerry Falwell's exempted—to take geology 101 and change their minds about evolution" (1991, p. 358). As explained by P. Johnson, the Mims episode

> ... shows us that science is beset by religious fundamentalism—of two kinds. One group of fundamentalists — the Biblical creation-scientists — has been banished from mainstream science and education and has no significant influence. Another group has enormous clout in science and science education, and is prepared to use it to exclude people they consider unbelievers. The influential fundamentalists are called Darwinists (1990, p. 12).

Smith (1990) calls professors with this unreasonable hostility against religion "academic fundamentalists," and Frair has concluded that "the scientific enterprise itself is weakened by the type of intolerance and censorship evidenced by the staff of *Scientific American*" (1992, p. 157).

A Response to This Situation

Eastland (1991, p. 34) has concluded that had it not been for religious bigotry,

> "Forrest Mims would be writing today the column he so clearly would have been good at. *Scientific American's* worry about 'a possible inadvertent linking' of Mims' beliefs 'with the good name of this magazine' is irrational unless one irrationally assumes that its readership is also irrational."

He adds that "the Mims affair has demonstrated the 'public relations nightmare' a magazine can have when it acts like *Scientific American*." The solution to the problem, as stated in broad terms by Flesher (1990, p. 12) a professor of pharmacology and toxicology at the University of Kentucky College of Medicine, is "to resist the impulse to exclude, *a priori*, any competent scientist from contributing work or comment in open publication, discussion, and debate. Science is about knowing, it is not about believing."

The wider importance of this controversy is that

> ... millions of people in oppressed lands would consider themselves truly blessed if the worst thing that could happen to them was denial of employment at one bigoted firm. But ... this is the only country that *professes* such an intolerance of discrimination .... Against that buffoonishly self-righteous background comes the case of a man denied employment for the most pernicious reason of all: his private inner beliefs. In Mims' 20 years as a science writer, he has not brought up, even once, the creationism he believes in. And there is certainly no reason to believe he would have mentioned the unmentionable in any employment at the close-minded *Scientific American*. Indeed, it appears his private beliefs were revealed only as a result of an intrusive employment interview.... What, Mims asked incredulously, does this have to do with my writing articles on such things as how amateurs can measure the length of lightning bolts, or build a solar observatory. As this is being written and read, cataclysmic reforms are taking place in the Soviet Union. For all we know, they may presently be enacting legislation making it a crime to discriminate on the basis of an individual's inner beliefs—or even to *ask* about them as a condition of employment. Just the thought of such potential monumental embarrassment to this nation should make every concerned American drop whatever he or she is doing and rally to the cause of Forrest M. Mims 3rd (Freedman, 1990, p. 10).

Mims' track record should speak for itself, but in this case something else obviously spoke far louder (Keleher, 1991; Taylor, 1991). As Mims put it, *Scientific American* judged him on his beliefs, not for what he can do (Truehart, 1990). Art Salsberg, the editor of *Modern Electronics* and one who knows Mims' record, stated in an editorial that when filling out directories for writers that list their publication needs and their article requirements, "I have never come across a question related to anything personal, such as religious beliefs, political leanings, ..." (1991, p. 5). And as for the work of Forrest Mims, which he has long been familiar with, Salsberg said,

> "it seems that *Scientific American*'s editor feared that he would be embarrassed if other people found out about Forrest's beliefs and tried to exploit the fact that he was writing for the publication. Now that's paranoid, at best, I think, given the subject matter that Forrest writes about."

Salsberg adds, "that Mims' personal beliefs have nothing to do with the work he does," noting that two other regular *Modern Electronics* writers also "share his private beliefs" and that whether one is a creationist is "simply not a consideration here for accepting or rejecting anyone's articles (1991, p. 5). For many scientific journals, though, it is obviously very important—*Scientific American* even refuses paid ads for all creationists' publications (Frair, 1992).

Mims agrees with Salsberg, noting that:

> Gardner also ridiculed the fact that I am editor of *Science Probe!* —[what he calls a] "a handsome new science magazine." Scientific writings stand or fall on their own merit. Would Gardner reject the writings of Galileo, Newton, Bacon, Kepler, Linnaeus, Pasteur, and a host of others because of their abiding faith in God? Would he have written for *Scientific American* had he known its founding editor, Rufus Porter, advocated in its pages belief in a Creator God?
>
> What is puzzling about all this is that Gardner has assured me that he, too, believes in a "creator God" who is also a "personal God." Although Gardner believes God created life through evolution, he has also assured me that his theism does not preclude the possibility that God is capable of creating life spontaneously and without evolution (Mims, 1992b, p. 444-445).

An interesting comparison of *Science Probe!* with *Scientific American* was made by Lovelock:

> ... neither the journals of science nor the news media have commented on the colours of the night sky since the eruption of Pinatubo. [Yet]... Pinatubo and the night sky were covered in the new magazine *Science Probe!*. An informative article answered many of my questions, and even showed how to estimate the height of the aerosol layer from the length of time colours lingered after sunset. This journal brings back a world of which science was a familiar part. For me it recalled an altogether lighter and more friendly *Scientific American*, read with joy in the public library at Brixton, south London, 60 years ago. Such reading and amateur experiments led me to a fulfilling life in the vocation of science, reading that was the antidote to the scientifically correct but utterly dull teaching of my grammar school. Science taught then, as now, was mere knowledge needed to pass exams (1992, p. 436).

Mims is only one of many persons who were labeled "creationist" and consequently were locked out of their scientific publishing positions. The Editor of *Scientific American* also refused to "give Dr. [Phillip] Johnson space to respond to a rancorous and sulking four-page review of his book by Stephen J. Gould,* despite the urging of numerous fair minded scientists" (Buell, 1992, p. 2). Professor P. William Davis, the author of several best selling college biology textbooks, including *The World of Biology, Human Anatomy and Physiology* and several others, was dropped by Saunders College Publishing Company as an author when the scientific community complained to Saunders because he had co-authored another book that alluded to the need for a designer to explain the natural world (P. W. Davis, 1988; Solomon et al, 1983). The other book, *Of Pandas and People*, (P. W. Davis, et al, 1989; see also Frair and P. W. Davis, 1983) resulted in the end of Davis' highly successful career as a college biology textbook author. Many do succeed, because as Pittman concluded, it is difficult to even determine the number of creationists in academia because "few creationists are willing to risk their jobs by 'outing' their principles in this climate" (1992, p. 9). ❋

* *Phillip Johnson's response to Gould's review follows this article.*

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Genesis is not a book of science.
It is accidental if some things agree in detail.
I believe the heavens declare the glory of God
only to people who've made a religious commitment.

Owen Gingerich
Historian-Astronomer, Harvard University

The Religion of the Blind Watchmaker

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Stephen Jay Gould published a four page book review which was highly critical of Phillip E. Johnson and his book Darwin on Trial *in the July 1992 issue of* Scientific American. *Editor Jonathan Piel has refused to publish this response.*

"Biology is the study of complicated things that give the appearance of having been designed for a purpose."[1] So writes Richard Dawkins in *The Blind Watchmaker*. As a Darwinist, Dawkins maintains that the appearance is deceptive, and that living organisms are actually the product of purposeless material forces — random genetic variation and natural selection. This "blind watchmaker thesis" is the most important claim of evolutionary biology. If scientists were able to say only that primitive fish "somehow" became amphibians, and then mammals, and finally humans, nobody would be very impressed. Absent a credible mechanism, the transformation of a fish into a human being is nearly as miraculous as the creation of man from the dust of the earth. What makes the story of evolution impressive is that Darwinist scientists think that they know how such transformations occurred, through natural processes requiring no divine guidance or non-material orienting force.

The blind watchmaker thesis has enormous religious significance because it purports to explain the history of life without leaving any role to a supernatural Creator. "Before Darwin," writes Stephen Jay Gould, "we thought that a benevolent God had created us."[2] After the acceptance of Darwinism, that belief became intellectually untenable. According to Gould,

> No intervening spirit watches lovingly over the affairs of nature (though Newton's clock-winding god might have set up the machinery at the beginning of time and then let it run). No vital forces propel evolutionary change. And whatever we think of God, his existence is not manifest in the products of nature.[3]

God as a remote First Cause remains a possibility, but God as an active creator is absolutely ruled out by the blind watchmaker thesis. That is why Richard Dawkins exults that "Darwin made it possible to be an intellectually fulfilled atheist."[4] That doesn't, however, mean that Darwin made it impossible to be anything but an atheist. For example, Darwinism and theism can easily be reconciled by those who, like Asa Gray and Charles D. Walcott, misunderstand Darwinian evolution as a benevolent process divinely ordained for the purpose of creating humans. (Gould himself has been particularly emphatic in correcting that sort of misunderstanding.) On the other hand, Darwinism does give atheists and agnostics a decisive advantage to the extent that belief in God's existence is a matter of logic and evidence. Those who really understand Darwinism, but still have spiritual inclinations, now have the option of making a religion out of evolution. Theodosius Dobzhansky — Gould's prime example of a Christian evolutionist — actually exemplified the religious dimension of Darwinism. Dobzhansky discarded the traditional Christian conception of God, spiritualized the evolutionary process, and worshipped the glorious future of evolution.[5]

Gould writes that religion and science should not conflict, "because science treats factual reality, while religion struggles with human morality." But this statement implies a distinction between morality and reality which does not exist, and which Gould himself would never observe in practice. Does the morality of racial discrimination, for example, have nothing to do with the factual reality of human equality? The author of *The Mismeasure of Man* (Norton, 1981) didn't seem to think so. And what gives Gould the authority to proclaim that religion may not concern itself with the factual reality of God? God can't have any moral authority unless he really exists, and if God really exists he might take a hand in creation. When a scientific elite claims exclusive authority to decide what is "real," it is asserting control

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over science, religion, philosophy, and every other area of thought.

Religion, like science, starts with assumptions or conclusions about reality. If we were created by God for a purpose, that is one starting point. If we are the accidental product of blind natural forces, that is a very different starting point. In the former case we try to learn the will of our creator, and in the latter case we discard that "intervening spirit" as an illusion and proceed to chart our own course. Thus Gould himself, in the concluding sentence of *Wonderful Life*, proceeds directly from a Darwinist starting point to the religious conclusion that we are morally autonomous beings who create our own values:

> We are the offspring of history, and must establish our own paths in this most diverse and interesting of conceivable universes — one indifferent to our suffering, and therefore offering us maximum freedom to thrive, or to fail, in our own chosen way.[6]

The author of all those statements castigated me for suggesting that Darwinism is tied to naturalistic philosophy and opposed to any meaningful theism. David Hull, reviewing *Darwin on Trial* for *Nature*, was equally severe with me for refusing to concede that Darwinism has finished off theistic religion for good. Hull emphatically proclaimed a Darwinist doctrine of God:

> What kind of God can one infer from the sort of phenomena epitomized by the species on Darwin's Galápagos Islands? The evolutionary process is rife with happenstance, contingency, incredible waste, death, pain and horror.... The God of the Galápagos is careless, wasteful, indifferent, almost diabolical. He is certainly not the sort of God to whom anyone would be inclined to pray.[7]

So much for Darwinism's religious neutrality. Now to the more important question: Is the blind watchmaker thesis *true*? To put the question another way, does natural selection really have the fantastic creative power which Darwinists claim for it? That seems an appropriate question, but persons like Gould, Dawkins, and Hull insist that the very definition of "science" rules the question out of order. They say that science is inherently committed to naturalistic premises, that Darwinian evolution is the best scientific (i.e. naturalistic) theory of biological creation that we have, and even that Darwinism possesses a virtue called "consilience of induction" — meaning that it explains a lot if we assume that it is true. One way or another, Darwinists meet the question, "Is Darwinism *true*?" with an answer that amounts to an assertion of power: "Well, it is *science*, as we define science, and you will have to be content with that."

Some of us are not content with that, because we know that the empirical evidence for the creative power of natural selection is somewhere between weak and non-existent. *Artificial* selection of fruitflies or domestic animals produces limited change within the species, but tells us nothing about how insects and mammals came into existence in the first place. In any case, whatever *artificial* selection achieves is due to the employment of human intelligence consciously pursuing a goal. The whole point of the blind watchmaker thesis, however, is to establish what material processes can do in the *absence* of purpose and intelligence. That Darwinist authorities continually overlook this crucial distinction gives us little confidence in their objectivity.

Examples of natural selection in action, like Kettlewell's observation of population shifts in the peppered moth, actually illustrate cyclical variation within stable species that exhibit no directional change. The fossil record — characterized by sudden appearance and subsequent stasis — is notoriously reluctant to yield examples of Darwinian macroevolution. The therapsid reptiles and *Archaeopteryx* are rare exceptions to the general absence of plausible transitional intermediates between major groups, which is why it is important to understand that even these Darwinist trophies are inconclusive as evidence of macroevolution. No wonder that prominent authorities like Stephen Jay Gould and Lynn Margulis have yearned for a new theory, on the grounds that the evidence contradicts the neo-Darwinist claim that macroevolutionary innovation results from the accumulation of small genetic changes by natural selection.[8]

The point is not whether "evolution" in some vague sense is true. "Evolution" has certainly occurred, but the scientific importance of this statement is slight when evolution is defined vaguely as "change" or modestly as "shifts in gene frequencies." No doubt the pattern of relationships among plants and animals invites an inference that there was some process of development from a common source. But how much do we know about this process of development? Perhaps one day scientists will be able to test some macroevolutionary mechanism, involving changes in the rate genes or whatever, that will explain how a four-footed mammal can become a whale or a bat without going through impossible intermediate steps. The difficulties should be honestly acknowledged, however. What evolutionary theory needs is a reliable creative mechanism, ca-

pable of building highly complex structures like vision and breathing systems again and again in diverse lines. Speculation about how an occasional jump might occur won't do the job.

Readers who know the score will understand why I feel honored that Stephen Jay Gould could find no better response to my challenge in *Darwin on Trial* than a vitriolic attack that evades the main points and instead wanders through the book in search of something to complain about. (Compare what I wrote on page 16 of *Darwin on Trial* with Gould's complaint about "recombination," and you will see how hard he worked to find a nit to pick.) I welcome criticism on specific points; that is why I circulated preliminary drafts of the book to many distinguished scholars, including Gould. The subject of controversy, however, is my argument that the blind watchmaker thesis is not supported by the evidence — i.e., that science does not know how life could have evolved to its present complexity and diversity without the participation of preexisting intelligence. If Gould had a convincing answer to that argument, you may be sure that he would have stated the issues clearly and met the main line of reasoning head on.

Gould's review itself merits no further response, but what requires explanation is the hostility. What divides Gould and me has little to do with scientific evidence and everything to do with metaphysics. Gould approaches the question of evolution from the philosophical starting point of scientific naturalism, which denies *a priori* that a non-material being such as God could influence the course of nature. From that standpoint the blind watchmaker thesis is true in principle by definition. From this perspective, science may not know all the details yet, but something very much like Darwinian evolution simply *has* to be responsible for our existence because there is no acceptable alternative. If there are gaps or defects in the existing theory, the appropriate response is to supply additional naturalistic hypotheses. Critics who disparage Darwinism without offering a naturalistic alternative are seen as attacking science itself, probably in order to impose a religious straitjacket upon science and society. One does not reason with such persons; one employs any means at hand to discourage them.

But maybe Darwinism really is false — in principle, and not just in detail. Maybe mindless material processes can't create information-rich biological systems. That is a real possibility, no matter how offensive it is to scientific naturalists. How do Darwinists know that the blind watchmaker created the animal phyla, for example, since the process can't be demonstrated and all the historical evidence is missing? Darwinists may have the cultural power to suppress questions like that for a time, but eventually they are going to have to come to grips with them. There are a lot of theists in America, not to mention the rest of the world, and persons who promote naturalism in the name of science will not forever be able to deny them a fair hearing.

Scientific naturalists who think that Darwinism can be defended by waging ideological war against the critics are free to follow the example of Stephen Jay Gould. Others may prefer to take the path of Michael Ruse and the Darwinist scientists who participated in an academic symposium on the issues raised by *Darwin on Trial* in March 1992, at Southern Methodist University. These persons learned that it is possible to debate metaphysical differences in an academic setting in a fair-minded and mutually respectful manner. In the end, the entire scientific community will have to acknowledge that honest discussion — with assumptions identified and terms precisely defined — is the only method for resolving disagreement that is consistent with the best traditions of science itself. When scientists defend a cherished doctrine by obscuring the issues and intimidating the critics, it is a sure sign that what they are defending isn't science. ❄

NOTES

[1] Richard Dawkins, *The Blind Watchmaker* (Longman, England 1986), p. 1. (Hereafter Dawkins.)

[2] *Ever Since Darwin*, p. 267.

[3] Stephen Jay Gould, "In Praise of Charles Darwin," from *Darwin's Legacy*, pp. 6-7 (Charles L. Hamrum, Ed., Harper & Row, San Francisco, 1983). This essay appeared originally in *Discover* magazine, February, 1982.

[4] Dawkins, supra note 1, p.6.

[5] See Francisco Ayala, "Nothing in Biology Makes Sense Except in the Light of Evolution," *The Journal of Heredity*, vol. 68, pp. 3, 9 (Jan.-Feb. 1977). Ayala described his teacher's religion as follows: "Dobzhansky was a religious man, although he apparently rejected fundamental beliefs of traditional religion, such as the existence of a personal God and of life beyond physical death. His religiosity was grounded on the conviction that there is meaning in the universe. He saw [evidence of] that meaning in the fact that evolution has produced the stupendous diversity of the living world and has progressed from primitive forms of life to mankind. Dobzhansky held that, in man, biological evolution has transcended itself into the realm of self-awareness and culture. He believed that somehow mankind would eventually evolve into higher levels of harmony and creativity."

[6] Stephen J. Gould, *Wonderful Life* (New York, Norton, 1989), p. 323.

[7] *Nature*, vol. 352, p. 485-86 (8 August 1991).

[8] See S.J. Gould, "Is a New and General Theory of Evolution Emerging?" in *Evolution Now*, pp. 129, 131 (Maynard Smith, Ed. 1982; Profile, "Lynn Margulis: Science's Unruly Earth Mother," *Science*, vol. 252, pp. 378, 379 (19 April 1991).

Two Kinds of Personhood: A Reply to Clifford Grobstein

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An issue occasionally arises which tests a culture to the very roots of its being. The issue of abortion is dividing America more deeply than almost any issue of this century, partly because it is tied to so many other volatile issues such as women's liberation and gender roles, but also because the divisions arise out of an even deeper ontological split about the nature of life itself. As the *Roe v. Wade* debate shows, we are divided over the very meaning of our Constitution.

