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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MANUSCRIPT GUIDELINES

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Thursday or Friday?

Biblical scholars occasionally contact the ASA office for help. A recent request involved an attempt to clear up the chronology of Holy Week. Did Christ die on Thursday or Friday? An analysis of relevant texts in the Gospel of John and the Synoptic Gospel coupled with Amos 8: 7–10 led to the conclusion that Christ was crucified on a Thursday. This interpretation noted that there was no conflict with the traditional observance of Good Friday, because the timeline was altered as the Amos passage was fulfilled. Our Friday today corresponds to Thursday in Jesus' day. Key for this was the supernatural cessation of the normal motion of the Sun while the earth continued its normal path. This allowed the right combination of events to provide a total eclipse at noon and ultimately have it both ways.

My concern is not with biblical exegesis but with the request that the ASA comment on the scientific aspects of the sun "standing still." The assumption seems to be that you find a verse that seems to fit the situation, link it with an abnormal physical event, then look for supporting scientific justification. This kind of request occurred more often in the early days of the ASA in an evangelical community which emphasized a more highly literal reading of Scripture.

My response was to remind the writer of the Anglican tradition, held by Robert Boyle and John Wesley, that some things in theology and nature are not meant to be known. In this case solar physics is unlikely to find a marker for this singular event. Our scholar reminded me that the purpose of the ASA is to investigate *any* area that relates Christian faith with science. Perhaps a restatement is in order.

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In This Issue

In the month that Spring makes an uncertain appearance it is appropriate to lead with Steven Bouma-Prediger's "Creation Care and Character: The Nature and Necessity of Ecological Virtues." The value of studies concerned with the care of creation must be buttressed by such virtues as respect, receptivity, self-restraint, frugality, humility, honesty, wisdom, hope, patience, serenity, benevolence, love, justice, and courage—"character is central to care of creation."

The claim that theology is a science has long been viewed with disdain by philosophers, theologians, and scientists alike. Greg Peterson seeks to counter this view by arguing that the philosophy of science developed by Thomas Kuhn and Imre Lakatos can be applied across many disciplines, including theology. He argues a nuanced "scientific" approach which can enhance theological understanding. For Peterson, "Religion is the living of the faith, theology represents a second order reflection on that faith ... the two are ultimately interconnected."

Jim Ball's communication seeks to describe and analyze the concept of ecology contained in the evangelical Protestant response to the ecological crisis, and to raise questions about its use. He separates this response into four stewardship types: wise use, anthropocentric stewardship, caring management, and servanthood stewardship. These typologies have been expressed thematically along seven lines. Ball views interdependence, community, and human participation as features that need to be emphasized.

Mathematicians have recently made fresh attempts to demonstrate the *religious* significance of their discipline. In the closing communication, Brendan Kneale offers a historical study of the link between the infinity considered in mathematics and the infinity found in religion. He finds contemporary methodologies in dealing with mathematical infinity to be rich in theological import.

Richard Bube begins our book review section with a full-orbed review of the four volume *Facets of Faith & Science* edited by Jitse M. van der Meer. In capturing the thought of the sixty papers in this exceptional series, Bube reminds us that it is important to have experience in "doing science" before we speculate about its historical and philosophical implication and to distinguish between what "science is" and what "scientists say"—sticky points.

Young Scientists' Corner

From the "Ideal" to the "Real" World

Anonymous*

With two academic scientists for parents many would say it was inevitable that I, too should become one. Yet, it can honestly be said that a push in the direction of a career in science was never given, unless you count our family's ritualistic Sunday afternoon nature walks in the woods. No, becoming a scientist, and an analytical chemist at that, was a product of God's leading through my own interests and fascinations.

Growing up, I was not acutely aware of the strain of science vs. religion which seems to have been experienced by many other ASAers. This is probably because both my scientist parents were also strong Christians who served at a Christian college, without any apparent philosophical difficulty. They clearly taught me and my younger siblings that the heavens and the earth were God's awesome creation, and we were to be good stewards of them. I cannot recall any sermons being preached on the topic in our conservative Presbyterian church, which I joined by profession of faith at age 12. In school, I found my Christian faith far more at odds with the social studies curriculum than with the science curriculum. To this day, I still wonder how anyone could encourage 13 year olds to establish and act according to "value systems" which were entirely self-generated. Influence from parents, church, or tradition (history) was expressly forbidden!

I first began to consider issues of science and Christianity while in college. This was prompted mostly by papers read in the ASA journal (my father had enrolled me as a student member) and impromptu debates with fellow students. However, time for these considerations was limited by a rigorous, pre-med curriculum. In my senior year, I took an instrumentation class for organic chemists and was intrigued by the capabilities of modern analytical equipment. Much to the chagrin of my Ivy League mentors, this prompted a change of career direction toward graduate school in analytical chemistry. As I reflect back on this decision, I see God's leading me into a discipline for which I was well suited and motivated by the call for stewardship (my interest was in developing better methods to detect environmental pollutants).

It is now ten years since I completed my Ph.D. and my career is underway as a research and development chemist developing portable instrumentation for environmental applications. During that time, I have often found working in the "real world" difficult as a Christian. Although science/religion debates with fellow students were at times heated and frustrating, my Christian perspective was tolerated by my collegiate peers. I think this was largely a product of academia's encouragement of open-minded inquiry, where the pervasive attitude is that all views deserve a respectful hearing as part of a well-rounded liberal arts education. I have found little of this open-mindedness in the business world. Instead, my working colleagues espouse in no uncertain terms that Christianity has nothing to do with science and should remain outside the workplace. My present employer has officially stated in company policy memoranda that involvement in "science/religion activities will not be supported."

**ASA Member*

While to some degree I was prepared for the dismissal of a Christian view of science in the secular workplace, I did not anticipate the way in which I have found science to be conducted. Again, my academic experiences led me to expect that working scientists were primarily engaged in the pursuit of truth, and therefore the integrity of scientists would necessarily stand high above that of other professionals. This view was expelled during my first five years of employment at a large national laboratory. While there, I learned much about government bureaucracy and discovered that most "scientists" were really engaged in the business of technology. The typical scientist spent most of his time promoting his ideas (whether original or borrowed) and previous accomplishments in pursuit of funding. In many instances, good science took a back seat to sales ability. This approach was successful, I learned, because research funding decisions were frequently made as much on the basis of "politics" as innovative scientific thinking. It was only through the Lord's provision that I was able to secure regular project funding. However, in time it became apparent that there was no commitment by my employer to actually implement the instruments I was developing in my projects—i.e., my work would effect no active stewardship of God's creation. Therefore, I moved on to the private sector where I was promised that things would be different.

While to some degree I was prepared for the dismissal of a Christian view of science in the secular workplace, I did not anticipate the way in which I have found science to be conducted.

Working for the past five years as the sole Christian in a small contract research and development laboratory of seventy people has presented its own challenges. Compared to the government laboratory, I have found little difference in the general way that science is conducted in this type of private business, although the drive to produce something useful (salable) is certainly keener. I believe that most of the challenges I have met here are not unique to a scientific enterprise and are faced by many Christians in the secular business world. Dishonest treatment of fellow employees and customers, office gossip, and irreverence for God are some of the things which I have frequently encountered. In one instance, refusing to lie about the capabilities and accomplishments of our company to a potential customer, I was slandered by a retaliatory superior and the new project was taken away from me. In situations such as these, I have found support and solace in prayer, the Scriptures, my family, and fellow church members in the business community. Above all else, I have found that it is essential that my actions obey God's Word as a witness to Christ. This is especially true in a small business, where the Christian stands out.

It is not my objective to paint a picture of science as an evil vocation from which Christians should flee. Instead, my early work experiences cause me to become increasingly convinced that science is theologically neither more nor less at odds with Christianity than other professions. For the Christian in any profession, working for God's glory is of paramount importance. For the scientist in business, the greatest struggles will probably be in the area of interpersonal relationships with non-Christian coworkers—not science-religion debate. I want to emphasize too, that as a scientist in my current position, I now feel a special blessing and peace as an active steward of God's world. For me, my science and faith are integrated in this way. In relating so many adverse experiences above, it is also not my goal to discourage younger scientists; rather, my hope is to let them know that they are not alone in the difficulties they will face in the secular business world. To those just leaving academia, be ready to encounter a scientific workplace that may be very different from that you have known or expected. In closing, my last word of advice is: seek to establish strong fellowship with other Christians in science. They will be an invaluable source of encouragement to you. Look foremost for those in your workplace, but remember that fellow ASA members are there too. It is the goal of forums such as this one to help open communication and foster relationships between older and younger ASA members in a spirit of mentoring. May God help each of us in this endeavor as we seek to bring glory to him in the workplace. ✦

For the scientist in business, the greatest struggles will probably be in the area of interpersonal relationships with non-Christian coworkers—not science-religion debate.

News & Views

Directed or Adaptive Mutation?

by Alan McCarrick, The Christian Academy, Media, PA

A confusing group of terms (directed, adaptive, selection-induced, Cairnsian) describing mutations has spread in the scientific literature. As I see it, two basic areas can be distinguished: (1) an increase in the beneficial mutation occurring in stressed organisms;[1] and (2) the imposition of a specific selection on large numbers of organisms in order to find and amplify certain novel mutations.[2] The first aspect is most important to the evolution/creation discussion, the second to the pharmaceutical industry.

In the September 1997 issue of *Scientific American*, Tim Beardsley reviewed the current Adaptive Mutation situation.[3] The possibility that living organisms possess the ability to select for beneficial mutations when stressed has challenged the conventional notion that mutations are purely random events and overwhelmingly harmful. The starting point was a 1988 article by Cairns et al.[4] In those experiments, bacteria deprived of the ability to utilize lactose were plated onto media with only that food source available. Cairns reported a significant increase in the occurrence of mutations that restored the lactose utilization ability compared with the same bacteria living with other sugars available.

The most conservative explanation is that cells may simply sustain higher rates of random mutations (hypermutation) under stress. This may be for no other reason than that the resting bacteria experience a breakdown of their normal biochemical processes. Therefore, rare beneficial mutations will numerically occur more often. A more radical explanation is that the genetic tool box of cells selectively mutates portions of its DNA with a much higher likelihood of achieving beneficial results. A debate of these issues can be found in *Science*.[5] In my opinion, the weight of evidence seems to be on the side of non-random mutation (shades of Lamark!). God seems to have incorporated into life the ability to "find a way." ✦

Notes

[1]J. Cairns, J. Overbaugh, and S. Miller, "The Origin of Mutants," *Nature* 335 (1988): 142–5 and A. Gillis, "Can Organisms Direct Their Own Evolution?" *Bioscience* 41 (1991): 202–4.

[2]M. Wright and G. Joyce, "Continuous in Vitro Evolution of Catalytic Function," *Science* 276 (25 April 1997): 614–7 and G. Joyce, "Directed Mutation," *Scientific American* (December 1992): 90–7.

[3]T. Beardsley, "Evolution Evolving," *Scientific American* (September 1997): 15–8.

[4]J. Cairns, J. Overbaugh, and S. Miller, "The Origin of Mutants," *Nature* 335 (1988): 142.

[5]A series of letters with references in *Science* 269 no. 21 (July 1995): 285–9.

Strange Bedfellows

by Arthur Chadwick, Southwestern Adventist University, Keene, TX

The Spring/Summer 1996 issue of the postmodernist ("pomo") journal *Social Text* unwittingly laid the roots for the unfolding of the most notorious academic prank in recent years. Alan Sokal, a physicist from NYU, troubled by the growing influence of postmodernist philosophy on science, submitted a fully contrived essay to that journal entitled "Transgressing the Boundaries: Toward a Transformative Hermeneutics of Quantum Gravity" (http://www.physics.nyu.edu/faculty/sokal/transgress_v2/transgress_v2.html). The erudite, apparently carefully studied piece argued against the existence of an external, knowable world, using the convoluted verbiage of "pomo" and suggested that even physics was just another venue for cultural criticism. For example, he states:

> It has thus become increasingly apparent that physical "reality," no less than social "reality," is at bottom a social and linguistic construct; that scientific "knowledge," far from being objective, reflects and encodes the dominant ideologies and power relations of the culture that produced it; that the truth claims of science are inherently theory-laden and self-referential; and consequently, that the discourse of the scientific community, for all its undeniable value, cannot assert a privileged epistemological status with respect to counter-hegemonic narratives emanating from dissident or marginalized communities.

Not that Sokal believed a word of it, but the editors, taken in by the possibility of so eminent a scientist defecting to their ranks, published the article without external review. Sokal immediately revealed the prank in the May 1996 issue of *Lingua*

Franca (http://www.physics.nyu.edu/faculty/sokal/lingua_franca_v4/lingua_franca_v4.html) to the absolute horror of the *Social Text* editors Bruce Robbins and Andrew Ross, but to the delight of many in the scientific community. The editors responded by attacking Sokal as a scientist and as a person (Stanley Aronowitz, the founder of the journal suggested he was "ill-read and half-educated"—a condition apparently missed by the editors while accepting his article for review). Subsequently the editors made things worse by insisting that they really never were taken in by the ruse, even claiming "From the first, we considered Sokal's unsolicited article to be a little hokey" (http://www.nyu.edu/pubs/socialtext/sokal.html).

Whatever one's opinion of postmodernism, there is a feeling shared by some inside as well as outside of science that Sokal transgressed the boundary of acceptable conduct in making his point. Postmodernism is largely an outgrowth of the loss of perspective in a society where for over a century scientific rationalism has prevailed. For example, the once popular view of science as a revolutionary process elaborated by Thomas Kuhn, a view supported by the entire historical development of science, was rejected finally, not because it did not comport with experience, but because such a model clashed with the more rational linear, cumulative view of science presented in every textbook. For whatever excesses postmodern advocates have been guilty of (and there are plenty of examples), they have had a role in drawing attention to the excesses and limitations of a purely rationalistic worldview. In an ironic twist, Sokal's farcical article unconsciously draws attention to the very excesses of science postmodernistic thought has sought to address. Perhaps at least part of the joke is not on the advocates of "pomo." In any case, a continued, spirited and occasionally acrimonious debate between the editors and Sokal has ensued, and it is clear they share precious little common ground.

There is, however, one element that these advocates of antithetical views may find as common ground. While they cannot agree about whether the universe exists or has meaning apart from context, or whether there are universal truths or even any truth, perhaps they can agree that creationism does not belong in the science classroom. At least this was the hope of *Social Text* co-editor Robbins during a panel discussion with Sokal and others in the Physics Department of Rutgers University. He states:

> I will conclude by saying that we may not agree on a common epistemology, but I think we have a better chance at a common politics. If and when we have to argue with people who want creationism given equal time in science class, we are going to be on the same side, and we should perhaps remember that when we talk to each other.

By depicting creationism as the common enemy, Robbins may have been attempting conciliation, knowing postmodernists are sometimes accused of aiding the cause of creationists, through their deconstructing of science. He might have been surprised if he had sought Sokal's response. What could have been Robbins' justification for this statement, since as a postmodernist, he could not argue, as Sokal might have, that there is a body of evidence that contradicts the assertions of fundamentalist Creationism? But what a sad commentary on the values of two disparate worldviews that the only common ground they can find is a common antipathy for the view that God created life on the earth. Whatever perspective one may entertain respecting the details of or meaning of "Creationism," this is bad news for those in pursuit of Truth. ✦

Sources for further information:

http://www.blarg.net/~jwalsh/sokal/ includes the text of the original articles as well as a number of subsequent discussions and debates.

http://www.nas.org National Association of Scholars web page. Numerous links to "pomo" related subject matter.

http://www.nyu.edu/pubs/socialtext/sokal.html *Social Text* editors respond to Sokal

http://www.blarg.net/~jwalsh/sokal/articles/bog_tls.html Steven Weinberg analyzes Sokal's article.

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Creation Care and Character: The Nature and Necessity of the Ecological Virtues

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This article explores a neglected but significant area of research in ecological ethics, namely, virtue theory. More precisely, the author attempts to answer this cluster of questions: What exactly is a virtue? Are there particular virtues which arise from a biblically informed Christian ecological ethic? If so, what are those virtues? How important are they? Are they merely nice to have or are they necessary? The thesis is that certain virtues—like frugality, humility, and wisdom—are indispensable if Christians are to responsibly fulfill their calling to be earthkeepers. In short, certain character traits are central to creation care.

Much has been written in recent years in the area of ecological ethics,[1] including Christian ecological ethics.[2] The vast majority of this scholarship adopts, intentionally or not, one of two basic ethical perspectives: deontology, a focus on rules and obligations, or teleology, attention to goods and consequences. While there has been important and influential work done in the area of virtue theory or areteology in moral philosophy[3] and Christian theological ethics,[4] relatively little has been done on the application of virtue theory to ecological ethics, at least from a Christian point of view.[5]

This paper will explore this often neglected area of ecological ethics. More precisely, it will ask and seek to answer this cluster of questions: What exactly is a virtue? Are there particular virtues which arise from a biblically informed Christian ecological ethic? If so, what are those virtues? How important are the virtues? Are they merely nice to have, or are they necessary?

As the subtitle of this paper indicates, my thesis is that certain virtues are indispensable if Christians are to responsibly fulfill their calling to be earthkeepers. In short, certain traits of *character* are *central* to *creation care*. I attempt to redeem this claim by first gaining greater understanding of the nature of virtue. What is virtue and what are the virtues? In the second section, by attending to Scripture, I draw out various theological motifs and ethical principles and in so doing develop a list of virtues and corresponding vices. Which virtues are prominent in the Bible, especially with respect to the study (ecology) and ordering (economics) of the household that is the earth? Along the way I (all too briefly) argue for the necessity of these ecological virtues.

The Nature of Virtue

Virtue is one of those phenomena, like pornography and religion, about which it is often said: "I can't define it, but I know it when I see it." We all have some intuitive sense for what virtue is—or more exactly what certain virtues are, like courage and justice and humility—even if we find it difficult to define. But what precisely is virtue? Can it be delimited with any precision? If so, how? While there remains considerable debate concerning the nature of virtue, there is little controversy over where to look to find insight into the question, for almost all who ponder this issue return to Aristotle and Aquinas. As Philippa Foot puts it: "In spite of this recent work [on virtue theory], it is best when considering virtues and vices to go back to Aristotle and Aquinas."[6] Foot goes so far as to claim that "it is my opinion that the *Summa Theologica* is one of the best sources we have for moral philosophy."[7] Simi-

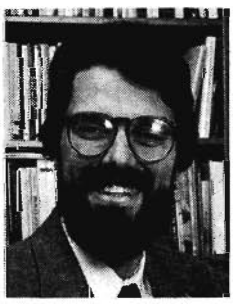
larly, Alasdair MacIntyre in his magisterial *After Virtue* turns to Aristotle (and in his later work Aquinas) for guidance in developing his own virtue-based moral philosophy. So as we seek to answer the question of the nature of virtue, let us turn to these two influential thinkers.

In his famous discussion of virtue in book II of the *Nicomachean Ethics*, Aristotle first speaks of virtue (*aretê*), better translated excellence, in terms of habits. Virtues, especially moral virtues, are formed by habitual behavior (ch. 1). We become just, says Aristotle, by doing just acts, and brave by doing brave acts. In other words, our doing shapes our being, our conduct forms our character. This understanding of moral virtue in terms of character is reinforced when Aristotle distinguishes between acts which create virtue and acts which flow from virtue (ch. 4). The question is a common one: If the doing of virtuous acts requires that one already be virtuous, how then is virtue acquired? Aristotle argues that "if the acts that are in accordance with the virtues have themselves a certain character it does not follow that they are done justly or temperately" (1105a 30). The necessary conditions for virtuous action include, in addition to the act being in accord with the virtues: (1) that the agent must have knowledge of the act; (2) that the agent must choose the act, and choose it for its own sake; and (3) that the action "must proceed from a firm and unchangeable character" (1105a 35). Therefore, a just act may not necessarily be done by a just person. A person may have performed such an act unknowingly, or accidentally, or merely to appear just. The just acts of a truly just person, in contrast, are typical of that person's character.

Virtue is, Aristotle concludes, neither a passion nor a faculty but a state of character (ch. 5). That is, a virtue is not a feeling or a capability to feel since neither involves choice. Passions, like anger and fear, as well as the capacity to have such passions are part of our natural human endowment and as such are neither praiseworthy nor blameworthy. Virtues and vices, on the other hand, are "modes of choice or involve choice" (1106a 4). They are dispositions to act by reference to which we are rightly praised or blamed (1106a 6). So, in short, a virtue is something like a settled disposition to act excellently. It is a state of praiseworthy character, developed over time, and made perfect by habit.

Aristotle further refines his notion of virtue or excellence by describing it as a mean lying between two extremes (ch. 6). For example, courage is that excellence of character which disposes one to act, when fearful, in neither a rash nor cowardly way. Moderation is that excellence of character which disposes one to act, when faced with various pleasures, in neither a self-indulgent nor insensible manner. Since there is no algorithm for determining in every situation what the mean is, Aristotle affirms that ultimately we must look to recognized exemplars of virtue—people of great practical wisdom—in order to know how to act "to the right person, to the right extent, at the right time, with the right motive, and in the right way" (1109a 27). Given that this is so, Aristotle wryly remarks: "it is no easy task to be good" for "in everything it is no easy task to find the middle" (1109a 24). With his understanding of virtue as a mean Aristotle not only points to the significance of practical wisdom (*phronêsis*)—itself an intellectual excellence—but also indicates how important it is to have role models, people of virtue, to whom one can look for guidance and insight.

Aristotle ties these various strands together in his final definition of virtue, especially as it pertains to moral virtue: "virtue, then, is a state of character concerned with choice, lying in a mean, i.e., the mean relative to us, this being determined by a rational principle, and by that principle by which the man of practical wisdom would determine it" (1107a 1). In other words (bracketing the issue of intellectual virtue), a moral virtue is an excellence of character, developed by conscious choices over time for which one can and should be praised, which disposes one to act in such a reasonable way as to



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avoid extremes—to act, in short, as a sage would act. As Aristotle argues in *Nicomachean Ethics* books I and X, it is the life of virtue—not the life of pleasure, wealth, or honor—which constitutes living well (*eudaimonia*).

... a moral virtue is an excellence of character, developed by conscious choices over time ..., which disposes one to act in such a reasonable way as to avoid extremes ...

Aristotle's treatment of virtue is outdone only by Thomas Aquinas, who provides one of the most detailed discussions of virtue available. In his *Summa Theologiae* I–II, questions 49–67 (the so-called "Treatise on the Virtues"), Aquinas delves with considerable depth into a host of issues dealing with virtue and the virtues. After an extended exposition on the nature, formation, and variety of habits or dispositions (*habitus*), in question 55 he addresses "the essence of virtue." For Aquinas a human virtue (*virtu*) is a kind of habit or disposition (article 1). More exactly, a virtue is "an operative habit" for it "implies a certain perfection of power." That is, while there is power with regard to both being (body) and acting (soul), human virtue pertains "only to that which is proper to the soul." In short, virtue has to do with human action (article 2). Virtue is, furthermore, a good habit. Since virtue is the perfection of a power, and since such perfection is the maximum of that power, and since the maximum must be what is good, human virtue "is a good habit and productive of good works" (article 3).

With this background in mind, Aquinas offers a definition of virtue which he borrows from Lombard's *Sentences* (and ultimately Augustine), and explains and defends this definition part by part. A virtue is "a good quality of the mind, by which we live rightly, of which no one can make bad use, which God works in us without us" (article 4). This definition, Aquinas remarks, "expresses perfectly the whole nature of virtue" for it encompasses all four of the Aristotelian causes. First, the formal cause is expressed in the claim that virtue is "a good quality" or, as Aquinas prefers, a good habit or disposition. Second, virtue is a good quality "of the mind"—the material cause in the sense of that in which virtue is, i.e., a subject. Third, the final cause or end of virtue is made evident in the statements that virtue is that operative habit "by which we live rightly" and "of which no one can make bad use." And fourth, the efficient cause of (infused) virtue is indicated by the phrase "which God works in us without us." In sum, for Aquinas, virtue is a firm disposition in humans to act necessarily for the good; and while some virtues can be acquired through habitual human action (though not without divine action), other virtues must be caused in us by God without any action by us (though not without our consent).

While Aristotle and Aquinas provide rich insight into the nature of virtue, more recent thinkers offer additional clarity. For example, while agreeing with both Aristotle and Aquinas that virtue is a good quality—that it is in some sense beneficial—Philipa Foot asks how virtue differs from other beneficial qualities like memory and concentration. Pursuing this question, she concludes that virtues have as much to do with dispositions, desires, and attitudes as with intentions.[8] While "it is not wrong to think of virtues as belonging to the will," she asserts that the will "must here be understood in its widest sense, to cover what is wished for as well as what is sought."[9] Robert Roberts concurs with Foot in claiming that there is more to virtue than merely that which belongs to the will, since some virtues are or involve emotions, e.g., gratitude, hope, peace, and compassion, and other virtues are in large measure skills, e.g., courage, moderation, and patience.[10] Thus the definition of a virtue must include more than intentions, dispositions, and the like. Virtues go beyond the will and/or the mind to encompass the whole person.