This split is reflected in opposing interpretations of the fundamental object of study in the discipline of psychology. Is there a "psyche" of which we might have an "-ology"? Is there a "self," or "soul," as it used to be called? Is there a "me" independent of the observable characteristics which we measure, tabulate, and turn into statistical averages? Behaviorists would tend to answer "no" to these questions. Others of a more traditional bent would affirm that indeed, yes, there is some kind of independent self that makes itself known through the things that we study with our technological expertise, but which is not itself directly visibly or tangibly observable.

Clifford Grobstein, an embryologist and Professor Emeritus of Biological Science and Public Policy at the University of California, San Diego, was interviewed by Elizabeth Hall of *Psychology Today* on the subject of "When Does Life Begin?"[1] That article gives a clear perspective on the behaviorist end of the philosophical spectrum. This paper critiques that position, and suggests that the alternative view has much to be said for it.

Defining the Issue

He who defines the terms controls the debate. Grobstein sets up his own discussion by defining his terms:

> The pro-life movement's contention that a person exists fully and absolutely from conception sidesteps the difficult questions. As I wrote in *Science and the Unborn*, extending full personhood to an individual cell that is barely visible makes no more sense than declaring acorns to be oak trees and selling them at oak tree prices. (p. 43)

When asked by Hall, "What kind of individuality exists at conception?," he replies,

> Only genetic individuality, a set of hereditary properties that define an individual, is present at conception. But there are five other essential aspects of individuality still to come: developmental, functional, behavioral, psychic and social — *which means that full individuality emerges in stages over time.* [Emphasis added.]

> It's important to ask when individuality in the developmental sense begins. When does the developmental process become committed to the production of a single person? It doesn't happen at conception, but about two weeks later, during the course of implantation. Until then there is no embryo, and the future of the cells that will become an embryo is not fixed .... That's why I think it's important and proper to call this early stage a preembryo. (p. 43.)

> Pregnancy is a state of the woman. It does not begin until implantation takes place. (p. 44)

The terms of the discussion are already set up so that one can arrive only at the position that the growing entity is not a person, at least not yet. Grobstein has set up his definition of a person as what philosophers would call an "operational definition."

It is noteworthy that a definition of the basic object of psychological study, the psyche or self, is being offered from the field of embryology, not from within psychology itself, which reflects the lack of total self-sufficiency within any discipline and a curious interrelatedness between disciplines. The fact that embryology, not philosophy or theology, is selected

to define the substance of psychology, also suggests a basic ontological slant, a specifically "behaviorist" perception about the nature of being.

One would like to receive that bit of news with the usual academic detachment, but it is staggering just the same to consider the possibility that literally millions of lives are hanging in the balance of this "merely academic" question.

People in the marketplace seldom really follow the arguments and reasoning of the "experts." What the layman in any field hears is that "psychology says," or "science says," or "the Church says." None of us can do everything, so only rarely do lay persons take the time in any field to explore the deep reasoning behind the issues, and that for the most part only when crisis descends upon the social order. They trust or at least hope that the experts are performing their rightful task of providing accurate knowledge for the functioning of society. Such trust requires that among the experts there be a truly open, honest, and self-policing debate occurring with all the issues put clearly on the table, for otherwise we are so deeply vulnerable to each other's nonsense.

"Operational" Definitions

When physicists "look for" electrons, they never actually see, touch, hear, taste, or smell an actual electron. None of the five physical senses ever directly perceives an electron. We know of electrons only by inference from things that we do see, hear, taste, touch, or smell. The direct observations are, for example, of visible trails in a cloud chamber apparently created by the passage of "something" through the cloud, or of readings on the dials of electronic devices which detect electrical influences, never directly of electrons themselves. We see certain effects and try to figure out what the cause of them might be. And so we come to "believe in" these unseen and unseeable electrons because they are needed to explain what we do see directly.

But some physicists and philosophers (e.g., Werner Heisenberg) have concluded that it is meaningless to talk of actual electrons, or atoms, or anything else we cannot directly observe.[2] We can talk *only of those operations* by which we observe certain "effects." We can talk of an electron as a symbolic way of referring to the set of operations which produce that effect, e.g. of certain readings in an electronic device or the trail in a cloud chamber. But we have no direct evidence for talking of an electron in and of itself as an existing entity.

This is, of course, the radical form of materialist philosophy. If you cannot measure it, count it, put it in a test tube, directly observe it, then it does not exist. And that is what Grobstein does with the definition of 'person.' When asked, "What kind of individuality exists at conception?" he replies:

> *Only* genetic individuality, a set of hereditary properties that *define* an individual, is present at conception. (p. 43) [Emphasis added.]

He thereby defines 'individuality' or 'person' solely in terms of the (more or less) observable characteristics — characteristics that a non-behaviorist might normally look for as evidence of the presence of the unseen person-as-such. A person on the behaviorist view is not "unseen-but-manifesting" those characteristics. A person is simply the coming together of those characteristics. Before they have come together there is no person, and if, having come together, they fall apart, there is again no person. It is a matter of definition of the word 'person.'

One can define words (such as 'person') any way one likes. But one cannot define objective *realities* (such as *persons*) any way one likes. Words are defined arbitrarily for the sake of communication. But realities have to be defined or described according to what they really are, not just any way we find convenient. It is the subtle confusion of these two kinds of defining (words vs. realities) that gives Grobstein's kind of argument plausibility. It seems as though he has defined a *real* person when he has in fact defined only the *word*, 'person.' If we do not realize what he has done, we may conclude that his scientific expertise in embryology has shown us something about real and substantive personhood — about which that field of science is incapable of telling us.

Grobstein's use of the terms 'individual' or 'person,' in other words, begs the issue he is trying to prove. By *defining* individuality as the coming together of six kinds of characteristics (genetic, developmental, functional, behavioral, psychic, and social), he naturally can, indeed must, emerge with the conclusion that a true individual exists only as the specified process comes to completion. His conclusion is already contained in his definition, *not* in his scientific observation of the characteristics, with which pro-lifers have no argument.

But if 'person' is defined that way, that word 'person' is no longer referring to what pro-life people want to give protection of law. Pro-lifers are talking about a kind of person quite different from what

Grobstein is talking about. In one rather odd sense, the whole abortion debate is a verbal dispute.

His definition of pregnancy, for example, as "a state of the woman," leaves out any reference to the child, implying, rather strangely, that the child is merely incidental to the process. We are not dealing with a child yet because the required characteristics have not yet fully come together. We are dealing only with "a state of the woman" which we call pregnancy. He wants us to understand pregnancy not as the presence of a baby, but simply as a certain biological state of the woman.

Grobstein makes his key point:

> It's important to ask when individuality in the developmental sense begins. When does the developmental process become committed to the production of a single person? (p. 43)

Grobstein is implying that individuality "in the developmental sense" begins *when the developmental process becomes committed to the production of a single person.* And the answer to his question is two-fold, for it depends entirely on whether you hold an "operational" view of definitions or a "substantive" view.

The answer on the operational view is that the developmental process *never* becomes committed to the production of a single person, for there are always more characteristics developing, people are always changing. With the growth of gerontology, we have discovered that life really does begin at forty. It also begins at fifty, and at sixty. It keeps on beginning. Today is the first day of the rest of our lives. Only by an arbitrary restricting of the definition of the developmental process can one say of a given set of characteristics that — THIS is a person and there is no more to happen to make an actual person.

Although Grobstein may want to define individuality in terms of observable traits for the sake of his embryology, that does not give him license to inflict that definition on the whole of the human race.

The answer to Grobstein's question on the traditional view of the human soul is that the developmental process is committed to the production of a single individual right at the beginning. It is only the characteristics of that individual that are developing, not, in the strict sense, the existence of it. All of the characteristics which embryologists, psychologists, educators, clergy, parents, politicians, career counselors, and many others might look for in an individual can continue to grow and sometimes even reverse themselves. But it is ontologically the *same person* going through these changes right from beginning to end.

When Grobstein states that "only genetic individuality, a set of hereditary properties that define an individual, is present at conception," one has to conclude that those hereditary properties are sufficient then to indicate the presence of an already substantial person — who a few months (or many decades) later will still be the *same* substantial person, albeit a person with perhaps a greatly enriched (or impoverished) set of characteristics being observed by folks like Grobstein.

Unfortunately the pro-lifers often make the same mistake, trying to prove, on the same assumptions, that *biological evidence* can prove the existence of human life at conception. Paul Byrne, M. D., writes,

> A new human life begins at conception when the sperm providing half the chromosomes penetrates the ovum, providing the other half of the chromosomes to form a new set of chromosomes.[3]

To be accurate and to avoid the impression that biological observables can *define* personhood, he needs to state, *"Insofar as biological science can give us information on the subject* ... a new human life begins at conception .... "Biological evidence can *indicate,* but not *define,* the presence of a person.

It is a much more humble position, but also much more accurate. To fail to do that is to adopt the very mistake that the behaviorist is making and therefore to engage the battle on the wrong (because insoluble) grounds.

While one wants to grant to embryologists their area of expertise, namely embryology, one still has to point out that embryology has not got the capacity to *define* personhood in the sense that pro-life people would want to guarantee it legal protection. Or, to put it differently, embryology as a science cannot give us any definitive information about *either the existence or non-existence* of souls or selves as such. Pro-life people are not interested in protecting merely a certain conglomeration of attributes, which an embryologist for his professional convenience might choose to call "individuality." As important as those characteristics to which Grobstein points are for our understanding the *growth* of the individual, they do not define individuality. Those characteristics are *manifestations* of the individuality (personhood) that is already there, but not *definitions* of it.

Empirical science therefore cannot rightly be asked to *define* 'personhood' — a task beyond its capability. It is being asked rather to *describe* the growing signs of the presence of a person. Of logical necessity, personhood cannot be empirically defined. At some point life begins — a free willing, independent, purpose choosing and purpose fulfilling organism, self-aware and conscious, however primitive. We cannot examine (yet, at least) with any clarity the "personal" characteristics of the initial two celled being. But our knowledge is being pushed back earlier and earlier at an extraordinary rate, and the lines of present knowledge clearly converge on conception as the beginning of it all. As many have noted, after conception, only two things are added: time and food. (One must also add to that the requirements of caring and bonding.)

Or Substantive Definitions

When one makes those empirically measurable characteristics which Grobstein lists into a definition of individuality, then one puts the whole human race at risk. What used to be called the "sanctity" of life is reduced to the "quality" of life, which can be defined only by the "convenience" of life, which then quickly becomes the narcissistic private pleasure of life. And at that final stage, all life outside of oneself is seen as having value *only* insofar as it promotes my personal convenience and pleasure. Once one abandons the objective value of individual personality, quite apart from any functional or commodity value, all personhood is at risk and vulnerable to the manipulation and destructiveness of raw power struggles.

Grobstein might reply that he never meant his remarks to be an operational definition of substantial personhood. But if so, the implications of his article for the abortion debate are all vitiated, for his embryological evidence then has no bearing on when substantial personhood begins — only on when his valid but limited embryological methods can begin to detect the presence of that personhood.

In any event, it is clear why so-called "quality of life" has replaced sanctity of life. There is nothing left, on the operational view, to be sacred. Everything comes and everything goes. Nothing is of eternal merit or worth. All human life is a constant flux with no objective permanence, moral binding power, or value. If that is the case, then indeed the *best we can do* is to make life as pleasant for ourselves as possible, and to form a social contract of hopefully noble values. But a social contract with no objective binding power will be quickly eliminated so that we can dispose of one another as we perceive that other person to be inconvenient to our *own* domain.

On the other hand, if something quite extraordinary happens at conception, if that is an event of new creation, new life coming into being which is of such paramount value that it must be defended by constitutional law, then we have quite a different situation. One is not here declaring acorns to be oak trees and selling them at oak tree prices. One is declaring that these particular acorns have an inestimable value already invested in them, partly indeed because of what they can become, but also because of what they already are.

The analogy of "oak tree prices" being paid for an acorn works for Grobstein only because of his assumption of a commodity value system. An acorn has value commercially only because of what is going to be in the future, namely a oak tree which can be sold for landscaping, lumber, or firewood. To make that comparison with a child is to assume the conclusion already, namely that there is no value of the two-celled being which is independent of the future conjunction of the clinically measurable "commodity values" to which Grobstein is referring. It may be Grobstein who sidesteps the difficult issue by redefining the terms of the discussion.

Pro-life people are generally coming to the very same scientific evidence out of a quite different framework from that of operational materialism. Since embryology itself logically cannot define 'personhood' in the sense that most people use the word, but only in an operational sense, the wider definition which Grobstein wants to apply to all of us has to come from some other source. Grobstein's definition of personhood did not come out of his embryology, but from the world view he brought to his embryology, namely some form of secular materialism, a feature of which is an operational definition of substantive reality.

And that is his prerogative, but then that world view must stand on its own feet against other competing world views to decide which gives us the truth of the matter. It is no one's prerogative to bring all the weight of a world view and its conclusions into a discussion as though one's technical expertise had established that world view as scientific fact. A great deal of expert testimony is being given with the "expertise" trying to carry a philosophical freight it has neither the right nor the ability to carry. If Grobstein had told us that his definition of individuality was a professional convenience limited to what embryologists can observe of individuality, not a definition of universal personhood, there would be no argument.

Only Coincidence...

Most pro-life people are saying that something exists which is beyond those observable characteristics which are rightly studied by embryology, psychology, sociology, etc. That something, they are saying, is not simply the conjunction of those characteristics. The whole (or the self) is more than the simple sum of the observable parts. Rather, the self *manifests itself* into the world with those bodily behaviors and appearances which are studied by various scientific disciplines.

Pro-lifers want to say this for at least two reasons, the first and most common being the intuitive sense of rightness about it. A mother bonds to a baby, not to a convenient conjunction of attributes.

Secondly, the alternative given by behaviorist and operationalist definitions of reality leads to the final breakdown of both moral and philosophical meaning. And that is, after all, the final proof *par excellence* of the wrongness of a view. Grobstein-type definitions for the human self can therefore be helpful only as part of the jargon within a specific discipline. But when one generalizes from that to define not only one's limited sphere of study but the nature of reality itself, that very reality which one so defines is rendered meaningless.

If, for example, there is no conscious self independent of the observed list of characteristics, *then* one has to conclude that that bunch of characteristics has no more meaning than any other accidental and chance conglomeration. If a monkey were set to typing, and should, lo and behold, produce a manuscript which looked exactly like Shakespeare's *Hamlet*, one could say that that was an extraordinary bit of luck. It would not be a display of intelligence rivaling that of Shakespeare on the part of the monkey, but only an accident which looked like an intelligent display.

Likewise, if there is no meaningful self in Grobstein apart from the observable characteristics one might see in him (as he apparently believes), then his embryology might be mistaken for meaningful labor, but it is in fact merely a monumental accident which looks like meaningful labor. If we have only phenomena or appearance as reality, and if we are therefore limited to operational definitions, it is then impossible to make any clear distinction between total chance and meaningful intelligent behavior.

It is *only* the supposition that there is within each of us a reasonable, feeling, thinking, purposeful, self-aware "me" that gives weight to one's claim to be doing intelligent work. The worth of Grobstein's embryology therefore requires that sense of selfhood which he, by implication at least, denies to exist.

To give another example, in a test intended to measure intelligence, the operational definition of "high intelligence" would be *only* "the appearance of large numbers of correct answers on the test sheet" (or some other visible, countable item). The test would not be measuring a non-visible ability called intelligence, which is what most of us assume. The visible correct answers on the sheet would *be* the intelligence. But anyone who has cribbed on a test knows perfectly well the difference between correct answers and intelligence. A test is not intended to measure correct answers: it is intended to measure a physically imperceivable intelligence which is *manifested* (or not) *by* those perceivable correct (or incorrect) answers.

If a behaviorist working with this sort of philosophy really thinks that in an exam he is measuring correct answers rather than the unseen and unseeable ability called intelligence, then one suspects his definition of intelligence to be faulty, or worse, that he is only verifying his own contention concerning the normal definition of intelligence, namely that he lacks it.

The problem, therefore, with operational definitions of the self is that the person who makes such a definition thereby renders himself incapable of making intelligent definitions. He declares himself to be merely another accident *looking* like he is making definitions. And if that is the case, then, if there are any persons around who *do* happen to have real and therefore potentially intelligent selves, they cannot reasonably be required to pay very much attention to those who by their own admission do not.

And that in turn raises thoughts about the fact that Grobstein is Professor Emeritus of Biological Science *and Public Policy*. This sort of thought process is bad enough in embryology, but one certainly hopes that public policy emanates from persons with minds of substantial content and not merely passing phenomena. We excuse politicians, of course, but we expect better from our scholars.

... and Therefore Disposable

Furthermore, given Grobstein's definition of individuality, there is no logical reason why *any* person with defective individuality at any age whatsoever should not be subject to the same disposability as

pre-born infants. If a person at 40 is in fact defective in his viability (e.g., cannot live outside of hospital care — why limit ourselves to the womb?), if his developmental, functional, behavioral, psychic, or social individuality is impaired, as it is to some degree for everyone of us, then logically he is not yet (or is no longer) a full person, and therefore less than that which is protected by constitutional law.

Indeed, is anyone at all protected under such a scheme?

I might, for example, consider Grobstein a "social defective" for his disagreeing with my notions of human life. And to add insult to injury, he is disagreeing with me as a (self-defined) non-intelligent being in the first place. In that case, on his own terms he is logically a candidate for being disposed of. And besides, being over 70 years old, he is most likely past his social usefulness, and in any event, not a likely prospect for conversion to the *true* (my) view. Bang.

If this seems silly and far-fetched, that is because we live in America where disposability for convenience has not been legally practiced for over a hundred years on adult human beings. It might not seem far-fetched in the former Soviet Union, South Africa, Cambodia, or Germany. A view of human worth based on commodity value, as Grobstein's operationism must be, will lead to a replay of Nazi eugenics — as documented, for example, in the June 1992 issue of *Perspectives on Science and Christian Faith*.[4]

The operationalist philosophy at issue here, which is the basis of human disposability, falls apart at the seams in any direction one wants to push it. It is not a philosophy by which any human being can consistently live. We tend to assign it to others, but seldom follow out the logical implications for ourselves. It lends itself to manipulative persons who are pleasure and power oriented, which may help explain why the 20th century has veered and lurched so strongly that way. Self-centeredness has found a not-very-well-thought-out, but nonetheless vigorously articulated philosophy of "enlightened narcissism" to justify its pursuits — the belief that we should each defend the other's right to his own circle of self-centeredness.

In 1980, about 27% of pregnancies nationwide ended in abortion, better than one quarter of all pregnancies.[5] We have turned the mother's womb — the deepest archetypal symbol of warmth, safety, and nurturing — into the most lethal place in the world for a child to be. Your statistical chances of survival shoot up dramatically if you can survive the nine month gamut of your mother's potential rejection.

If the maternal bonding process means anything at all for our self-image and personal identity, then this image of the womb and motherhood cuts right at the heart of who we are. This must have disastrous effects on the secure personhood of the whole human race. We can no longer even have a comforting "back to the womb" neurosis. Who would risk it?

Grobstein and Heraclitus and Ancient Wisdom

Heraclitus was an ancient Greek philosopher most famous for his saying that "one can never step into the same river twice." Change is the basic reality of life, he believed. Life is like a kaleidoscope, with patterns changing from one shift to the next, and with no inherent connection between the different patterns. Life has no permanence so that from one instant to the next, the river that flows is changing its own identity. The Mississippi River, then, cannot be stepped into twice by the same person. Immediately after the first stepping, the first Mississippi would no longer be there. It would be another Mississippi the second time one stepped in.

Such an assertion makes sense if and only if one *defines* identity in terms of the observable characteristics. For Heraclitus, the river was defined in terms of its sensory characteristics at any given instant. Since at no two given instances would those characteristics be exactly identical, he concluded that there was never the same river in existence for more than an instant.

This is just an ancient version of Grobstein's way of defining people. The ultimate conclusion of operational definitions is that there is no continuing person at all. Not only can one never step into the same river twice, there is no continuing "me" to do the stepping. I cannot do *anything* twice. I am in the same predicament as the river if the definition of "me" is only operational. For, just as the empirical river is always changing, so am I always changing. I am empirically therefore never the same person for more than a single instant. It is a different "me" stepping into a different Mississippi.

Does a person change identity with artificial limbs? If my wife should have a heart transplant, a wig, a wooden leg, and false teeth, should I therefore consider her anyone else than my wife?

Or can this particular ball in my hand be *defined* by listing its characteristics (round, red, bouncy)?

The particular ball might certainly manifest those characteristics, but there is also an objectivity, even to a ball or sock, that is more than simply the sum of those observables.

Obviously more so, a human being is not merely the sum of the observable and measurable characteristics with which an embryologist might legitimately busy himself. Unlike a ball, a human being is not merely "there" being observed like a lump. A human being also takes initiative. It observes back, perhaps thinks about the embryologist, chooses and acts independently of the observer. The difference between a continually mended sock and a developing baby is that the baby has a psyche, a soul, a substantial self which is not merely the conjunction of its observable parts.

For the sake of our social sanity, we need to avoid taking the very limited vision of any empirical scientist, embryologist or otherwise, as though that were a definition of the substance of the whole human race. The ancient wisdom, both Hellenic and Hebraic, upon which western culture has flourished so extraordinarily understood that distinction.

Heraclitus was not the most popular philosopher, then or now, because his philosophy is unlivable. Grobstein and Heraclitus can offer such philosophies only because they tacitly exempt themselves from the implications of their philosophy, and consider themselves as enduring, rational, thinking, feeling, willing beings, not merely momentary accidental conjunctions of passing phenomena.

Modern technology may inform and clarify that ancient wisdom which understood the meaning of selfhood, but it does not have the logical capacity to replace it, for science and technology themselves always presuppose a deeper wisdom. Empirical science as such is incapable of defining the meaning or substance of life. And so when empirical science tries to run the universe through operational redefinition, it creates the very chaos which it was supposed to help overcome.

In order to ignore the self, one has to define it out of existence. It is impossible to hold consistently to the legitimate disposability of persons apart from something like the operational definitions of individuality and personhood given by Grobstein. And that is true even without appeal to traditional religion. It just happens that the primary tap roots of western wisdom, the Hellenic and the Judeo-Christian traditions, were aware of that long before the science of embryology, which is a Johnny-come-lately on the scene of human knowledge.[6]

Life is more than a mere concatenation of various phenomena. Any life reduced to a kaleidoscope of phenomena is reduced also to utter meaninglessness. Putting empirical scientists to work studying and categorizing a meaningless display of passing phenomena does nothing at all to make the phenomena more meaningful. Studying chaos does not make it less chaotic, especially when the study is done by persons who, by their own definition, have no hope of being intelligent and meaningful creatures.

> For thus says the Lord,
> who created the heavens
> (He is God),
> who formed the earth and made it
> (He established it);
> he did not create it chaos,
> (He formed it to be inhabited!):
> "I am the Lord, and there is no other.
> I did not speak in secret,
> in a land of darkness;
> I did not say to the offspring of Jacob,
> 'Seek me in chaos.'
> I the Lord speak the truth,
> declare what is right."
>
> (Isaiah 45:18-19)

If the world around us is not objectively meaningful in the first place, studying it will not improve the situation. Studying a world lacking in objective meaning will only drive us to turn inward to make up our own inner and private universe. We see this happening around us in the resurgence of escapist religions and self-help cults, an inward turn of events which quickly and inevitably leads to the social insanity suggested above. David Hume, when his philosophical wanderings into meaninglessness depressed him too greatly, would go play Backgammon.

There are those on both sides of the selfhood debate, no doubt, who are more wedded to their opinions than to the truth, whatever that may be. Much of the abortion debate has been carried on in a vacuum of knowledge, most especially about the issues of the nature of selfhood. And yet the nature of selfhood is *the issue* for the discipline of psychology. As a society, our answer to that question will tell us both what it is we are observing under the headings of psychology (or embryology) and give us the underlying pattern for wholeness toward which to aim in therapy and healing. But those are issues of which neither psychology nor embryology can tell us — without appeal beyond their own borders to philosophy. And philosophy itself must ultimately appeal to theology.

The founding fathers of our country and the documents they wrote which constitute the philosoph-

ical, political, and moral basis of our national identity, testify to the sanctity of human life, not to its happenstance character or to its mere technological convenience. The foundations of western civilization rest on the distinction between *who I am* substantially in and of myself and *what I do or manifest outwardly* and which therefore can be empirically studied. That is a distinction effectively denied by Grobstein's operational and behaviorist philosophy, but it is nevertheless fundamental to any reasonable and liveable view of human life. ❄

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NOTES

[1] "When Does Life Begin?" by Elizabeth Hall, *Psychology Today*, September 1989, p. 42 ff. A conversation with Clifford Grobstein, 73, Professor Emeritus of Biological Science and Public Policy at the University of California, San Diego.

This article was submitted to *Psychology Today* in response to Grobstein's article, but was not accepted for publication.

[2] See *Physics And Philosophy*, Harper and Brothers, 1958, for a fairly readable explanation of Heisenberg's view of electrons and his "operational ontology."

[3] "Life Begins at Conception," by Paul Byrne, M.D., *All About Issues*, April 1990, p. 28 ff.

[4] "Eugenics and the Development of Nazi Race Policy," by Jerry Bergman, *Perspectives on Science and Christian Faith*, June 1992, p. 109 ff.

[5] National Center for Health Statistics, Washington, D.C.

[6] Pro-lifers need to acquaint themselves with this operational and behaviorist philosophy of secular humanism as exemplified by Grobstein in order to counter it intelligently.

Books Received and Available for Review

Please contact the Book Review Editor if you would like to review one of these books.

Richard Ruble, Book Review Editor, Perspectives on Science and Christian Faith, *212 Western Hills Drive, Siloam Springs, AR 72761*

W. Ball, (ed.), *In Search of a National Morality: A Manifesto for Evangelicals and Catholics*, Baker/Ignatius
I. Barbour, *Ethics in an Age of Technology*, HarperCollins
P. Bowler, *The Eclipse of Darwinism*, Johns Hopkins
P. Bowler, *The Non-Darwinian Revolution: Reinterpreting a Historical Myth*, Johns Hopkins
J. Carr, *The Art of Science: A Practical Guide to Experiments, Observations, and Handling Data*, High Text
D. DeYoung, *Weather and the Bible: 100 Questions and Answers*, Baker
J. Fisher, *RX 2000: Breakthroughs in Health, Medicine, and Longevity by the Year 2000 and Beyond*, Simon and Schuster
C. Gay, *With Liberty and Justice for Whom? The Recent Evangelical Debate over Capitalism*, Eerdmans
N. Geisler, *Miracles and the Modern Mind: A Defense of Biblical Miracles*, Baker
G. Habermas & J. Moreland, *Immortality: The Other Side of Death*, Nelson
W. Harwood, *Mythology's Last Gods: Yahweh and Jesus*, Prometheus Press
T. Hill & D. Shirley, *A Good Death: Taking More Control at the End of Your Life*, Addison-Wesley Publishing Company
J. Hillman & M. Venture, *We've Had a Hundred Years of Psychotherapy and the World's Getting Worse*, HarperCollins
D. Hopper, *Technology, Theology and the Idea of Progress*, WJKP
A. Jones, *Capitalism and Christians*, Paulist Press
M. Lappe, *Chemical Deception: Exposing Ten Myths that Endanger Us All*, Sierra Club Books
J. Loder & W. J. Neidhardt, *The Knight's Move: The Relationship Logic of the Spirit in Theology and Science*, Helmers and Howard
G. MacGregor, *Images of Afterlife: Beliefs from Antiquity to Modern Times*, Paragon House
L. Margulis & L. Olendzendki, (eds.), *Environmental Evolution: Effects of the Origin and Evolution of Life on Planet Earth*, MIT Press
H. Nebelsick, *Renaissance and Reformation and the Rise of Science*, T & T Clark
R. Numbers, *Prophetess of Health: Ellen G. White and the Origins of Seventh-Day Advantist Health Reform*, Tennessee University Press
D. Overbye, *Lonely Hearts of the Cosmos: The Story of the Scientific Quest for the Secret of the Universe*, HarperCollins
I. Pardes, *Contradictions in the Bible: A Feminist Approach*, Harvard
E. Paul, *Science, Religion and Mormon Cosmology*, University of Illinois Press
J. Pearce, *Evolution's End: Claiming the Potential of Our Intelligence*, Harper
W. Rusch, Sr., *Origins: What is at Stake?* Creation Research Society
D. Story, *Defending Your Faith*, Nelson
S. Strahler, *Understanding Science*, Prometheus
J. Stott, *The Contemporary Christian Applying God's Word to Today's World*, IVP
L. Swindler, *The Meaning of Life at the Edge of the Third Millennium*, Paulist Press
D. Walton, *Slippery Slope Arguments*, Clarendon Press Oxford
C. Wassermann, et al., (eds.) *The Science of Information*, Geneva University
R. Wooffitt, *Telling Tales of the Unexpected: The Organization of Factual Discourse*, Barnes & Noble

Dialogue

Should Natural Science Include Revealed Truth? A Response To Plantinga

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I am grateful to Alvin Plantinga for his reply to my discussion of his debate with McMullin and Van Till,[1] and to the Editor for giving me the opportunity to respond. I shall be discussing two main topics: the need for Plantinga to provide an alternative to the theory of common ancestry (TCA), and his proposal for "theistic science."

Both Ernan McMullin and I have urged that if Plantinga is going to reject evolution he needs to present his own view about how the variety of living things on the earth, past and present, came about. Plantinga disagrees, and rightly sees this as a major point at issue between us. Unfortunately, however, he devotes most of his space to refuting a view which I have never endorsed and do not hold. I do *not* believe that, in general, "if you reject a theory or explanation as unlikely on the evidence, you have to be prepared to propose some other theory in its place," with the rider that the replacement theory must be "equal in content" with the theory it replaces. Certainly I may think it improbable, less likely than not, that a given horse will win the Kentucky Derby, without being prepared to say which horse *will* be the winner.

My own reasoning for saying Plantinga needs to present an alternative is much more specific. In the interest of conciseness, I present it here in the form of an argument with numbered steps:

> 1. The modern natural sciences over the past several centuries have proved to be by far the best method we have of learning the truth about the structure, processes, and history of the natural world. (They have been incomparably more successful than the speculations of creationists.)
>
> 2. Therefore, one who wishes to learn about these things is well advised to study and carry out research in these sciences.
>
> 3. Once a theory has enjoyed some success and has established itself in some branch of the natural sciences, the normal and appropriate scientific procedure is to continue to accept that theory until it can be replaced by a superior alternative.
>
> 4. Therefore, one who wishes to gain increased knowledge concerning the natural world is well advised to follow the procedure outlined in step 3.

Presumably Plantinga would not agree with this, but it is not clear to me just which step(s) he would object to. Perhaps he would agree with (3) if properly qualified;[2] at least, he has so far shown little disposition to contest it. Is it the case, then, that he supposes he has access to some other method of study (perhaps the method exhibited in his two articles) which is *better, more* likely to reach the truth, than the methods of the natural sciences as generally practiced? I don't know the answer to this; perhaps Plantinga will explain sometime.

In any case, I do have another reason for insisting that Plantinga needs to specify an alternative, and this reason is drawn from his own procedure. In several places Plantinga makes assertions to the effect that some piece of putative evidence for evolution is "reasonably probable on the hypothesis of special creation, hence not much by way of evidence against it, hence not much by way of evidence for evolution" (p. 23, and see similar remarks on pp. 24, 104, 105, and 107-8). My question is, "*Which* hypothesis of special creation is referred to here?" Plantinga replies that "the hypothesis of special creation I had in mind was just the hypothesis that

> **SC:** God created at least some forms of life specially, in a way that did not involve common descent."

Now, the particular piece of evidence referred to on p. 23 is simply the "similarity in biochemistry

of all life." And with regard to that particular evidence, I will admit that SC is specific enough to enable us to see that Plantinga's claim is true; it *is* reasonably probable that God, in specially creating a variety of living creatures, would have endowed them with similar chemistries.

But Plantinga makes similar assertions about other types of evidence, and to evaluate *these* assertions we do need a more specific creationist hypothesis. He says, for instance, that "The fossil record fits versions of special creation considerably better than it fits TCA" (p. 104), and also that "the typological structure of the molecular evidence fits very well with various typological views as to how God might have created some forms of life specially" (pp. 107-08). Now "the fossil record" and "the typological structure of the molecular evidence" represent very broad categories of evidence. And with respect to those categories of evidence, I submit we cannot evaluate Plantinga's claim without knowing more specifically *which* creationist hypothesis he has in mind. The crucial question, of course, is *which of the alleged evolutionary transitions does he accept and which does he reject?* If we are considering the evidence of the hominid fossils, for instance, or the remarkable genetic similarities between humans and chimpanzees, then it makes a great deal of difference whether the hypothesis in question accepts the ape-human transition as valid or rejects it. So as I pointed out before, the question that cries out for an answer is, *at what taxonomic level* are the acts of special creation supposed to have occurred?[3] Plantinga's response, I take it, is that he doesn't know the answer and doesn't need to know. My view is quite different; I believe that without an answer to this question Plantinga's assertion that some special creationist theory is more probable than TCA represents a pious hope but not a proposition that either we or he can seriously attempt to evaluate.

What shall we say about "theistic science," Plantinga's proposal for a special, distinctively Christian discipline of natural science which incorporates "what we know by faith, by way of revelation, as well as what we know in other ways" (p. 30)? I think it needs to be emphasized that our disagreements about theistic science are less extensive than they might appear. To begin with, I wish to limit my comments here to the *natural* sciences; the sciences of human behavior raise different issues which require separate treatment. My disagreement, furthermore, is specifically with the proposal for *a natural science which includes content derived from faith and revelation*. But I would strongly encourage Christians in the sciences to reflect critically about their scientific work in the light of their Christian faith, and to endeavor to arrive at a comprehensive world view, integrating their scientific understandings with their faith perspective (see my comments on p. 159). Now this task, also, would be included by Plantinga under the heading of "theistic science," and with regard to that part of his program we have no disagreement whatever. I mean to focus, then, on the idea that natural science should include content derived from revelation. About this, three points need to be made.

To begin with, if we understand "theistic science" in this restricted sense, Plantinga's claims about the dangers of rejecting it are unwarranted. He says such rejection carries with it the dangers of "failing to discern the patterns and currents of spiritual and intellectual allegiances of contemporary culture, intellectual compartmentalization, failing to lead all of life captive to Christ, [and] being conformed to this world." I agree that, were Christians in the sciences simply to ignore issues of integration between faith and science, the dangers Plantinga cites would threaten. But I do *not* think these dangers are especially pressing if these scientists follow the suggestion to intensively pursue issues of faith and science, but *without incorporating content from revelation into their scientific theories.*

My second point is this: When we are working with the restricted conception of theistic science, it becomes apparent that TCA is not merely a handy illustration, but is rather the point on which the whole debate hinges. The reason for this is that the question of evolution vs. special creation is really the *only* substantial point concerning which it is still claimed that revelation provides knowledge which natural science must incorporate. It wasn't always this way, of course. We all know the sad story of Galileo and the Church; since then, astronomy has generally been left to the astronomers.[4] There is an equally impressive, though less well known, story of the retreat and eventual disappearance of "biblical geology," as one attempt after another to harmonize earth history with data derived from Genesis has gone awry.[5] So if the claim that the Bible teaches special creation has to be given up, there won't be any biblical data left to incorporate into natural science.

My third point is simply to point out that Plantinga has made no case for saying that Scripture *does* teach special creation. To be sure, he thinks it *likely* that God "intends to teach us that human beings were created in a special way and by an act of special creation" (p. 82) (though he doesn't *believe* that God intends to teach us this![6]). But I pointed out in my discussion (and Plantinga doesn't contest

this) that he fails entirely to give us any reasons to suppose that his favored interpretation (on this and related matters) is correct (see pp. 153-54). So on the crucial point (with respect to the narrow sense of "theistic science") he gives us nothing to go on.

But things are even worse than this. In my discussion I said that Plantinga should find "devastating" the view of James Barr according to which the author(s) of Genesis intended to teach a literal six day creation, a young age for the earth and mankind, and a universal flood. In reply Plantinga reminds us of his view (which he shares with Calvin and Aquinas) that God is the ultimate author of Scripture, and that what matters is what *he* (and not the human authors) intends to teach us through it. Quite so, and I, also, am happy to say that what ultimately matters is what God is teaching us in the Bible.[7] But to say this underscores the need for some systematic account of how it is that we distinguish what God is teaching us from the other things the text apparently says which God does *not* intend to teach us. In short, we need a hermeneutic of Scripture. But here's the rub: I believe (though the point can't be argued here in detail) that the case *in the biblical text* for saying that God is teaching us that the earth is young, that it was created in six literal days, and that it was covered by a universal flood, is very much on a par with the case for saying he is teaching us about the special creation of human beings. If that is so, then it is extremely likely that any sensible hermeneutic which removes young-earth theory from the scope of "what God is teaching us in the Bible" will do the same for special creationism. In order to defend Plantinga's view, on the other hand, one would have to be able to distinguish, in some principled way, between the special creationism which God supposedly *is* teaching us, and the young-earth theory which he *can't* be teaching us, since we know on independent grounds that it is false. It's conceivable that this can be done, but my present attitude towards such a project is one of deep skepticism.