Like Aristotle and Aquinas, Foot distinguishes between virtues and other practical excellences, such as arts and skills. Because deliberate mistakes in art or skill, e.g., spelling, are exculpable while deliberately vicious actions are not, arts and skills are mere capacities, she claims, while virtue "must actually engage the will."[11] Gilbert Meilander agrees with Foot that "the virtues are not simply techniques."[12] According to Meilander, while virtues are like skills in that they require habitual practice, it is nevertheless more accurate to think of virtues as traits of character. But is this distinction airtight? Are virtues and skills quite different things? Roberts thinks not, since he identifies a class of virtues which "are to a large extent skill-like."[13] These moral strengths he calls "virtues of will power" since they are not inclinations, desires, or motivations to act excellently, but "a family of capacities for *resisting* adverse inclinations."[14] In other words, honesty, justice, and compassion are "substantive virtues" because "they are the psychological embodiment of ethical rules;"

patience, courage, and moderation, on the other hand, are "virtues of will power" and do "not imply any characteristically ethical patterns of behavior, judgment, or emotion."[15] Racists and thieves can be patient and self-restrained. As Roberts perceptively observes, "actions exhibiting courage and self-control are not done *out of* courage and self-control," whereas actions exhibiting justice and compassion are done out of moral motives, though "such actions may be done *by virtue of* courage and self-control and patience" if the circumstances demand them.[16] So it seems that a certain class of virtues is more skill-like and less moral than is often acknowledged and that certain virtues have what Plato in the *Republic* calls a "preserving" function (429c).

All virtues shape our character and substantially influence how we see the world.

Foot also argues that virtues are, by and large, corrective. That is, each virtue stands "at a point at which there is some temptation to be resisted or deficiency of motivation to be made good."[17] Courage and moderation, for example, are necessary only because fear and desire for pleasure function as temptations. And justice and love "correspond not to any particular desire or tendency that has to be kept in check but rather to a deficiency of motivation."[18] But is Foot correct to think that virtually all virtues are corrective in this way? Once again, Roberts demurs. While courage and moderation may be necessarily or intrinsically "corrective," virtues like industriousness, hope, and honesty are not corrective, since "industriousness could exist in a world in which no one suffered from laziness, and hope in a world where no one ever despaired, and honesty in a world where no one ever lied."[19] This difference between those virtues which are corrective and those which are not, or are so only in some trivial sense, corresponds to Roberts' distinction between "the virtues of will power," like courage and moderation, and "the substantive virtues," e.g., hope and honesty.

One additional piece of the puzzle must be added to make the picture (for our purposes) reasonably complete. Meilander and Stanley Hauerwas make this point especially well, namely, that whatever else is true about virtue, virtue is primarily a matter of character. While virtues involve dispositions to act in certain ways, there is "never a perfect or tight fit" between virtue and action.[20] And while virtues are in certain respects skills or skill-like, "virtues engage the will in a way that skills do not."[21] Virtues, according to Meilander and Hauerwas, are best thought of as traits of character. Character in this context refers to that set of attributes or qualities which distinguishes us from others—that complex of traits which marks us as the persons we are. Hauerwas speaks of character as more than merely "the determination of our self-agency," i.e., the sum of all we do as agents; character reflects "the particular direction our agency acquires by choosing to act in some ways rather than others."[22] This way of construing virtue has the benefit, they argue, of highlighting the intimate connection between virtue and vision. The virtues "influence how we describe the activities in which we engage, what we think we are doing and what we think is important about what we are doing."[23] Thus as Meilander puts it: "what duties we perceive—and even what dilemmas—may depend upon what virtues shape our vision of the world."[24] In short, virtue informs vision and vision shapes action.

What does all this reflection on the nature of virtue amount to? While much, much more remains (and needs) to be said, we have now sufficient conceptual resources at hand to gain some greater clarity on what a virtue is. In sum, a virtue is a state of character—with the attendant desires, attitudes, and emotions—formed by choices and habits over time, which disposes one to act in certain ways, and shapes one's vision of the world. Some virtues are intrinsically morally good, while others are instrumentally good. Some have more to do with intellectual excellence, while others have more to do with moral excellence. Some are corrective in the sense that their necessity derives from various temptations; others would exist in a perfect world. All virtues shape our character and substantially influence how we see the world.

The Ecological Virtues

Any responsible Christian perspective must begin with the Bible, since within the Christian tradition—Orthodox, Catholic, and Protestant—Scripture functions as both the source and the norm for thinking properly and living rightly. That is, the Bible is not only one of the main places Christians go—along with tradition, reason, and experience—when seeking guidance on how to live, but the Bible is that source which takes precedence over all others. The canonical Scriptures, as the term implies, are the standard according to which all claims are judged. For evangelical Protestants, this affirmation of the primacy of Scripture is especially important. With respect to virtually any issue, evangelicals instinctively turn to the Bible for insight and direction.

In this section my procedure is as follows. First I examine biblical texts which directly address the issues before us. Such reflections will be brief, but of sufficient depth to properly indicate the biblical basis for the theology and ethics which follow. Next I identify particular theological motifs or themes which emerge from the biblical narrative. Not exactly full-fledged doctrines, these theological motifs nevertheless function like doctrines insofar as they, like doctrines, are portable stories.[25] That is, they attempt to summarize in one word or expression what the biblical text narrates. Lastly I derive certain ethical principles and the corresponding moral virtues or excellences. Needless to say, much will be left unsaid.

Creational Integrity and Dependence

We must begin at the beginning—in the book of beginnings, namely, Genesis. Genesis 1 is a rich and multifaceted narrative. This seminal text communicates much, not only about who we are and what God is like, but also about the character of that which God creates and sustains. For our purposes here, it is important to note a number of things about creation itself. First, creation has a diversity of creatures. Through God's "let there be" the earth brings forth living creatures of every kind: birds, fish, animals both domestic and wild, flying and creeping things, and even sea monsters. Again and again the text speaks of God bringing forth many kinds of creatures. Second, this plethora of creatures—the diversity of life—is good. God sees what God creates and declares it to be good. Indeed, in Gen. 1:31, God sees everything created (not just humans) and declares that it is very good. Creation is a place of beauty, blessing, and delight. Third, creation as a whole evinces integrity or soundness. Because of God's wise and orderly creative activity, the diverse kinds of creatures fit together into a harmonious whole. Creation is a place of shalom—of flourishing fittedness. In short, biodiversity is an intended result of God's wise and orderly creative activity.

This picture of creational integrity and dependence is reinforced in various Psalms. Psalm 104, for example, speaks of all things as having been created by God. Everything in heaven and on earth is a result of God's creative activity. Furthermore, the world God has brought into being is a cosmos—an intelligently designed and meaningfully ordered whole. This cosmos, moreover, is not autonomous, but exists solely because of the continuous care and sustenance of God, its Creator. All creatures—the wild asses, the cedars of Lebanon, the storks, the rock badgers, the young lions—depend upon God for their existence and their flourishing. In addition, God's creatures are valuable not because of their usefulness to humans—though some are useful, indeed essential, to us. Rather, they are valuable to each other: for example, the cedars are valuable as places for birds to nest and the mountains are valuable as places of refuge and rest for the wild goats. Most importantly, rocks and trees, birds, and animals are valuable simply because God made them. Their value resides in their being creations of a valuing God, not in their being a means to some human end. Finally, a close reading of this Psalm reveals that the human creature is but one creature among God's many creatures. We are to cultivate the earth, but in harmony with the needs of other creatures and in such a way that all creation is enabled to sing praises to God the Creator, since the chief purpose of all creatures is to glorify God.

We are to cultivate the earth, but in harmony with the needs of other creatures and in such a way that all creation is enabled to sing praises to God the Creator ...

Psalm 148 is an enthusiastic and eloquent exclamation point to this affirmation concerning the purpose of creation. Here the psalmist calls upon all created things to praise God their Maker: the angels and hosts of heaven; the sun, moon, and stars; fire and hail; snow and frost; water and wind; mountains and hills; fruit trees; wild animals; creeping things; kings, princes, and rulers; women and men—nothing is left out. God's glory is unsurpassed and all creatures are invited to sing in a symphony of praise.

In sum, in these texts we find the theological motif of *creational integrity and dependence*. Individual creatures and creation as a whole have an integrity as created by God and as such have more than merely instrumental value. Creatures are valuable irrespective of human utility and exist to praise God. From this theological theme, we derive the ethical principle of *biodiversity*. Because species have intrinsic value, they have moral standing. And because they have moral standing, humans have certain duties with respect to species.[26] Given, furthermore, that species are dynamic natural kinds, unique and irreplaceable, entire forms of life, the extinction of which is a form of superkilling,[27] I offer the following moral maxim: we should act so as to preserve diverse kinds of life. More exactly, we have a *prima facie* duty to protect and preserve nonhuman species. In other words, while the possibility exists that

other moral considerations could outweigh or overrule this duty, normally we are obligated to preserve nonhuman species. Holmes Rolston proposes the following yet more precise specification of this duty. While we have "no duty of benevolence to preserve rare species from natural extinction," except to save certain endangered species as resources or museum pieces, we do have "a duty of nonmaleficence to avoid artificial" or anthropogenic extinction.[28] That is to say, we have an obligation to avoid human-caused extinction of species and in some cases we are obligated to preserve species whose extinction is, as far as we can tell, a product of nonhuman factors. This duty of nonmaleficence is a *prima facie* duty and thus can be overridden in certain cases, e.g., smallpox or malaria. But the duty to avoid harming nonhuman species still holds and so the burden of proof always resides with those who wish to do harm.

We have an obligation to avoid human-caused extinction of species and, in some cases, we are obligated to preserve species whose extinction is, as far as we can tell, a product of nonhuman factors.

Corresponding to the theological motif of creational integrity and dependence and the ethical principle of biodiversity are certain important moral virtues or excellences of character, namely, respect and receptivity. *Respect* names an understanding of and proper regard for the integrity and well-being of other creatures. A respectful person shows both esteem and deference to the other, because of the unique nature of that other. That which has intrinsic value calls forth a looking back—a respecting—which acknowledges and regards that God-given value. Respect names a look which neither overlooks nor merely looks over. There are two vices which correspond to the virtue of respect. The vice of deficiency is *conceit*, for conceit is ignorance of and disdain for other creatures. It is a failure to recognize the other as other. It is a lack of proper regard. Conceited people show no genuine interest in another, and will, if necessary, violate the integrity of the other—human or nonhuman—to serve their self-centered interests. The vice of excess is *reverence* or overregard for the other. In reverence of this sort, a person regards that which is not worthy of worship as an object of veneration. Reverence in this sense is misplaced regard in which creatures rather than the Creator are worshipped.

Receptivity is shorthand for the acknowledgment of our interdependence with other creatures. It denotes an acceptance of our kinship with our nonhuman neighbors—a willing embrace of our mutual dependence. Receptivity connotes openness and responsiveness to the other. It is a taking in, a *capere*, which nevertheless allows the other to remain other. Receptivity, in other words, is a form of hospitality. The vice of deficiency is *self-sufficiency* or the disposition to act as if we do not need others. It is living as if we can survive and even flourish independent of other creatures—as if we are not contingent creatures but the makers of our own world and destiny. It is living as if we exist *a se*. Self-sufficiency often manifests itself as isolating autonomy. The vice of excess is *addiction* or unhealthy overdependence on another. It is a taking in—a receiving—driven by fear or anxiety rather than grace and freedom. In contrast to the isolation of self-sufficiency, here one finds the inability or unwillingness to be alone.

In short, creation has a God-given integrity or wholeness and is dependent on God its Creator. We have a moral obligation to protect and preserve nonhuman species. Hence, we must cultivate the virtues of respect and receptivity, and actively discourage the vices of conceit and reverence, of self-sufficiency and addiction, in the shaping of our character.

Creational Finitude

The Genesis 1 creation narrative also emphasizes that creation is finite. Despite the manyness—many individual creatures, many kinds of creatures—there is no suggestion here that the panoply of God's creatures or the earth itself is unlimited. Creation has definite limits. Moreover, God's word to humans in verse 28 to be fruitful and multiply does not suggest, as some maintain, that the earth has an unlimited supply of "resources" for an ever growing human population. First, it is often overlooked that this call by God to be fruitful and multiply is (in verse 22) also given to all living creatures. The sea monsters, the fish, and the birds—indeed, every living creature of every kind—is given this command. This calling to reproduce is not a special privilege unique to humans. Second, this imperative is actually not a command at all, but a blessing by God on all living creatures brought forth by God's creative word. As Susan Bratton puts it, God's blessing "is not an ethical imperative, nor is it a way to please God by reaching to excess."[29] Rather, God's blessing conveys a reproductive power intended to contrib-

ute to the flourishing of all creatures on a finite planet. As Bratton concludes: "Human population growth has no mandate to damage or desecrate the cosmos."[30] Creation is finite and humans have no biblical license or warrant to act as if it is infinite.

We have a* prima facie *duty to preserve nonrenewable resources and conserve scarce though renewable resources.

This theme is present is other biblical texts. For example, after the Israelites escaped from Egypt they wandered in the wilderness on the way to the promised land. As narrated in Exodus 16, God provided bread and meat—manna and quail—for them to eat, but only enough for one day at a time. The portions were sufficient for the day, but there was to be no excess. Their resources were not unlimited, lest they forget their dependence on the God who not only delivered them but continued to sustain them. Jesus calls to mind this wilderness experience when he teaches his followers what and how to pray. After three petitions concerning God's glory, he petitions God for human needs. He first prays "give us this day our daily bread" (Matt. 6:11). In other words, in the Lord's Prayer, Jesus asks the provisioning God of the Exodus to give us the nourishment we need for today. As the Israelites received their daily bread, we are to ask for and with gratitude receive food sufficient for the day. This text, in a perhaps unnoticed way, reiterates this theme of finitude and sufficiency. In short, the biblical witness confirms what those most famous of photographs from space portray—that the blue-green sphere on which we live is finite. Only God is unlimited in power, knowledge, duration, presence, and compassion.

In sum, these texts provide us with the theological motif of *creational finitude*. Creation is finite; only God is infinite. There is only so much to go around. The only seemingly limitless physical resource is the energy from the sun—that divine provision fundamental to all life on earth. All else is limited. From this theological motif I derive the ethical principle of *sufficiency*. Given that the earth is finite, I propose the following moral maxim: we should acknowledge the finitude of the earth and act so as to live within our means. More precisely, we have a *prima facie* duty to preserve nonrenewable resources and conserve scarce though renewable resources. This duty applies to a wide range of things—from energy to species. We should, for example, conserve our fossil fuels like coal, oil, and natural gas, for once that solar savings account is depleted it will be a very long time before it is replenished.[31] So, too, we should preserve species, for that "resource" once gone will never return.

Corresponding to the theological motif of creational finitude and the ethical principle of sufficiency are the moral virtues of self-restraint and frugality. A cardinal virtue of the Greeks, *self-restraint* is moderation of inordinate desires. What is sought is not the extinction of all desire—as if that were possible—but the control of desire. Disciplined desire is the goal. To use an old-fashioned word, the virtue is temperance: habitual control of one's appetites or passions. The vice of deficiency is *profligacy* or unrestrained desire. Profligate people are overly self-indulgent at best and wildly extravagant at worst. They lack sufficient self-control. As Aristotle notes, "these people are called belly-gods, this implying that they fill their belly beyond what is right."[32] The vice of excess is *austerity*. Overly self-controlled people mistake masochism for moderation. Austerity implies that the passions are inherently evil. Desire *per se* is dangerous.

Frugality is economy of use or efficient use given the limits of the goods available. It is characterized not by a parsimonious wish to hold in or keep back, but by a desire to use sparingly that which God has provided in order to allow others to live and flourish. Thus rightly understood, frugality represents a form of hospitality. As its etymology suggests, to be frugal is to enjoy (*frui*) the proper use of the finite goods God has given us. The vice of deficiency is *greed*—the disposition to excessively acquire, especially beyond one's need. Avarice is perhaps a more accurate term, for it denotes a craving to acquire which is blinded to the limits inherent in creation. Driven by cupidity, the greedy person lacks any sense of the finitude of the world. The vice of excess is *stinginess* or thrift as an end in itself. Sparing to the point of being mean, the stingy person exhibits no generosity. Fearful of whether there will be enough, the penurious hold in and keep back. Economy for economy's sake is their motto. In the case of each vice, there is no enjoyment of that which God has provided.

In short, creation is finite. We have the moral obligation to preserve the resources God has provided and so joyfully live within our means. We must cultivate the virtues of self-restraint and frugality, thereby discouraging the currently fashionable vices of profligacy and greed while avoiding the vices of austerity and stinginess.

Human Finitude and Faultedness

If creation is finite and we are creatures, then it follows that we are finite. It might seem that this obvious point needs no special attention. However, we have a penchant for forgetting this central feature of our existence. Indeed, we have a deep desire to avoid looking at our finitude, especially our temporal finitude or mortality, straight in the face.[33] For to acknowledge the limited nature of our existence produces anxiety and often fear. It raises the question of whether death is the end of one's life or whether there is Someone who is sufficiently able and willing to preserve our life beyond biological death and in whom we can rest despite our fear and anxiety. Not surprisingly, the Bible speaks often of human finitude. For example, in Genesis 2 the narrative tells us that the human creature is formed out of the ground and is made alive by God's life-giving breath (verse 7). We are *'adam*, earth creature, because we are clumps of earth, *'adamah*, animated by the Spirit of God. Like all of God's creations we are finite.

The finitude of humanity is powerfully portrayed also in the book of Job. After numerous conversations between Job and his friends about Job's plight, chapters 38-41 narrate God's speech from a whirlwind. In the deluge of questions put by God, Job is, among others things, forcibly reminded of his finitude. Job has not commanded the morning or entered the storehouses of the snow or provided prey for the ravens. He does not know when the mountain goats give birth or who lets the wild asses go free. That the hawk soars and the eagle mounts up is not Job's doing. Job's power and knowledge are finite. He is a creature. Even Psalm 8, which speaks of humans as having been created a little lower than God and crowned with glory and honor, reminds us that humans are creatures and therefore finite. We have a God-given dignity and calling, but we are nevertheless limited in our abilities. Only God is infinite and hence worthy of praise—the one whose name is majestic in all the earth.

But we are not just finite; we are faulted. Though often confused, these two are not the same. Finitude is a good feature of human existence. It is simply how God made us—a feature of our humanity to joyfully accept. Faultedness, however, is not God's intention. The brokenness we know in ourselves and all around us is something we acknowledge with regret and seek with God's grace to overcome. This feature of human existence is also powerfully depicted in the Genesis narrative. Adam and Eve desire to transcend their creaturely finitude and become, like God, omniscient. But in this attempt they fail to trust in God and thus become estranged from God. They also become estranged from each other. For example, they scapegoat and attempt to pass the blame. They lose touch with their own true and best self, hiding and concealing their actions. They are out of joint with the earth, working the earth becomes burdensome and toil. In these four ways they, and we, are alienated. In short, our lives are interwoven with a contagion called sin which we knowingly and unknowingly foster. The Bible confirms what we know in our hearts: the world and our own lives are not the way they are supposed to be.[34]

In our care of creation, we must be circumspect and exercise forethought.

In sum, in these and many other biblical texts we find the theological motif of *human finitude and faultedness*. As humans we are creatures—limited in power and knowledge as well as space and time. We are *'adam* from the *'adamah*, humans from the *humus*. We are not God, though we are God's. Furthermore, we are faulted creatures—alienated from God, other humans, ourselves, and the earth. Though we are not God, we all too often think and act as if we are. From this theological motif we derive the ethical principle of *responsibility*. Given the limited scope of our human knowledge and power and given our stubborn unwillingness to admit such limitations, I propose the following moral maxim: we should act cautiously, in full acknowledgment of our limited ability to know the future consequences of our actions and with honest awareness of our penchant for self-aggrandizement and self-deception. To be more precise, we have a *prima facie* duty to survey all possible consequences before making decisions. In our care of creation, we must be circumspect and exercise forethought.

The theological motif of human finitude and faultedness and the ethical principle of responsibility presuppose the moral virtues of humility and honesty. *Humility* is the proper estimation of one's abilities or capacities. It is the fitting acknowledgment that we as humans are earth creatures. Humility implies self-knowledge and unpretentiousness. Aware of their weaknesses, humble people do not pretend to be something other than what they are. The vice of deficiency is *hubris*—exaggerated self-confidence or overweening pride. Here, as for the Greeks, it means the failure to acknowledge one's own limits, often resulting in tragic consequences for all concerned.

Overestimating their abilities, prideful people are vain and boastful. The vice of excess is *self-deprecation*. People who display this vice play down their abilities and speak disparagingly of their legitimate achievements. They are unable or refuse to properly assess their genuine strengths. Aristotle speaks of those who disclaim or belittle their authentic accomplishments as "mock modest."[35]

Honesty is the refusal to deceive others, oneself, or God. Honest people are without guile. They do not have a duplicitous bone in their body. There is, rather, a singleness of intention, a straightforwardness of conduct. Honesty brings with it a what-you-see-is-what-you-get transparency and sincerity. There is no need to do business at night. No need for coverups or slush funds or secrets. The vice of deficiency is *deception* or the culpable failure to be truthful. Deception is willful fraud, represented in the lowest circles (eight and nine) of Dante's Inferno. It is perversion of the truth for personal gain. Deception is cunning misrepresentation, most often fueled by envy and spite. The vice of excess is *false honesty*. Difficult to name but understood by all, this vice has never known a secret that it did not tell. Enamored by Kant's categorical imperative, persons who exhibit this vice always tell "the truth," even if it means turning in Anne Frank to the Nazi stormtroopers. They have no feeling for the relational context of truth-telling, famously described by Dietrich Bonhoeffer in his classic essay "What is Meant by 'Telling the Truth.'"[36] To the falsely honest, truth is truth and must be told, no matter who the conversation partner or what the situation.

In sum, as humans we are both finite and faulted. We have the moral obligation to act responsibly and with forethought. Therefore we must cultivate the virtues of humility and honesty while discouraging the vices of hubris and self-deprecation, deception and false honesty.

Fruitfulness

We have already examined the Genesis texts which speak of God blessing not only humans but all living creatures with the power to reproduce. As we have seen in 1:22 and 1:28, God wills that fish and birds and humans be fruitful and multiply. The ability to bear fruit—to produce others of one's kind—is an important feature of a flourishing creation. As Calvin DeWitt reminds us: "It is God's will that the *whole of creation* be fruitful, not just people. And thus human fruitfulness may *not* be at the expense of God's blessing of fruitfulness to other creatures."[37] This concern for fruitfulness is also evident in the case law of the Old Testament—the various specific instructions meant to guide the Jews in the living of their everyday lives. For example, in Deut. 22:6–7 we read: "If you come upon a bird's nest in any tree or on the ground, with fledglings or eggs, you shall not take the mother with the young. Let the mother go, taking only the young for yourself, in order that it may go well with and you may live long." And just two chapters before we are advised that in laying siege to a town in a time of war "you must not destroy its trees by wielding an ax against them. Although you may take food from them, you must not cut them down" (Deut. 20:19–20). We are permitted to use the fruit of creation, but we are not allowed to destroy the ability of creation to be fruitful. Indeed, as these texts suggest, the kind of wise use which preserves creation's ability to replenish itself is an important ingredient in living well.

We are permitted to use the fruit of creation, but we are not allowed to destroy the ability of creation to be fruitful.

Perhaps the most famous passage which conveys the importance of the fruitfulness of creation is the story of the flood in Gen. 6–9. The narrative tells us that God grieved that he brought humans into existence, for their wickedness and violence wrecked destruction on the earth. God resolved to wash away this wickedness, but decided to spare Noah and his family and two of every kind of living creature, male and female (6:19). So Noah obediently gathered his menagerie of creatures—birds, wild animals, creeping things—in numbers sufficient to preserve their fruitfulness. And there was with Noah in the ark "all flesh in which there was the breath of life" (7:16). In the climatic turning point of the narrative (8:1), God remembered all of the inhabitants in the ark—including the animals—and, as in the beginning of creation (1:2), sent a wind to reorder the chaotic waters. The ark dwellers are saved from the waters—waters which as it turns out cleanse the earth and provide Noah and his kin a fresh start. In chapter nine, the text tells us that God made a covenant not only with Noah but with all the creatures in his floating species preserve. Like a constant drumbeat, six times in verses 8–17 we are told that God's covenant is with "every living creature." Indeed, God's everlasting, unconditional covenant is with "the earth" (verse 13). And the rainbow is not only a sign of promise to us of God's faithfulness, but a reminder to God of his covenant with all creation. In short, in this rich and suggestive story we learn of

the first endangered species act—initiated by God and obediently carried out by Noah. God cares for and covenants with more than just humans. God acts to preserve the fruitfulness of creatures great and small.

We should act in such a way that the ability of living creatures to maintain themselves and to reproduce is carefully preserved.

In short, in these texts we find the theological theme of *fruitfulness*. As designed by God, creation is fruitful. Creatures produce sustenance for others and reproduce themselves. In the interconnected and interdependent world provisioned by God, even the most "unimportant" species, e.g., wild animals, and "ugly" species, e.g., creeping things, are important. From this theological motif, we derive the ethical principle of *sustainability*. From this flows the following moral maxim: we should act in such a way that the ability of living creatures to maintain themselves and to reproduce is carefully preserved. To make this maxim more exact, we have a *prima facie* duty to judiciously use those creatures under our care so as to provide for future generations. We cannot but use plants and animals to survive and maintain our own existence. Like all creatures we affect our surroundings, in part by consuming other organisms. However, we have an obligation to so use the creatures under our care that we provide not only for our own generations but also for the generations—the fruitfulness—of nonhuman creatures.