I conclude, then, that there is no credible case for the view that Christians should attempt to construct a "theistic natural science" which includes content derived from revelation. But there are other aspects of Plantinga's proposal for "theistic science" which are admirable and deserve to be pursued vigorously. ❄

NOTES

[1] See Alvin Plantinga, "When Faith and Reason Clash: Evolution and the Bible," pp. 8-32; Howard Van Till, "When Faith and Reason Cooperate," pp. 33-45; Pattle Pun, "Response to Professor Plantinga," pp. 46-54; Ernan McMullin, "Plantinga's Defense of Special Creation," pp. 55-79; and Alvin Plantinga, "Evolution, Neutrality, and Antecedent Probability: A Reply to McMullin and Van Till," pp. 80-109; all in *Christian Scholar's Review* XXI:1 (September 1991); also my article, "Evolution and Alvin Plantinga," *Perspectives in Science and Christian Faith* Vol. 44 No. 3, September 1992, pp. 150-162 and Plantinga's reply, "On Rejecting the Theory of Common Ancestry: A Reply to Hasker," *Perspectives on Science and Christian Faith* Vol 44 No. 4, December 1992, pp. 258-263. Page references in the text are to these articles.

[2] Plantinga quite properly points out (fn. 4) that a theory inconsistent with known data cannot be accepted as *completely true*; such a theory may, however, be accepted as *substantially true*, or *approximately true*, or perhaps (as Plantinga says) as being "in the *neighborhood* of truth." And what is required of the replacement theory is that it be *more* likely to be true, *more* "truth-like," than the theory it replaces—as shown by its better satisfying the various desiderata standardly applied in judging scientific theories.

[3] Thus, my claim is not that the replacement hypothesis must be "equal in content" with the hypothesis it replaces, but that it must be *specific enough to enable us to evaluate the evidence* which is alleged in favor of the original hypothesis.

[4] There remains, to be sure, the question of whether or not the universe has a temporal beginning. But even if we think Christian faith requires an affirmative answer to this question, it surely is not essential that this answer should be part of the science of astronomy. If astronomy were to find no evidence for a temporal beginning we could simply revert to the position of Thomas Aquinas, who held that the world does have a temporal origin but that this fact is undiscoverable by natural reason (and thus is not a part of natural science) and must be accepted by faith.

[5] This history is well documented by Davis Young in *Portraits of Creation*, as well as in his earlier book, *Christianity and the Age of the Earth* (Grand Rapids: Zondervan, 1982).

[6] And herein lies a tale. Misunderstandings have arisen because of the fact that Plantinga and I use the word "believe" somewhat differently (see fn. 5 of his response). Plantinga will say that he *believes* a proposition only when he can give *unqualified assent* to that proposition; if on the other hand he considers it a genuine possibility that the view he favors may be mistaken, he will not say that he *believes* the proposition in question but only that he thinks the proposition *likely*, or *probable*. I, on the other hand, use "believe" somewhat more liberally. So I would say of myself that I believe that TCA is true, but that it's possible that I am mistaken and that some version of special creation is true instead. Plantinga, on the other hand, would describe this situation by saying that I think TCA is *probable* but I don't (in his sense) *believe* it. (I think my way of using "believe" would be accepted by most users of standard English, but I'm not sure about that. Which is to say: I *believe* my usage is the normal one, but I could be wrong!)

[7] As regards Aquinas and Calvin, however, I think Plantinga is glossing over an important difference between his position and theirs. If Barr's view concerning the intention of the authors of Genesis is correct, then the text of the Bible says, and was intended to say, that the earth was created in six literal days a few thousand years ago and was covered by a universal flood in historical times. If so, then Plantinga would be forced to say in spite of this that God never intended us to believe any of this and in fact it is all definitely false. I submit that both Aquinas and Calvin would have found this to be utterly scandalous.

Book Reviews

THE POLITICS OF EVOLUTION: Morphology, Medicine, and Reform in Radical London by Adrian Desmond. Chicago and London: University of Chicago Press, 1989, 503 pages.

Recent writing on the history of science has undergone something of a sociological revolution. Rather than treating scientific knowledge as the objective distillation of a disinterested pursuit of truth, historians of science have increasingly come to regard science as itself a cultural product whose practitioners employ rhetorical devices of persuasion that embody social interests and political power. In such scenarios, claims to scientific knowledge about the world are to be understood less as descriptions about natural phenomena than as expressions of ongoing social debates about such issues as where intellectual authority should reside in our society, who controls the knowledge industries and how the maintenance of the social order should be secured. Of course, social histories of science come in a variety of interpretative styles, from those that take cultural networks as just the diffusion channels along which ideas migrate, to those arguing in determinist fashion that social circumstances condition the cognitive content of scientific knowledge itself.

Given this trend, it is hardly surprising that there have been growing calls for historians to place evolutionary theory in the social settings of its time. This is the project that Adrian Desmond takes up in *The Politics of Evolution*. The story he has to tell focuses on the internecine feuds over anatomy and evolution among the medical fraternities in London during the 1830s. It is a rich and complex narrative. Yet the heart of the argument is readily recounted: the transformist, law-bound, deterministic science that was imported into Britain from Paris in the 1830s spread like wildfire among certain young doctors. Marginalized within the medical establishment and outcasts from the gentlemanly science of the day, they mobilized it in the cause of radical assaults on professional injustice, political expediency, and a hierarchical social order bolstered by priestcraft, providence, and Paleyan natural theology.

Desmond specifically focuses on what he refers to as the scientific "low-life," namely those radicals hitherto ignored by students of the intellectual elite. In this underworld of medicine, serviced by secular anatomy schools and radical nonconformist colleges, Lamarckian evolution easily gained a foothold. It became a means of challenging the Anglican Tory stronghold of the Royal College of Physicians and the Royal College of Surgeons. The migration tracts of this revolutionary scientific and social philosophy from Paris to Edinburgh and on to London, which Desmond uncovers with great skill, together with his mapping of the social topography of the anatomical factions in Edinburgh and London, thus expose a political geography of science for too long hidden beneath the abstractions of a disengaged history of scientific ideas. The consequence is a remarkably fine-grained account of the early history of evolution theory in Britain, so detailed as to all but overwhelm the reader from time to time. It is, if I may use Clifford Geertz's terms, "thick description" of the highest order: philosophical anatomy, strategies of management reform, the vicissitudes of career ambitions and personal loyalties, the casting of compromise measures, power struggles—all these are interwoven to produce a remarkably variegated map of a hitherto ignored stretch of early Victorian science. Not, of course, that this is a piece of static cartography. A sense of historical dynamic pervades the volume: the decline of the radical Robert Grant, Peter Mark Roget's extracting the teeth of Grant's radicalism by divinizing organic unity, Richard Owen's taming French science by recasting it in Coleridgian idealist terms—all these reveal the biography-bound character of scientific practice.

Desmond's study, of course, has implications for the understanding of Darwin's hesitancy to publish his own theory of evolution by natural selection. Aware of the way in which evolutionary doctrines had fallen into the hands of extremists casts considerable light on Darwin's efforts to modulate his own materialism. As Desmond puts it:

> Darwin would not have wanted his evolutionary views associated with this fierce radicalism: indeed his mature Malthusian theory supported a far less destructive social program ... By "netting" man and ape together in a materialist evolutionary sweep Darwin invited being identified with Dissenting or atheistic lowlife, with activists campaigning against the "fornicating" Church, with teachers in court for their politics, with men who despised the "political archbishops" and their corporation "toads." Ultimately Darwin was frightened for his respectability" (pp. 403, 413).

Certainly this is a persuasive sociological account of Darwin's publishing strategy; whether it can at the same time provide a sociological basis for the genesis of his theory remains to be seen.

The Politics of Evolution is an impressive piece of historical probing, most persuasive in the details of the case. On page after page Desmond sketches fine-grained social topographies, exposes the juiciest of quotes to the light of day, and consistently writes in a spicy style. Yet when he surfaces to make grander philosophical claims he seems less sure, and soon recedes into what he is best at—history. Thus the concluding remarks which begin with methodological prescriptions and general observations soon moves off into further detail on Grant's decline. That Desmond himself is committed to a relativist philosophy of science uninterested in eternal verities is clear. But whether this is an inevitable and necessary consequence of either writing sociological history or of suspending judgement on the truth or falsity of particular theories is, I think, a

logically separate matter. That evolution theory has been—in the profoundest of ways—socially and politically impregnated, Desmond has clearly shown us; to sustain the claim that scientific knowledge is nothing but the epiphenomenon of social factors will require much further philosophical interrogation.

That said, as a social constructivist study of the social topographies and scientific knowledge of the medical communities in early Victorian London, this book is simply splendid—an altogether worthy sharer of the History of Science Society's Pfizer Award for 1991.

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RETHINKING GOODNESS by Michael A. Wallach and Lise Wallach, Albany, NY: State University of New York Press, 1990. 149 pages, index. Paperback, $14.95. Cloth; $44.50.

"There is a crisis in our ethics," begins this short, dense, and insightful discussion by two Duke University psychologists. Two opposing schools dominate our ethics. Both are wrong. First, what the authors term "ethical minimalism" holds that we shouldn't interfere with each other. Beyond that, morality amounts to whatever the minimalist feels is right. Ethical minimalism, they contend, is too small.

To illustrate this, the authors interviewed students at Duke. The responses are both fascinating and alarming. One young lady admits, "I'm not even going to waste my time any more with anyone or anything that doesn't have a certain value to me" (p. 18). Her "value"? Attending law school and becoming rich: "You could just kill me after I become a lawyer and I'd die happy" (p. 19).

The other ethical school is a "reactive authoritarianism," which could be embodied in Allan Bloom, Ronald Reagan, or Billy Graham. Western ethics went wrong when it discredited man's innate wisdom and judgment. What we most desired, *eudaimonia*, became seen as totally depraved. "Good" became whatever God, or the law, said. If the authors stopped at debunking these two schools, they would have an interesting long essay. But their vision extends to offering a third approach to ethics: autonomy—not some untenable relativism or feelings-oriented minimalism—but an autonomy based on the hard work of finding the common good. They contend that the humanists forgot "the point that ethical conduct does not just spontaneously happen but requires thought and discipline" (p. 71).

Both minimalists and authoritarians agree that if there is any absolute morality, it must come from some external source: an authority, God, or laws. Authoritarians accept the external source; minimalists call any external source a fiction and conclude no absolute morality exists (beyond the ethic of non-intervention). The authors disagree with the premise of an external source of morality. They cite four classical sages in support: Plato, Aristotle, Confucius, and Buddha. All four agree that our innermost desires are congruent with what is wise and moral. But discovering our morality desires requires hard work—practicing philosophy, living virtuous lives, and meditating were among the disciplines required. Virtue, the sages warn, is easy to forget.

Using studies from a variety of fields, Wallach and Wallach argue convincingly that humans have at least some innate goodness. For instance, young, "unsocialized" children comfort other crying children for no apparent reason but sympathy. But they disagree with humanist psychology which says ethics amounts to searching out your own feelings, then becoming self-actualized. We have conflicting feelings. What basis do we have for following one set over another? What if murder honestly self-actualizes some people?

Their response, instead, lies closer to the Biblical concept of servanthood. "May the point of ethics be found in our desires for the common good, for ways we all really want the world to be...?" (p. 112). The discipline of finding the common good is similar to the that of the scientist finding truth. Geocentrism seemed reasonable until Copernicus and others proved it to be unreasonable. In a similar way, they appeal to scholars and citizens to evaluate our ethics and weed out theories—advance ethics too, not just science.

This is not a "quick read." But the authors kindly avoid bogging down their prose with jargon. Their language is conversational, even clever. For example, in debunking evolution's "survival of the fittest" concept, they write, "Familiarity breeds not contempt but adoption" (p. 76). Though they spend much more energy on attacking the problem than on describing the solution, they offer challenging arguments from an atheistic or agnostic perspective. The authors seriously consider "religion," but not God. However, their "third way" could be useful to Christians. After all, how did we choose to follow Christ but from observation, introspection, and discipline? In the world of secular ethics, theirs appears to be the least agenda-ridden, and the most honest.

Reviewed by James G. Bishop, English Department, United States Air Force Academy, Colorado Springs, CO 80840.

THE WAY THE WORLD IS by John Polkinghorne. London: Triangle, 1992. 130 pages, appendix, glossary and index. Paperback.

Readers of this publication will be familiar with John Polkinghorne. He was the former Professor of Mathemat-

ical Physics in the University of Cambridge until 1979, who resigned to pursue ordination to the Anglican ministry (ordained in 1982). This is the first of five books (it was first published in 1983) relating to Christian faith and science which he has written since then. The other four are: *One World* (1986), *Science and Creation* (1988), *Science and Providence* (1989), *Reason and Reality* (1991). Dr. Polkinghorne currently serves as President of Queen's College, Cambridge.

This book was written soon after Polkinghorne began his parish ministry. According to his preface, he wrote with his "physics friends particularly in mind, as I wanted to explain to them the basis of my religious belief" (p. VIII). To that end, the glossary includes many biblical and theological terms, as well as scientific terms. Polkinghorne comes across as an honest and independent thinker who weighs evidence for himself and draws his conclusions. His approach is both reasonable and cautious. Whenever possible he draws parallels between biblical/theological scholarship and science. He notes, for example, that "...New Testament scholarship is closely akin to observational science (as opposed to experimental science). We cannot return to first century Palestine to interrogate the authors or chief actors any more than an astronomer can take flight to investigate a quasar at first hand. In both disciplines, an understanding has to be reached on the available evidence interpreted in ways that are sensible and consistent" (p. 36). This defines the approach he uses.

Those who are interested in considered discussions of science and faith, however, will find this to be the least helpful of Polkinghorne's books. It is more concerned with a reasoned defense of the Gospel and an evaluation of the biblical evidence. In this area there are better books. For example, Polkinghorne rejects the "liar, lunatic or God" argument about Christ on the grounds that "the difficulty lies in establishing the premise that Jesus ever said he was God" (p. 48). For a much more positive discussion of Jesus' claims see Christopher Kaiser, *The Doctrine of God*, (pp. 29-41).

Evangelical readers will also find Polkinghorne's equivocations about the reliability of some new testament writings (Chapter 5) to be disappointing, as well as his accepting a 2nd century B.C. date for the book of Daniel. Furthermore, his discussion of the New Testament emphasis upon "the strangely spirit-filled world" (p. 50) is entirely inadequate. He might have done better not to bring up the subject in a book of this type.

This book's credibility derives mostly from the scientific qualifications and visible Christian commitment of its author. It is a good source for following a scientist's quest for a credible Christian faith. For more interesting science and faith discussions, consult John Polkinghorne's other books mentioned above.

Reviewed by Daniel E. Wray, Pastor of Kinderhook Reformed Church Kinderhook, NY 12106.

THOMAS AQUINAS: An Evangelical Appraisal by Norman Geisler (Baker, Grand Rapids, 1991), 195 pp, $12.95.

Professor Norman Geisler, a student of Aquinas for 35 years, believes the evangelical community is long overdue for a re-appraisal of the medieval Roman thinker, Thomas Aquinas. Noting from the outset (pp. 12-20) that most of the leading 20th century evangelical apologists have been critical of Aquinas, Geisler believes that he has been misappropriated, and is deserving of a second hearing. Except for C.S. Lewis, most of the evangelical stalwarts in apologetics, Van Til, Carnell, C. F. H. Henry, R. Nash, G. Clark, and F. Schaeffer reserved stringent critiques for Aquinas. Geisler believes all of the above have mis-read Aquinas. While he makes that accusation clear from the beginning, and fills this short treatise with numerous references to Aquinas' works, he never accounts for how this vast tradition of apologetic could have so consistently and thoroughly misread the Angelic Doctor.

Nonetheless, the evangelical public is given a fine survey of Aquinas' life (chap. 2), and an introductory overview of his thought (chap. 3), which serves as an outline for successive chapters. In subsequent chapters, Geisler reports Aquinas' views on scripture, faith and reason, ontology, metaphysics, the traditional proofs for the existence of God, the nature of God, religious language, the problem of evil, and law and morality. In these chapters, Geisler provides a service to evangelicals, who can now have a concise summary of the font of Thomism. The book also contains a Select Bibliography, two helpful Indexes, and Appendixes on Aquinas' writings and a chronology of his life.

Geisler sees his role as apologist for the apologist. He warns evangelicals not to throw out the baby with the bath-water, urging us not to reject Aquinas simply because of his Catholicism. Geisler surmises, "In our Reformation zeal we have thrown out the Thomistic baby with the Romanistic bath water. My plea is this: the baby is alive and well. Let us take it to our evangelical bosom, bathe it in a biblically based theology, and nourish it to its full strength. As a mature evangelical, Aquinas is a more articulate defender of the faith than anyone in our midst" (p. 23). Geisler intends to issue a positive assessment of Thomistic thought and does note that another admirable apologetic tradition within evangelicalism (exemplarized by the likes of J. Gerstner, S. Hackett, A. Vos, and R. C. Sproul) does not sever its connection to Aquinas. He regrets that "often stereotypical distortions [are] mediated through the teaching magisterium of our evangelical scholars" (p. 15). He further proposes that a proper understanding of Thomistic apologetic "can provide a needed mediation between opposing camps of evangelical apologetic" (p. 20).

Throughout Geisler is prone to overstate, e.g., when he claims that "in whatever sense we engage in Christian thinking, we are in the broad sense of the term indebted to Aquinas" (p. 15), or "Aquinas would heartily agree with virtually everything Van Til says" (p. 18), or "Protestant theology, whether Calvinistic or Arminian, is de-

pendent on Aquinas's view that God is all-powerful and omniscient ... In fact, if the basic metaphysical attributes of God, as articulated by Aquinas, are not preserved, then all of orthodox Catholic and Protestant theology collapses. Herein is another powerful reason for not neglecting the major contribution of Aquinas to the contemporary discussion about God" (p. 117), and even on modern philosophy, "According to Wittgenstein, the distinctions among univocal, equivocal, and analogical expression are obsolete." (p. 147). If Thomism is to regain favor it will have a better chance to do so absent such tendencies to overstatement.

While this volume is a handy introduction to Thomism, it could have benefitted from more biblical evaluation of Aquinas' thought. Most readers of apologetics could stand to see even Aquinas subjected to biblical scrutiny. Also this is lacking in specific explication of the relationship of reason and science, although it does discuss matters of general apologetic interest to some scientists. Moreover, the volume could have been strengthened by reference to some of the other, excellent, modern studies of Aquinas, from a protestant view. One has only to think of *Luther on Thomas Aquinas: The Angelic Doctor in the Thought of the Reformer* by Dennis R. Janz (Stuttgard: Franz Steiner Wiesbaden, 1989), for example where it is noted that Luther, although admitting the hegemony of Thomastic thought in the Curia of the 1520s, only included one citation to aquinas in his whole written corpus. Perhaps, others may be forgiven their lack of appreciation of Aquinas, or their lethargy in re-appraising one who has already been found wanting, apologetically speaking.

Geisler's point about benefitting from the past without throwing out the good is definitely worth hearing:

> But can a seven-hundred-year-old thinker still be relevant today?" Students of logic will recognize the implication of the question as the fallacy of "chronological snobbery." "New is true" and "old is mold," we are told. Logic informs us, however, that time has no necessary connection with truth. Or at least, if there were any kind of connection, then the time-honored thought ought to have the edge. (p. 11).

Geisler confesses "that one of the highest compliment[s] that could be paid to me as a Christian philosopher, apologist, and theologian is to call me 'Thomistic'. This, of course, does not mean I accept everything Aquinas wrote naively and uncritically. It does mean that I believe he was one of the greatest systematic minds the Christian church has ever had, and that I can see a lot farther standing on his shoulders than by attacking him in the back. No, I do not agree with everything he ever wrote. On the other hand, neither do I agree with everything I ever wrote."(p. 14). Perhaps at a future time, Geisler will find himself in disagreement with Aquinas. Until then, we can benefit from the worthy contributions of Aquinas, without necessarily buying into his whole system, as does Geisler. Aquinas may be re-appraised in this work, but his own writings will still evidence much Aristotelianism, and at least lend themselves to interpretations which permit an autonomy of reason, the cause for which most 20th century apologists have criticized Aquinas all along, such strain still remaining despite any later appraisals or attempts at vindication.

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REAL SCIENCE, REAL FAITH by R. J. Berry (ed.). Eastbourne, E. Sussex, England: Monarch Publications Ltd., 1991. 218 pages, bibliography, index. Paperback; £8.99.

Sixteen leading British scientists, including nine professors, the Director-General of The Meteorological Office, the Director of Kew Gardens, and the Secretary of the International Whaling Commission — 15 men and 1 woman — join here in producing a marvelous testimony to the possibilities for integration of insights from science and biblical Christian faith.

Introduced by a Foreword by Philip Hacking (Chairman, The Keswick Convention) the book brings together the personal testimonies and experiences of its varied authors, who bring a common message: "Anyone who assumes that it is only possible for a scientist to be a Christian if his science and faith are kept separate must also think again" (p. 7). Having said this, the authors also are careful to avoid the pitfalls of distortion and revision of the Christian Gospel sometimes proposed to make its acceptance more palatable to a scientifically-nurtured society. Appropriately, the book concludes with a paper published in 1960, and not written specifically for this book, by the eminent champion of these views, Donald MacKay.

Since the book is a collection of personal reflections and experiences, the flavor of the book can best be given by a few brief quotations. Roy Peacock, engineer, writes about the physical laws:

> They aren't laws in the sense that they declare what is going to happen, prescriptive —as legislation on the statute books of nations — rather, they are descriptive, summing up the body of observation made by scientists (p. 41).

John Houghton, meteorologist: "Because God's activity continually pervades the world, I do not like to talk about God intervening in our world" (p. 47).

Ghillean Prance, botanist:

> As my interest in Christian ecology has grown under the guidance of the Holy Spirit, so has my sadness that the church has been slow to respond to this issue - the care of God's creation" (p. 61). "Perhaps one of the common temptations for an environmentally concerned ethnobotanist, who has spent considerable time living among indigenous peoples, is to embrace the animist beliefs which often make them strong protectors of the environment. This is where the New Age movement would have us go (p. 62).

Robert Boyd, space scientist, includes a poem that he wrote about the Creation in 1972. It is a beautiful supplement for anyone expounding on Psalm 8 and related portions of the Bible.

Andrew Miller, molecular biologist, "Philosophy is not always a sound guide to reality .... Our ideas must be regulated by reality and not vice-versa" (pp. 88,92).

Colin Humphreys, materials scientist:

> "thus I believe that science and Christianity describe the same territory, the same building of truth, but from different viewpoints" (p. 111). "If conflicts arise it is therefore because either our understanding of Christianity, or of science, or of both, is incorrect" (p. 113). "Many aspects of reality can be known only by personal involvement". (p.113). "We owe our moment-by-moment existence to the upholding of God" (p.116). "The key question to ask is not 'what could God do?' but "what did God do?'" (p.118). "The notion of God intervening is inconsistent with the biblical picture of God upholding the universe moment by moment. God is not a passive God who sometimes intervenes: God is always active. On rare occasion he chooses to act differently from usual (p. 121).

Malcolm Jeeves, psychologist:

> Scientific models of man, by their nature, remain silent on questions of good and evil, sin, redemption, and eternal life — issues which are central to the Christian view of man .... The descriptions we give at the different levels are complementary, not identical or independent .... Thus it is possible for an explanation to be complete in its own terms but not to render superfluous another explanation given at a different level" (pp. 154, 155). "If only we could accept Scripture for what it is and let it speak for itself, we could gain so much and avoid so many unnecessary time-consuming and energy-draining debates and conflicts ... this will make it even more important, I believe, to recognize increasingly the Hebrew-Christian emphasis on psychophysical or somatopsychical unity (p. 159).

Sam Berry, evolutionary biologist:

> If I draw one lesson from my experiences as a scientist and a Christian, it is that compartmentalisation of life, thought or worship is damaging and potentially dangerous .... Science and faith have different methodologies, but they are complementary, not contradictory; a faith without reason is as stultifying as a reason without faith (pp. 193-195).

Many of the above sentiments are found also in the article by Donald MacKay, which may well have been where some of them started. We can do not better than end with a quote from MacKay:

> Christian faith is not just a body of second-hand beliefs, however self-consistent - not even if acquired from the Bible itself. Its essence is an active, day-to-day relationship of personal dependence on and obedience to the Giver of our daily round as he has revealed himself and his will in Christ and Scripture, in fellowship with other Christians — a relationship which both illuminates, and is illuminated, by, the doctrines from which it is inseparable (p. 215).

In brief this is an excellent selection of Christian witnesses, profound without being scholarly, full of content without lacking in inspiration. The ASA should take a major role in making it known.

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

THE SCIENCE GAP: Dispelling the Myths and Understanding the Reality of Science by Milton A. Rothman. Buffalo: Prometheus Books, 1992. 254 pages. Hardcover; $24.95.

The Science Gap is a book intended to dispel some myths concerning the nature of science, such as nothing is known for sure, all theories are equal, or all scientists are objective. The author wants to defend science from such misrepresenting myths by using facts established by physics and his version of true philosophy.

Rothman makes a distinction between idealism and realism reminding the reader on almost every page that he is a realist, that realism is the only acceptable approach to reality, that realism is the way, the truth, and the light. However, realism is defined as "the assumption that things exist outside of us independently of our thoughts" (p. 20). But in this sense, Plato is also a realist, since to him the world of ideas is in no way dependent on his thoughts. What Rothman seems to have on his mind is materialism rather than realism, the latter term being an opposite of nominalism and not idealism.

The materialist (realist, in Rothman's terminology) sees nothing beyond the tangible, beyond the sphere of matter that can be observed and measured by empirical means. The supernatural is discarded since it cannot be observed and measured, as required by science. Rothman is right in defending the purity of science by not admitting in it what is not of empirical nature or what flatly contradicts its principles (e.g., *perpetuum mobile* or flat Earth). However, he makes philosophy out of methodological principles by saying that what science analyzes is real, and what cannot be — at least potentially — accessed by its means is fantasy, figment of mystics' imagination. Whoever says that science is not the only way to true knowledge is worthy of at least verbal admonition. Therefore, the author is very critical of everyone who does not embrace science (physics) entirely and dares to have a dissenting opinion. Everyone who is guilty of that is treated equally, even if he is a scientist. Therefore, no distinction is made between the New Age movement, philosophers, idealists, or *perpetuum mobile* constructors. It is a black-and-white presentation in which very few people are positive figures.

Thus, we read that a "dyed-in-the-wool idealist" Werner Heisenberg contributed to "a grand outpouring of pseudoscientific and pseudo-philosophical writing" (p. 22-3); James Jeans is a scientist with "a penchant for mysticism" (p. 132), Donald MacKay conspires to combine science and religion (p. 225); and Roger Penrose makes an impression as "a mystic trying to break out of the unconscious areas" of his mind (p. 134). It can be seen in these epithets that mysticism is not a descriptive term for Rothman; it rather is an equivalent of unreasonableness, a lack of realism, or an expression of outright stupidity. He chooses to be oblivious to the fact that great mystics are known as great philosophers, theologians or scientists and not simply as madmen (e.g., Augustine, Aquinas and Pascal). Rothman's assumptions cannot allow anything going beyond physics, since "pragmatism is a decisive

factor." Interestingly, William James, a pragmatist, wrote that "it must remain an open question whether mystical states may not possibly be superior points of view, windows through which the mind looks out upon a more extensive and inclusive world." Rothman's pragmatism does not see here any question, much less an open question. For him it is obvious that the mind is just a result of the activity of the brain, and the claim to the contrary "is not accepted by any contemporary neuroscientists" (p. 11), regardless of the fact that such distinguished neuroscientists as John Eccles, Wilder Penfield, Donald MacKay, or Roger Sperry go beyond this simplistic conception of the mind.

Scientists cannot admit that there is no certain knowledge. The author takes great pain to prove that such knowledge exists, if only for practical purposes. But on the same page he states that although we are 98% sure of the existence of three classes of particles, "it cannot be denied that forces can exist that are so weak that they have until now avoided notice" (p. 60). Yet, certain knowledge exists. However, as Rothman admits, such a statement is merely a rhetoric catch, since "by saying 'we don't know anything for sure,' the scientist leaves himself without a defense against the theories of the UFO, ESP, and astrology enthusiasts" (p. 61). It suffices to remark that if this dogmatic statement were the only defense scientist have against pseudoscience, then science would truly be worth very little.

"We cannot say *a priori* that miracles are impossible. But for us to believe that these miracles exist, we need unambiguous empirical evidence" (p. 107). One can wander what this evidence would be. A miracle could always be explained away by reference to natural causes temporarily being out of sight. Realist assumptions are incompatible with the existence of miracles. Therefore everything that is, is a result of natural forces. An "unambiguous empirical evidence" of miracles is simply impossible; after all, "neither will they be persuaded, though one rose from the dead."

Rothman distinguishes ontological reductionism from theoretical reductionism. The former claims that the whole of reality is built from a certain set of objects, such as particles. This claim is of philosophical nature and science is not very helpful in denying the claim of the existence of a supernatural realm. Science by nature is confined to natural, empirical means and as such has little relevance to the discussion concerning whether there is something beyond nature.

But scientists are often guilty of theoretical reductionism, which is a claim that everything can be explained by a particular theory. There were attempts to explain everything by classical mechanics, by quantum physics, or genetics. Even assuming that only elementary particles underlie all that exists, not everything can be explained by physics, despite Rothman's promulgations. Psychology and sociology may admit that man is a cloud of particles, but this level of explanation has no relevance to the type of explanation these two branches of science submit. Positivists of the Vienna Circle tried to do exactly that and failed. Reality is too complex to be encompassed by one branch of science, let alone by one theory. Rothman himself admits that "scientific methods do not work well ... outside the domain of science: aesthetics, ethics, literary criticism" (p. 16). But even restricting our attention to science, reductionism is an unfeasible program. There always have to be different theories irreducible one to another. Putting them together to form one theory would not help either, as proved by Gödel: a theory's consistency cannot be proven by the same theory, unless it is a contradictory theory. This classical result shows the impossibility of a total theoretical reductionism.

Rothman's book intended to denounce certain myths to defend the integrity of science, but it creates new myths of certainty, reductionism or impossibilities. It is poor propaganda in favor of science attained by the means of thumping the table and using a rich name-calling catalog. True, there is a great deal of pseudoscience, and science has to prevent its invasion, but it hardly can be successful by Rothman's means.

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GENESIS REVISITED: Is Modern Science Catching Up with Ancient Knowledge? by Zecharia Sitchin. Santa Fe, NM: Bear & Company Publishing, 1991. 343 pages. Hardcover; $21.95.

This is another example of the genre typified by Von Daniken's *Chariots of the Gods* and Baumann's *The Bermuda Triangle*. Sitchin proposes to show that the conflict between evolution and Creation is baseless, and that "Genesis and its sources reflect the highest levels of scientific knowledge." He attempts to do this by taking the Genesis account of Creation and the ancient Mesopotamian myths, such as *The Creation Epic (Enuma Elish)*, as a symbolic description of the activities within the solar system of a highly advanced people from a wandering planet (equated with Marduk of Mesopotamian myth), which he calls Nibiru. The people of Nibiru needed gold to place in their dwindling atmosphere as a shield "to reverse the loss of heat, air, and water" (p. 228) and they came to earth to get it. Since mining is hard work, they used genetic engineering to produce the first true humans from the early hominids on earth.

Sitchin's training is in economic history. He was an editor and journalist in Israel for many years before coming to New York. Nothing is said of his training in Semitic and Biblical studies, but the book jacket says that he is "one of the few scholars able to read and understand Sumerian," a non-semitic language. While advances have been made in Ancient Near Eastern Studies by people outside their field, the work of these people was presented to the scholarly world for all the normal give-and-take of the scholarly process. In contrast, *Genesis Revisited* is presented in a popular format with no bibliography, no

footnotes, few usable references within the text, and a number of problems. I looked up three references with sufficient information to be useful, and found that two of them were erroneous. The book does have an extensive index. It is the latest in a series of books on this subject by the author.

The word "Anunnaki" is said (p. 19) to literally mean "Those Who from Heaven to Earth Came" in Sumerian, and to be identical in meaning with the Hebrew "Nefilim" (Sitchin's spelling). I don't have the resources to check the Sumerian, but *nephilim* in Hebrew does not mean "Those Who from Heaven to Earth Came." While the meaning is not certain, reasonable suggestions include: beings that are wonderful, strong, or mighty; or even a separated or distinguished people.

Another example is found on pp. 298-299, where Sitchin is discussing the Biblical narrative of the tower of Babel reaching to heaven, "in which a *Shem* — a space rocket — was to be installed." *Shem* comes from the last half of the verse, in which the builders express the desire to establish a name for themselves. The Hebrew word means simply "name"; although the meaning is extended to include "reputation" or "memory," as in English. He does give a drawing of a Hellenistic coin depicting a temple in Babylon with a conical object in it, implying that this supports his contention. He does not identify the coin or give any information about it. However, it is obviously Hellenistic and therefore must be at least 2,000 years younger than the supposed event he describes! It completely escapes me how even a hint of "space rocket" can be obtained from the Biblical story, even with this anachronistic and irrelevant "evidence."

One example of the fantastic way that the Sumerian/Akkadian myths are interpreted will suffice. In the *Creation Epic*, Tiamat was making war against the other gods and they couldn't stand up against her, so they called in Marduk to fight for them. Marduk used the four winds (plus some others) to help subdue her. Sitchin says that the four winds were satellites of the planet Nibiru/Marduk, that collided with Tiamat and split her into the earth and moon and created the Asteroid Belt. Tiamat's general, Kingu, was a satellite that was growing to planet size and threatening the solar system with further instability. This kind of allegorical interpretation, with a little imagination, can produce anything out of anything.

This fantastic interpretation is aligned with New Age thought when Sitchin asserts that the Sumerian view of planets as "alive" is being borne out by recent research. He cites the Gaia Hypothesis approvingly, "Earth is not just an inanimate globe ... it is a coherent if complex body that is itself alive ..." (p. 106).

Sitchin is a skillful and entertaining writer; anyone interested in this genre of writing will no doubt enjoy it, but do not expect a reliable commentary on either the biblical or scientific accounts of Creation.

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GENESIS AND THE BIG BANG: The Discovery of Harmony Between Modern Science and the Bible by Gerald L. Schroeder. New York: Bantam Books, 192. xi, 212 pages. Paperback; $10.00.

Schroeder, a physicist, brings Jewish insights to bear on the relationship of Scripture and science. He cites the twelfth-century sage, Maimonides: "Conflicts between science and religion result from misinterpretations of the Bible." He goes beyond a literal reading of the sacred text as, he says, science goes beyond literal appearance to interpretation. Yet he has Adam living about 3800 B.C.E., approximately fourteen centuries before Tuval-Cain began the bronze age (Genesis 4:2). Since the continuous tradition of metalworking began shortly before the Deluge, he argues, the Flood could not have torn the earth apart.

He claims that the six days of Genesis 1 and the 15 billion years since the Big Bang are both literal. The former is God's time, springing from relativistic motion. He clearly explains the history and meaning of relativity, with its consequences for cosmology. The gigayears involve our time, extrapolated back on the basis of our zero velocity relative to our frame of reference. Unfortunately, this ingenious explanation works only if the deity is within space-time.

The impossibility of knowing what preceded the Big Bang is biblical. The first verse of Genesis presents the creation of all things. The first letter of this verse, beth, is open only in the forward direction. It is also demonstrated in the reference to "day one" in verse 5. Already in the seventh century, a Jewish commentator had noted that there was no time before the creation. Maimonides also held that there was no prior space. The later cabalists theoried that the universe began when the infinite God contracted, providing a place for the universe to expand. This is an interesting anticipation of the Big Bang. But it seems to place the universe within some sort of spatio-temporal deity, as noted above.

In Chapter 4, Schroeder outlines the Steady State, oscillating and expanding universe theories, indicating that the last is correct. In the following chapter, he notes that the Big Bang gave only hydrogen and helium. The other elements were produced later, in stars. Or, as Talmudic Rabbi Abahu explained the appearance of the sun on the fourth day: "From this we learn that during the first three days, the Holy One Blessed Be His Name used to create and destroy worlds." This requires a process, clearly expressed in the contrast between the instant of Genesis 1:1 and the time of Exodus 2:11. He argues that the universe at the moment of the Big Bang was the ultimate black hole, requiring the spirit's intervention to produce our familiar cosmos (Genesis 1:2.) In the following chapter he explains "evening" and "morning" etymologically: mixed up or disorderly and discernible or orderly, respectively.