The virtues implied by the theological motif of fruitfulness and the ethical principle of sustainability are wisdom and hope. *Wisdom* is sound practical judgment based on uncommon insight, honed through long experience, and informed by cultivated memory. It is, as Aristotle puts it, "a reasoned and true state of capacity to act with regard to human goods."[38] Wisdom is an intellectual virtue or excellence of intellect, developed over time, which allows one to live the good life. For Christians wisdom originates, as the wisdom literature in the Old Testament insists, in the fear of God.[39] From a biblical point of view, in other words, wisdom is rooted in the proper worship of God. As far as I can tell, wisdom is not a mean; hence there are not two vices but only one. The vice contrary to wisdom is *foolishness* or the habitual absence of sound judgment. The fool lacks good sense. He shows no discernment and eschews learning from the past. Regarding ecological ethics, foolishness is the disposition to act as if creation is endlessly exploitable and expendable. By living only for today the fool acts as if the future does not matter.

Hope is confident expectation of future good. It is the desire for a good future accompanied by the belief that such a future will come to fruition. Hope is trust oriented forward in time. For Christians this expectation is solidly based on God's promises and God's character as a keeper of promises. Christians hope because they worship a God who keeps covenant with creation. As one of the classic theological virtues, listed with faith and love in 1 Cor. 13, hope is a *sine qua non* for life itself.[40] The vice of deficiency is *despair*, for despair is the absence of any expectation for a good future. As its etymology suggests, it is the loss of all hope (*de-sperare*). Despair is cynicism of a profound kind for it signals a failure or inability to trust. Despair is the hopelessness which leads, as Søren Kierkegaard powerfully describes it, to the sickness unto death.[41] The vice of excess is *presumption*. This vice can take two forms. Sometimes presumption has to do with what we call a presumptuous attitude.[42] That is, in contrast to the confident expectation of genuine hope this kind of false hope exudes an unwarranted overconfidence that tends to take the sought after good future for granted. It is an unwarranted audacity of belief or confidence. But there is another kind of presumption—one that concerns the grounds of belief rather than the level of confidence. Not all objects of hope are worthy of trust. There are many pretenders to hope in our exceedingly anxious world. Prophets (and profits) of easy credulity are lurking everywhere. Gnostic hope is abundant. If some tend to cynicism, others bend toward an illusory expectation that life bears no suffering. As J. Christiaan Beker puts it: "For just as suffering without hope degenerates into passive resignation, cynicism, or despair, so hope without a relation to suffering degenerates into false hope."[43]

In sum, creation is fruitful. We have a moral obligation to use the fruit of creation in a way which is sustainable. Hence we must foster the development of people who embody the virtues of wisdom and hope, and thereby strive to diminish the vices of foolishness, despair, and presumption.

Sabbath

According to Scripture, work is good. As humans we are called to labor, e.g., till the ground (Gen. 2:15), and in our work we are to find joy and blessing.[44] The curse of the fall is not that we now must work, but that our work is now toil and drudgery. It no longer is a meaningful service to neighbor and

a form of worship to God. Even God works. The act of creation itself is a work of God. And at its completion, God rests. In Gen. 2:1–3, we are told that after the heavens and the earth and their teeming multitude of creatures were made, God rested and "blessed the seventh day and hallowed it." God works and God rests, and so also should we and the creatures under our care. The sabbath rest is, as it were, built into the fabric of creation—a divinely blessed feature of our creaturely existence.

We are reminded of this need for rest in the Ten Commandments—better rendered God's ten best ways to live. In Exod. 20:8–11, we are called to "remember the sabbath and keep it holy" for the seventh day is a sabbath to God on which "you shall not do any work—you, your son or daughter, your male or female slave, your livestock, or the alien resident in your towns." Notable for our purposes is the injunction to rest farm animals on the sabbath. Cows and horses and mules need to be rested too. This is spelled out in greater detail in the case law in Leviticus and Deuteronomy. For example, in Leviticus 25 they are told that the land must be given a sabbath rest every seventh year. In the seventh year "you shall not sow your field or prune your vineyard. You shall not reap the after growth of your harvest or gather the grapes of your unpruned vines" because "it shall be a year of complete rest for the land" (verses 4–5). Furthermore, after seven seven-year cycles there shall be a year of jubilee. In the fiftieth year "you shall proclaim liberty throughout the land to all its inhabitants" and "you shall return, every one of you, to your property and to your family." As in the sabbatical year, so too in the year of jubilee "you shall not sow, or reap the after growth, or harvest the unpruned vines" (verses 10–12). And these stipulations are given "so that the land will yield its fruit, and you will eat your fill and live on it securely" (verses 18–19). Life on the land goes better when one observes God's statutes and commandments.

Lest these instructions in shalom-filled living seem quaint or out-of-date—relics from the (very) Old Testament, it is important to take note of the inaugural address of Jesus, as recorded in Luke 4. As he begins his public ministry in his hometown synagogue, Jesus quotes from the prophet Isaiah, chapter 61, and boldly declares that this prophetic text has been fulfilled. He asserts that, empowered by the Holy Spirit, he has come to bring good news to the poor, to proclaim release to the captives and recovery of sight to the blind, to let the oppressed go free, and to proclaim the year of the Lord's favor (verses 18-19). In other words, Jesus announces that in his person the messianic age has come. The year of jubilee—the year of the Lord's favor—is a reality. In short, Jesus the Messiah dramatically reaffirms that the kingdom of God he has come to inaugurate is a reign of redistribution and rest. Those in need will be comforted, those wronged will be set right, and the weary will find rest. Sabbath is gospel.

God intends that humans give the people, animals, and land under their care periodic rest and the opportunity for restoration.

In sum, these texts illustrate the theological motif of *sabbath*. God calls humans to regularly rest from their labors. Indeed, God intends that humans give the people, animals, and land under their care periodic rest and the opportunity for restoration. Such intentional rest and nurture of creatures human and nonhuman resists the relentless use and exploitation which drives much of modern society. From this theological motif I derive the ethical principle of *rejuvenation* and the following moral maxim: we should live in such a way that the creatures under our care are given their needful rest. More exactly, we have a *prima facie* duty to appropriately rest the land and its inhabitants. Though directed primarily to agricultural land and animals, this duty can be reasonably extended to include other things, including species and their habitats.

Corresponding to the theological theme of sabbath and the ethical principle of rejuvenation are the moral excellences of patience and serenity. *Patience* is calm forbearance. It is that trait of character which allows us to resist the press of the moment. It steels us against the temptation to take the fast track. Patience presupposes a long view. As Cardinal Newman once said: "Great acts take time." Patience helps us learn the truth of that aphorism. For Christians patience is grounded in God's merciful forbearance (2 Peter 3:9). In contrast, the vice of deficiency is *impetuousness*. It is the impulsiveness which, fearful of the future, drives us to gratify our desires in the immediate moment, irrespective of the legitimate need of others. Those who exhibit this vice lack the ability to wait. They always eat first at the wilderness supper table. They never put off a purchase in order to pay cash when they can charge it now. The vice of excess is difficult to name, but it is something like *meekness*. I use the term here not in the New Testament sense of gentleness or the endurance of injury without resentment, but to name a deficiency of spirit. It is the disposition to be overly

patient—to wait when one must wait no longer. Meekness in this sense denotes the failure to properly act when the situation calls for prompt action.

Serenity is unruffled peacefulness. It is an inner calm amidst the chaos. It is the relatively rare ability to remain undisturbed by the raging seas surrounding you. It is tranquillity borne not of indifference or apathy, but nurtured by the assurance of God's grace. Serenity is the Augustinian heart finally resting—at home—in God. The vice of deficiency is *restlessness*. It is characterized by fidgety, directionless activity. Lacking any sense of inner peace, the restless person is ruffled by the slightest winds of trouble or discontent. Restlessness is living as if one is never at home. Ever feeling on the road or on the run, such a homeless wayfarer never finds a place to call home. The vice of excess is *passivity*. Unruffled repose can degenerate into a kind of quietude which is indifferent to injustice or sorrow or joy. There is no virtue in an inner calm which resembles rigor mortis. Tranquillity is not lethargy. Being serene is not the same as being passive.

In short, all creatures need sabbath rest. We have the moral obligation to rest and rejuvenate the land and its creatures. And so we must cultivate the virtues of patience and serenity and thereby actively discourage the vices of impetuousness and meekness, restlessness and passivity.

Earthkeeping

In the history of the interpretation of the Genesis, most of the attention has been given to Gen. 1:26–28. There we read that humans are given dominion over the fish and the birds and the cattle and the wild animals and the creeping things. For many readers this means that we humans have license to exploit the nonhuman creatures of the earth. That is to say, dominion is understood as domination. That this reading is clearly wrong, not to mention self-serving, will not be argued here.[45] For even if such a misguided reading were right, it is still the case that many other biblical texts declare that dominion is not domination but responsible care. For example, in Gen. 2:15 we are told that God placed *'adam* in the garden "to till and keep it." These rather pale English words do not, however, do justice to the Hebrew, which speaks of our task to serve (*'abad*) and protect (*shâmâr*) the garden that is the earth. To till the earth means to serve it for its own sake. To keep the earth means to caringly guard it the way that, in Aaron's benedictory blessing, God blesses and keeps his people (Num. 6:22–26). In other words, we are to serve the earth for its own good and keep creation as God keeps us. In summing up the message of this text, Cal DeWitt puts it well:

> Such keeping is not preservation as applied to pickles in a jar; it is the kind of keeping we ask God to give us. When, in accord with Genesis 2:15, we keep the creation, we make sure that the creatures under our care are maintained with all their proper connections—connections with members of the same species, with the many other species with which they interact, with the soil, air, and water upon which they depend.[46]

We are called by God, in short, to be earthkeepers.

That the earth is God's and that we are to keep it is reiterated in many of the Psalms. Psalm 24:1 declares that "the earth is the Lord's and all that is in it, the world, and those who live in it." Contrary to popular opinion, we do not own the earth or its creatures. God is the owner of the earth, for it was God who created it and continues to sustain it. Psalm 95 invites us to make a joyful noise to God not only because God is our Savior, but preeminently because "in his hand are the depths of the earth; the heights of the mountains are his also. The sea is his, for he made it, and the dry land which his hands have formed" (verses 4–5). As we have seen with the flood narrative—perhaps the most powerful biblical reminder of our calling to be earthkeepers, God covenants with all creation. All creatures—indeed the earth itself—are in covenant fellowship with God. Through the faithful work of "Noahs," ancient and modern, all living things are kept, protected, and preserved.

We are to serve the earth for its own good and keep creation as God keeps us.

In sum, in these texts we find the theological motif of *earthkeeping*. God is the rightful and proper owner of the earth. But God gives us the calling to care for creation. We are given the joy and the responsibility to lovingly keep the garden that is the earth—in all of its intricate fullness and dynamic relatedness. Preserving species and their habitats is a central dimension of responsible earthkeeping. From this theological motif, I derive the ethical principle of *beneficence*. Put in the form of a moral maxim: we should act so as to care for the earth's creatures, especially those creatures in need. More precisely, with respect to nonhuman species in particular, we have a *prima facie* duty to actively pre-

serve species threatened with extinction. Here we move beyond Rolston's duty of nonmaleficence to the more demanding duty of beneficence. In other words, it is not enough merely to refrain from doing harm; in certain cases we are morally required to do good. Thus failure to promote the good makes one morally blameworthy.

The earth is the Lord's and the fullness thereof; humans are not owners but earthkeepers.

The moral virtues implied by the theological theme of earthkeeping and the ethical principle of beneficence are benevolence and love.[47] *Benevolence* is the willingness to promote the well-being of the other. Benevolent people are disposed to act kindly. They have a good (*bene*) will (*voluntas*) and thus usually produce (*facere*) good (*bene*) acts—acts which are beneficial. Such good-making acts are willed even if the bonds of affection are absent. It is in this sense that Jesus commands us to love one another (Matt. 22:36–40) for while our affections cannot be commanded, our will can. We can and should will the good, even to those, like our enemies (Matt. 5:44; Rom. 12:19–20), for whom we have no good feelings. There is only one vice corresponding to this virtue since, as with wisdom, benevolence is not a mean but an intrinsic good which admits of no excess. The vice contrary to benevolence, as its Latin etymology suggests, is *malice*. Malice or malevolence is the intention to do evil or cause harm. Malice is ill-will. It is the willful and culpable breaking of shalom.[48] While often fueled by envy and resentment toward particular people, it can also be driven by an unexplainable desire to inflict suffering or cause distress—unexplainable in the sense that no feelings of spite or resentment toward the victim(s) necessarily accompany the willing of such actions. The malevolent can and sometimes do act indiscriminately, e.g., the terrorist whose evil actions are inflicted on a random group of people.

Love, as the term is used here, denotes strong affection for another. It is unselfish concern for the good of that for which one deeply cares. Such bonds of affection and care arise out of some kind of personal relationship, e.g., kinship or friendship, and therefore love stands in contrast to benevolence, for which no such feelings are required. Love is, simply put, the disposition to care for the other whom (or which) one has come to know. As with benevolence, love is not a mean, since there is no excess but only deficiency. Given this concept of love, its corresponding vice is *apathy*. Not to love is to lack (*a*) feeling (*pathos*). Not to love is not to care. The opposite of love is not hatred but indifference. Ecologically understood, apathy is the absence of any feeling of affection or concern for other creatures. Ecological apathy is oblivious to and unconcerned about the havoc wrecked upon the earth. On the other hand, as Aldo Leopold eloquently puts it: "One of the penalties of an ecological education is that one lives alone in a world of wounds."[49]

In short, the earth is the Lord's and the fullness thereof; humans are not owners but earthkeepers. We have a moral obligation to protect the creatures under our care, especially those whose existence is imperiled. Thus we must encourage the formation of people who exhibit the virtues of benevolence and love, while discouraging the vices of malice and apathy.

Righteousness

Two of the most frequently occurring words in the Bible are righteousness and justice. In the Old Testament, God requires, in addition to mercy and compassion, righteousness (*sedâqâh*) and justice (*mishpât*) of his people. For example, the last half of the decalogue assumes that justice among humans is a central feature of human flourishing (Exod. 20:12–17). Stealing and bearing false witness, for example, are violations of justice. They are thefts of goods—material possessions and reputation, respectively—which rightly belong to someone else. The covenant stipulations in Leviticus and Deuteronomy often include requirements to execute justice—especially for widows, orphans, and aliens (e.g., Deut. 10:18, 16:20, 24:17; Lev. 19:15, 19:33)—precisely because such action accords with God's character. The prophets regularly thunder that God's justice be done. Amos proclaims "let justice roll down like waters, and righteousness like an ever-flowing stream" (Amos 5:24). Micah summarizes the requirements of right living in these words: "do justice, love kindness, and walk humbly with your God" (Micah 6:8). And Jeremiah's bones burn with the message of justice (Jer. 7:1–7). We find this concern for justice eloquently and passionately articulated in Psalm 72. In the first four verses, the psalmist prays:

> Give the king your justice, O God,
> and your righteousness to a king's son.
> May he judge your people with righteousness,
> and your poor with justice.
> May the mountains yield prosperity for the people,
> and the hills, in righteousness.
> May he defend the cause of the poor of the people,
> give deliverance to the needy, and crush the oppressor.

The Psalm continues on in this spirit, interweaving appeals for justice with hopes for an abundant and fruitful land. As in many other texts, e.g., Isaiah 24, here justice among people is intimately tied to the health and fruitfulness of the land. Social justice and ecological health are bound up together.

In the New Testament, the words and deeds of Jesus and the message of the apostle Paul also speak of righteousness and justice. Jesus, for example, is keen to redefine for the people of his day what true righteousness is all about. In the Sermon on the Mount, recounted in Matt. 5–7, Jesus emphasizes, often in arresting antitheses, that true piety is a matter of the heart. True righteousness is not a matter of externals, but of purity of heart and hunger for justice. In a famous admonition, Jesus encourages his followers to "seek first the kingdom of God and God's righteousness" (6:33) and in so doing they will receive the nourishment and bodily provisions they need. In Luke 4, Jesus defines his mission, in part, as bringing justice to the oppressed. No amount of interpretive gymnastics can drive Jesus' concern for social justice out of the gospels. Turning to Paul, some would say that righteousness or justice (*dikaiosunê*) is at the center of his understanding of the gospel. It is, of course, the righteousness or justice of God that is most central for Paul—that righteousness which we cannot attain on our own but which Jesus through his death has achieved for us (Phil. 3:9). Though this idea of righteousness as grace or divine favor looms largest for Paul, he is also concerned about justice between people (Phil. 4:8).

In sum, these texts and many others like them give rise to the theological motif of *righteousness*. Because the God of the Bible is righteous and just, those who follow this God must be righteous and just. Of particular concern are those most likely to be treated unjustly, namely, the voiceless, the powerless, the homeless. And while this concern is appropriately and most often directed to humans, it also includes those nonhuman creatures whose voices remain silent to human ears. From this theological theme, I derive the ethical principle of *equity*. Given the notion of justice as equity sketched above, I propose the following moral maxim: we should act so as to treat others, human or nonhuman, fairly. More exactly, we have a *prima facie* duty to treat equals equally and unequals differentially. In other words, equity is not the same as equality. Equality implies sameness: one treats all, regardless of circumstance, the same. Equity implies different treatment when the circumstances warrant it precisely in order to be fair. To cite a homely example, as any parent knows, to be equitable or just one must treat similar children in similar circumstances the same, but treat children in dissimilar situations differently. All the seven year olds at your child's birthday party must be given the same amount of ice cream, on pain of loud cries of injustice. But seven year olds have privileges (and responsibilities) which four year olds do not.

Corresponding to the theological motif of righteousness and the ethical principle of equity are the moral virtues of justice and courage. *Justice* is the disposition to act impartially and fairly. It involves the ability to discern when to treat equals equally and unequals differentially, and thus implies a kind of practical wisdom. Furthermore, Lewis Smedes reminds us that justice implies respect—respect for the rights of others.[50] And as Plato accurately insists, justice signifies a kind of personal integrity—a harmony between the other virtues of wisdom, courage, and moderation. As far as I can tell—like wisdom, benevolence, and love—justice is not a mean and thus has only one corresponding vice, namely, *injustice*. Injustice is the propensity to be partial—to play favorites for no good reason or, more perversely, for personal gain. It is the failure to give people their due. It manifests itself in the continual willingness to violate the rights of others.

Courage is moral strength in the face of danger. It is tenacity in the face of opposition. It is stubborn persistence in the face of adversity. One of the four cardinal virtues for the Greeks, courage implies a firmness of mind and resoluteness of spirit despite the fearful awareness of danger. A virtue particularly sought after by soldiers in the ancient world, in the Christian tradition it was transmuted into fortitude. The vice of deficiency is *cowardice* or the inability to overcome fear without being reckless. At times less directly associated with outright fear, it is a kind of timidity or lack of firm determination to reach one's goals. The vice of excess is *rashness*. While courageous people honestly face their fear and persevere despite its sometimes paralyzing effects, rash people refuse to acknowledge their fear and as a consequence act hastily or without proper caution. In so acting they often puts themselves and/or others in danger.

In short, righteousness and justice are integral features of God's world of shalom. We have the moral obligation to treat others fairly, giving special care to those human and nonhuman creatures which by virtue of circumstance require it. Therefore we must cultivate the moral excellences of justice and courage—while discouraging the vices of injustice, cowardice, and rashness—in the formation of our individual and collective character.

Recapitulation

First, the various kinds of animals and plants which populate the earth are created by God and are therefore valuable, irrespective of their usefulness to humans. Such value implies that we must not needlessly harm those species under our care. We must respect our nonhuman neighbors and with receptivity acknowledge our mutual interdependence and common dependence on God. Second, the earth and its creatures are finite. Thus, we must live within our means, preserving nonrenewable resources, such as species, by exercising self-restraint and living frugally. In so doing we show hospitality. Third, we are limited and often self-deceived in how we view the world. Though we think our crystal ball provides infallible insight into the future, it does not and never will. We must be cautious—acting with humility and honesty—when making decisions about the future of the earth and its inhabitants.

Fourth, the God-designed world is fruitful and able to sustain itself. We must wisely use the creatures under our care so as to provide for future generations. We dare not eat the last seed corn. We must preserve creation's fruitfulness. In so doing we witness to the divinely inspired hope which is within us. Fifth, work is good, but so is rest. We all—people, animals, and land—need a sabbath from our labor. We must allow for times of rejuvenation. With patience and serenity we must resist the relentless drive to exploit. Sixth, the earth is God's, not ours. We are not owners but earthkeepers—called to serve and protect creation. We must be willing to promote the well-being of all those who live within the garden. Fighting malice and apathy with benevolence and love, we follow the pattern of Christ. Seventh and last, the cries for righteousness and justice must not go unheeded. God the Just calls us to do justice, not only with and for hurting humans but with and for an aching earth. We must have the courage of our convictions and treat others justly. That which needs special treatment—homeless people, fragile land, rare species—we are obligated to treat with special care. In all that we do and say, we must gratefully acknowledge our Creator-Redeemer—the Maker of heaven and earth—who richly provisions us for the journey.

Conclusion

Regarding caring for creation there is much good work to be done. There are biological field studies to perform. There are groundwater remediation experiments to run. There are creation awareness centers to be established. There are school-yard ecology programs to be devised and implemented. There are old milk cartons to be recycled. There are lights to be turned off. There is compost to be turned. And with so much to do, some might say that attending to the topic of this paper is a waste of time—pie-in-the-sky theoretical good-for-nothing nonsense.

But in reality very little of that good work of keeping creation will be accomplished without the concrete embodiment of the virtues set forth in this paper. While the subject matter of this paper, in one sense, is theoretical, it is also intensely practical. For virtues are, after all, not only to be studied, but to be put into practice, into action (*praxis*). As Aristotle reminds us concerning the reading of his own book of ethics: "Surely, as the saying goes, where there are things to be done the end is not to survey and recognize the various things, but rather to do them; with regard to virtue, then, it is not enough to know, but we must try to have and use it."[51] The good work of earthkeeping is impossible without respect, receptivity, self-restraint, frugality, humility, honesty, wisdom, hope, patience, serenity, benevolence, love, justice, and courage. To do the work God calls us to do on behalf of our nonhuman neighbors and to God's glory, these ecological virtues, these fundamental traits of character, are necessary. To repeat the thesis of this paper, character is central to the care of creation.

But lest we succumb to the alluring though false belief that human character is not only necessary but also sufficient—that the virtues listed above will be enough to silence the groaning of the earth, Wendell Berry reminds us that our care is not ours alone, and we dare not think that on our slim shoulders the world and its fate rests. I conclude with this poem from his volume *Sabbaths*.

Whatever is foreseen in joy
Must be lived out from day to day.
Vision held open in the dark
By our ten thousand days of work.
Harvest will fill the barn; for that
The hand must ache, the face must sweat.

And yet no leaf or grain is filled
By work of ours; the field is tilled
And left to grace. That we may reap,
Great work is done while we're asleep.

When we work well, a Sabbath mood
Rests on our day, and finds it good.[52] ✦

Notes

[1]For example, Robin Attfield, *The Ethics of Environmental Concern*, 2d ed. (Athens, GA: University of Georgia Press, 1991); Joseph DesJardins, *Environmental Ethics* (Belmont,

CA: Wadsworth, 1993); Roderick Nash, *The Rights of Nature* (Madison, WI: University of Wisconsin Press, 1989); E. G. Nisbet, *Leaving Eden* (Cambridge: Cambridge University Press, 1991); Holmes Rolston III, *Environmental Ethics* (Philadelphia: Temple University Press, 1988); Christopher Stone, *Earth and Other Ethics* (New York: Harper and Row, 1987); Paul Taylor, *Respect for Nature* (Princeton: Princeton University Press, 1986).

[2]Calvin DeWitt, *Earth-Wise* (Grand Rapids: CRC, 1994); Jay McDaniel, *Of God and Pelicans* (Louisville: Westminster/John Knox, 1989); James Nash, *Loving Nature* (Nashville: Abingdon, 1991); Max Oelschlaeger, *Caring for Creation* (New Haven: Yale University Press, 1994); Loren Wilkinson et al., *Earthkeeping in the 90's* (Grand Rapids: Eerdmans, 1991); Richard Young, *Healing the Earth* (Nashville: Broadman and Holman, 1994).

[3]For example, Robert Adams, *The Virtue of Faith* (New York: Oxford University Press, 1987); Elizabeth Anscombe, *Collected Papers of G.E.M. Anscombe* (Minneapolis: University of Minnesota, 1981); Philippa Foot, *Virtues and Vices* (Berkeley: University of California Press, 1978); and Alasdair MacIntyre, *After Virtue* (Notre Dame: University of Notre Dame Press, 1984).

[4]For example, Benjamin Farley, *In Praise of Virtue* (Grand Rapids: Eerdmans, 1995); Stanley Hauerwas, *Character and the Christian Life* (San Antonio: Trinity University Press, 1985); Gilbert Meilander, *The Theory and Practice of Virtue* (Notre Dame: University of Notre Dame, 1984); Lewis Smedes, *A Pretty Good Person* (San Francisco: Harper and Row, 1990).