Chapter 7 tackles the impossibility of random events producing life. Chapter 8 argues similarly from the suitability of the earth for life. I see two problems with these arguments. First, they are a God-of-the-gaps ploy. Second,

they misuse probability. For example, there are 2,598,960 hands possible in poker. But no poker player can rationally claim, "Because the odds are 2.6×10^6 against it, I cannot have this hand." However, Schroeder shows his openness by noting, at the start of Chapter 9, that the origin of life requires guidance "by phenomena, natural or divine, which have yet to be discovered by human inquiry."

He solves the problem of plant life (day 3) before the luminaries (day 4) by arguing that the latter were first hidden by dense clouds. These thinned because of the effects of photosynthesis. But this would seem to indicate that plants began to grow some three or more billion years before the earth came into existence. Unless getting through the six days involved marked changes in God's relativistic speed, the third day ended about 7.5×10^9 years ago.

He argues that the fossil record excludes gradual evolution. This ties into a further God-of-the-gaps explanation. It also ties into a view new to me. Homo sapiens had existed for some 300,000 years when, about 5700 years ago, one member uniquely received God's image and became human. But this raises the question: What happened to all the widely distributed humanoids? Schroeder has excluded a world-wide Flood to destroy them. So Homo sapiens today must be a mixture of men, humanoids and, probably, hybrids. Since people have been in the New World for over 10,000 years, isolated for millennia from the Old World, the natives of the Americas must be humanoid, not human. If Acts 17:26 is true, then this view cannot be.

A review cannot do more than suggest the value of this introduction to a biblical tradition of which most Christians know nothing. Despite the problems I have noted, it is a thoughtful and thought-provoking book. Christians interested in the connection between Scripture and science will profit from reading it.

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1001 THINGS EVERYONE SHOULD KNOW ABOUT SCIENCE by James Trefil. New York, N.Y.: Doubleday, 1992. 286 page, index. Hardcover; $20.00.

The author of this somewhat curious book holds a Ph.D. in theoretical physics and has served as a faculty member in physics at the University of Virginia, and George Mason University. In his own words the purpose of the book is to "break all of science down into bite-sized chunks.... The book ... is intended to be browsed. You are supposed to open it to a random page, read a bit, say, 'Gee, I didn't know that' or 'How interesting,' and then put it down until next time."

Within this framework the author has done an incredibly exhaustive job of coming up with 1001 bits and their answers in the fields of classical biology, evolution, molecular biology, classical physical science, modern physical science, earth science and astronomy. The only problem with the book is: does it really contribute to science knowledge and understanding or is it only a collection of science trivia suitable for reading before participating in a TV quiz show? If the reader knows enough to appreciate and understand the "bites," does she really need the book? Or if the reader really needs the book, does he know enough to make any sense out of it? Accompanying the book is a test of "scientific literacy" in 15 questions: the only question under "classical physical science" deals with when the sun spot cycle last stopped. Bite No. 448 answers this question, but is this really science?

Some of the "bites" appear to be contradictory. For example, Bite 92 is 13 lines on "All life comes from preexisting life." Bite 169 is 18 lines on "Life on earth developed through the process of evolution." And Bite 176 is 14 lines on "Evolution of life on earth proceeded in two stages: chemical and biological." The first sentence in Bite 176 is "Life on earth must have developed from inorganic materials — what else was there for it to come from?" Is this really science? Bites 187 to 192 then continue with brief statements of the evolution of complex life.

Other noteworthy items include Bite 173, "There is a difference between the fact of evolution and the theory of evolution;" Bites 184-186 offer critiques of "creation science" but offer only the problem of "apparent age" as an example of shortcomings of this view; Bite 367 says, "Light is a wave," and Bite 368 says, "Light is a particle," neither of which is accurate since light is neither a wave nor a particle but may act like one or the other depending on the experimental circumstances; Bite 456 tell us that "Voltage measures the 'oomph' with which electrical charges are pushed through a material;" and Bite 570 tells us that "The simplest semiconductor device that can be built is a diode, which is an N- and P- type semiconductor brought up against each other," which if taken literally will certainly not yield a diode.

In brief the book is a remarkable achievement, good fun, a great source for trivia buffs, and little help in understanding issues dealing with authentic science and its practice. Anyone who takes the book seriously will be misled into identifying the language and "facts" of science with the actual nature of science itself.

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

Letters

On Lohr's Critique of Siemens

I welcome Andrew Lohr's response (44, p. 281, December 1992) to my article (44, pp. 169-174, September 1992) because he so clearly demonstrates what I tried to point out. I noted that flood geologists sometimes wrote carelessly, even to the point of contradicting themselves; that they presented *ad hoc* arguments with parameters changed without regard for connected phenomena; and that they sometimes ignore empirical evidence.

For example, Lohr suggests that carnivores may not have needed meat until some time after leaving the ark. This, he notes, is speculation. Yet he advances such pure conjecture to rebut a rational analysis based on available evidence. He does not consider that it has the consequence that lions evolved from herbivores to carnivores in less than 5000 years — within the species, of course. Some carnivores, specifically dogs, can get many of their calories from processed grains. But they will not be adequately nourished on raw seeds, let alone on grass and leaves. Unless we are to posit miraculous caches or harvests of grain, at best only green vegetation would have been available to the creatures departing the ark. Yet the teeth of dogs, let alone cats, are not capable of masticating vegetation finely enough to secure the nutrients contained in the cells. The stomachs of carnivores are not large enough to contain enough vegetation for total nutrition, nor the guts long enough to extract what nutrients are available. Hence, on Lohr's suggestion, the broad grinding molars of a vegetarian lion became the cutting molars of a carnivorous lion in less than 5000 years, perhaps in a few centuries, decades, or even years. The massive stomach and elongated intestine of the vegetarian became the smaller stomach and shorter intestine of the carnivore, evolving with a speed that is more than amazing.

But wait! Lohr gives evidence for an even faster change: the curse of the tempter (singular, applicable to the individual, in Genesis 3:14f) and the lion eating straw when Messiah rules (Isaiah 11:7). These must be classed as miraculous events. If he is suggesting that the lions that entered the ark were miraculously transformed sometime after their exit, we must grant that God has that power. But we must also exclude flood geology from science, for "Then there is a miracle" is never a scientific claim.

There is another problem here. How did the seeds of the plants survive a year's soaking? The seeds I know, placed in water, either sprout or drown in a few days. It appears that we must call on another miracle to preserve plant life, perhaps either hydroponic culture in a quiet backwash or a celestial seed bank with aerial reseeding of the earth by teams of angels. This is not entirely frivolous, for Lohr has already introduced miracles. Having once called in miracles without explicit scriptural warrant, any additional miracles must be allowed.

He has yet another surmise, which may also have a bearing on the preservation of plant life. Maybe the flesh of the animals killed by the flood did not putrefy. This, on the normal flood-geology interpretation, runs into two problems. The first is that the waters of the flood were so tumultuous that everything, except for the divinely protected ark, was either torn apart or quickly buried. Indeed, given the "official" description, I am amazed that any fish could have survived the posited churning, sediment-laden waters. But perhaps there were pockets of water at intermediate depth which were not as violent as those at depth, where all land was torn up and then redeposited, or as those agitated by the gales near the surface. Even so, the corpses would not have been in the protected areas, but would have been torn apart or buried—unless miraculously preserved. Of course, they would have had to have been preserved for years, until the reproduction of herbivores of all types could provide enough prey for all the carnivores. But note the vast number of ungulates and other herbivores relative to the much smaller number of carnivores in nature, and the faster reproduction rate of most carnivores. The second difficulty is that such problems with plants as thorns, with animals as ferocity, and with bacteria and fungi as disease and putrefaction, are consistently declared to begin with the Fall and Curse. Are we now to hold that the carcasses of the animals God killed to clothe Adam and Eve remained (unless eaten) until some time after the flood? Was there a special creation of protists (mostly single-celled creatures), which the Bible does not mention, sometime after the Flood? If so, how did the ruminants digest their food during the thousands of years between the Fall and the Flood without the activity of the enteric flora? How did the soil remain fertile? More miracles? Lohr's suggestions only exacerbate the original problems with flood geology.

Lohr taxes me with not presenting explanations for some of the phenomena I note. Part of the response to this challenge is simple, because the information is readily available. The flightless moas, or their flying predecessors, could have walked from Australia to New Zealand any time between the rise of what would become New Zealand about 145 to 125 million years ago and its separation from Australia about 80 to 60 million years ago. Somewhat earlier, a creature could have walked essentially between all land areas, for all formed a single continent, Pangaea. That there were birds fossilized 150 million years ago completes the answer.

I have no experimental data to explain the expanding range of opossums. I can only note that they seem to flourish where human occupation alters the natural environment. They apparently thrive in urban southern California, where they were introduced. I saw one regularly at night on the Pierce campus. I also cannot explain coyotes doing well while the wolf population declines. While ecologists may have at least partial answers, I am a philosopher and logician. So my questions primarily involve the con-

sistency of the flood geologists' statements, along with the philosophical comparison of their approach with normal scientific experimentation and theory construction.

Though my article contains no mention of evolution or the age of the earth, Lohr brings in evolution as if it were the basis of my critique. He apparently assumes that anyone who does not accept the flood geologists' line must be an evolutionist. While some Christian "old-earthers" hold that evolution is God's method of creating, others believe that He created plants and animals at various times over perhaps a billion years—to mention but two of a range of alternatives. Belief in an old earth and acceptance of unlimited evolutionary change are not interchangeable.

Lohr writes, " 'Careless' contradictions can be corrected." True. But, as he inadvertently demonstrates, they may also be multiplied.

David F. Siemens, Jr., Ph.D.
2703 E. Kenwood St.
Mesa, AZ 85213-2384

On Siemens' "More Problems with Flood Geology"

I read with considerable interest the article by Dr. David Siemens, "More Problems with Flood Geology," which appeared n the December 1992 issue of *Perspectives on Science and Christian Faith*. Assuming that earthquakes were the mechanism employed by God to produce the changes in elevations described in Scripture, he has certainly offered a potent challenge to Dr. Morris and his supporters.

At the same time, I cannot help noticing that the ongoing debate on origins within the Christian community does not always take into consideration the current attack on Christianity coming from various segments of modern culture. In particular, our atheist colleagues are using the apparent conflict between science and the first eleven chapters of Genesis as a lever to discredit all Scripture, and as a result there are others who are remaining separated from Christ.

While the scenario proposed by Dr. Morris may have errors, he at least deserves credit for attempting to reconcile modern science with the Bible, and furthermore using as many relevant details within the Bible as he can. In contrast, most Christian intellectuals seems to be satisfied with mapping out a general correspondence between Scripture and science. Meanwhile, the opponents of Christ can be expected to target the *details* of Genesis whenever they deem it necessary to debunk the Bible. However meritorious his article may be, Dr. Siemens offers no difficulties for the atheist community. I for one am looking forward more eagerly to articles that *improve* the scenarios advanced by other believing scientists, than in ones which remain limited to the attacking mode.

Phillip F. Rust, Ph.D.
2319 S. Lander Ln
Charleston, SC 29414

A Response to Wonderly

Just a quick comment in response to Daniel Wonderly in *Perspectives on Science and Christian Faith*, Vol 44:2.

I agree that we who love truth now must make a major effort to confront young earth creationist science (YECS) claims because of the damage being done worldwide. I myself was a victim of YECS who struggled unnecessarily with the implications of the fallacies of creation science while in graduate school. How many have rejected the faith altogether when shown the errors of YECS?

Now, as a missionary to Kazakhstan, when I order Russian language materials from the Slavic Gospel Association, I find that YECS works are being sold by SGA. I have nothing to give them to protest, unless I write my own letter, which will have no impact. Even in Kazakhstan this lunacy is spreading.

We need an ASA produced anti-YECS, but pro Christian pamphlet especially designed for distribution to our ignorant brothers. It needs to:

1) be fairly short (perhaps a short one and a more detailed one are in order)

2) be signed by as many credible Christians in the sciences and respected evangelical theologians as possible (safety in numbers)

3) be devastating to YECS, yet written in a spirit of love

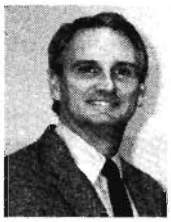
4) offer the best Biblical alternative interpretations available.

I think you get the idea. We need to act, despite the fact that we will be misunderstood, attacked as compromisers, and that this "ministry" will be looked upon as destructive.

Dr. F. M. Phelps IV
290 Cedar Drive
Mt. Plesant, MI 48858

AMERICAN SCIENTIFIC AFFILIATION
1992 Annual Report

REPORT FROM THE PRESIDENT



Greetings in the Savior's Name. It seems like just last week we were meeting at the University of the Nations and here we are late in the year. In this letter I would like to report to you on some short-term goals for ASA that resulted from the 47th Annual Meeting at the University of the Nations. Secondly, I am pleased to announce the establishment of the ASA endowment program for long-term support of ASA activities and programs. Next, I will present a specific international mission opportunity to help our colleagues in the African Institute for Scientific Research and Development (AISRED). Finally, I will ask you for your prayers, recommendations and assistance in: 1) seeking a replacement for Bob Herrmann as he approaches retirement; and 2) for financial assistance in the transitional period while the endowment program is being launched.

I. It has been my "theme" this year as your president that ASA increase its Christian world view and global outreach. Our collective and individual talents in both the scientific and spiritual arenas could provide such tremendous assistance and encouragement to brothers and sisters in science in the developing world and recovering nations such as the Commonwealth of Independent States. Thus, University of the Nations in Kailua-Kona was selected as our meeting site. UON has projects and sub-campuses in about 100 countries. They combine ministry with assistance in such disciplines as agriculture, education, science and technology by training students in both classroom and the field. Faculty and students were a scriptural example for us at the Annual Meeting. Even the whole campus was built by volunteer effort!

During the Past President's Discussion Panel at the end of the meeting I challenged the audience to discuss 5-year goals which we could present to you for your consideration and comment. Chi-Hang Lee, Gerald Hess, Elving Anderson and Don Munro composed the panel. I present to you the following recommendations to be considered by the membership.

Elving Anderson: Future ASA Annual Meetings

1. **Expand the multidisciplinary perspective.**
The 1992 meeting was exemplary in the scope of topics considered: environment, hunger, population size, energy sources and use, genetic intervention, health care, euthanasia. Areas of broad concern, however, usually involve disciplines and specialties outside of the sciences, such as economics, theology, ethics, philosophy, history, and humanities. For a few selected topics speakers or discussants could be invited to cover these extra dimensions.

2. **Plan part of each meeting as the basis for a publication.**
3. **Have papers prepared and circulated in advance.**
4. **Increase global participation.**
The ASA should continue to reach out to scientists and other scholars from other countries, and with some effort and advanced planning it may be possible to secure partial funding for their travel. Strengthening the ASA involvement in Africa would be an obvious goal. For next year in Seattle, an emphasis on China, Taiwan, Japan, and Korea would be appropriate.

5. **Reach out to scientists and other professionals in the area.**
6. **Reach out to students and churches in the area;**
I would urge that evening sessions be announced widely as open to the public without registration (and hence in a larger facility).

Chi-Hang Lee: Meetings and Teaching

1. I suggested that we plan to hold a Science/Faith conference somewhere in the third world, or possibly Japan, 3 to 5 years from now. In 1987 we were hoping to have such a meeting in China, but despite several contacts it did not materialize. It seems to me, based on my experience in Brazil, many of the third world Christians would appreciate a visible demonstration that it is perfectly reasonable to be both a scientist and a genuine Christian. Such a meeting would strongly encourage both the missionaries, where allowed, and the national Christians, who might already begin to feel more and more humanistic/atheistic intellectual challenges.

2. I also suggest that perhaps 3 years from now we should plan to have all speakers in our 1995 National Meeting to have their talks written ahead of time, very much like the 1985 ASA meeting in Oxford, England. This practice will not only help to elevate the quality of the presentations, but will definitely help to keep the proceedings to a more punctual schedule.

Gerald Hess: Research & Teaching In the Developing World

In light of the theme of the 1992 ASA Conference, I see the continuation of our support of AISRED as a key goal for the next five years. Initially conceived as an outgrowth of the 1985 meeting at Oxford, this concept received additional support with the presence of George Kinoti and Wilfred Mlay at the 1990 ASA Annual Meeting.

Since that time much background work has been accomplished but both the incorporation process and funding are incomplete as of August, 1992. Important networking has taken place in the interim. The most crucial aspects seem to be funding and practical support of scientists who are African Nationals by specifically identified ASA members who are willing and able to work along side the Africans.

Having begun a good work, it seems that our goal should be to bring this project to a functional state. Because of links to existing universities in Kenya, including Daystar University College, there is a good likelihood of success for AISRED if we can patiently sustain our enthusiasm for this project over the next decade. We will need to suppress our American tendency to seek a "quick fix" and give a concentrated effort toward seeing that AISRED receives the financial support it so desperately needs to meet its perceived potential. There is also much that ASA

members can do apart from finances to assist in the maturation of this new organization.

Don Munro: Membership and Recruitment

We need to increase our membership with an emphasis on young scientists and women. The organization should set up a network of Christians in science throughout as many Christian colleges and secular colleges and universities as possible. ASA was a great help to me as a young scientist in graduate school. In addition, women need special encouragement since they often experience discrimination in science in subtle ways.

I would like to see the following things occur:

1. Appoint more women to the commissions, panels and nominating committee, have a least one woman on the Council, and have female members write to female prospects to encourage them to join the organization.

2. Continue to expand our international contacts by becoming a clearing house for secondhand equipment, journals and textbooks that could be shipped overseas, and by planning sabbaticals where we can become co-workers and co-researchers with Christian colleagues overseas.

3. We need to continue to serve as mediators between the scientific and the religious communities and to better reach the lay public through publication and church activities.

4. We need to strengthen our contacts with other organizations that have close ties to the areas that we serve.

II. The Executive Council and Director are very pleased to report that we have initiated an endowment program and are exploring additional means of giving that will benefit both the donor in terms of taxes and income and ASA in terms of long-term operations and programs. ASA is often in a summer slump and the Director then has to make appeals just to keep the office operating. The endowment program will help to solve that problem. As we pray about and seek a new Executive Director, his/her fund raising activities should be concentrated on the big projects and not just meeting the payroll and keeping the office operating. So, we have talked with other Christian non-profit organizations, explored possibilities with several Christian investment counseling organizations and hope to implement a deferred-giving program in the near future.

III. Well, by now you know that our Executive Director, Bob Herrmann is looking forward to a well-deserved retirement. His target is to complete the transition to a new Director by the end of July 1993. We want to hear from you about individuals, ideas, methods of searching, screening and selecting. Actually, we would simply like this to be a spiritual and scientific exercise for the whole ASA membership.

It has been my honor to serve as your President in 1992. I see tremendous global potential for ASA in serving the Lord through science. In our families, churches, neighborhoods, laboratories and classrooms I pray that we individually and as an organization of science help to preserve the land in righteousness.

Kenneth J. Dormer, Ph.D.
President, Executive Council

REPORT FROM THE EXECUTIVE DIRECTOR

This has been another busy traveling year for me, with trips to London and Rome in connection with Templeton Foundation-supported lectures, then the Annual Meeting in Hawaii, followed by meetings of the Tournier Institute in Washington and another pair of Templeton Lectures at Yale. 1992 will probably be the last full year in which I serve as your Executive Director. I announced at the Annual Business Meeting in Kona, Hawaii, that I planned to retire in August 1993, and that the Executive Council was beginning the search for my successor. I also suggested that the qualities I found most useful for the job were, 1.) a background in academic teaching and research, 2.) an interest in and appreciation for the excellent people in ASA and 3.) some good administrative experience. I plan to finish out this year and the first half of '93 and then phase out as soon as possible. If the office could remain in Ipswich, where we have an excellent, stable working group, that would be ideal!

One of the disappointments of my twelve years with ASA has been the inability to bring the TV Series "Space, Time and God" to completion. We have finally put together an excellent team in Owen Gingerich and Geoff Haines-Stiles, after a long "incubation period" (for which I am largely responsible), and excellent treatments for each of the six episodes, but we have not been able to get the large donations required to begin final production of the series. Several of you have been worthy supporters, and Ken Olsen of Digital fame has been a tremendous help. We believe one large challenge grant would give us the start we need for acquiring some $3,000,000 needed for completion of the series.

One of the brightest hopes for ASA's future is the recent initiative by Ken Dormer and myself to develop a strong research linkage with East African Christians in science through the newly-formed African Institute for Scientific Research and Development (AISRED) We are very impressed with the scientific stature and Christian commitment of African brethren like Dr. George Kinoti of the University of Nairobi and Dr. Wilfred Mlay of the University of Dar es Salaam. It is our prayer that we may be able to substantially support the Institute financially, to develop ways to share our expertise, and to provide logistical support in the coming years. We acknowledge the excellent input from Martin Price of ECHO, who has joined Ken and I on the AISRED Board, and also the encouragement of many others.

Finally, next year will be a year of transition for me in which retirement will allow me more flexibility for writing and Templeton Foundation work. My dozen or so years at ASA have been very rewarding, and I hope to maintain close ties with many of you in the years ahead. Thank you for your support and encouragement over the years. Whoever takes over my role has the great privilege of working with some of God's best!

Robert L. Herrmann, Ph.D.
Executive Director, ASA

1992 ASA Approved Budget: Summary Form

Income	
Operating Income:	
Dues	80,000
Subscriptions	18,000
Member Contributions	85,000
Annual Meeting, General Sales, Misc.	57,150
Project Overhead	32,966
Operating Income Total	273,116
Expenses:	
Operating Expense:	
General Office & Salaries	192,653
Budgeted Program Expense	82,800
Total Operating Expense	275,453
Special Projects Income:	
T.V. Series (Carry Over)	49,056
Templeton Lectureship Series I	30,000
Templeton Lectureship Series II	63,500
Book Project: *On Being a Christian in Science*	63,000
African Res. & Devel. Inst. (Proposal)	83,600
London Lectures (RLH)	47,400
Templeton Center Project (RLH)	49,000
Total Projects Income	385,556
Special Projects Expense	
T.V. Series	10,000
Templeton Lectureship Series, Yr. 1	30,000
Templeton Lectureship Series, Yr. 2	63,500
Book Project: *On Being a Christian in Science*	63,000
African Res. & Devel. Inst.	2,000
London Lectures (RLH)	47,400
Templeton Center Project (RLH)	49,000
Total Projects Expense	264,900

Frances Polischuk
Financial Manager

AMERICAN SCIENTIFIC AFFILIATION Financial Statements: December 31, 1991

Independent Auditor's Report

Board of Directors
American Scientific Affiliation

February 13, 1992

We have audited the balance sheet of AMERICAN SCIENTIFIC AFFILIATION (A Non-Profit Organization) as of December 31, 1991, and the related statements of revenues, expenses and changes in fund balance, and cash flows for the year then ended. These financial statements are the responsibility of the Organization's management. Our responsibility is to express an opinion on these financial statements based on our audit.

We conducted our audit in accordance with generally accepted auditing standards. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall financial statement presentation. We believe that our audit provides a reasonable basis for our opinion.

In our opinion, the financial statements referred to above present fairly, in all material respects, the financial position of American Scientific Affiliation as of December 31, 1991, and the results of its operations and its cash flows for the year then ended in conformity with generally accepted accounting principles.

Vance, Cronin & Stephenson, P.C. *Boston, Massachusetts*

Balance Sheet: December 31, 1991

(With Comparative Totals for 1990)

The accompanying notes are an integral part of these financial statements

Assets

Current Assets	**1991**	**1990**
Cash	$118,529	$89,587
Accounts Receivable	441	223
Investment, at Cost	2,101	993
Publication Inventories, at Cost	3,350	7,573
	1,500	500
Total Current Assets	125,921	98,876
Property and Equipment, Net	8,657	13,405
Other Asset		
Security Deposit - Rent	400	400
Total	$134,978	$112,681

Liabilities and Fund Balance

Liabilities		
Accounts Payable	$ 4,944	$ 15,262
Taxes Withheld	—	1,907
Restricted Deferred Revenue	127,472	104,509
Total Liabilities	132,416	121,678
Fund Balance	2,562	(8,997)
Total	$134,978	$112,681

Statement of Revenues, Expenses, and Changes In Fund Balance:Year Ended December 31, 1991

(With Comparative Totals for 1990)

The accompanying notes are an integral part of these financial statements

	1991			1990
Revenues	**Unrestricted**	**Restricted**	Total	**Total**
Contributions	$104,712	$ 82,797	$187,509	$139,956
Dues	75,558	—	75,558	80,549
Subscriptions	22,172	—	22,172	35,386
Conferences and Meetings	37,211	—	37,211	33,867
Sales of Publications	6,851	—	6,851	8,468
Advertising and Royalties	1,849	—	1,849	364
Investment Income	4,996	—	4,996	5,112
Gain (Loss) on Sale of Securities	(429)	—	(429)	670
Total	252,920	82,797	335,717	304, 372
Expenses				
General Administrative Expenses	155,330	24,366	179,696	197,838
Program Service Expenses	86,031	58,431	144,462	130,708
Total	241,361	82,797	324,158	328,546
Excess (Deficiency) of Revenues over Expenses	11,559	—	11,559	(24,174)
Prior Year Adjustment of Overhead Income Allocation	—	—	—	21,444
Fund Balance, Beginning of Year	(8,997)		(8,997)	(6,267)
Fund Balance, End of Year	$ 2,562	$ —	$2,562	$(8,997)

Statement of Cash Flows Year Ended December 31, 1991

(With Comparative Totals for 1990)

The accompanying notes are an integral part of these financial statements

Cash Flows From Operating Activities	**1991**	1990
Excess (Deficiency) of Revenues Over Expenses	$11,559	$(24,174)
Adjustments to Reconcile Excess (Deficiency) of Revenues Over Expenses to Net Cash Provided by (Used for) Operating Activities:		
Gifts of Stock (Stated at Fair Market Value)	(7,464)	(8,250)
(Gain) Loss on Sale of Stock	429	(670)
Depreciation	6,409	6,285
(Increase) Decrease in Assets:		
Accounts Receivable	(218)	541
Publication Inventory	4,223	5,265
Prepaid Expenses	(1000)	217
Increase (Decrease) in Liabilities:		
Accounts Payable	(10,318)	6,416
Taxes Withheld	(1,907)	323
Restricted Deferred Revenue	22,963	4,102
Net Cash Provided by (Used for) Operating Activities	24,676	(9,945)
Cash Flows From Investing Activities		
Purchase of Property and Equipment	(1,661)	(529)
Sale of Stock	5,927	8,836
Net Cash Provided by Investing Activities	4,266	8,307
Cash Flows From Financing Activities		
Reduction of Debt	—	(573)
Net Increase (Decrease) In Cash	28,942	(2,211)
Cash at Beginning of Year	89,587	91,798
Cash at End of Year	$118,529	$89,587

Notes to Financial Statements December 31, 1991

Note 1 - Summary Description of the Organization

The American Scientific Affiliation is a Christian organization founded in 1941. The stated purposes of the Organization are to "investigate any area relating Christian Faith to Science" and "to make known the results of the investigations for comment and criticism by the Christian community and by the scientific community."

Note 2 - Summary of Significant Accounting Policies

The significant accounting policies followed are described below to enhance the usefulness of the financial statements to the reader. Certain reclassifications have been made to the 1990 financial statements (which are shown in total for comparative purposes only) to conform with the presentation for 1991.

Fund Accounting

To ensure observance of limitations and restrictions placed on the use of resources available to the Organization, the accounts of the Organization are maintained in accordance with the principles of fund accounting. This is the procedure by which resources for various purposes are classified for accounting and reporting purposes into funds established according to their nature and purposes. Separate accounts are maintained for each fund; however, in the accompanying financial statements, funds that have similar characteristics have been combined into fund groups. Accordingly, all financial transactions have been recorded and reported by fund group.

The assets, liabilities, and fund balance of the Organization are reported in one self-balancing fund as follows:

Operating funds, which include unrestricted and restricted resources, represent the portion of expendable funds that is available for support of organization operations.

Expendable Restricted Resources

Operating funds restricted by the donor, grantor or other outside party for particular operating purposes are deemed to be earned and reported as revenues of operating funds, when the organization has incurred expenditures in compliance with the specific restrictions. Such amounts received but not yet earned are reported as restricted deferred amounts.

Property and Equipment and Depreciation

Property and equipment are stated as follows:

Cost	$45,715
Less: Accumulated Depreciation	37,058
Net Property & Equipment	$ 8,657

Depreciation of equipment is provided over the estimated useful lives of the respective assets on a straight-line basis.

Tax Exemption

The American Scientific Affiliation is a not-for-profit organization and is exempt from income taxes under section 501(c)(3) of the internal revenue code.

Other Matters

All gains and losses arising from the sale, collection, or other disposition of investments and other noncash assets are accounted for in the fund that owned the assets. Ordinary income from investments, receivables, and the like is accounted for in the fund owning the assets.

Legally enforceable pledges less an allowance for uncollectible amounts are recorded as receivables in the year made. Pledges for support of current operations are recorded as operating fund support. Pledges for support of future operations and plan acquisitions are recorded as deferred amounts in the respective funds to which they apply.

Note 3 - Cash Flow Information

In 1989, American Scientific Affiliation adopted Statement of Financial Accounting Standards No. 95 which replaces the statement of changes in financial position with the statement of cash flows. Although this change is not required of non-profit organizations the Affiliation has adopted the change for its financial statements.

Supplemental Disclosures of Non-Cash Financing Activities:

During the year ended December 31, 1991 American Scientific Affiliation received gifts of stock valued at $7,464.

Note 4 - Investments

Investments are presented in the financial statements at the lower of cost or market. Market value of investments at December 31, 1991 was $2,338.

Note 5 - Commitments

The Organization had entered into an agreement totaling approximately $271,000 for the funding of a television series. As of December 31, 1991, the agreement has been terminated at no additional cost to the Organization. The Organization is working with other vendors to complete the television series.

Note 6 - Concentration of Credit Risk

The Organization maintains two accounts under the same name at the same bank. As such the combined balances in the accounts at times exceed the federally insured limits.

Independent Auditor's Report on Additional Information

Board of Directors
American Scientific Affiliation

February 13, 1992

Our report on our audit of the basic financial statements of American Scientific Affiliation for 1991 appears on page 72. We conducted our audit in accordance with generally accepted auditing standards for the purpose of forming an opinion on the basic financial statements taken as a whole. The schedules of expenses are presented for purposes of additional analysis and are not a required part of the basic financial statements. Such information has been subjected to the auditing procedures applied in the audit of the basic financial statements and, in our opinion, is fairly stated in all material respects in relation to the basic financial statements taken as whole.

Vance, Cronin & Stephenson, P.C. Boston, Massachusetts

General Office Expenses
Year Ended December 31, 1991
(With Comparative Totals for 1990)

	1991			1990
	Unrestricted	Restricted	Total	Total
Bad Debts	109	—	109	785
Commissions	175	—	175	2,581
Depreciation	6,409	—	6,409	6,285
Employee Benefits	13,200	—	13,200	14,700
Equipment Rental and Maintenance	6,779	—	6,779	7,951
Insurance	500	—	500	481
Office Supplies and Expense	2,357	—	2,357	4,059
Overhead Allocation — Restricted Funds	(24,366)	24,366	—	—
Payroll Taxes	10,630	—	10,630	10,240
Payroll Services	573	—	573	533
Postage and Shipping	7,650	—	7,650	6,070
Printing	4,180	—	4,180	836
Professional Fees	2,480	—	2,480	2,150
Public Relations	—	—		1,933
Rent	9,900	—	9,900	9,990
Salaries	111,527	—	111,527	125,227
Telephone	3,171	—	3,171	3,278
Utilities	56	—	56	829
Total	$155,330	$ 24,366	$179,696	$197,838

Program Service Expenses
Year Ended December 31, 1991
(With Comparative Totals for 1990)

	1991			1990
	Unrestricted	Restricted	Total	Total
Annual Meeting Expense	$ 31,264	$ —	$ 31,264	$30,828
Editor Stipend and Expense	4,096	—	4,096	6,462
Executive Council	2,165	—	2,165	2,241
Field Representative	2,000	—	2,000	1,000
Geology and Biology Divisions	1,257	—	1,257	549
Mailing Costs	6,439	—	6,439	4,902
Public Relations	2,299	—	2,299	2,389
Publicity and Advertising	4,476	—	4,476	4,582
Printing	32,035	—	32,035	37,116
Special Projects:				
African Research Development	—	1,700	1,700	1,000
Conferences	—	3,500	3,500	—
Lectureship Foundation	—	28,010	28,010	—
Middle East Tour	—	—	—	1,800
Printing — "TS" Project	—	312	312	2,732
Subscription Campaign	—	8,382	8,382	33,908
TV Series	—	777	777	1,199
Walter Hearn Project	—	15,750	15,750	—
Total	$86,031	$58,431	$144,462	$130,708

The accompanying notes are an integral part of these financial statements

ANNUAL REPORT OF THE CANADIAN SCIENTIFIC AND CHRISTIAN AFFILIATION

At this year's Annual Meeting we intend to explore some aspects of abuse and family breakdown involving Christians. The serious nature of this problem arrests our attention and demands our interest in soberly assessing the situation and sincerely attempting to use all our knowledge and energy in alleviating the hurt and confusion which arise. The meeting is planned for Saturday, October 24, 1992.

The Executive Council of CSCA considered the great need for young energetic Christians, with an interest in the sciences, to pursue career paths which will inspire them to continue the work of organizations like CSCA. The subject is part of an urgent plea by physicist John A. McIntyre in an article entitled, "It's Time to Rejoin the Scientific Establishment" in the June 1992 issue of *Perspectives on Science and Christian Faith.*

Norman MacLeod, President

ANNUAL REPORT OF THE EDITOR OF PERSPECTIVES ON SCIENCE AND CHRISTIAN FAITH

The third year of my tenure as Editor has seen a continuing busy round of activity. There has been a continuing good flow of editorial material. We currently have accepted material in hand for the next six issues. I have, however, noted a sharp reduction of manuscripts which deal with social science issues. New Christian journals in these disciplines have taken manuscripts previously sent to us. We were, however, able to "continue" a discussion on evolution initially begun in the *Christian Scholar's Review.* Papers on origins themes continue to dominate our pages.

An analysis of our "Reader's Survey" will be published in an early 1993 issue.

Managing Editor Patsy Ames has taken a firm hold on the production process. Modern communications have allowed a much faster turn-around in our work. A positive response to our recent foundation request for computer hardware and software will enable even more effective production of *Perspectives.*

J. W. Haas, Jr., Ph.D.
Editor, *Perspectives on Science and Christian Faith*

ANNUAL REPORT OF THE BOOK REVIEW EDITOR

During the past year, fewer books and reviews were solicited and received, with the intent of reducing the backlog of reviews for *Perspectives on Science and Christian Faith*. However, due, in part, to special issues, the number of book reviews in print dropped from 115 in the previous year to 37 this year.

Number of Books Requested from Publishers	79
Number of Books Received from Publishers	64
Number of Book Reviews Received	58
Number of Book Reviews Published	37
Expenses (postage and supplies)	$ 176.46

Richard Ruble
Book Review Editor
Perspectives on Science and Christian Faith

ANNUAL REPORT OF THE ASA MANAGING EDITOR

Since September 1991, I have edited, typeset, and produced 6 issues of *Perspectives on Science and Christian Faith*. I very much enjoy working with Jack Haas, and I believe we have developed a strong, effective team relationship. I have also edited, typeset, and produced 7 issues of the Newsletter. Walt Hearn and I work well together, and this process is working very smoothly.

In addition, I oversaw the final phase of the preparation and the printing of *Contemporary Issues in Science and Christian Faith: An Annotated Bibliography* (Resource Book), and have continued to work to market it. Between late May and the end of October 1992, we had sold about 475 of the 1200 copies we had printed.

I've also solicited about $800 worth of paid advertising in *Perspectives* and continue to explore ways to market ASA as an organization, including exchange ads, press releases, reprint permissions, promotion of products, and limited purchased advertising. I worked with Carol Aiken on a new design, then typeset the 1992 Annual Meeting program, and ran the meeting "book store," in Hawaii.

I researched and wrote (at Dr. Herrmann's request) a proposal requesting computer upgrades, and worked with Jack Haas on a membership questionnaire. Finally, I've been developing a national office book review tracking system and am currently exploring alternatives and options for getting ASA onto an email link.