[5]The only treatment of which I am aware is Nash, *Loving Nature*, 63–7.

[6]Foot, *Virtues and Vices*, 1.

[7]Ibid., 2.

[8]Ibid., 4–5.

[9]Ibid., 5.

[10]Roberts, *Spirituality and Human Emotion* (Grand Rapids: Eerdmans, 1982), 12–5.

[11]Foot, *Virtues and Vices*, 8.

[12]Meilander, *The Theory and Practice of Virtue*, 8.

[13]Robert Roberts, "Will Power and the Virtues," in *The Virtues*, eds. Robert Kruschwitz and Robert Roberts (Belmont, CA: Wadsworth, 1987), 122.

[14]Ibid.

[15]Ibid., 123.

[16]Ibid., 124.

[17]Foot, *Virtues and Vices*, 8.

[18]Ibid., 9.

[19]Roberts, "Will Power and the Virtues," 125.

[20]Meilander, *Theory and Practice of Virtue*, 8.

[21]Ibid., 10.

[22]Hauerwas, *Character and the Christian Life*, 115–7.

[23]Ibid., 11; cf. pp. 5, 17. See also Hauerwas, *Vision and Virtue* (Notre Dame: Fides, 1974), ch. 2.

[24]Gilbert Meilander, "Virtue in Contemporary Religious Thought," in *Virtue—Public and Private*, ed. Richard John Neuhaus (Grand Rapids: Eerdmans, 1986), 9.

[25]This understanding of doctrine is developed in N. Thomas Wright, *The New Testament and the People of God* (Philadelphia: Fortress, 1992), ch. 5.

[26]For an explanation of moral standing and human duties, see DesJardins, *Environmental Ethics*, 109ff.

[27]For an informed and informative discussion on species, see Rolston, *Environmental Ethics*, ch. 4.

[28]Ibid., 155.

[29]Susan Power Bratton, *Six Billion and More: Human Population Regulation and Christian Ethics* (Louisville: Westminster/John Knox, 1992), 43.

[30]Ibid.

[31]For a helpful analysis of this issue, see Wilkinson, *Earthkeeping in the 90's*, ch. 4.

[32]*Nicomachean Ethics*, 1118b, 19.

[33]For a powerful presentation and insightful analysis of the human tendency to deny mortality and in so doing create and perpetuate evil, see Ernest Becker, *Denial of Death* (New York: Macmillan, 1973) and *Escape from Evil* (New York: Macmillan, 1975).

[34]Two recent books which illuminate the phenomenon of sin very clearly are Ted Peters, *Sin: Radical Evil in Soul and Society* (Grand Rapids: Eerdmans, 1995) and Neal Plantinga, *Not the Way It's Supposed To Be: A Breviary of Sin* (Grand Rapids: Eerdmans, 1995).

[35]*Nicomachean Ethics*, 1127a, 22.

[36]Dietrich Bonhoeffer, *Ethics* (New York: Macmillan, 1955), 363ff.

[37]Calvin DeWitt, "Take Good Care: It's God's Earth," *Prism* 1 (Dec–Jan 1994): 10.

[38]*Nicomachean Ethics*, 1140b, 20.

[39]See, e.g., Psalm 111:10, Proverbs 1:7, Job 28:28.

[40]On the indispensability of hope for living a human life, see Victor Frankl, *Man's Search for Meaning* (New York: Simon and Schuster, 1963), and the writings of Elie Wiesel, for example, *Night* (New York: Bantam, 1958). The centrality of hope in Christian theology is evident in the many works of Jürgen Moltmann, for example, *Theology of Hope* (New York, Harper and Row, 1967).

[41]Søren Kierkegaard, *The Sickness Unto Death* (Princeton: Princeton University Press, 1980).

[42]See, e.g., Thomas Aquinas, *Summa Theologiae*, I–II.64.4.

[43]J. Christiaan Beker, *Suffering and Hope* (Grand Rapids: Eerdmans, 1994), 89.

[44]See, for example, Lee Hardy, *The Fabric of this World: Inquiries into Calling, Career Choice, and the Design of Human Work* (Grand Rapids: Eerdmans, 1990).

[45]For such argumentation, see, for example, *Earthkeeping in the 90's*, ch. 14; or Steven Bouma-Prediger, "Is Christianity Responsible for the Ecological Crisis?" *Christian Scholar's Review* 25, no. 2 (Dec. 1995).

[46]DeWitt, "Take Good Care," 10.

[47]For an explication of the difference between beneficence and benevolence, see William Frankena, *Ethics* (Englewood Cliffs, NJ: Prentice-Hall, 1973), 45.

[48]See, e.g., Neal Plantinga, *Not the Way It's Supposed To Be* for an excellent discussion of sin in these terms.

[49]Aldo Leopold, *Sand County Almanac* (New York: Ballantine, 1970), 197.

[50]Lewis Smedes, *Mere Morality* (Grand Rapids: Eerdmans, 1983), ch. 2.

[51]*Nicomachean Ethics*, 1179a 35–1179b 4.

[52]Wendell Berry, *Sabbaths* (San Francisco: North Point Press, 1987), 19. Many thanks to the following colleagues and friends for helpful comments on this paper: Susan Power Bratton, Andrew Dell'Olio, Don Munro, James Nash, Dave Unander, Fred VanDyke.

The Scientific Status of Theology: Imre Lakatos, Method and Demarcation

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Is theology a science? This claim would normally receive considerable skepticism, not only from scientists but from many philosophers and theologians as well. To the contrary, I use the philosophy of science as developed by Thomas Kuhn and Imre Lakatos to argue that the scientific method applies across many different disciplines, including theology. The result is that there is no firm demarcation between science and nonscience. One must judge, instead, between good and bad science, as well as between progressive and degenerative research programs. In this light, theology can and should be considered a science, but with significant limitations and qualifications.

Is theology a science? This claim would normally receive considerable skepticism, not only from scientists but from many philosophers and theologians as well. Is not the story of science the story of its liberation from the theological dogmatism of the Middle Ages? Are not religion and science at odds or, at the very least, dealing with quite separate realms (the subjective and objective)? To the contrary, I argue that the scientific method applies and is used across many different disciplines, including theology, and not simply among those natural sciences which usually claim exclusive right to the title of science. This argument is based upon the analysis of scientific method by Imre Lakatos, a well-known philosopher of science, and the further application of his analysis beyond the natural sciences. Lakatos' account, while not perfect, accurately describes the practice of science and reveals that there is no firm demarcation between science and nonscience. The judgment, rather, must be between good and bad science and between progressive and degenerative research programs; between good and bad theology and between progressive and degenerative theological research programs.

What Is Science? A Lakatosian Approach

While there is some agreement on very basic structures and characteristics of science, there is currently no consensus view on a normative or even simply descriptive account of scientific methodology among philosophers of science. This may strike some (especially scientists) as surprising, since science goes about its business daily with quite a bit of success. Certainly, some features of scientific method are used regularly and are not in dispute. Science frequently relies on quantitative analysis, and those disciplines which are considered "most scientific" (physics, mathematics, chemistry) usually are the ones that rely most heavily on quantitative measurement. Science also involves hypothesis testing. Across disciplines it is generally considered that a hypothesis must be testable to be scientific, though some fields, such as cosmology, stretch this criterion considerably. But other issues, such as whether science is progressive, whether scientific theories represent reality or are merely instrumental, or whether science proceeds in terms of evolution or revolution, remain subject to intense debate.

One real problem lies in delineating what is and is not science. This is the well-known problem of demarcation. Physics is a science. So are astronomy, computer science, and biology. But is economics a science? Or psychology? Or history? All these disciplines can include some level of quantitative analysis and some level of hypothesis-testing. The latter three, however, are usually considered more qualitative and, thus, more subjective. Can a firm demarcation be made between science and nonscience?

Karl Popper thought so, and drew the line between those ideas which were subject to falsification

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and those which were not.[1] Physics, because it could provide hypotheses which could testably be falsified, was a science. Freudian psychology, because its hypotheses were so all encompassing as to be untestable and irrefutable, was not. This strict demarcationism was prevalent throughout much of twentieth century philosophy of science and is still prevalent in some circles today.

The historicist revolution, led by Thomas Kuhn, Paul Feyerabend, and others, significantly changed the landscape in the philosophy of science when their work first began to appear and be recognized in the 1960s and 1970s.[2] Among other things, Kuhn argued that the history of science revealed that normal science is remarkably immune to falsification, through the development of ad hoc hypotheses, the conviction that somehow the measurements made were imprecise, or the faith that scientists had not yet considered undiscovered phenomenon. The Newtonian paradigm, for instance, could never accurately predict Mercury's orbit, which can only be satisfactorily described in terms of relativity theory. This anomaly, however, was never considered a serious threat to the paradigm, since elsewhere Newtonian mechanics was so powerfully predictive. It was only toward the end of the nineteenth century, when a range of increasingly disturbing anomalies began to appear that Newtonian mechanics was seen to be in crisis. Kuhn's interpretation, in particular, was seen as a challenge, if not a single knockdown blow, to both Popper's criterion of falsification and nearly all positivist accounts of science.

It is not, however, Kuhn's philosophy of science on which I wish to dwell, but rather that of Imre Lakatos. This is for several reasons. Kuhn and Lakatos together provide two of the most prevalent approaches to the philosophy of science which also take into account the data that the history of science has to offer. Lakatos, however, was more directly concerned than Kuhn with the problems of demarcation and of scientific progress, so that his account is somewhat fuller and more relevant to our purposes than that of Kuhn.

Among Kuhn's difficulties was describing the rationality of scientific revolutions, the switch by scientists from one scientific theory to another. While Kuhn did seem to believe that science is progressive, he nevertheless seemed to think that the switch between paradigms could not be rationally described and even referred to this switch as a conversion experience.[3] It is this seeming irrationality at the basis of science that has sparked much of the debate over Kuhn's theory. Lakatos himself derisively referred to this portion of Kuhn's thesis as a matter of mob psychology.[4] But Kuhn's historicist approach certainly impacted Lakatos and it is in his response and rejection of Kuhn that one finds also his departure from Popper. Lakatos, it would appear, was trying to find a third way that salvaged the rationality of science as depicted in the Popperian tradition while adopting the more historicist posture of Kuhn and others.

At the center of Lakatos' theory lies the research program which he describes as follows:

> The basic unit of appraisal must be not an isolated theory or conjunction of theories but rather a "*research programme*," with a conventionally accepted (and thus by provisional decision "irrefutable") "*hard core*" and with a "*positive heuristic*" which defines problems, outlines the construction of a belt of auxiliary hypotheses, foresees anomalies and turns them victoriously into examples, all according to a preconceived plan.[5]

Like Kuhn's paradigm, a research program possesses a set of unquestioned assumptions called its hard core. The hard core is the explanatory center of the research program and it is to the core's defense and propagation that the program is devoted. A negative and a positive heuristic then protect the hard core.

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The negative heuristic protects the hard core by deflecting criticism from it to the auxiliary (ad hoc) hypotheses stated to be the subjects of examination and test or by simply denying the significance of anomalies with the faithful proviso that eventually scientists will explain them. Darwin, for instance, never had an adequate account of how humans inherited individual traits. It was not until the much later recognition of first Mendelian genetics and then the discovery of DNA that scientists discovered a satisfactory account of inheritance compatible with natural selection.

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The positive heuristic, on the other hand, serves to strengthen the research program by the discovery of novel facts that the hard core can explain. These novel facts can be either new discoveries or anomalies in older research programs that the scientist's own research program unexpectedly confirms. A second form that the positive heuristic takes is to develop increasingly sophisticated models. While Lakatos' formulation of what counts as a model is unclear (it seems to me that the word "theory" conveys better Lakatos' intention), it seems that a model is a refutable variant of the hard core used to develop plausibility. Apparently, a model is a way of systematizing the hard core—if one way of systematization fails, it is replaced with another. In this vein Lakatos cites the development of Newton's theory.[6] Newton's hard core was gravity as the source of planetary motion. In the course of his work, he went through several different formulations (models) of how this might be explained. First he assumed that planets did not revolve around the sun but revolved around each other. Then he revised this by assuming that the planets were not point objects but had extension, and so on. Each model becomes more elaborate and increases in explanatory power.

In turn, it is this description of positive and negative heuristics, Lakatos believed, that allowed for an evaluation of competing research programs. We can now describe research programs as either progressive or degenerating. First, is one program more consistent than another? Secondly, is the program producing novel facts and how fast is it producing them? Thirdly, is the program plagued by continual modification and addition of ad hoc hypotheses? If the success of its positive heuristic characterizes the program more than the failures of its negative heuristic, it is progressive. If, however, novel facts are becoming scarce or nonexistent while the negative heuristic is having problems and consistent models are becoming more difficult to formulate, the program is degenerating. Lakatos states:

> A research programme is said to be progressing as long as its theoretical growth anticipates its empirical growth, that is, as long as it keeps predicting novel facts with some success ("progressive problemshift"); it is stagnating if its theoretical growth lags behind its empirical growth, that is, as long as it gives only post hoc explanations either of chance discoveries or of facts anticipated by, and discovered in, a rival programme ("degenerating problemshift").[7]

Lakatos asserts, however, that we must give a certain tolerance to degenerative research programs, especially young ones. In contrast to naive falsificationism, there can be no one crucial experiment (here like Kuhn) upon which the research program rises or falls. For a research program to be dealt a decisive death blow, it must have suffered a string of obvious setbacks without any prospects of novel facts expected. There is, in Lakatos' words, no such thing as "instant rationality" by which we can by an immediate appraisal determine which theory may be better.[8] It is only by evaluating programs in a historical context that we can objectively evaluate them. With younger programs, this may include having to wait until the program matures. A temporarily degenerative program may rebound. It is only in the face of obvious, continued failure of a program competing with one or more, more successful programs that we are required to abandon one line of research for another.

Several criticisms have been lodged at the Lakatosian approach over the years, but the more severe ones are largely without merit. It has been asserted, for instance, that Lakatos' methodology does not tally itself with the history of science. Lakatos himself described his task as primarily a normative one and not a descriptive one. That is, he was concerned primarily with how science should operate and only secondarily with how science has operated, though, as Kuhn pointed out, that is of considerable relevance too. A second criticism, made by Feyerabend, is that Lakatos' methodology is so general that "anything goes."[9] This comment, unfortunately, is somewhat misleading. Anything can go, but it can go for

only a limited amount of time. The prescription against instant rationality means that an evaluation of a research program must take place over a range of time. However, that discipline must first be structured as a research program to be identified as scientific (or possibly scientific). Also scientists will hardly take the hard core of a theory seriously if it quickly degenerates without any promise. One thinks here of phrenology in the nineteenth century, which advanced itself as a science but became thoroughly discredited. No one considers phrenology a science today, and one would be hard pressed to find any current champions. Lakatos' account, however, does leave much to be filled in. A comparison with the work of Kuhn is enlightening, for while these two philosophies are usually considered antagonistic to each other, there are significant elements which are actually complementary.

The positive heuristic, on the other hand, serves to strengthen the research program by the discovery of novel facts that the hard core can explain.

Kuhn, it may be recalled, challenged the older evolutionary approach of the positivists and neopositivists and claimed that science is characterized by long periods of normal science interrupted by periodic revolutions. At the basis of normal science lies the much popularized notion of a paradigm. Roughly speaking, the paradigm is the core set of beliefs, models, and exemplars that provide the basis for the conduct of normal science. Standard problem sets in textbooks, foundational experiments such as the Michelson-Morley experiment, and particular formulas such as $F = ma$ or $e = mc^2$ can all serve as part of the functional paradigm. Problem-solving, the sometimes tedious everyday type of research that can serve to expand and concretize the paradigm, characterizes normal science, secure within the knowledge of its established paradigm.

As the paradigm develops, however, new anomalies appear and some old anomalies persist. At some point, these anomalies accumulate to such a point as to threaten the veracity of the paradigm itself. At this point, normal science gives way to revolutionary science. Theories compete with each other for acceptance as each tries to account for new evidence that sparked the collapse of the old paradigm. When a satisfactory position emerges, it quickly gains momentum. Scientists relatively swiftly abandon the old paradigm and the foundation of the new theory becomes the new paradigm and new basis for normal science. This switch from one paradigm to another is, according to Kuhn, not fully explainable and he likens it to a conversion experience. At the basis of science, for Kuhn, lies things not fully explainable in rational terms.

In comparing Lakatos to Kuhn, one may observe at the outset that Lakatos relates his notion of research programs to that of Kuhn's paradigms.[10] This is, however, incorrect. The point of comparison in Kuhn to Lakatos' research programme is the idea of normal science. In this regard, Lakatos' notion of research programme is clearly an improvement. It possesses greater detail than that of normal science and better explains the competition among programs as opposed to the monolithic unity of normal science. Kuhn, on the other hand, better shows the underlying assumptions shared among research programs. For a field to be even recognized as a scientific discipline there must be some basic level of agreement between research programs for them even to compete. We could say that Newton's laws functioned in this way in the nineteenth century, while Einstein's relativity theory functions this way in the twentieth century. Competing research programs in (say) stellar evolution still have some basic agreements among them.

Secondly, the proper point of comparison of Kuhn's paradigm (as he has further developed it) is Lakatos' hard core. Here it seems that Kuhn is more specific than Lakatos (we may recall the difficulty above of relating the notion of a hard core to that of a model). Arguably, it is this extended notion of a paradigm that best describes what the hard core is, namely the shared matrix of values, beliefs, symbolic expressions, and exemplars that form the basis of the research program. It is important to enunciate, as Kuhn has done, that the hard core often contains different types of statements. Evolutionary biology contains computer models of ecosystems, law-like generalizations, famous examples (e.g., the panda's "thumb"), and so forth. All these are used to varying degrees in the scientist's work and belie the notion that scientific work is simply contained in mathematical operations.

Thirdly, I would argue that Lakatos undervalues the role of puzzle solving in Kuhn's work. While the notion of a positive heuristic is useful, something remains to be said for the more nondescript and often seemingly irrelevant research that many scientists engage in but that sometimes produces interesting and novel (in the full Lakatosian sense) results. This observation refers back to our first: there

are different levels of agreement and disagreement. It is the puzzle solving (particularly as manifested in the various engineering professions) that is the predominant scientific work. Puzzle solving, while displaying the disagreements typical of Lakatosian research programs, nevertheless requires some significant agreement (an underlying paradigm).

In spite of this, Lakatos displays a methodology that is both reasonably true to the actual practice of science, while it also answers the questions of scientific progress and demarcation. It is this latter concept, however, that plays a particularly important role for our purposes here. The idea of demarcation determines how we define theology and in what sense we may consider it a science.

Science and Demarcation

Like Popper, Lakatos was concerned with the problem of demarcation: what does and does not count as a science? For Popper, the line that demarcated science from nonscience was the line of falsification—those disciplines that could produce falsifiable statements could be construed as a science. The solution that Lakatos proposed, however, was significantly different. Research programs, some of which are progressive and some of which are degenerative, characterize science. When degenerative programs reach a certain nadir, we no longer can consider them science. Lakatos himself refused to say exactly when this takes place and limits himself to stating that we should give younger programs more leniency than older ones. Superstring theory is given a longer leash than steady state cosmology. But how do we know? This is left to the judgment of the scientific community, which presumably operates rationally.

This lack of some sharp criteria of demarcation will trouble many, no doubt, but it does accurately describe the current state of the sciences. No one, for instance, questions whether physics is a science, although there are many who question whether physics can or should operate as the primary model of the sciences as it has done in the past. Physics is largely quantitative and is composed of well-defined research programs whose hard cores share many similarities and are intensely competitive. We demarcate research programs as progressive or degenerative with relative ease in a relatively short amount of time. Quark theory is now firmly established, but bootstrap theory is nearly forgotten.

What of paleontology, a discipline that is usually classed among the sciences although it is not very quantifiable or experimental (two typical criterions of being a science)? Paleontology, from a Lakatosian viewpoint, is a science because it has been and continues to be characterized by progressive research programs, while degenerative programs that do occur are replaced by progressive ones. One may take as an example the fairly recent dinosaur "revolution," championed by Robert Bakker and others.[11] The picture of dinosaurs as cold-blooded, lumbering, thoughtless brutes has been significantly challenged by a body of research that suggests that dinosaurs were nimble, warm-blooded animals who cared for their young. Sometimes bitter competition has characterized the two approaches, and while the newer warm-blooded picture has considerable momentum, dissension remains. Both programs are, currently, scientific, although the day will come when one no longer is.

Lakatos displays a methodology that is both reasonably true to the actual practice of science, while it also answers the questions of scientific progress and demarcation.

Unlike paleontology, psychology has inhabited a sort of scientific netherworld, wanting to be a science but never quite gaining acceptance. The behaviorism of B. F. Skinner succeeded only at the high price of sacrificing nearly everything that psychology was supposed to be about (namely, the *psyche*). Some current branches of psychology, such as cognitive psychology, are now largely considered within the fold of science, while Freudianism (typically) only gets marginal respect. Was Freudian psychology ever scientific? Under a Lakatosian approach, one may reply yes and say that it was even progressive for a while. But its often sloppy methodology and its increasing difficulty in producing novel facts or reconciling anomalies (such as the superiority of biochemical explanations and treatments of some forms of mental illness to psychoanalytic ones) has resulted in a serious (if tenacious) degeneration of the program. In the twentieth-first century, Freudianism may be treated much as phrenology is now.

One might move, however, from these increasingly borderline cases to one that is clearly seen to be not a science: metaphysics. Why is metaphysics not currently regarded as a science? One might observe that metaphysics, as it is currently practiced, does not identify a single subject matter. Therefore, we cannot organize it into competing research pro-

grams, though specific topics within metaphysics may take on the character of a research program and thus be considered as scientific. But how scientific are such programs? As long as they are progressive, they are scientific. If their limited scope inhibits the discovery of confirming data or novel facts, this progress might be limited to such an extent that it would get only marginal recognition or may eventually be seen as degenerating. If neither realism nor idealism has any measurable consequences or tie-in with other theories, then their scientific status is endangered.

Finally, let us take a bogus case: astrology. Can astrology be a science? Presumably, one could organize astrology in a way that follows a Lakatosian research program. There would be a hard core of shared beliefs and exemplars (a theory of how the planets affect human lives, anecdotal accounts of past successes, etc.) protected by auxiliary hypotheses (astrology only predicts general patterns, not specific events) that produce a series of papers (the positive heuristic) predicting several consequences of astrology, reconciling discrepancies, demonstrating successes, and so forth. Of course, one wonders how long astrologers could carry it off, and the suspicion of most of us is: not very long at all. In fact, one may observe that they have already tried this. In the Middle Ages and through the Renaissance period, astronomy was tied to astrology. But as the former gained in power and scope the other quickly began to degenerate, until only vestiges remain today. Astrology *is* a failed research program.

Is Theology a Science?

Is theology a science, or can it be? Surprisingly, several theologians have, in pondering the status of their discipline in relation to the rest of academia, considered this question. In part, this is because the concept of science as found in continental thought is broader, where the distinction is not between science and the humanities (nonscience) as between the natural sciences (*naturwissenschaft*) and the human sciences (*geisteswissenschaft*), the former often characterized as mere "technical" reason, the latter as dialectical reason. In this vein, Thomas Torrance writes of a theological science based upon the revelation of God, practicing a unique method distinct from that of the physical sciences.[12] Wolfhart Pannenberg, by contrast, argues that theology is the science of God and that its method is largely the same as that of the physical sciences, though some differences remain.[13] Since, in Pannenberg's theology, God is the all-determining reality, all of reality is necessarily the object of theology. Theology differs from the physical sciences, however, in the degree of incompleteness and in its emphasis on the future. Ian Barbour, while not claiming a scientific status for theology, does observe that certain broad similarities exist between theories in the sciences and in religion.[14] Barbour relies heavily on the concepts of model and paradigm, suggesting that the roles these concepts can and do play in religious life are very analogous to the ways that they are used in the sciences.

Theology differs from the physical sciences ... in the degree of incompleteness and in its emphasis on the future.

Equally interesting is previous research suggesting that theology can or does act as a research program in the Lakatosian sense. William Austin is, to my knowledge, the earliest advocate of this approach, but Philip Hefner and Nancey Murphy have suggested it as well.[15] Of these scholars, Murphy has developed this approach at greatest length. She argues that the Lakatosian method solves the methodological crises that have faced academic theology in recent decades and that if theology follows a Lakatosian approach, then theology can be a science. The concern here is a normative one. In the past, Murphy argues, theology has not been a science, but it can be. Unlike Pannenberg, Murphy does not take the time to state what theology is a science of (namely God), although one might presume this from the tenor of her works. Murphy is concerned, however, with what counts as data and devotes considerable attention to this. Data, for Murphy, comes primarily from religious experience, whether past or present, as "Christian discernment," meaning the relevant Christian community, evaluates it. In Murphy's conception, Christian discernment becomes a theory of instrumentation, a device for evaluating religious experiences as either true or false, much in the way (presumably) a theory of optics allows us to interpret freely the objects under a microscope.[16] Similarly, Scripture, which is the result of the religious experiences of others, provides another data set, with theological hermeneutics playing the role of a theory of instrumentation in this case. Murphy is not altogether convincing in these passages, and for the idea of theories of instrumentation to work much more needs to be said. What, after all, is it about religious experiences that count as data? Not the experiences themselves, since they are private. Presumably, we must rely on the verbal or written reports of these

experiences and what they purportedly disclose. These statements, presumably, then form the basis of testable hypotheses about God and the world, from which we can build a theological theory.

Murphy argues that the Lakatosian method solves the methodological crises that have faced academic theology in recent decades and that if theology follows a Lakatosian approach, then theology can be a science.

More important is Murphy's claim that theology has not been a science, but that it can be. Murphy herself is not totally consistent on this point, as she draws (in my mind not altogether successfully) on the Catholic Modernist movement of the turn of the century as an example of a briefly progressive theological research program. It seems to me, however, that the history of theology reveals numerous theological programs which, in their day were seen as progressive or degenerating. The highly technical scholastic theology of the Middle Ages or the theological programs of Martin Luther and John Calvin and, even later, of Friedrich Schleiermacher and Karl Barth can be seen in terms of a scientific research program. The question remains, however, as to how scientific these programs were. The above discussion about which disciplines we may correctly see as a science now becomes relevant. There it seemed that while the physical sciences possess the clearest claim to the status of science, theirs is not an exclusive one. Psychology and metaphysics, if properly approached, can be sciences. Even astrology can take a scientific approach, although its lack of scientific claim should soon become clear. No discipline is barred, *a priori*, from the scientific approach, although the attempt to scientize a subject may make inherent theoretical weaknesses apparent.

The great difficulty lies in the fact that while the natural sciences seem obviously progressive, theology does not. One can historically trace the development of Newton's theory from its initial appearance to its near unanimous acceptance within the physics community. One can further trace the demise of that theory in its absolute form with its replacement by Einstein's relativity physics, which again eventually (and relatively speedily) gained near unanimous acceptance within the physics community. Theology, it is argued, only rarely, if ever, achieves this level of consensus, and it is not nearly as obviously progressive as the physical sciences are, if it can claim to be progressive at all.

This dipolar characterization, however, is misleading, as the previous discussion on demarcation should indicate. While the physical sciences do have a broad consensus within specific fields on fundamental theories and goals, disagreement also characterizes them, as the debates regarding cosmology in astrophysics or regarding the extinction of the dinosaurs in paleontology should indicate. Disagreement and conflict are a normal part of science, and without it scientific disciplines would not thrive but ossify. The question is, how much disagreement is permissible among research programs within a given field without calling into question its scientific integrity.

From a Lakatosian perspective, as long as competing research programs characterize a field, it is scientific. The scientific status of any one research program within the field will depend on whether it is progressive or degenerative in comparison to the other programs it is competing with. The real distinction, however, seems to be between good science and bad or marginal science. Recall here our previous thumbnail characterization of several fields from physics to astrology. Most would agree that physics is a good science. Most would agree that biology is a good science as well, though it is not nearly as quantitative as physics is. Economics, by some lights, is on its way to being a good science. Psychology, however, is still in muddy waters in the eyes of many.

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A distinction, then, needs to be made between the research programs themselves, and the scientific character of the field as a whole, with the latter being dependent on the health and coherence of the competition among individual research programs. From this perspective, theology qualifies as a science in the Lakatosian sense of the term, since it is characterized by competing research programs that may be variously described as progressive or degenerative. But theology as a field does not represent a good or

strongly rooted science in its present state, because of the level of disagreement, not only on particulars but on basic methodological questions. One might observe that while we can characterize some research programs in theology as scientific (with a hard core, auxiliary hypotheses and instances of confirmation/disconfirmation), others may not be.

From a Lakatosian perspective, as long as competing research programs characterize a field, it is scientific.

One might even observe that this is an occupational hazard of "higher level" disciplines, that the greater the level of generalization required the poorer the grade of science that can be achieved. Physics, by its very nature, will always be more precise (and in some ways more limited) than chemistry, which is more precise than paleontology, which is (possibly) more precise than psychology. Each scientific discipline has its own character and its own strengths and weaknesses. Theology, arguably the most general of all disciplines, would naturally suffer from this reality as well.

Is theology, then, a science? One can answer yes, but with a few qualifications. We can broadly construe certain theological research programs as scientific in character. We might fairly say that neo-orthodox theology was a progressive research program in its heyday. It possessed a hard core based upon the self-revelation of God and was arguably progressive in relation to its competitors on many fronts. Work done in the analytic philosophy of religion on very specific issues (such as arguments over the existence of God and over God's attributes of omniscience and omnipotence) has also reached a high level of technical formulation and expression and possibly represents another progressive research effort.

But while theology may be considered scientific, currently we cannot say that it is, on the whole, a good science. The level and kind of theological disagreement are remarkably high when compared to well-formulated sciences. When one considers that Christian theology is in competition with Islamic and Jewish theology, and all three are in competition with nontheistic programs (such as Buddhism), the level of disagreement is even higher.

The real question, then, is whether theology can be a good science, or at least a better one. Murphy, in essence, argues that theology can be such. The possibility is worth considering, although the difficulties are rather steep, as many important changes would have to occur. Theological research programs are, historically speaking, much more loosely knit than scientific ones. Both Kuhn and Lakatos emphasize that much of the core of a research program is unspecified, but I am inclined to believe that it is nevertheless better articulated than many theological programs. To be a good science, theology would have to be composed of well-formed, competing research programs operating within a coherent framework. Furthermore, some of these programs would have to be progressive, discovering novel facts or resolving old anomalies. The category of novel fact is probably the most troublesome and its applicability will depend mostly on the theology at the base. One can, of course, imagine what might count as confirming facts: answer to prayers, changes in attitudes/lifestyles among influenced groups, achievement of social justice, developments in cosmological theory and so on, depending on the program in question. But for novel facts to be found would mean that theologians would have to look for them. Do they? I would argue that in, some sense, many theologians do, by appeal to better interpretations of scripture, accord with the latest physics or other criteria. But this is not done in a rigorous and premeditated fashion. Can theology do this? Probably, but it would require a significant reorientation for many theologians.

While theology may be considered scientific, currently we cannot say that it is, on the whole, a good science.

These would be the minimum requirements for such an approach. Whether it would succeed or fail is beyond my guess (success being relative in this context anyway) and would be as dependent on the personalities and the theories employed as the method itself. It may be, too, that the nature of the data, the higher order character of theology, ultimately prevents theology from being a good science, much as the higher order character of the social sciences force similar problems on them. But if God is a true God, then God is made manifest in the world, whether through nature, Scripture, or religious experience. To the extent that God is faithful, and rational, we can put forth a scientific theology which relates the activity of God to the world.

Some Considerations and Conclusions

The idea of theology as a science will strike many as difficult to accept. We have often seen religion and science as traditionally opposed, and likewise faith and reason. From a Lakatosian (as well as Kuhnian) perspective, this dichotomy is poorly constructed. One should instead speak of a faithful reason. The prohibition against "instant rationality" means that there is a faith component in one's choice between scientific programs. At any given time, then, the choice between research programs is governed not simply by rational considerations, at least in the usual sense. Faith (of a limited sort) or a hunch also governs it. The relationship between faith and reason are more complex than the usual antagonistic faith-science dichotomy would indicate.

Even so, we may object that theology seems to lack several features typical of the sciences. Science depends on the strict demarcation (at least in theory) between theory and data. Science requires testable hypotheses. Can theological hypotheses be testable? The answer here seems to be yes, although it would take considerable effort to indicate in what way theology may be testable. Murphy, in her discussions of religious experience and Scripture, has taken one approach to testability and the data/theory distinction. Even if one disagrees with her specific proposals, her work can nevertheless serve as a guide to further progress. One should observe that there are different grades of testability, and this has been an insight of the historicist approach to the philosophy of science. The falsificationist program inspired by Popper saw science in terms of bold theories that thrived or failed in the face of critical experiments. The more historicist approach taken by Lakatos recognizes that such events are rare and predominantly recognized well after the fact, such as with the Michelson-Morley experiments that were only much later seen as the critical test for the existence of ether. One may observe as well that there are grades of confirmation/disconfirmation, and that this is especially true of "higher level" sciences. To refer to paleontology again, the discovery of a layer of iridium and of a massive crater in the Caribbean basin certainly establishes that an asteroid did indeed hit Earth at the end of the Cretaceous period, but it has proven much more contentious to link that directly to the extinction of the dinosaurs.[17] One should only expect the same level of ambiguity, if not more, in theology.

Finally, in recognizing theology to be a science, are we putting science on a pedestal, as the only valid source of knowledge and thereby denigrating other ways of knowing? Such a question assumes that there is a hard and fast distinction between scientific knowledge and nonscientific knowledge, whereas part of the task here has been to argue that there is no easy distinction. Even so, science, as presented here, does constitute a certain form of activity. Science is both a social and critical activity and we need both aspects for a research program to be possible at all. Theology has historically been both social and critical when it is at its best, so the inclusion of theology among the sciences has some merit to it. Certainly, there are other forms of knowledge that are generally considered nonscientific, although I have not taken the time to elucidate them here. The everyday knowledge of my work telephone number, how to do the dishes, and how to write a good letter are generally not considered forms of scientific knowledge. Nevertheless, these things still constitute knowledge of a kind.

The challenging task will be to see to what extent theology can be construed as a good science and what level of theological consensus and progress can be achieved in a world that seems to be increasingly global and increasingly fractured at the same time.

One might further observe that there remains a distinction between theology and religion. Religion is the living of the faith; theology represents a second order reflection on that faith. The two are ultimately interconnected. Theology, at its best, clarifies and elucidates faith. Faith, in its day-to-day living, poses many problems, at least on a personal level, that theology has to deal with.

The more difficult task, however, still awaits us. A Lakatosian approach aids us in seeing how we can say that theology can be a science. But currently, theology exists in a type of scientific netherworld. While we can say that some programs have a broadly scientific approach, the sheer diversity of approaches tends to cancel the effectiveness of theology as a field. The challenging task will be to see to what extent theology can be construed as a good science and what level of theological consensus and progress can be achieved in a world that seems to be increasingly global and increasingly fractured at the same time. ✦

Notes

[1]Karl Popper, *The Logic of Scientific Discovery* (London: Hutchinson, 1959).

[2]Thomas Kuhn, *The Structure of Scientific Revolutions* (Chicago: University of Chicago, 1970); Paul Feyerabend, *Against Method: Outline of an Anarchistic Theory of Knowledge* (London: NLB, 1975).

[3]*The Structure of Scientific Revolutions*, 158. It should be pointed out, however, that Kuhn does not see progress in terms of increasing verisimilitude, but more instrumentally in terms of the ability to solve a greater range of puzzles. See Thomas Kuhn, "Afterwords," in *World Changes*, edited by Paul Horwich (Cambridge, MA: Bradford Books, 1993).

[4]Imre Lakatos, "Falsification and the Methodology of Scientific Research Programmes" in *The Methodology of Scientific Research Programmes*, edited by John Worrall and Gregory Currie (Cambridge: Cambridge University Press, 1978), 91.

[5]Imre Lakatos, "History of Science and its Rational Reconstructions," in *The Methodology of Scientific Research Programmes*," op. cit., 112.

[6]Lakatos, "Falsification and Methodology," 50–1.

[7]Lakatos, "History," 112.

[8]Lakatos, "Falsification," 87.

[9]Paul Feyerabend, in Imre Lakatos and Alan Musgrave, *Criticism and the Growth of Knowledge* (Cambridge: Cambridge University Press, 1970).

[10]Lakatos, 91, n. 2.

[11]Robert T. Bakker, *The Dinosaur Heresies: New Theories Unlocking the Mystery of the Dinosaurs and Their Extinction* (New York: William Morrow, 1986).

[12]Thomas Torrance, *Theological Science* (Oxford: Oxford University Press, 1969).

[13]Wolfhart Pannenberg, *Theology and the Philosophy of Science*, translated by Francis Mcdonagh (Philadelphia: Westminster Press, 1976).

[14]Ian Barbour, *Myths, Models and Paradigms* (New York: Harper & Row, 1974); *Religion in an Age of Science* (San Fransisco: HarperCollins, 1990).

[15]William H. Austin, "Religious Commitment and the Logical Status of Doctrines," *Religious Studies* 9 (1973): 39–48; *The Relevance of Natural Science to Theology* (London: Unwin Brothers, 1976); Philip Hefner, *The Human Factor: Evolution, Culture and Religion* (Minneapolis: Fortress Press, 1993); Nancey Murphy, *Theology in the Age of Scientific Reasoning* (Ithaca, NY: Cornell University Press, 1990).

[16]The application of theories of instrumentation to theology is elaborated in Nancey Murphy, "What Has Theology to Learn From Scientific Methodology," in *Science and Theology: Questions at the Interface* edited by Murray Rae, Hilary Regan, and John Stenhouse (Grand Rapids, MI: Eerdmans, 1995).

[17]See William Glen, ed., *The Mass-Extinction Debates: How Science Works in a Crisis* (Stanford: Stanford University Press, 1994).

Communications

The Use of Ecology in the Evangelical Protestant Response to the Ecological Crisis

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This article explores how the concepts of ecology are presented and utilized in the evangelical Protestant response to the ecological crisis. It finds that there are seven basic themes in the literature: (1) etymological discussions; (2) the concepts of interdependence and balance; (3) cycles and energy flow; (4) food chain/food web/ecological pyramid; (5) carrying capacity; (6) the idea that humans are the disrupters of "nature's" balance; and (7) the contrary idea that humans are a part of the ecosystem. In light of these themes, I make several observations. One is that the summarized findings of ecology becomes the latest version of natural theology: God's will is for each ecosystem to be a climax ecosystem which never declines. If this is the case, then western agriculture, industry, and the use of much technology will have to be severely curtailed—a situation unacceptable to most evangelical Protestants.

Many scholars have argued that western culture, infused with a Christian understanding of the world, provided a nurturing environment for the development of science. The belief in a purposeful God, the argument goes, who gave order and coherence to the universe allowed scientists to assume that they could discover such order, such "laws." God made a world which was consistent and real, and therefore predictable. The discipline of ecology has also benefited from Christian assumptions embedded in western culture. By the time ecology began to develop as a scientific discipline, however, these assumptions had become "secularized," or stripped of their God-talk. In other words, early ecologists did not have to believe in a Christian God to assume that the world was orderly, consistent, real, and predictable. These beliefs had become cultural norms taken for granted by everyone in the West; they could be understood by an ecologist as simply similarities between Christianity and science, rather than shared beliefs which have their "genesis" in Christian doctrine.

Not surprisingly, it is these assumptions that evangelical Protestants emphasize when informing their audience about the concept of ecology.[1] Furthermore, probably in part because of these shared assumptions, the languages of ecology and theology are mixed together without any serious discussion about what the potential differences could be—not so much a synthesis as a bricolage. This article is an attempt to describe and analyze the concept of ecology contained in the evangelical Protestant response to the ecological crisis, and to raise questions about its use.

But before addressing this, a brief overview of the evangelical Protestant response to the ecological crisis is necessary. I have summarized the four main ways evangelical Protestants have utilized the concept of stewardship and have created a four-part stewardship typology (see Fig. 1). The capacity for the theological and ethical position of each type to be turned into a justification for exploitation of the rest of creation is what I call its *co-optation potential.*

Rating each type in this way is obviously a judgment on my part. As such, I should declare that I have the greatest affinity with the fourth type, Servanthood Stewardship. The four stewardship types are as follows:

1. Wise Use: Happily, only a few evangelical Protestants fall into this type.[2] The name comes *not* from Gifford Pinchot's utilitarian conservation ethic, which actually reflects the phrase, and is in keeping with my Anthropocentric Stewardship type. Rather, it comes from the co-opted version represented by former Reagan Interior Secretary James Watt, Ron Arnold of the Center for Defense of Free Enterprise, Alan M. Gottlieb, editor of *The Wise Use Agenda*, and Rush Limbaugh.[3] This political "movement," bankrolled by companies who would profit from deregulation, seeks to promote an open-throttle, all-out exploitation of the rest of creation (ROC).

The evangelical Protestants of the Wise Use type are providing a theological rationale for such exploitation. Wise Use does not include the evangelical Protestants who are opposed to *any* ethic of creation-care.[4] Rather, those in this type seek to offer an alternative which actually works against caring for creation. God is indifferent to the rest of creation, and thus it has no moral status. Moreover, the best strategy for achieving the welfare of present and future generations is not conservation but economic growth and "resource substitution." Thus, Wise Use's co-optation potential has been fully realized.

2. Anthropocentric Stewardship: This type, a legitimate ethical stance when compared to Wise Use, is widely held by evangelical Protestants.[5] Persons who fall into this type stress that the rest of creation was created for the welfare of humanity. Some writers may mention briefly that God declared the rest of creation to be "good," a few even suggesting that it has some modicum of intrinsic value. But this is overwhelmed by talk of "resources" and a strong (and usually defensive) emphasis on the idea that humans come first. Theologically, the focus is on the divine-human relationship. Since the possibility of a moral status for the rest of creation is either denied or discounted severely by adherents of this type, its co-optation potential is high. Rhetorically, the only difference between Wise Use and Anthropocentric Stewardship is the argument that it

Fig. 1. Evangelical Protestant Stewardship Types

Wise Use	Anthropocentric Stewardship	Caring Management	Servanthood Stewardship
• Humans = rulers God has left in charge • God = ultimate Provider of resources • ROC = resource for humans • ROC has no moral status; cannot be sinned against • Stewardship rhetoric a cover for exploitation • Dominant attitude: extreme arrogance • Completely co-opted	• Humans = kings with power over ROC, but responsible to God • God = Creator/Owner • ROC = resources, God's property • Sin = disobeying God • Humans come first • Humans are to take what they need and "improve" ROC • Fulfilling divine commands and leaving resources for future generations are key ethical guides • Dominant attitude: arrogance toward ROC • Co-optation potential: high	• Humans = both "lord" and "servant"; gardners and managers • God = Creator/Owner; loves ROC, but humanity more • ROC = resource and fellow creature • ROC can be sinned against • ROC has intrinsic value, but less than humans • Cosmic redemption emphasized • Stress on human uniqueness ("*imago dei*") and responsibility ("dominion") • Human need wins in conflict situations • Dominant attitude: paternalism toward ROC • Co-optation potential: moderate	• Humans = servants of ROC; to love ROC • God = Creator/Redeemer of all, loves and desires shalom for all of Creation • ROC = fellow members of Christ's creation • ROC can be sinned against • ROC has intrinsic value • Cosmic redemption emphasized • Christ's servanthood example is key • "Uniqueness" curtailed • Not priority, but responsibility • Dominant attitude: humility • Co-optation potential: low

Please note: ROC stands for rest of creation

would be better for future generations to conserve rather than exploit the rest of creation.

3. Caring Management: Many of the writings of the "major players" in the evangelical Protestant response to the ecological crisis belong in this type.[6] There is a both/and quality to Caring Management. Humans are both "lord" and "servant" when it comes to the rest of creation, unique in the sense of being created in the image of God, but responsible for the care and management or "dominion" of the rest of creation. In many instances, the two Genesis texts (1:26–28 and 2:7, 15) are balanced off each other, with the Golden Mean being what I describe as Caring Management. The rest of creation is both a resource for legitimate human needs and something which shares in our creaturehood and deserves our respect and care. Sometimes the tension within the both/and juxtaposition is so great as to be contradictory. Their rhetoric, i.e. the specific language they use and the way in which they structure their arguments, appears to be based upon an awareness of the writings of "environmentalists," and an awareness that many evangelical Protestants are characterized by the Wise Use and Anthropocentric Stewardship perspectives. In effect, they are saying to their fellow evangelical Protestants, "Look, some of what the environmentalists are saying is true. Trust us; we've listened to them critically and we've weeded out all the crazy stuff. But the biblical message is that we can't be anthropocentric. We've got to care for the rest of creation, too." Thus, due to its both/and nature, Caring Management's co-optation potential is moderate. Its most effective bulwarks against the erosion of its position are the espousal of the concepts of *intrinsic value* and *cosmic redemption.*

4. Servanthood Stewardship: While the majority of evangelical Protestant writings on the ecological crisis fall under the categories of Anthropocentric Stewardship and Caring Management, a strong and significant minority belong in the Servanthood Stewardship type.[7] The Lord/servant tension of Caring Management is relaxed in the direction of servanthood. There is less of an emphasis on the Genesis texts when it comes to understanding humanity's role, and more of an emphasis upon emulating Christ in servanthood as described in Phil. 2:6–11. Following Christ in servanthood is the key to understanding a Christian's ethical attitude toward *all* creation. There is an avoidance of hierarchical thinking. A belief in cosmic redemption suggests that God loves and desires shalom for *all* creation. Thus, the stress is not on whether humans have priority but on their responsibility. Servanthood stewardship's co-optation potential is low due primarily to its attitude of humility, its espousal that God loves the rest of creation, and its resulting belief in intrinsic value and cosmic redemption.

Now that a brief overview of the evangelical Protestant literature on the ecological crisis has been given, a description and analysis of the literature's use of the concepts of ecology can proceed. In general, many of the writings do not define the concept of ecology or describe it in any great detail.[8] When they do, the discussion is usually quite brief, and the overall effect is to paint a picture of stasis, that what is "natural" for "nature" is a static harmony.

There are seven basic themes in the literature concerning the concepts of ecology. First, some writings begin with an etymological discussion: the word ecology comes from the Greek word, *oikos*, meaning the family household and its order and maintenance; numerous commentators point out that the English words ecology and economy come from this common root.[9] (Many writers tie in the idea of stewardship: a steward is one who manages the household, which in this instance encompasses both "nature" and the economy.[10]) Early on Barnette provided the best and most succinct definition in the evangelical Protestant literature: "Ecology is the study of the relationship of all living creatures to each other and to their environment."[11]

Second is the theme of the two interrelated overarching concepts of *interdependence* and *balance*, both of which serve as the theoretical core around which the other themes cluster. Concerning interdependence, the literature really does not go much farther than John Muir's oft quoted statement from *My First Summer in the Sierra*: "When we try to pick out anything by itself, we find it hitched to everything else in the universe."[12] Indeed, in many instances the words of evangelical Protestants are—whether intentionally or not—a paraphrase of Muir. For example, Snyder states of the world that "everything within it is tied to everything else."[13] It could also be the case that evangelical Protestants are picking up Muir's quotation from Barry Commoner, or from those who utilize his work. He takes Muir's quotation and makes it into his "First Law of Ecology: Everything is Connected to Everything Else."[14] Indeed, evangelical Protestant Richard Young summarizes each of Commoner's four laws of ecology.[15] Although many ecologists would not want to make such a sweeping "metaphysical" statement, (i.e. that everything is connected to everything else) evangelical Protestants writing on the ecological crisis are quite comfortable making this type of assertion because they share with Muir a belief that God in fact made the world this way: interdependent, everything *related* to everything else.[16] The word "com-

munity" is often used. This type of relational holism is seen as consistent with the biblical (Hebraic) view of creation.

When it comes to the idea of balance, the underlying assumption is stasis; left undisturbed by humans, the rest of creation is a balanced harmony. The concept of balance is stressed because the anthropogenic ecological crisis is perceived to have created various imbalances. This attitude is summed up in the first proposed title by George Perkins Marsh for his classic, *Man and Nature*, "Man, the Disturber of Nature's Harmonies."[17] If there is any sense of *natural* ecological change, it is teleological development: left to its own devices, each ecosystem will eventuate in a rich, stable, balanced fecundity and diversity of life.[18]

The third theme stresses the biochemical side of ecology: *cycles* and *energy flow*. Evangelical Protestants succinctly describe how energy from the sun is stored in plants which become food for animals, and how in this life-sustaining process of energy flow the Earth has various cycles, such as the carbon cycle, the hydraulic cycle, and the nitrogen cycle. Closely aligned to energy flow is the fourth theme, that of the *food chain*, *food web*, or *ecological pyramid*. Here, obviously, are specific ecological terms which reinforce the general concept of interdependence.

The idea that ecosystems have a *carrying capacity*, which means that there are *limits* beyond which ecosystems cannot be pushed without the possibility of collapse, is the fifth theme. Pollution, habitat destruction, species extinction, and many other anthropogenic disruptions, if not halted, will lead to the degradation and eventual collapse of the Earth's ecosystems.

The sixth and seventh themes, that *humans are the disrupters* of "nature's" balance and that *humans are a part of the ecosystem*, are in constant tension with each other. They highlight the fact that borrowing from the discipline of ecology has not answered one of the key theological questions underlying the ecological crisis: "What is humanity's relationship to the rest of creation?"

In light of these seven themes several comments are in order. First, the evangelical Protestant versions of the concepts of ecology which the literature has emphasized appear to put all of my stewardship types except Servanthood Stewardship on the defensive. This is ironic, considering that, according to Worster, a "bioeconomics paradigm" with a perspective quite in sympathy with Anthropocentric Stewardship began its reign in the field of ecology in the mid-forties, and is still widely followed today.[19] As Worster points out, this bioeconomics perspective has a great deal in common with a "Progressive conservation philosophy" (e.g., Gifford Pinchot), wherein scientifically trained experts utilize the information obtained from the field of ecology to better manage the eco*systems* of the Earth.[20] When answering the question "What is humanity's relationship to the rest of creation?" both Anthropocentric Stewardship and Caring Management rely on the "both-a-part-of-and-apart-from" answer. The "bioeconomics paradigm" leans toward the more transcendent "apart-from" view of humanity. Yet the evangelical Protestant emphasis on interdependence, "community," and the literal stress on the idea that human beings are to be viewed as "a part of" the ecosystems they inhabit, obviously leans towards the immanent "a-part-of" understanding of humanity's relationship to the rest of creation. This means that Anthropocentric Stewardship and Caring Management proponents must counter this effect to create a more "balanced" answer to the question: "What is humanity's relationship to the rest of creation?" In many instances they do so theologically, by highlighting the concepts of *imago dei* and dominion.