Patricia Ames
Managing Editor

ANNUAL REPORT OF THE ASA/CSCA NEWSLETTER

The six issues published in the past twelve months have brought the bimonthly ASA/CSCA Newsletter through No. 5 of Vol. 34, the Oct/Nov 1992 issue. The final Dec 92/Jan 93 issue of Volume 34 will contain stories and photos from the 1992 Annual Meeting in Hawaii; and some thoughts looking forward to ASA's second half-century.

In August 1992 the Editor suggested to the Council that 1993 should be his final year (his 24th) of editing of the Newsletter. He expects to work with his replacement for a smooth transition as long as necessary, however, beginning whenever a suitable person can be appointed. Potential applicants for the editorship should contact the ASA Executive Director at the Ipswich office. Besides a love for ASA and a cheerful blend of creativity and responsibility, an applicant should have some writing or editorial experience and preferably a knowledge of and interest in computers and electronic communication. The new Editor can expect ASA Managing Editor Patsy Ames to continue to play a key role in getting out the Newsletter. The current Editor thanks Patsy and also the whole ASA/CSCA membership, who constitute the Newsletter's staff of reporters.

Walter R. Hearn, Editor
ASA/CSCA Newsletter

ANNUAL REPORT ON *SEARCH: Scientists Who Serve God*

No issues of SEARCH have been produced since No. 14 appeared in the September 1991 issue of *Perspectives on Science and Christian Faith*. SEARCH was omitted from the next three issues of the journal as a cost-cutting move. At its August 1992 meeting the Executive Council put production of further issues on hold until a general review could be made of its function. The switch to "perfect" binding of *Perspectives* with the December 1990 issue meant that SEARCH could no longer serve as an easily removable centerfold "pull-out."

Walter R. Hearn
Editor, *SEARCH*

ANNUAL REPORT OF THE AFFILIATION OF CHRISTIAN GEOLOGISTS

The A.C.G. has officially completed three years as an organization and independent subdivision of the A.S.A. A consistent pattern of fellowship, outreach and communication characterizes the present organizational emphasis. Each year the A.C.G. has utilized meetings of the A.S.A. and Geological Society of America as times for members to gather. Open presentations are given during the G.S.A. national meeting in order to serve as a bridge between the church and the geological community. The 1991 San Diego presentation was on environmental ethics. The October 1992 G.S.A. meeting in Cincinnati will feature an A.C.G. presentation focusing on the personal apologetics of being both Christian and scientist. In San Diego, several members made a friendly geological excursion to Torrey Pines Park with staff from the Institute of Creation Research. This year we will make a field trip to exposures of Ordovician fossils in the Cincinnati area.

The excellent newsletter *The News* remains an effective vehicle for membership unity. Affiliation Secretary and Newsletter Editor John Suppe has set a high standard of quality and deserves much gratitude. John and other original A.C.G. officers, President Davis Young and Vice President Solomon Isiorho are succeeded by the new Vice President Paul Ribbe of V.P.I., new Secretary/Newsletter Editor David Dathe of Alverno College and myself as President. Fortunately, we retain Ken Van Dellen as Treasurer.

Jeff Greenberg, A.C.G. President-elect
Professor, Wheaton College

ANNUAL REPORT OF THE AFFILIATION OF CHRISTIAN BIOLOGISTS

The Affiliation of Christian Biologists has completed its second year. This year we received many new members and completed the publication of the third newsletter thanks to our editor, Roman Miller. Roman plans to produce one more publication and then hand the editorship over to Stanley Rice. We had a short but lively meeting at the University of the Nations in Kailua-Kona, Hawaii and enjoyed some marvelous field trips to beautiful tropical gardens, volcanoes and so forth. Our next meeting will be

at Seattle Pacific University, probably just before the August 6-10, 1993 ASA meeting.

Donald W. Munro, President

ANNUAL REPORT OF THE COMPUTER APPLICATIONS COMMITTEE

The ASA Computer Applications Committee seeks to apply new developments in computer technology to ASA as needed for both information and research. In terms of information, the Committee provides to ASA readers a PC-based subject index of all articles and communications in the 42 volumes of the ASA's journal, *Perspectives on Science and Christian Faith.*

This index, actually a data base program and related files, is currently distributed on three 5.25-inch 360kb floppy disks. Starting this year we can also provide the data base on 3.5-inch floppy disks in both the 720kb and 1.44 Mb formats for newer IBM-compatible computers.

The data have recently been updated to include citations up through volume 44, number 3 (Sept. 1992). The subject index now covers about 660 keywords in 90 disciplines. The index is distributed from the main office for a nominal fee of $20.

We note that CD-ROM disks and hardware have come down in price significantly. Also, it is now possible to have data placed on a master CD-ROM for mass distribution at a reasonable cost. Already, a CD-ROM containing several Bible translations and related reference books is being sold for about $40. We hope eventually (given time and money) to provide ASA related literature in this format. The main technical problem is to scan and read printed matter into digital form with accuracy.

Again this year I wish to thank Dr. David Siemens for his ideas and help in support of this committee's goals. As always, ideas and suggestions from all ASA members are welcome.

Paul Arveson, Chair

ANNUAL REPORT OF THE COMMITTEE FOR INTEGRITY IN SCIENCE EDUCATION

The 1989 version of the Committee's booklet for high school teachers, *Teaching Science in a Climate of Controversy*, continues to be distributed and to draw favorable responses.

In 1992 a Spanish translation of *Teaching Science* (*Enseñando ciencia en un clima de controversia)* was published in Spain by Libros CLIE (Galvani, 113, 08224 Terrassa, Barcelona) as two-thirds of a small book, *En el Principio: Una perspectiva evangélica del debate sobre los orígenes*. The Spanish version includes over twenty of the ASA booklet's illustrations. The first third of *En el Principio* consists of a Spanish translation of Charles E. Hummel's pamphlet, *Creation or Evolution?* (IVP, 1989). Translators were professors David Andreu of the University of Barcelona and Enrique Mota of the University of Valencia. The 110-page booklet is part of the Coleccion Andamio series published by Editorial CLIE for the GBU (Grupos Biblicos Universitarios), affiliated with IFES (International Fellowship of Evangelical Students). Andamio publications are widely available in Latin America as well as Spain.

Passage in December 1991 by the ASA Executive Council of a resolution expressing "A Voice for Evolution as Science" encouraged the Committee to continue designing curriculum materials clarifying the difference between evidence and inference, as stressed in the resolution. A pilot project developed by a high school biology teacher was field-tested in 1992 at several stages in the development process.

At the 1992 Annual Meeting in Hawaii, Committee member Walter Hearn described the booklet he has been writing for graduate students, *On Being A Christian in Science.* He distributed a tentative draft with a request for feedback from ASA members, whose helpful suggestions are being incorporated into the next draft, with publication now expected in 1993. The Committee sponsored two other plenary sessions at the Hawaii meeting: a lecture by U. of California law professor Phillip Johnson ("Science and Scientism in 21st Century Education") and another by Access Research Network director Mark Hartwig ("Science Education in the 21st Century").

John L. Wiester, Chair

ANNUAL REPORT OF THE LONG RANGE PLANNING COMMITTEE

For the 1992 Annual Conference in Hawaii, Program Chairman Tom Hoshiko requested that the LRPC be involved in the discussion sessions in order to elicit opinions from the membership about the long range goals of ASA.

Newsletter Editor Walt Hearn included in the announcement of the conference plans that discussions leaders were being sought to address topics of concern for the future of the Affiliation and that these sessions would be organized by the committee chair, David Swift. In response to this announcement, four sessions were organized covering the following topics:

(1) Educational Opportunities in the Third World;

(2) Research and Development Opportunities in the Third World;

(3) Science Education in North America, and;

(4) Opportunities for Service in the North American Science Establishment.

The discussion leaders of the groups were specifically urged to compile a list of concrete proposals upon which the Affiliation and its Council could take action. In the final plenary session of the conference, these proposals were presented and discussed. Each group leader was asked to present the proposals in written form to the ASA Council for consideration.

The leaders of the discussion groups were Stanley Anderson, Paul Chien and Chi-Hang Lee (Group 1), Ken Dormer and Martin Price (Group 2), David Wilcox and John Wiester (Group 3), and Elving Anderson and David Swift (Group 4).

Several areas of present and future concern to the ASA were not covered by the discussion groups, such as the role of the ASA in building bridges between the scientific community and the church, the manner in which ASA should bring young scientists into the Affiliation, and the larger role of ASA in the educational arena to a wider community of individuals potentially interested in the science-faith dialogue. These topics are areas of special interest to members of the LRPC who were not at the Annual Meeting in Kailua-Kona. It is the intent of the committee to assemble a similar list of specific proposals in these areas with the intent to submit these in the form of a final report to the council by the end of the calendar year 1992.

The committee members are Paul Arveson, John Brobeck, George Murphy, Donald Munro and David Swift.

David Swift, Chair

ANNUAL REPORT OF THE ARMS CONTROL COMMISSION

The Arms Control Commission has not met in the past year. However, in light of the present proposals on the negotiating table to reduce the number of warheads to 2500 on each side, etc., a panel discussion at the next ASA meeting would be appropriate. On one side are those who are fearful of either nuclear winter or destruction of the ozone layer (requiring major reductions in the number of warheads to between 200 and 1200 overall), and on the other side are those who are still discussing the issue in terms of second strike capability, in maximalist-minimalist terms. I would be willing to set up such a panel for the summer of 1993.

Stanley Moore, Chair

ANNUAL REPORT OF THE PUBLICATIONS COMMITTEE

Because of an overload schedule at NJIT and health problems the chairman and the committee were relatively inactive this year. I think some "new blood" at the top and among the membership would do much to restore the committee's vitality. I would like very much to serve as a committee member. We are sorry for the loss of Purnell Benson, committee member and specialist in Marketing, who died this year.

Contemporary Issues in Science and Christian Faith, the Resource book, was published this year. Advertising placed in *PSCF* has continued to enhance its sales among our membership.

I would recommend that the committee take a more active role in soliciting proposals and fund raising for ASA publishing ventures. It would help if some committee members had experience in fund raising.

"Caring for Creation: A Christian Perspective on the Environment"

The 1993 Annual Meeting of the American Scientific Affiliation

Seattle Pacific University
Seattle, Washington
August 6 - 10, 1993

The *Search* inserts in the Journal were a valuable service for lay people and should be continued when costs permit.

Jim Neidhardt, Ph.D.
Associate Professor of Physics

ANNUAL REPORT OF THE SPECIAL COLLECTIONS ARCHIVES: WHEATON COLLEGE

Materials continue to be received at Wheaton and filed in The Special Collections Section at Buswell Library. In addition to the 1991 publications, materials concerning Conference and Annual Meeting proceedings and Executive Council Meetings for most of the past 20 years were archived.

A number of attendees at the Annual Meeting at Wheaton in 1991 visited the collection, and it was used heavily this past summer with use continuing throughout the remainder of the year.

Archivist Larry Thompson has pointed out that other special collections include an extensive Frederick Buechner archive, a Calvin Miller collection and a Malcolm Muggeridge collection. The adjacent Wade Center of Buswell Library houses an extensive collection of C.S. Lewis. A list of materials received this year is available from the ASA office.

Robert L. Herrmann

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(Required by 39 U.S.C. 3685)

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B Paid and/or Requested Circulation 1 Sales through dealers and carriers, street vendors and counter sales	0	0
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D Free Distribution by Mail, Carrier or Other Means Samples, Complimentary, and Other Free Copies	318	244
E Total Distribution (Sum of C and D)	3184	2894
F Copies Not Distributed 1 Office use, left over, unaccounted, spoiled after printing	192	256
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Patricia Ames, Treasurer

PS Form 3526, January 1991 (See instructions on reverse)

WHAT EXACTLY IS THE AMERICAN SCIENTIFIC AFFILIATION?

The American Scientific Affiliation (ASA) is a fellowship of men and women of science who share a common fidelity to the Word of God and to the Christian Faith. It has grown from a handful in 1941 to a membership of over 2,500 in 1990. The stated purposes of the ASA are "to investigate any area relating Christian faith and science" and "to make known the results of such investigations for comment and criticism by the Christian community and by the scientific community."

HOW DO I JOIN THE ASA?

Anyone interested in the objectives of the Affiliation may have a part in the ASA. Full, voting membership is open to all persons with at least a bachelor's degree in science who can give assent to our statement of faith. Science is interpreted broadly to include mathematics, engineering, medicine, psychology, sociology, economics, history, etc., as well as physics, astronomy, geology, etc. Full member dues are $45/year.

Associate membership is available to anyone who can give assent to our statement of faith. Associates receive all member benefits and publications and take part in all the affairs of the ASA except voting and holding office. Associate member dues are $40/year.

Full-time students may join as Student Members (science majors) or Student Associates (non-science majors) for discounted dues of $20/year. Retired individuals, parachurch staff, and spouses may also qualify for a reduced rate. Full-time missionaries are entitled to a complimentary Associate membership..

An individual wishing to participate in the ASA without joining as a member or giving assent to our statement of faith, may become a Friend of the ASA. Payment of a yearly fee of $45 entitles "Friends" to receive all ASA publications and to be informed about ASA activities.

Subscriptions to *Perspectives on Science & Christian Faith* only are available at $25/year (individuals), $35/year (institutions) and $20/year (students).

MEMBERSHIP/FRIEND OF ASA APPLICATION/SUBSCRIPTION FORM

(Subscribers complete items 1-3 only)

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

1) Name (please print) _____ Date _____

2) Home address _____

_____ Zip _____ Phone _____

Office address _____

_____ Zip _____ Phone _____

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

4) Place of birth _____ Date of birth _____

Marital status _____ Sex ____ Citizenship _____

Is spouse a member of ASA? _____ Eligible? _____

5) ACADEMIC PREPARATION

Institution	Degree	Year	Major

Field of study (major concentration) _____

Area of interest (20 character limit) _____

Recent publications _____

Please complete back of this form ☞

WHAT DOES THE ASA BELIEVE?

As an organization, the ASA does not take a position when there is honest disagreement between Christians on an issue. We are committed to providing an open forum where controversies can be discussed without fear of unjust condemnation. Legitimate differences of opinion among Christians who have studied both the Bible and science are freely expressed within the Affiliation in a context of Christian love and concern for truth.

Our platform of faith has four important planks, listed on the back of this membership application.

These four statements of faith spell out the distinctive character of the ASA, and we uphold them in every activity and publication of the Affiliation.

WHY MUST THERE BE AN ASA?

Science has brought about enormous changes in our world. Christians have often reacted as though science threatened the very foundations of Christian faith. ASA's unique membership is committed to a proper integration of scientific and Christian views of the world.

ASA members have confidence that such integration is not only possible but necessary to an adequate understanding of God and His creation. Our total allegiance is to our Creator. We acknowledge our debt to Him for the whole natural order and for the development of science as a way of knowing that order in detail. We also acknowledge our debt to Him for the Scriptures, which give us "the wisdom that leads to salvation through faith in Jesus Christ."

Church Affiliation _____

What was your initial contact with the ASA? _____

If you are an active missionary on the field or on furlough or a parachurch staff member, please give the name and address of your mission board or organization.

Name _____

Street _____

City _____ State _____ Zip _____

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

STATEMENT OF FAITH

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

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

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

Amount enclosed _____ Category _____

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

OTHER RESOURCES AVAILABLE FROM ASA

"Teaching Science in a Climate of Controversy"is a 48-page booklet that guides science teachers in presenting origins with accuracy and openess. It is available from the Ipswich office for: $6.00/single copy; $5.00/2-9 copies (sent to same address); $4.00/10 or more copies (sent to same address).

Gift subscriptions to *Perspectives on Science & Christian Faith* are also available. Give the gift of challenging reading for $20/year.

Please enter gift subscriptions for:

Name _____

Address _____

City _____ State _____ Zip _____

Name _____

Address _____

City _____ State _____ Zip _____

We believe that honest and open study of God's dual revelation, in nature and in the Bible, must eventually lead to understanding of its inherent harmony.

The ASA is also committed to the equally important task of providing advice and direction to the Church and society in how best to use the results of science and technology while preserving the integrity of God's creation.

AS A MEMBER YOU RECEIVE:

- ASA's bimonthly Newsletter.
- ASA's science journal, *Perspectives on Science & Christian Faith*, the outstanding forum for discussion of key issues at the interface of science and Christian thought.
- Discount on *Contemporary Issues in Science & Christian Faith: An Annotated Biblligraphy*, the ASA Resource Book — a catalog of science books and tapes on current issues of concern.
- ASA's Membership Directory.
- Opportunities for personal growth and fellowship, through meetings, conferences, field trips, and commissions.
- *Search: Scientists Who Serve God*, an occasional publication relating current trends in science and the people involved in them.

* * * * *

THE CANADIAN SCIENTIFIC & CHRISTIAN AFFILIATION was incorporated in 1973 as a direct affiliate of the ASA, with a distinctly Canadian orientation. For more information contact:

Canadian Scientific Affiliation
P.O. Box 386
Fergus, Ontario N1M 3E2 CANADA

The American Scientific Affiliation

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

Canadian Scientific & Christian Affiliation

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

LOCAL SECTIONS

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

Central California	Chicago-Wheaton	Delaware Valley	Eastern Tennessee	Guelph, ONT
Indiana-Ohio	New England	NY-New Jersey	North Central	Oregon-Washington
Ottawa, ONT	Rocky Mountain	St. Louis	San Diego	San Francisco Bay
South Central	So. California	Southwest	Toronto, ONT	Vancouver, BC
Virginia-Kentucky	D.C.-Baltimore	Western Michigan	Western New York	

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Vol. 1-15	(1949-1963),	Journal ASA	15,	126-132	(1963);
Vol. 16-19	(1964-1967),	Journal ASA	19,	126-128	(1967);
Vol. 20-22	(1968-1970),	Journal ASA	22,	157-160	(1970);
Vol. 23-25	(1971-1973),	Journal ASA	25,	173-176	(1973);
Vol. 26-28	(1974-1976),	Journal ASA	28,	189-192	(1976);
Vol. 29-32	(1977-1980),	Journal ASA	32,	250-255	(1980);
Vol. 33-35	(1981-1983),	Journal ASA	35,	252-255	(1983);
Vol. 36-38	(1984-1986),	Journal ASA	38,	284-288	(1986);
Vol. 39-41	(1987-1989),	Perspectives	42,	65-72	(1990);
Vol. 42-44	(1990-1992),	Perspectives	44,	282-288	(1992).

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

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

ARTICLES

COMMUNICATIONS

DIALOGUE

BOOK REVIEWS

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

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