The reason for this irony, I believe, and this need to counterbalance theologically the concepts of ecology evangelical Protestants highlight, is because they have been influenced more by the popularizers of ecology (e.g., Aldo Leopold, Rachel Carson, and Barry Commoner). These thinkers are more "organismic,"[21] in their writings, more willing to create a holistic, ecological ethical philosophy from their understanding of the findings of ecology than the average scientist in the field of ecology itself.

A second observation concerns the overall impression of stasis created by the evangelical Protestant descriptions of the concepts of ecology. The themes of *balance* and *cycles* seem to diminish any sense of change or linear, temporal movement. This can feed into the dualistic separation of "nature" and "history" wherein the only significant changes occur in human culture—when in fact the rest of creation is constantly changing, moving into ecological successions and regressions without any help from humanity.

A third comment regards the fact that the concepts and summarized findings of ecology at times become the latest version of natural theology: the rest of creation reveals to us the character and intentions of God. God blessed all creation; God's will is for each ecosystem to be a rich, stable, balanced and harmonious diversity—a "climax" (Clements)

or "mature" (E. Odum) ecosystem which never declines. This, of course, sounds more like the Garden of Eden than the findings of a scientific discipline. At times writers approach Muir's dualism. For Muir, wilderness (i.e., creation which had not been disrupted by human culture) was "unfallen, undepraved,"[22] and therefore "perfectly clean and pure and full of divine lessons."[23] In wilderness or undisturbed ecosystems, God's intentions and character can be much more easily seen when compared with fallen human culture.[24] Many times in the evangelical Protestant literature, the invocation of the mantra "Nature knows best" appears to be leaning toward this humanity is fallen, rest-of-creation is unfallen dualism. In other words, an undisturbed climax ecosystem is an excellent picture of God's will for creation.[25] If God's intentions are for each ecosystem to be arrested at the climax stage of succession, then western agriculture will have to be junked, as will most of the other activities of an industrial, technological society.[26] None of the evangelical Protestants reviewed here would be in favor of this, nor would they want to be perceived as advocating some type of return to a romanticized version of hunter-gatherer societies. Furthermore, do evangelical Protestants really want to profess that the rest of creation is "unfallen," or that the "curse" has been completely lifted? Does the rest of creation need the healing of Christ's atoning death irrespective of human activity?

Finally, an obvious consideration not to be overlooked is the context within which evangelical Protestants write: the perception that there is a problem, a crisis. Since things appear to be out of "balance," or even out of control, then balance and limits must be stressed; and since humans appear to be the problem, then interdependence, community, and being a part of the ecosystem needs to be emphasized. ✦

Notes

[1]On the understanding of ecology in the evangelical Protestant literature on the ecological crisis, see: J. Frank Cassel, "The Christian's Role in the Problems of Contemporary Human Ecology," in *Environmental Ethics: Studies in Man's Self-Destruction*, ed. Donald R. Scoby (Minneapolis: Burgess, 1971): 154–60; John W. Klotz, *Ecology Crisis: God's Creation and Man's Pollution* (St. Louis: Concordia, 1971): 17–24, 44–57, 143; Carl H. Reidel, "Christianity and the Environmental Crisis," *Christianity Today* 15 (April 23, 1971): 5; Eric C. Rust, *Nature—Garden or Desert? An Essay in Environmental Theology* (Waco: Word, 1971): 41–51; Henlee H. Barnette, *The Church and the Ecological Crisis* (Grand Rapids: Eerdmans, 1972): 12; Martin LaBar, "A Message to Polluters From the Bible," *Christianity Today* 18 (July 26, 1974): 8–12; James M. Houston, *I Believe in the Creator* (Grand Rapids: Eerdmans, 1980): 16–17, 28, 254; Vernon J. Ehlers, "Christian Stewardship of Energy Resources: Twenty Theses, in *The Environmental Crisis: The Ethical Dilemma* ed. Edwin R. Squires (Mancelona: Au Sable Trails, 1982): 334–5; Max R. Terman, "The Ethical and Ecological Basis for Earth Sheltered Housing," in Squires, ed., *The Environmental Crisis*, 309–10; William B. Badke, *Project Earth: Preserving the World God Created* (Portland: Multnomah, 1991): 135; Loren Wilkinson, ed., *Earthkeeping in the 90s: Stewardship of Creation* (Grand Rapids: Eerdmans, 1991): 19–35, 216–7, 319; Calvin B. DeWitt, "Ethics, Ecosystems, and Enterprise: Discovering the Meaning of Food Security and Development," in *Growing Our Future: Food Security and the Environment* eds. Katie Smith and Tetsunao Yamamori (Hartford: Kumarian Press, 1992): 9–10; Mark Stanton and Dennis Guernsey, "Christian's Ecological Responsibility: A Theological Introduction and Challenge," *Perspectives on Science and Christian Faith*, 45 (1993): 2–3; Calvin DeWitt, "God's Love for the World and Creation's Environmental Challenge to Evangelical Christianity," *Evangelical Review of Theology* 17 (April 1993): 137; Thomas Finger, "Modern Alienation and Trinitarian Creation," *Evangelical Review of Theology* 17 (April 1993): 193–8; W. Dayton Roberts, *Patching God's Garment: Environment and Mission in the 21st Century* (Monrovia: Marc, 1994): 10–13, 19–22; Richard A. Young, *Healing the Earth: A Theocentric Perspective on Environmental Problems and Their Solutions* (Nashville: Broadman and Holman, 1994): 51–55.

[2]For examples of works which reflect Wise Use, see E. Calvin Beisner, *Prospects for Growth: A Biblical View of Population, Resources, and the Future* (Westchester: Crossway, 1990); Ruben C. Alvarado, "Environmentalism and Christianity's Ethic of Dominion," *Journal of Christian Reconstruction* 11 (1986–87): 201–15; Billy A. Melvin, "One Perspective on the Environment," *United Evangelical Action* 49 (May/June 1990): 18; and Elver H. Voth, "Time in a Christian Environmental Ethic," in *The Environmental Crisis, The Ethical Dilemma* (Mancelona: Au Sable Trails, 1982): 57–66.

[3]See Alan M. Gottlieb, *The Wise Use Agenda: A Task Force Report Sponsored by the Wise Use Movement* (Bellevue: Free Enterprise Press, 1989); Rush Limbaugh, *The Way Things Ought to Be* (New York: Pocket Books, 1992) and *See, I Told You So* (New York: Pocket Books, 1993). On James Watt, see evangelical Protestant Susan Power Bratton's, "The Ecotheology of James Watt," *Environmental Ethics* 5 (1983): 225–36. See also Richard T. Wright's helpful analysis in "Tearing Down the Green: Environmental Backlash in the Evangelical Sub-Culture," *Perspectives on Science and Christian Faith* 47 (June 1995): 80–91.

[4]See, for example, Constance E. Cumbey, *The Hidden Dangers of the Rainbow: The New Age Movement and Our Coming Age of Barbarism* (Shreveport: Huntington House, 1983). An excellent article reviewing evangelical Protestant anti-environmentalism, is Richard T. Wright, "Tearing Down the Green: Environmental Backlash in the Evangelical Sub-culture," *Perspectives on Science and Christian Faith* 47 (June 1995): 80–91.

[5]Examples of writings which reflect this perspective include: Norman L. Geisler, *Knowing the Truth About Creation* (Ann Arbor: Servant Books, 1989); John Stott, "Our Human Environment," chap. in *Involvement: Being A Responsible Christian in an Non-Christian Society* (Old Tappan, Revell, 1984): 151–66; Harold Lindsell, "The Lord's Day and Natural

Resources," *Christianity Today* 20 (1976): 816–20; Robert P. Meye, "Invitation to Wonder: Toward a Theology of Nature," in *Tending the Garden: Essays on the Gospel and the Earth* ed. Wesley Granberg-Michaelson (Grand Rapids: Eerdmans, 1987): 30–49; David T. Williams, "The Christian and the Environment: Prophet, Priest, and King," *Evangelical Quarterly* 66 (1994): 143–58; William J. Dumbrell, "Genesis 1–3, Ecology, and the Dominion of Man," *Crux* 21 (December 1985): 16–26; Neil Summerton, "Principles for Environmental Policy," *Evangelical Review of Theology* 17 (April 1993): 225–40; John Emil Halver, "Are We Responsible for the Earth?" *Decision* 30 (1989): 14–15; Peter Cormack, "Finding the Natural, Enduring Balances," *Together: A Journal of World Vision International* (July–Sept 1991): 4–7; Reverie Greenburg, "South Africa: Creating Jobs While Conserving the Environment," *Together: A Journal of World Vision International* (April–June 1991): 6–8; Richard D. Land, "Overview: Beliefs and Behaviors," in *The Earth is the Lord's: Christians and the Environment* eds. Richard D. Land and Louis A. Moore (Nashville: Broadman, 1992): 18–26; David S. Dockery, "The Environment, Ethics, and Exposition," in *The Earth is the Lord's: Christians and the Environment* eds. Richard D. Land and Louis A. Moore (Nashville: Broadman, 1992): 113–25. In addition, a large number of the articles published in the *Journal of the American Scientific Affiliation* (hereafter *JASA*), later titled *Perspectives on Science and the Christian Faith* (hereafter *PSCF*) reflect anthropocentric stewardship. Examples include: Laurence C. Walker, "Resource Managers and the Environmental Ethic," *JASA* 38 (June 1986): 96–102; Walker, "Ecologic Concepts in Forest Management," *JASA* (December 1980): 207–13; E. James Kennedy, "The Christian and Ecology, *JASA* 25 (March 1973): 1–2; Carl E. Armerding, "Biblical Perspectives on the Ecology Crisis," *JASA* 25 (March 1973): 4–9; D. Wayne Linn, "Christian—It's Your Environment Too," *JASA* 25 (March 1973): 13–16; Helmut Fandrich, "The Engineer, the Consumer, and Pollution," *JASA* 25 (March 1973): 17–20; James C. Peterson, "Should We Be Concerned About People Who Do Not Yet Exist?" *PSCF* 47 (June 1995): 103–9.

[6]Examples of Caring Management include: Francis A. Schaeffer, *Pollution and the Death of Man: The Christian View of Ecology* (London: Hodder and Stoughton, 1970); Eric Rust, *Nature—Garden or Desert?: An Essay in Environmental Theology* (Waco: Word, 1971); Richard A. Young, *Healing the Earth: A Theocentric Perspective on Environmental Problems and Their Solutions* (Nashville: Broadman and Holman, 1994); Loren Wilkinson, "Global Housekeeping: Lords or Servants?" *Christianity Today* 24 (June 27, 1980): 752–6; Wilkinson, "Redeemers of the Earth," in *The Environmental Crisis: The Ethical Dilemma* ed. Edwin R. Squires (Mancelona: Au Sable, 1982): 39–56; Wilkinson, "Christ as Creator and Redeemer," in *The Environment and the Christian: What Can We Learn From the New Testament?* (Grand Rapids: Baker, 1991): 25–44; Ronald J. Sider, "Green Theology," *ESA Advocate* 13 (July / August 1991): 1–4; Sider, "Redeeming the Environmentalists," *Christianity Today* 37 (June 21, 1993): 26–29; Carl F. H. Henry, "Stewardship of the Environment," in *Applying the Scriptures: Papers From ICBI Summit III* ed. Kenneth S. Kantzer (Grand Rapids: Zondervan, 1987): 473–88; Millard J. Erickson, "Biblical Ethics of Ecology," in *The Earth is the Lord's: Christians and the Environment* eds. Richard D. Land and Louis A. Moore (Nashville: Broadman, 1992): 70–90; William A. Dyrness, *Let the Earth Rejoice!: A Biblical Theology of Holistic Mission* (Westchester: Crossway, 1983); Rowland Moss, *The Earth in Our Hands* (Leicester: Inter-Varsity Press, 1982); Richard H. Bube, "A Christian Affirmation on the Stewardship of Natural Resources," *JASA* 29 (September 1977): 97–98; Bube, "Energy and the Environment: Barriers to Responsibility," *JASA* 35 (June 1983): 92–100; Bube, "Do Biblical Models Need to be Replaced in Order to Deal Effectively with Environmental Issues?" *PSCF* 42 (June 1994): 90–97; Fred Van Dyke, "Beyond Sand County: A Biblical Perspective on Environmental Ethics," *JASA* 37 (March 1985): 40–48; Van Dyke, "Ecology and the Christian Mind: Christians and the Environment in a New Decade," *PSCF* 43 (September 1991): 174–84.

[7]The numerous works of Wesley Granberg-Michaelson and Calvin DeWitt are the key examples. To sample Granberg-Michaelson's work, see Wesley Granberg-Michaelson, *A Worldly Spirituality: The Call to Redeem Life on Earth* (San Francisco: Harper and Row, 1984); *Ecology and Life: Accepting Our Environmental Responsibility* (Waco: Word, 1988); and *Redeeming the Creation: The Rio Earth Summit—Challenges for the Churches* (Geneva: WCC Publications, 1992). For examples of DeWitt's writings, see "Seven Degradations of Creation," *PSCF* (February 1989): 4–8; "Assaulting the Gallery of God: Human Degradation of Creation," *Sojourners* 19 (February / March 1990): 19–21; "Seven Degradations of Creation: Challenging the Church to Renew the Covenant," *Firmament* 2 (1990): 5–9; "God's Love for the World and Creation's Environmental Challenge to Evangelical Christianity," *Evangelical Review of Theology* 17 (April 1993): 134–49; *Earthwise* (Grand Rapids: CRC Publications, 1994): 27–38; and "Christian Environmental Stewardship: Preparing the Way for Action," *PSCF* 46 (June 1994): 80–89.

[8]The most extensive treatment appears to be that of Rust, *Nature* 40–50.

[9]As Donald Worster reports, before the coining of the term by Ernst Haeckel, who began using it in 1866 (the actual word being *Oecologie*), the common phrase for this emerging branch of science was "the economy of Nature." Haeckel created the term by going back to the root for economy, *oikos*. See Worster, *Nature's Economy: A History of Ecological Ideas*, 2nd ed. (New York: Cambridge, 1994): 192. (See also the Oxford English Dictionary, 2d Ed., which corrects an earlier assertion that Henry David Thoreau first used the term in a letter in 1858. Apparently, "geology" was mistaken for "ecology.")

[10]Wilkinson, ed. *Earthkeeping in the 90s* is an example (pp. 216–7). It is interesting to note that this discussion takes place at the beginning of the chapter devoted to economics.

[11]Barnette, *The Church and the Ecological Crisis*, 12.

[12]For Muir's words, see, *The Eight Wilderness Discovery Books* (London: Diadem, 1992): 248. Although first published in 1911, this quote was penned in 1869. The context makes it clear that it was Muir's belief in a Creator which supplied this perspective.

[13]Howard A. Snyder, *Liberating the Church: The Ecology of Church and Kingdom* (Downers Grove: InterVarsity Press, 1983): 39.

[14]Barry Commoner, *The Closing Circle: Nature, Man, and Technology* (New York: Knopf, 1971): 33.

[15]Richard Young, *Healing the Earth*, 52–53.

[16]Several writers utilize a somewhat humorous example of the case of the parachuting cats. I will let Klotz tell the story: "The best recent example of how DDT can upset the balance of nature is what happened in Borneo after the World Health Organization sprayed huge amounts of the pesticide there. The pesticide killed the house flies, and these were in turn feasted on by geckos or lizards. The geckos in turn were devoured by local cats. Unhappily the cats died in such large numbers from this that the rats they once kept in check began to overrun whole villages. Because of the threat of bubonic plague WHO officials were forced to replenish Borneo's supply of cats by parachute." See *Ecology Crisis*, 143. See also Ron Widman, "When You've Seen One Beer Can You've Seen Them All," *Eternity* 21 (May 1970): 16.

[17]George Perkins Marsh, *Man and Nature: Or, Physical Geography as Modified by Human Action*, ed. David Lowenthal (Cambridge: Harvard, 1965): xxiii. Lowenthal states in the introduction: "Marsh's view of nature is explicit throughout the book: nature left alone is in harmony. Like most other men of his time, he conceived this harmony as essentially static" (p. xxiv).

[18]These ideas were championed by one of the "pioneers" of ecology, Frederick Clements, who began his career by studying the grasslands of Nebraska where he grew up. Worster's comments are quite instructive at this point: "Whether one talked about the virginity of the grassland or about the climax of the biome, it was clear to Clements, as it had been to others, that the white man was not a part of it: he came as a disrupter, an alien, an exploiter. From the eighteenth century on, biogeographers and ecologists had drawn up their elaborate schemes of classification, usually without ever considering the presence or influence of humans ... [The white man] was not really a member of the community, perhaps could not be. Indeed he was responsible for the destruction of the natural pattern of successional development, and gave the idea of a stable climax, even in Clements' time, a certain academic unreality." See Worster, *Nature's Economy*, 217–8.

[19]Worster, *Nature's Economy*, 311–2.

[20]Ibid., 312–3.

[21]See Worster, *Nature's Economy*, 316–38.

[22]John Muir, *A Thousand Mile Walk to the Gulf* (San Francisco: Sierra Club Books, 1991): 56.

[23]Muir, *Eight Wilderness Discovery Books*, 248.

[24]This is a key religious motivation for why Muir wanted to preserve wilderness—for the spiritual edification of fallen civilization. He wanted urbanites to have the opportunity to see, experience, and reflect upon "unfallen" creation, to enter into a relationship with it to further their relationship with the Creator.

[25]As Worster points out, the influential Eugene Odum propounded a secular version of this "Nature knows best" mantra. For Odum, "The goal of ecology ... was to study nature as a model for society." See Worster, *Nature's Economy*, 368.

[26]The most sophisticated reflection on this concern is done by Richard Young. See *Healing the Earth*, 53–55. He states the problems, and then appears to lapse somewhat back into them.

Books Received and Available for Review

(Please contact the book review editor if you would like to review one of these books. Please choose alternate selections.) Richard Ruble, Book Review Editor, *Perspectives on Science and Christian Faith*, 212 Western Hills Drive, Siloam Springs, AR 72761 or e-mail to: rruble@acc.jbu.edu

D. W. Bjork, *William James: The Center of His Vision*, APA Press, 1997

John Cafferky, *Evolution's Hand: Searching for the Creator in Contemporary Science*, East End Books, 1997

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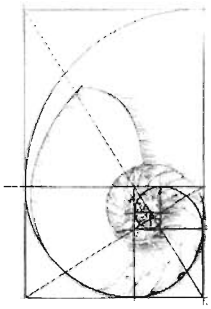

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God and Mathematical Infinity

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The Problem

How does mathematics relate, if it does, to religion? As a Christian mathematics teacher, I have often asked myself and others that question—without satisfactory answers. I envied my colleagues in other academic areas. Teachers of philosophy, social studies, literature, psychology—and even the physical sciences—can establish rich and legitimate connections with theological, ecclesiological, and perhaps even devotional matters. But teachers in my discipline generally welcome the fact that religion in no way impinges on their field. I find that disappointing.

In answers to my past inquiries, it was hardly satisfactory to hear religiously-minded people point out that the arithmetical number three and the Trinity were related, that the number 666 is important in one book of the Bible, or that (as I once read) 153 is numerologically important because it signified Christ on the occasion when Peter at the Sea of Tiberias hauled in that many fish—provided that one more fish be added from the fire on the beach to make 154! Nor was it much more helpful to read in Copernicus that mathematics is important in religion for setting up the liturgical calendar, in particular for determining the dates of Easter. Both he and Ptolemy, however, start their astronomy books by praising mathematics (Copernicus recalls that it is a liberal art) as a sort of propaedeutic for the abstract thinking required in philosophy. That answer is a little more promising but still rather indirect. Also, a few people have written on the ethical value of studying mathematics, but I do not find that they extend the argument beyond secular ethics to religion.

Its quantitative nature seems to make mathematics an unlikely science to connect in any important way to a religion. The involvement of higher mathematics with logic, moreover, is no help in this regard, nor does the lively history of mathematics itself seem to impact religion (or be impacted by it). What is left? Aristotle would probably have claimed that my quest for connections was futile since he believes that religion is primarily concerned with the efficient and final while mathematics is primarily concerned with the formal and material.

A Proposed Answer

As can be surmised from the title of this essay, one opening to a solution of the problem is provided by the contemporary treatment of mathematical infinity. What mathematicians have done with this topic, especially in the last hundred years, shows some relevance to religion. Of course, it needs to be emphasized that this proposed "opening" does not identify God with infinite number or with infinite space. The claim is, rather, that the careful distinctions made by recent mathematicians, and the methodology they currently use, can provide us with ways of thinking about God's infinity that turn out to be religiously useful. In other words, *how* they think about the infinite, more than *what* they think of it, can provide some guidelines in our thinking about God.

Some earlier mathematicians and nonmathematicians, from classical Greek times up to the last century, had useful things to say. A few such people will be cited in the following paragraphs.

Background

As in most matters of this kind, the Greeks anticipated, in their own fashion, the question raised here. While it is only since the time of Richard Dedekind and Georg Cantor in the 1880s and 1890s that real progress (in my opinion) has been made, the Greeks

did provide insights—as did thinkers such as Galileo and Nicholas of Cusa in Renaissance times. A quick inspection of a few of these efforts is helpful and sets the problem in the context that Dedekind and Cantor emerged from.

The pre-Socratics, such as Zeno, highlighted the paradoxes that can arise in physical and mathematical considerations of infinity. Anaximander, Anaxagoras, and Pythagoras left references to their thoughts on this subject. Plato has Socrates saying, in Book 7 of *The Republic*, that the study of numbers elevates and orients the mind to Truth. But Aristotle argued effectively, during an extensive treatment of the role of the infinite in nature and in mathematics (see Book 3 of *The Physics*), that the actually infinite cannot exist, even in mathematics. He did however admit that the potentially infinite can exist in the same way that time, which is always coming into existence, is said to exist.

What came from analyzing these difficulties was the key distinction between potential and actual infinity. The counting numbers are readily seen to be potentially infinite in the sense that no matter how large an integer you name, there is a larger one. It is not so clear that, taken as a whole, the set of integers is actually infinite. The same thing can be said about geometric straight lines. For instance, Euclid uses the word "infinite" in the former sense though some readers think he means actually infinite. Aristotle notes that it is enough for geometers to have potentially infinite lines available for their theorems. And, of course, the famous Euclidean theorem about "the infinity of the prime numbers" establishes their potential infinity, not their actual infinity.

But Galileo is quite clear in his *Dialogue on Two New Sciences* that, if we are careful, we can talk, *pace* Aristotle, about the actual infinity of the counting numbers. What is entailed in such thinking is a willingness to give up familiar rules of arithmetic. For example, there is a sense in which the whole is no longer greater than the part, and this is illustrated by a new definition of "size." Thus, if we take the positive integers as a whole, {1, 2, 3, 4, 5, ... , n, ... } and call the set Z, we can also take its subset of even integers, {2, 4, 6, ... , 2n, ... }, call it E and claim that even though E is a part of Z, the two sets are the same "size." The new definition states, quite reasonably, that two sets are the same size if their members can be put into one-to-one correspondence with each other. Since, in the case of Z and E, the even numbers can be put into such a correspondence simply by doubling each member of Z (or by halving each member of E), it follows that the whole of Z is the "same size" as the whole of its subset E. Modern mathematicians use this insight to define an actually infinite set: An actually infinite set is one the members of which can be put into one-to-one correspondence with members of one of its own proper subsets. Thus, not only is Z an actually infinite set, so is E since its members, too, can be put into such a correspondence with, say, every fourth integer. A sort of corollary to this analysis is that combining two distinct infinite subsets does not produce a "larger" infinite set. Similarly, Galileo produces a number of geometric paradoxes to show that if we take a line to be made up of an infinite set of points, we must abandon some of our usual assumptions.

These kinds of reasoning about infinite sets, we know today, can be carried out with logical consistency, though it requires us to take great care not to confuse our intuitions about the finite with the counterintuitive rules about the infinite. I believe such analytical efforts to be salutary exercises for all people interested in the philosophy or theology of the Infinite. Mathematicians learn to treat the actually infinite with great respect, a respect that seems to me readily transferable to a reverence for God.

Galileo was a genius at clarifying the suggestions of his predecessors. One of these was Nicholas of Cusa, an early renaissance thinker much admired, it is said, by Cantor. One argument reiterated by Cusa was that we know the infinite first and the finite only derivatively. Later Descartes rediscovers this idea. His famous line in the *Third Meditation* puts it: "I see that there is manifestly more reality in infinite substance than in finite, and therefore that in some way I have in me the notion of the infinite earlier than the finite ... " Cantor liked this reasoning and switched it to mathematics. He argued that finite lines and finite numbers are embedded in the infinite—so that we can, for instance, proceed indefinitely far with the counting numbers only because they are like footsteps on the preexisting path provided by the actually infinite.

A recent contemporary philosopher, Karl Jaspers, selected Cusa as one of the five most important thinkers of all time. One characteristic of Nicholas of Cusa was that he liked mathematical analogies. For example, Cusa felt that the infinite is where opposites are reconciled. To show this he noted that "the straight" and "the curved" are opposites, but in a circle of infinite radius the curved circumference becomes straight. In theology likewise, we have to reconcile such opposites as the transcendent and the immanent, and we do so in God. Cusa also praised the role of mathematical symbols. Since we cannot know God directly, we must resort to symbols, as it were. The value of mathematical symbols is that

they tend to be univocal and part of a system that carries human certitude to its limits. Moreover, he recalled with approval that some of his predecessors compared the Trinity to an infinite triangle.

Toward the end of the renaissance, in the second book of his *Essay Concerning Human Understanding*, John Locke rediscovers the important notion which Boethius had stated centuries earlier in these words:

> "If you compare the duration of a moment with that of ten thousand years, there is a certain [mathematical] ratio between them, however small, since each is finite. But ten thousand years, however many times you multiply it, cannot even be compared to eternity. *Finite things can be compared, but no comparison is possible between the infinite and the finite"* (emphasis added).

This insight, it seems to me, can be turned into a profound religious one.

In the middle of the seventeenth century Blaise Pascal made a, perhaps superficial, application of mathematical infinity to religion. In his *Pensées* there is one entitled "Infinite Nothingness," an entry which is generally called "Pascal's Wager":

> We know that infinity exists, but we are ignorant of its nature. Since we know that it is false to say that number is finite, it must be true that there is infinity in number ... We cannot say that it is even, or that it is odd ... [Similarly] we may perfectly well know that God exists, without knowing what He is ... Let us now speak according to natural lights. ... Let us examine this point and declare: "Either God exists or He does not." To which view shall we incline? Reason cannot decide for us one way or the other; we are separated by an infinite gulf. At the extremity of this infinite distance a game is in progress, where either heads or tails may turn up. What will you wager? ... A bet must be laid. There is no option; you have joined the game. Which will you choose then? ... Let us estimate the two possibilities: if you win, you win all; if you lose, you lose nothing. Wager then, without hesitation, that He does exist. ... There is the infinity of an infinitely happy life to win, one chance of winning against a finite chance of losing, and what you stake is finite. That removes all doubt as to choice: wherever the infinite is, and there is not an infinity of chances of loss against the chance of winning, there are no two ways about it, all must be given ...

To substitute this kind of mathematical rationalization for true faith in the living God of Abraham, Isaac, and Jacob is, of course, open to criticism. Nevertheless, by taking actual infinity (both in mathematics and religion) meaningfully, Pascal supplies us with a valuable connection of the sort I have been seeking. On the other hand, infinity is only one of God's traits. An undue emphasis on it (in this paper, for instance!) is dangerous since it might lead to the evil of an "apophatic" religion, one which dwells exclusively on the remoteness of God.

There remain difficulties of these matters. The careful and meticulous thought of Immanuel Kant bears this out. He made a famous list of antinomies about infinity and concluded that the universe is neither finite nor infinite. Perhaps he meant that the universe is potentially infinite. He found the word "transcendental" useful and introduced the category of "the sublime." In this regard, he found the mathematics of number and measurement a hindrance since they dealt with the finite. Thus it became apparent that the time was ripe for mathematicians to develop a good theory of mathematical infinity.

Georg Cantor and Richard Dedekind

As mentioned earlier, we are indebted to two late nineteenth century thinkers for systematizing and rationalizing the treatment of actual infinity in mathematics. Without reviewing here how they did it, I will use their general conclusions to make several claims. The chief claim is that mathematical ideas about actual infinity are often justified and, more to the point, that they are useful in religious thought.

Cantor, in particular, felt that his work had theological value. He is quoted as writing in 1896, "From me Christian philosophy will be offered for the first time the true theory of the infinite." He got in touch with prominent theologians in order to be of service to them in this matter.

Of course, his work provoked vigorous opposition. Leopold Kronecker, a confirmed finitist in mathematics and one of his most famous teachers, opposed his ideas in writing. Henri Poincaré did likewise, citing Hermite on his side and calling Cantor's results "a disease." He divided mathematicians into two kinds, constructivists and Cantorians, and supported the former, claiming that our talk about the infinite in mathematics is unconsciously colored by our experience of the finite and is thereby unreliable. Hermite's view apparently was that Cantor was creating only a putative mathematical object; mathematicians are supposed to discover such objects, not create them. Bertrand Russell was also very skeptical.

Today, the opponents of Cantor and Dedekind are very few. The rigor and care with which infinite

or "transcendental" numbers are treated have persuaded almost everyone that they constitute proper objects of study. Graduate students are routinely taught Cantor and Dedekind's methods and results. Paradoxes and antinomies are taken seriously and are handled with appropriate definitions and axioms. My admiration for this intellectual achievement leads me to make the following applications.

Take an instance. When mathematicians, speaking about infinite sets, use the expression, "all but a finite number of members," they are saying (somewhat like Boethius) that the infinite "all" is still the same size "all" even if we take away some finite set. The removal of billions of members from an infinite set in no way diminishes its infinity. For me, such an insight helps to solve familiar problems in, say, the theology of Providence. For God as infinite can extend his care simultaneously to billions of details, since "billions" after all are only finite.

Applications

The least that can be said is that the infinity of the mathematicians supplies us with a useful metaphor: many of the assertions we make about God and about a mathematical infinity are similar. Pascal's "wager," described above, is a case in point.

Moreover, Pascal uses the argument from Boethius, Galileo, Locke, and many others—that the infinite and the finite bear no ratio to each other. This seems to me a key mathematical principle, one with important religious applications. For example, I find in it a basis for hope. As Pascal says, human beings should by rights disappear (he says, be "annihilated") in relation to God but in fact do not disappear. Indeed, a major part of the "good news" of Christianity is that human beings are important (indeed, have the grace to be sons of God). Hence, in spite of the infinity of God there is hope for us as individuals. Another way to put it is: the individual "one" counts as much with the Infinite as does any finite "all" no matter how numerous. On the other hand, our share in the ratio, being "infinitesimal" should keep us appropriately humble!

The poets and prophets of the Old Testament appreciated the force of the principle that the Infinite and the finite do not compare. "What is man that Thou art mindful of him?" Almost the whole of Psalm 90 is a song to Infinity. And II Peter 3:8 quotes Psalm 90:4: "A thousand years in Thy sight are but yesterday when it is past or as a watch in the night." More to the point, Isaiah 40 says: "All the nations are as nothing before him; they are accounted by him as less than nothing and emptiness." A mathematician can appreciate the observation of Sirach 42: "He is from everlasting to everlasting. Nothing can be added or taken away." Job notes in chapter 9: "His works are great, beyond all reckoning, his marvels beyond all counting." Again, in Quoheleth 3, we read: "God has put eternity into man's mind, yet so that he cannot find out what God has done from the beginning to the end. I know that whatever God does endures forever; nothing can be added to it nor anything taken from it; God has made it so, in order that men may fear him."

It seems to me that the difficult notion of *adoration* (one of the four kinds of prayer) is made easier by thinking also about actual infinity. And speaking of prayer, I have come to believe that the prayer of children and my more sophisticated prayer are only finitely different from each other, so that vis-à-vis Infinity they are indistinguishable.

Another insight is that the infinity of God requires the divinity of Christ, since the only possible atonement for sins committed against the Infinite is by way of an infinite redeemer. Psalm 50 calls attention to this necessity in words put into God's mouth: "I do not ask for more bullocks from your farms ... for I own all ... all that moves in the field belongs to me." No finite sacrifice is enough.

Again, it seems to me that we need not concern ourselves with any apparent insignificance in our careers. Measured against an infinite scale, all careers are infinitesimal. The humblest occupation, if it is in accord with God's will, is just as significant as the most glamorous. There is an ancient saying that we should look at things *sub specie aeternitatis*; another version could be that we measure things *sub specie infinitatis.*

Let me give a final eschatological application. To people who might worry that heaven will become boring, we might mention that the finite bears no ratio to the infinite. Even the potential infinity of heaven cannot exhaust the actual infinity of the vision of God. I like to think of heaven as an endless sequence of "peak experiences," each one larger and richer than the preceding one—like the sequence of natural numbers embedded in the actually infinite set of all numbers. This notion helps me appreciate, for example, the final stanza of the famous hymn, "Amazing Grace":

> When we've been there ten thousand years,
> Bright shining as the sun,
> We've no less days to sing God's praise
> Than when we'd first begun. Amen.

Summary and Conclusion

Theological and religious reflection is aided by modern developments in the mathematics of infinity. Contemporary mathematicians have worked out rules and principles for careful reasoning about infinite sets. Some principles that have direct or indirect application to religion include the following:

1. The finite, the potentially infinite, and the actually infinite can be properly and usefully distinguished, and can be made free of internal contradictions.

2. Reasoning about the infinite requires abandoning many of the familiar rules that apply to the finite.

3. The actually infinite bears no ratio to the finite, no matter how large the latter is.

4. The actually infinite provides a basis for resolving some problems that arise in ordinary matters and, perhaps further, a basis for a sense of wonder. ✦

Notes

1. A work that disagrees with this paper is *Logos: Mathematics and Christian Theology* by Granville Henry, Bucknell University Press, 1976. It seems to be written from the perspective of process theology rather than of classical theology.

2. An accessible source for details about Cantor's development of transcendental numbers and of the surrounding circumstances is the article by Joseph Dauben in *Scientific American* 248, no. 6 (June 1983). He also has a full-length treatment, *Georg Cantor: His Mathematics and Philosophy*, Cambridge, MA: Harvard University Press, 1979.

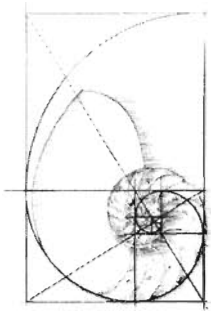
3. Many of the surviving classical Greek sayings and writings about infinity are collected in *Matter and Infinity in the Presocratic Schools and Plato* by Theodore Sinnige; Holland: Van Gorcum and Co., 1968.

4. Karl Jaspers included his book-length account of Nicholas of Cusa in his *The Great Philosophers;* New York: Harcourt, Brace and World, 1966.

5. Henri Poincaré's attack on Cantor is in his *Mathematics and Science: Last Essays*, New York: Dover Publications, 1963.

6. Bertrand Russell's reservations about infinity are in his *Introduction of Mathematical Philosophy*, Allen and Unwin, 1953.

7. The writer is indebted to the editor and his reader-consultants for recommendations regarding the text, and to a referee for the reference to Descartes.



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Essay Review

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***FACETS OF FAITH & SCIENCE**, ed. Jitse M. van der Meer.*
Lanham, MD: University Press of America, 1996.

Vol. I. Historiography and Modes of Interaction
Vol. II. The Role of Beliefs in Mathematics and the Natural Sciences: An Augustinian Perspective
Vol. III. The Role of Beliefs in the Natural Sciences
Vol. IV. Interpreting God's Action in the World

This major undertaking, involving four volumes of 60 papers written by 44 different authors for a total of 1475 pages, together with bibliographies and indices, presents the papers from a five-day research conference in 1992, the First International Pascal Centre Conference on Science. The Pascal Centre for Advanced Studies in Faith and Science was established in 1988 by Redeemer College, Ontario, Canada, and specializes in studies of the relationships between faith and science from a biblical perspective, principally in the Dutch Reformed tradition. The objectives were to review the current state of scholarship on the nature of the interactions between the natural sciences and belief, and to identify research that promises new insights. Biomedical and environmental issues were not included.

About three-fourths of the papers are written from the perspective of philosophy, theology, humanities, or history. The authors come primarily from academic positions in the United States or Canada. Those from other countries include two from England (Brooke and Cantor), one from Scotland (Torrance), one from the Republic of South Africa (Strauss), and two from the Netherlands (Strijbos and Geertsema).

It is desirable for the participants in such a discussion to have an experiential knowledge of what it means to actually "do science," rather than merely to speculate about its historical and philosophical implications. It is especially critical to make a distinction between what "science is" and what "scientists say." If a perceptive analysis is to be made of the relationship between science and faith, it is critical that each of these terms be clearly defined; an even more appropriate pair of categories to compare would be "science" and "theology."

To refer to a particular paper, a Roman numeral is used to indicate the volume number, an arabic numeral to indicate the section number, and a second arabic numeral to indicate the paper number, e.g., III.2.12 refers to the twelfth paper in Volume III, found in Section 2 of that volume.

I.1 Topics from the history of science and religion

Emphasizing the potential complexity of the interaction between religious belief and the natural sciences, J. H. Brooke (I.1.1) undertakes a history of the interaction between religion and science in terms of a three-dimensional map. He proposes six different roles for *religious beliefs in relation to science*: a presupposition of science, a sanction for science, a motive for science, support for the aesthetic dimension in scientific work, regulative principles, and source of primitive explanatory modes of science;

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five different roles for *scientific argument in interactions with religion,* corresponding to the scientist as investigator, reporter, popularizer, philosopher, and preacher; and six different roles for *theological argument in relation to science,* corresponding to the theologian as exegete and evangelist, systematist and apologist, and pastor and preacher.

S. J. Wykstra (I.1.5) seeks to shift Brooke's emphasis on historiography to an emphasis on the integration of religious outlooks into scientific theorizing by giving such outlooks a role in evaluating particular theories. He argues against the conclusion that worldview commitments have been mere veneer on the direction of scientific theorizing, and urges further investigation of interaction between worldviews and science that might lead to an integrationist conception of science.

Other papers in Volume I deal with the contributions of several historically significant thinkers: Oliver Lodge, J. H. Jeans, A. S. Eddington, Michael Faraday, Immanuel Kant, Thomas Aquinas, Blaise Pascal, Augustine, and Michael Polanyi.

D. Wilson (I.1.2) argues that the terms *science* and *religion* are best not used at all. He points out that to Lodge, "science" was more than an empirical knowledge of nature and "religion" was more than a biblical knowledge of God and Christ, whereas to Jeans "science" did come close to meaning an empirical understanding of nature, but "religion" was not a biblical understanding of God, and to Eddington "science" was more than an empirical study of nature, and "religion" was something primarily different from a biblical knowledge of God.

I.2. Modes of interaction between science and faith

T. F. Torrance (I.2.8) calls for a distinction between fundamental beliefs and their normative function in affecting our ongoing scientific inquiries. He suggests a distinction between *ultimate* beliefs, for which there are no alternatives, and *penultimate* beliefs, for which we are faced with alternatives. The existence of penultimate beliefs leads to the condition of contingent intelligibility upon which empirical science depends, which is definitely of Christian origin. Key areas of regulative beliefs affected by these considerations are the dualist vs. the nondualist character of the universe, the singularity vs. the uniqueness of the created universe, the primacy of the visible and tangible over the invisible and intangible, and the problem of order and disorder.

A paper by Alvin Plantinga (I.2.9) is titled with words that have become a battle-cry in many recent science vs. faith debates: "Methodological Naturalism." Plantinga offers the following general statement:

> According to an idea widely popular ever since the Enlightenment, however, science (at least when properly pursued) is a cool, reasoned, wholly dispassionate attempt to figure out the truth about ourselves and our world, entirely independent of ideology, or moral convictions, or religious or theological commitments.

Plantinga describes three examples of the religious non-neutrality of scientific claims or hypotheses, argues that a Christian academic and scientific community ought to pursue science in its own way *starting from* and taking for granted what we know as Christians, and explores the claim that science, properly so-called, cannot involve religious belief or commitment. Plantinga concludes by saying, "Methodological naturalism, however, though widely accepted and indeed exalted, has little to be said for it; when examined in the cool light of day, the arguments of it seem weak indeed. We should therefore reject it, taken in its full generality."

There are, however, some basic problems with this approach. "Naturalism" may properly be understood to represent a worldview that eliminates God and is therefore atheistic by definiton. To the representative practicing scientist, however, methodological naturalism does not describe a worldview, but a method of approach within the limited domain of science. Methodological naturalism simply means that when one does science, one limits oneself by choice to interpreting observations and empirical data in terms of theories involving natural mechanisms. This choice is not made because of the atheistic or anti-religious sentiments of the scientist, but because this approach makes it possible to have science be a well-defined and reliable, although deliberately limited, activity. Nor does it mean that no supernatural or metaphysical inputs or influences are allowed in the formulation of possible theories to describe the empirical observations. What it does insist is that the work is not considered to be *science* until it is tested and shown to be consistent with observable reality (i.e., to indicate accurately what that reality *is like*). It is admitted—at least by Christian scientists—that there may be phenomena where no such natural description is possible, e.g., an actual miracle; this does not mean that such phenomena are impossible, but simply that in such a case its description should not be called science. Many Christian apologists, however, have interpreted the term "methodological naturalism" to be synony-

mous with atheistic "naturalism," the deliberate rejection of any activity of God in the natural world.

C. B. Kaiser (I.2.10) proposes a "theology of science," by which he means the formulation and analysis of themes in the history and current practice of science that bring us into the realm of theological discourse. "Theological discourse includes all assertions and assumptions concerning the nature and order of reality as a whole. It implies the supraindividual and the metahistorical, as well as the metaphysical; yet it is often present in discourse about mundane subjects." This proposed "theology of science" is similar in some ways to traditional "natural theology," but differs in that it is based on the character of scientific work rather than on particular characteristics of nature described by science. It deals with the beliefs and ideals that function in the work of scientists, and might also be treated as a branch of the philosophy of science.

The occurrence and significance of conflicts between science and Christian theology are considered by K. W. Kemp (I.2.11). Four major causes for such conflict are suggested: (1) the interpretation of a particular biblical passage, as in the case of scientific creationism; (2) competing worldviews, as when doing science is identified with "naturalism" that includes the anti-Christian theses of materialism, determinism, and mechanism; (3) differences between scientific and theological methods of validating knowledge about the world; and (4) two attitudes toward the world, disagreeing on the meaning of natural and supernatural, or sacred and profane. Examples of existing conflicts are the static world, young universe, and sudden creation theses of creationists; or the Roman Catholic Church's theological commitment to a monogenetic origin for the human race. The author argues that such issues may force a choice between a scientific answer to a question and a theological answer, but this does not force a choice between the two activities. He concludes with a plea for humility and modesty in areas where we can know very little with certainty. A similar theme is discussed by M. Goheen (IV.2.19) as summarized below.

This view is questioned by F. Suppe (I.2.12), who desires to protect Christianity from metaphysical assaults based on science by removing metaphysical beliefs both from science and from theology. He argues that reality is found in observational experience, not in theory.

T. Settle (I.2.13) in turn disagrees with Suppe, and objects to bridging gaps between belief and knowledge by leaps of faith, by communal consent alone, or by "properly basic beliefs" as in Reformed epistemology, because each omits reason at the critical point. Settle advocates a realism that is qualified so as to avoid a God-of-the-gaps position: (1) one can be a scientific realist and argue that one's metaphysics cannot be inferred from science, thus making room for religious belief; (2) Settle's realism includes the original paradigm of causality as an unmediated sense of effort by an agent, making God's action all pervasive in the world and avoiding a God-of-the-gaps; (3) Settle's realism involves divine causes to fill legitimate explanatory gaps.

II.1. Beliefs in the philosophy of science, with specific reference to Kuyper, Bavinck, and Dooyeweerd

The second volume contains papers based on the writings of three distinguished philosophers: Abraham Kuyper (1837–1920), Herman Bavinck (1854–1921), and Herman Dooyeweerd (1894–1977). According to D. Ratzsch (II.1.1), Kuyper accepted a role for subjective beliefs at all levels of science, but saw no reason why Christian and unbelieving scientists could not work side by side on data collection, uncovering empirical regularities, and at least some theoretical matters. But as we move out to the more global theoretical perspectives of each of the individual disciplines, according to Kuyper, we enter areas where unbelieving subjectivity can make a major impact. The believer must reject anything in the unbeliever's science affected by subjectivity, and the effects of those beliefs encompassing unbelief and its products, materialism, mechanism, and so forth.

A distinguishing feature of Bavinck's Calvinism, as summarized by A. Wolters (II.1.2), is that it conceives of the relationship between nature and grace in an integral rather than a dualistic way, as normally held in other traditions in historic Christianity, such as Anabaptism, Lutheranism, and Roman Catholicism. His basic theme was "grace restores nature." Consistent with this theme was his insistence that Scripture has authority over the nontheological sciences, but this authority is qualified by relating scriptural authority in these sciences primarily to matters of history and worldview. In these ways, he avoided both a dualism that separates religion and science, and a naive biblicism that confuses the language of Scripture with that of science.

In two papers, R. A. Clouser (II.1.3; II.1.4) considers the general relationship among religion, metaphysics, and science, and invokes the philosophy of Dooyeweerd as insight into the answer, thus preparing the way for the discussions in other papers in

this volume. After briefly considering three common views of this relationship, rationalism, scholasticism, and insulationism, he advocates an answer given by John Calvin in the sixteenth century and developed and defended by Dooyeweerd and Kuyper: a nonreductionistic metaphysics in which having the right God is a necessary but insufficient condition for having truth and knowledge, including theoretical truth and scientific knowledge.

Then, in the following paper, Clouser gives a brief sketch of Dooyeweerd's cosmonomic philosophy of science.

> (Dooyeweerd) ... argues that belief in God requires the elimination of reductive theories in favor of a metaphysics in which all the aspects of creation are regarded as equally dependent on God and therefore equally real, mutually irreducible and simultaneously true of all creatures. It is this program—the systematic elimination of all reductionism—which is one of the guiding principles of all the other concepts and hypotheses of Dooyeweerd's philosophy.

Rocks, for example, may be said to have biological, sensory, or logical properties, when it is taken into account that such properties can be exhibited either actively or passively. This aspect of Dooyeweerd's thought is summarized in the final sentence of the paper: "Dooyeweerd ... provides a set of principles whose impact on the entire scientific enterprise is internal to the constructing and reforming of theories to provide systematically nonreductionist explanations of every aspect of creation."

Director of the Dooyeweerd Center at Redeemer College, D. F. M. Strauss (II.1.5) uses the perspective developed by Dooyeweerd and Dirk Vollenhoven (1892–1978) on eliminating reductionism. He sees rationalism, irrationalism, and semanticism as forms of reductionism, which replace God with a creature. Nominalism transposes the universal order for entities from God into the human mind, denying entities their universal side. Examples of the regulative role of nominalism in sociology, biology, and mathematics are given.

S. J. Wykstra (II.1.6) argues specifically for an integrating role that allows religious outlooks a legitimate role in shaping scientific theorizing in its specifics. He describes how the theism of Newton led him to understand matter in terms of God's action. Arguing that worldviews produce dispositions toward certain types of theories, and that the effects of worldviews extend from the selection to the constitution of theories, Wykstra contests the charge that this approach leads to a God-of-the-Gaps. He offers a tentative, "Yes," to the question about whether worldviews should shape scientific theorizing, awaiting future needed clarification.

D. Ratzsch (II.1.7) considers the prospects for a Christian natural science, especially in view of the claims of some Christians that it would be desirable to have such a distinctively Christian science. He is not convinced that the content of scientific theory differs depending on whether the theorists are Christians or non-Christians. Ratzsch notes that nature can teach us some things about how to do science, and that science has been described with some validity as "organized common sense," which is consistent with viewing such common sense extra-empirical factors as fairly rigorous limitations on what might be meant by a "unique Christian science." He summarizes the extra-empirical factors under the headings of common sense, scientific sense, secular worldview fallout, and theology. There is also the question about whether scientifically relevant data can be obtained from the Scriptures. Finally, he claims that Scripture itself contains some themes that point in the exact reverse direction to a Christian science. Ratzsch's conclusion is that it may be possible for there to be a uniquely Christian science, but that this would be an uncertain and very difficult undertaking.

II.2. Beliefs in mathematics, physics and biology

G. B. Chase (II.2.8) describes examples from the Middle Ages and the nineteenth century in which Christian theology potentially provided specific insights and motivations for the development of new branches of mathematics, in contrast to Blaise Pascal, Leonhard Euler, or August-Louis Cauchy, whose Christianity did not shape their mathematics.

1. The work of William of Ockham (1285–1347) led to the change in which mathematics today deals with abstract ideas, with attributes independent of substance. His work was an effort to be faithful to the doctrine of transubstantiation in the Eucharist, while still being consistent with observation.
2. In the Middle Ages, Christian theology clarified the mathematical notions of infinity and of continuity, basing the concept of infinity in mathematics initially on God's infinite nature rather than on his creation.
3. William Hamilton (1805–1865) freed algebra from being about numbers based on his belief that the subjective and the objective cohere in God.
4. In nineteenth-century London, George Boole developed Boolean algebra in which the symbols

no longer stand for numbers (but for True and False, or On and Off), through the inspiration of his commitment to the unity of the Godhead and of his understanding of the opposition of God and Satan.

5. According to Clerk Maxwell in the late nineteenth century, the universe can be described mathematically because the universe is contingent and actively upheld by God. Maxwell proposed an alternative to the materialistic approach toward the physics of his day through his electromagnetic field theory.

6. Georg Cantor (1845–1918) was the first mathematician to give rules for manipulating numbers that are beyond the finite-transfinite numbers. He established the definition of mathematical infinities, proving that there are many infinities, all of different sizes. Cantor rejected an absolute mathematical infinity, while admitting mathematical infinities each larger than the other, on the grounds that God's infinity is the necessary source of a coherent view of mathematical infinities.

In the following two papers, D. F. M. Strauss (II.2.9; II.2.10) argues that metaphysical beliefs affect the content of mathematics, bringing about a reduction to number (discreteness) and a reduction to space (continuity), and that the idea of infinity embodies this relationship between number and space. He (II.2.10) concludes that "God has established an order ... within creation" and that "mathematicians disclose existing mathematical order rather than create this order." Strauss introduces the idea of the mutual coherence and irreducibility of number and space suggested by the cosmonomic philosophy of Dooyeweerd, and develops a proposal to avoid antinomies based on two fundamental beliefs originating in the doctrine of creation: mathematics deals with a reality existing independent of the mind of mathematicians, and this reality displays a diversity of irreducible and coherent aspects.

D. N. Petcher (II.2.11) considers a case study in modern physics to illustrate the interplay between science and belief. Recognizing that one of the first tasks in speaking about a Christian view of science is to clearly define what is meant by "natural law," Petcher makes the helpful statement that "the laws of nature are not to be taken as blind mechanisms which are set in motion to function autonomously from God; rather, the laws actively express *God's very workings in history by his powerful word*—his handiwork, or if you will, his artwork." The central purpose of the paper is to consider a specific case of inconsistency between two fundamental physical theories, general relativity and quantum field theory, which involve a fundamental difference in beliefs about the nature of physical reality. The evaluation of these two theories by Einstein and by Dooyeweerd, two men with quite different philosophical orientations, is considered. Einstein believed that his theory of general relativity was the more fundamental because for him a theory must describe actual events themselves and not just a statistical description; he believed in a deterministic universe for which "the ideal of mathematical simplicity was actualized in nature." Dooyeweerd, on the other hand, held that the diversity of creation is seen, in part, in an irreducibility of various aspects of creation to one another. He concluded that if discontinuity is seen in matter-energy (as in quantum mechanics), then physical space must exhibit such discontinuity, i.e., physical space must be "quantized" following the quantum theory. Although most physicists today would agree in general with Dooyeweerd's perspective on this issue, it would be for quite different reasons, more clearly set forth in the debates between Niels Bohr and Einstein early in this century.

The last two papers of this second volume deal with the question of "emergent properties" as the result of a hierarchy structure: reality consists of matter, and this matter is organized in levels of complexity. The editor of the series, J. M. van der Meer (II.2.12) considers the implications for sociobiology in the thought of E. O. Wilson and C. J. Lumsden, and U. Zylstra (II.2.13) considers hierarchy models in evolution. At issue is how we can account for the complexity of structure and function in organisms, and how religious and metaphysical beliefs affect the choice of hierarchy structure. The viewpoint being criticized here is that of "emergent materialism" which claims that qualitatively different higher-level phenomena emerge when lower-level entities enter into relationship with each other. The reduction is expressed as a relationship between parts and wholes (ontological reduction) and among theories at different levels of organization (theory reduction). It is argued that Wilson and Lumsden exclude reference to higher-level causes (downward causation). Thus van der Meer charges them with allowing philosophical materialism to shape the relationships among theories.

Although materialism can lead to a specific perspective on the subject of "emergent properties," it is not at all clear that it is a necessary approach. A fundamental question appears to be whether mental, sociocultural, and religious phenomena are reduced to the implications of a materialistic ontology, if it is believed that these phenomena arise as genu-

ine realities from material interactions with appropriate boundary conditions that express the activity of God. Must the reality of creation be described in terms of brain-mind and body-spirit dualism? Does a person *have* a body, a soul, and a spirit? Or is it a more accurate description of God's activity to propose that he has brought human beings into existence as bodily, soulful, and spiritual creatures, in whom the relationship among the mind, soul, and spirit, and the patterned interactions of the material hierarchy, are a marvelous wonder of God's work? There is no reason why such a view cannot see the effect of the "wholes" on the "parts," as well as of the "parts" on the "wholes."

Zylstra argues that the theory of evolution cannot be supported by empirical evidence and that its universal acceptance has led to the proposal of hierarchy theories without ontological foundation. Evolutionary selection is assumed to begin with these hierarchy theories, and this strongly influences the consequent thinking. The author indicates that Dooyeweerd's "encaptic" theory is his own preference for understanding relationships between levels of organization. As discussed earlier by R. A. Clouser (II.1.4), this term refers to a situation "in which a subwhole exists and acts within the internal organization of a larger whole which has a different qualifying function from the subwhole, while the qualifying function of the subwhole is overridden by that of the larger whole, for example, the relationship between atoms included in a bird and the bird as a whole."

III.1. Beliefs in the physical sciences, including ancient to modern astronomy, Newton and his beliefs, the shroud of Turin, and seventeenth century science

L. Taub (III.1.1) deals with "Astral Piety: Astronomy and Ethics in the Ancient Mediterranean World," and explores the interaction among astral religion (the veneration of the heavenly bodies as divine or eternal), ethics, and astronomy in Greek antiquity, in particular in Plato and Ptolemy. In a second paper (III.1.2), Taub deals specifically with Chinese culture of the sixteenth and seventeenth centuries. During this time, various European missionaries in China attempted to win converts to Christianity, and Jesuit missionaries in particular sought first to interest the Chinese in astronomy and Western science, and then to convert them to Roman Catholicism.

B. Lightman (III.1.3) explores the role of religious and metaphysical beliefs in the popular science of the Victorian astronomer R. A. Proctor (1837–1888). Proctor's scientific theories and ideological position derived their authority from his religious thought. He used the analogy between the heavens and the earth to uphold the idea of extraterrestrial life and a naturalistic social ethics. "Proctor's lively astronomical imagination projects onto the skies a universe composed of planets, inhabited by aliens organized into industrial societies blessed by God."

Starting with the observation that cosmological knowledge is more difficult to obtain than knowledge in other sciences, J. Byl (III.1.4) emphasizes the need for fundamental assumptions derived from philosophical and religious convictions to guide cosmological theories, and gives some examples of how this has been done in the assumption of the validity of the principle of induction and the uniformity of nature throughout the universe. He concludes with the statement, "Christians must not permit modern cosmology to unduly modify their beliefs. On the contrary, they should hold on to the faith, construct a cosmology consistent with it, and look forward with confidence to the return of Christ."

The next two papers are concerned with the theological views of Isaac Newton. R. S. Westfall (III.1.5) argues that Newton was a deist, but E. B. Davis (III.1.6) contends that Newton believed that God is intimately involved in all phenomena and did not in fact embrace deism. Westfall does not doubt the influence of Newton's religion on his science, but can find no valid influence of his theology (Arianism) on his science. Instead he describes the effect of the basic stands of the scientific revolution on Newton's religion: "the central thrust of his lifelong religious quest was the effort to save Christianity by purging it of irrationalities." Davis on the other hand writes of "Newton's rejection of the 'Newtonian worldview,'" and contends that Newton's understanding of God's activity in the universe shaped both his theological perspective and the content of his science. He argues that Newton rejected both the metaphor of a clockwork universe and the kind of cold mechanical universe involved in such a description, and contended instead for the constant activity of God in a way unlike the rationalistic approach of Descartes and Leibniz. Thus Davis contends that "Theology and science were inextricably intertwined during the crucial years when the modern scientific worldview was being formed. ... theology exerted a subtle but significant influence on seventeenth-century science."

C. I. J. M. Stuart and T. Settle are coauthors of "Physical Laws as Knowledge and Belief" (III.1.7). They start with the fundamental assertion that "Sci-

ence implies the existence of a primitive reality deeper than the empirical reality scientists regularly encounter in their work," and conclude with the important perspective so often overlooked in discussions of science and faith, "Physical theories and the laws of physics are purely human constructions... The laws and theories of physics do not ... describe reality. They advance what we believe about it in the light of current thought." This perspective must be coupled with the equally significant one that an independent reality is the source for the kinds of observed empirical regularities that physical laws and theories describe.

T. J. Trenn (III.1.8) considers the radiocarbon dating of the Shroud of Turin and proposes that a predisposition to disbelieve in the resurrection of Christ could have caused investigators to ignore possibilities that obscured the true age of the garment. While insisting that the Shroud itself must not become an object of faith, he argues that "it may for some who already believe unconditionally, even reinforce and further validate the earthly claims of Jesus Christ."

The relationship of religion to science in the seventeenth century is the subject of a paper by E. B. Davis (III.1.9), who considers the theology of creation of Galileo Galilei (1564–1642), Rene Descartes (1596–1650), and Robert Boyle (1627–1691) to answer three major questions, "How was God's relationship to the human mind understood? How was God's relationship to nature understood? What overall view of the nature of scientific knowledge was proclaimed?" He agrees with M. B. Foster (1903–1959) that theological assumptions are closely associated with conceptions of scientific knowledge, but disagrees with Foster's belief that Christian theology caused the rise of modern science.

III.2. Beliefs in the biological sciences involving evolution, belief and neuroscience, and the concept of hierarchies

S. Strijbos (III.2.10) compares two basic models or metaphors for the organism: the classical machine metaphor, and the chemical open-system metaphor advanced by Ludwig von Bertalanffy. Life is, in von Bertalanffy's view, a dynamical flow of matter and energy through open systems, a chemical model that replaced earlier models of the machine (in mechanism) and of the vital force (in vitalism). Although this model of a dynamical flow through open systems was advanced to free one from mechanistic thinking in biology, Strijbos argues that it merely substitutes one kind of machine model for another, an approach that is inadequate for the types of open systems manifested in organisms.

P. A. Nelson (III.2.11) considers the bearing of theology on evolutionary explanation, and has much to say as well about the concept of "methodological naturalism." Nelson concludes that the use of arguments from divine perfection and freedom in evolutionary reasoning is inconsistent with the principle of methodological materialism; this is certainly true if such arguments are regarded as science, but such an approach does violence to the very nature of science itself. It is important to realize that science itself, properly understood, does not tell the whole story. And it is equally important to realize that the finding of natural mechanisms for evolutionary processes (a scientific description) is in no way inconsistent with the recognition of these processes as our perception of God's activity (a theological description). Nelson considers specifically the argument from divine perfection, which appears to be contradicted by the argument from imperfect design shown in vestigial organs and suboptimal design, and the argument from divine freedom, which appears to be contradicted by similarity (homology). The conclusion of the paper is:

> Science will have to deal with theological problems if science is a truth-seeking enterprise; theology must confront the patterns of scientific experience if it hopes to speak to all of reality. What this essay helps to show, I think, is how very easy it will be to do both theology and science badly.

M. J. McDonald (III.2.12) compares the perspectives of Donald M. MacKay and Roger W. Sperry in terms of their theories of mind-brain relationships, their philosophies of science, and their models of science-belief relationships. MacKay and Sperry share a theory of consciousness that is emergentist with a mutual causal determination of mental and neural events, but their resulting interpretation differs considerably. In relation to the question of life-after-death, for example, MacKay concludes that having a scientific understanding of the embodiment of consciousness in brains tells us nothing specific about the possibility of conscious life after death, whereas Sperry maintains that the inseparability of consciousness and brain function makes after-life notions untenable.

Hierarchy theory, that perspective which sees reality in terms of levels of organization, is explored further by D. L. Wilcox (III.2.13). In simple language, hierarchy theory sees reality as composed of a series of parts and wholes, any particular entity being a part of more complex entities at higher levels of organization, and a whole for less complex entities at lower levels of organization. New properties of the whole emerge because of a particular patterned

interaction of the parts. In this paper, Wilcox examines four different models of hierarchy: (1) hierarchies of classification which express their users' metaphysical convictions, but have no ability to explain emergence of new properties; (2) hierarchies of material composition which are unable to explain the emergence of complexity and information; (3) hierarchies of information which cannot decode themselves or follow their own instructions; and (4) control hierarchies, which are composed of entities that read and follow the genetic instructions, and are able to fulfill the tasks of the organism as a whole. This holistic control perspective is advanced as fully consistent with a theistic perspective on the world.

Another paper dealing with the concept of hierarchy by S. Strijbos (III.2.14) again raises the question of whether hierarchy theory is the key to overcoming reductionism. There is considerable debate about this issue; for example, von Bertalanffy considers hierarchy theory as the way to combat reductionism in science, whereas Herbert Simon develops a general theory of hierarchical systems precisely because he is a reductionist. After considering the strengths and weaknesses of these two approaches, Strijbos concludes that "current systems-theoretical conceptions of a hierarchical order of reality are inadequate for purposes of overcoming reductionism," and advocates development along the line of the "multimodal view" developed by Dooyeweerd.

IV.1. Theistic interpretations of God's actions in the world, including divine agency, transcendent causes, approaches to natural theology, evolution, the laws of nature, and design

The fourth volume faces the following issues: "Renewed interest in intelligent design is raising many old questions of natural theology. Can God's action in nature be used as an explanatory strategy in science and as an argument for his existence? How can Christians claim to be able to understand material nature by acting as if God does not act in nature while also believing that God acts providentially in nature, history, and in their personal lives?"

O. C. Thomas (IV.1.1) proposes that the best way to approach the general problem of God's activity in the world is to consider the model of double agency, i.e., that in one event both the divine and creaturely agents are fully active. Double agency has not received an intelligible solution in spite of the fact that central Christian beliefs include, for example: (1) obedient living as the result of God living in the person without taking away the person's freedom of action, (2) that God can act in nature and history, (3) that the Bible can have a human and a divine dimension, and (4) that Jesus' actions can be God's actions. After considering the suggestions of several authors, Thomas concludes that there are only two possible solutions to the problem: (1) follow the lead of process theology in which neither the divine nor the human agent is a sufficient cause of the event, or (2) affirm double agency but assert that it is mysterious by nature, that the actual connection lies outside our knowledge, similar to the mind-body problem.

Issues related to "double agency" are pursued further by T. Settle (IV.1.2) and D. B. Austin (IV.1.3). Settle argues that the concept of double agency is intelligible, possible, and not self-contradictory. He suggests that a better metaphysics for treating the issue when dealing with nonhuman creatures can be found in a metaphysics "that keeps faith with insights and principles drawn from Whitehead's philosophy of organism, though not orthodox process thought," but that this cannot be applied straightforwardly to human life with God. He proposes that insight from process theology offers some interesting suggestions, that it unifies God's activity, and that it gives a new interpretation of the biblical view that lawful behavior is a manifestation of creaturely obedience.

Austin tackles the same issues with a proposed redefinition of God's omniscience, informed by present-day knowledge about uncertainties at the quantum level, "as the knowledge of all things knowable (roughly in parallel with the idea that omnipotence is the ability to do all things do-able), including the actual as actual, the possible as possible and the *probable as probable*. ... God can still be said to know all things that can be known ... to have perfect knowledge of the probability that attends each future possibility." Perhaps both of these process-theology-related views is more limiting of God and his activity in the world than is necessary or biblically defensible.

W. A. Dembski (IV.1.4) states that his aim is to answer the question, in a primarily philosophical investigation of narrow scope: Can we "have knowledge of a transcendent cause if certain contingent facts about the world happen to turn out in certain specified ways?" His answer calls for imagining that a pulsar exists such that its emissions in Morse code can provide the answers to intractable computational problems beyond the computational resources of the material universe, but easily checkable for accuracy once received. Then we would be justified in concluding that the pulsar's computational ability warrants our belief in a transcendent cause. Whether evidence of such transcendent causes of this com-

pelling nature actually exist is a question postponed by Dembski for future discussion.

J. Byl (IV.1.5) considers the "Kalam Cosmological Argument" for the existence of God: "the finite past of the universe implies its *ex nihilo* creation by a personal creator," specifically as advanced by W. L. Craig in his 1979 book by that name. He concludes that all scientific arguments for a finite age of the physical universe involve a Big Bang singularity, which leads only to a "prime mover," not to the living God of the Bible. If it is to lead to conversions to Christianity, Big Bang cosmology must be replaced by a biblical cosmology involving a transcendent God, supernatural causes, and an immortal soul. Byl argues that "once the supernatural has been accepted as real, naturalistic explanation must be rejected in favor of divine intervention," and favors a view in which God created the entire universe *ex nihilo* in the more recent past. It isn't clear that an equally viable—and possibly preferable—approach might not call for a scientific description of the Big Bang in natural terms as the human description of God's free creative activity.

S. C. Meyer (IV.1.6) considers the use of "intelligent design" in scientific explanation, as "methodological naturalism" in science once again comes under attack. He questions whether distinction between "design" and "descent" in biological science, for example, is legitimate, and questions the use of naturalistic criteria to discriminate between them. This leads him to consider the basic question, "Must all scientific hypotheses be entirely naturalistic?" He accepts that the historical answer to this in science has been "Yes," but offers reasons for overturning the prohibition against nonnaturalistic explanations in science. There appears to be a confusion based on identifying a naturalistic description with the exclusion of a theological description. It is appropriate to limit the term "science" to descriptions involving natural categories only, when it is recognized that such "science" is not the only form of meaningful description. By tacitly accepting the premise that "science" and "scientism" are identical, the appropriate desire to make clear the role of nonscientific descriptions leads to the inappropriate conclusion that every kind of description should be included in the category of "scientific description." Meyer concludes with a key question, "Does a strictly materialistic evolutionary scenario, or one involving intelligent agency, or some other, best explain the origin of biological complexity, given all relevant evidence?" The answer is open to exploration, but what is neither helpful nor faithful to the activity of authentic science itself, is the conclusion that a nonnaturalistic theory should be included as part of a scientific description. Rather it should be recognized that a "naturalistic evolutionary scenario " may provide "the most adequate explanation of biological complexity" in terms that science can provide, but that nonscientific insights may be essential for a complete and adequate holistic perspective. This is the type of approach that a complementary description for science and theology attempts to provide, upholding the position that "descent" is the scientific description of mechanisms appropriate in biological science, which provides us with information about the pattern of God's "intelligent design."

Two Lutheran approaches to natural theology are discussed by G. L. Murphy (IV.1.7). He considers the question, "Can science proceed from knowledge of the world to tell us anything about the existence or nonexistence of God, who God is, or God's purpose for the world?" In response he considers the classic and the dependent views within the Lutheran tradition. The classic view argues that man may know certain fundamental but limited truths from his knowledge of nature, such as the existence of a supreme Divinity, his control over the whole universe, and that he has brought all things into being, but such knowledge of God is not adequate to secure redemption or everlasting life. The dependent view starts with the theology of the cross, with God as the crucified One, to be known in the crosslike events, revealed in the crucified and risen Christ, whose work is then to be discerned in the universe. Thus Murphy combines methodological naturalism in science with theistic interpretation of natural phenomena, grounding both in Luther's theology of the cross. The physical world can be understood "with no reference to God." In the event that it should become possible to explain the origin of the universe entirely in mechanisms that are scientifically describable, we will be brought to "the end of a theology of glory which expects God to reveal himself in an irresistible way. The theology of the cross does not look for such a God. Rather, it seeks the God of whom Second Isaiah speaks: 'Truly, thou art a God who hidest thyself, O God of Israel, the Savior.'"

D. H. Wacombe (IV.1.8) asks whether the Grand Evolutionary Story, including a naturalistic account of human origins, is basically improbable given the truth of Christian theism. His discussion is deliberately prior both to an examination of scientific evidence and to an examination of specific biblical accounts of human origins. He concludes that there can be compatibility between divine purpose and indeterminism, and between God's action in the world and the use of naturalistic explanation in science. "To accept the Grand Evolutionary Story with its naturalistic explanations is not necessarily to ac-

cept these explanations as naturalistic in any deeper sense. The possibility remains open that the basic laws they invoke are themselves explicable only as manifestations of God's free and rational creative activity." Thus Wacombe endorses a primarily complementary perspective. He argues that the realization that the laws of nature are not the result of inexplicable brute fact but are finely tuned for the production of intelligent life, and that they appear to be contingent rather than logically necessary, points in the direction of a distinctively Christian theism.

The subject of "design" vs. "descent" is considered again by K. W. Hermann (IV.1.9) who uses the historical interaction between Asa Gray's advocacy of "design" and Charles Darwin's insistence on "descent" without design. Gray undertook a defense of the position that "Darwin's views could be effectively harmonized with the natural theological claim that the world was the product of God's design." Unfortunately for the specific interaction between these two men (and for countless debates in more recent years), "Darwin rejected Gray's harmonizing efforts totally and completely as a misunderstanding of his philosophical and scientific position." This paper spells out some of the details of the debate between these two men that effectively destroyed the personal friendship between them except for what they could agree on: their mutual love of flowers.

The editorial remarks by J. van der Meer in the Introduction to Volume IV seek to shed a little further light on this topic. He believes that there is a fundamental reason for the differences on this subject to be found historically between Reformed theology and evangelical theology. "Reformed scholars tend to assume that the explanatory ideal is a logical entailment of the existence of God by observation of cases of design with suspension of faith in God." "Most evangelical design theorists know that faith is much more than logic and that conversion requires a divine act rather than logical coercion." Some of these characteristics are evident in modern-day attempts to argue that scientific results alone demand the truth of the biblical God, rather than recognizing the complementary nature between scientific descriptions of how God acts and the theological recognition that it is indeed God acting.

The discussion of natural theology continues in a paper by R. Maatman (IV.1.10). He gives two definitions of "natural theology": (1) the derivation of knowledge of God from creation, even to the extent of attempting to use observed design in creation to prove the existence of a Designer; and (2) the use of the wonders of creation to attract unbelievers so that they may be open to hearing the Gospel message. He argues against the first of these on the grounds that "Scripture teaches us to start with God rather than attempt to prove his existence from his works." He finds the second more desirable, provided that it is not limited to "attracting unbelievers." Thus Maatman asks for a "testimony from design" rather than "proof from design." He presents examples from both chemistry and physics, and especially emphasizes the need to praise God for giving us minds that can use design to make successful predictions about aspects of creation.

Natural theology is further investigated by C. B. Kaiser (IV.1.11) who considers the relationship between the "laws of nature" and the "nature of God." He poses a "theistic dilemma": "either God is redundant, and the biblical portrayal of divine action in the world is only figurative; or there are severe limits to science and the laws of nature it discovers." It would seem that there is also a third option, namely that our scientific descriptions of the world and our perception of the "laws of nature," are our limited descriptions of God's free activity. Kaiser considers three responses to the dilemma he has described, one focusing on science, one on history, and one on theology. His conclusion is that all three are needed for an adequate response to the dilemma. One helpful comment he makes is "Whatever takes place in creation as the result of God-given laws *is* the work of God in the biblical view. The work of God and the laws of nature are not mutually exclusive but mutually inclusive or even 'complementary.'"

G. W. Shields (IV.1.12) discusses the logico-philosophical difficulties found in the positions of several writers on physical cosmology (Brandon Carter, S. W. Hawking, John Barrow, and Frank Tipler) and biology (Richard Dawkins and John A. Wheeler), positions which their holders regard as being clearly preferable to any theistic interpretation. He suggests that the reasons for the strong nontheistic preferences have perhaps more to do with a cultural ethos of naturalism than with any genuine intellectual merit in their preferences. He argues that a theistic philosophy is capable of avoiding the extremes of necessitarianism and contingentism, both of which have logical difficulties. And he points out that naturalistic proposals by natural scientists effectively amount to a claim that their theoretical projects enable them to answer questions once thought to be the sole province of metaphysicians and theologians.

J. H. Brooke (IV.1.13) explores the role of chemistry, as opposed to biology or physics, in the interaction between science and theology. He points out

that chemistry has found a place within natural theology, and that it has been used both to attack and to defend materialism. To explore the diversity of some of these views, Brooke turns to the chemico-theologies of Joseph Priestley, Humphry Davy and William Prout from the eighteenth and nineteenth centuries. The unitarian Priestly removed the distinction between matter and spirit in his thought, Davy spoke about the divine purpose expressed in the laws of nature and argued against French materialism, and Prout was the author of a text on natural theology, one of the *Bridgewater Treatises*, and in the new science of organic chemistry he integrated vitalism and scientific research.

Editor J. M. van der Meer makes some insightful comments as he summarizes the various inputs of the papers in (IV.1.1–13) "A Christian context ... removes the need to identify divine action by local inference from observation which is the assumption behind both the God-of-the-gaps attitude and reactions to it, such as locating God's action at the quantum level. One can locate his action at the macrolevel and view natural causation and divine providence as mutually complementary ways of understanding nature."

IV.2. The role of Scripture in science, including Galileo, Copernicus, human responsibility, and creational revelation

"The question that defines the field of biblical hermeneutics as it relates to science is to understand how a message of absolute and eternal truth can be characterized by the limitations of human understanding, culture and history."

C. Pinnock (IV.2.14) starts with the recognition of two extreme responses to the question, "What does science have to do with Scripture?": "Nothing," as expressed by Karl Barth, or "Everything," as expressed by Wolfhart Pannenberg. Since both science and Scripture speak to one created reality, Pinnock argues that they should not be isolated into two noninteracting compartments, but allowed to interact for the good of both. Pinnock's "historic unified interactive model" calls for recognizing that (1) both general and special revelation are God-given sources of truth, (2) the utilization of science and Scripture each requires human interpretation that is not infallible, (3) the interaction between science and Scripture is a two-way street, with science sometimes indicating the preferred direction of interpretation of Scripture, and Scripture sometimes indicating the preferred direction of interpretation of the meaning of scientific descriptions, (4) the exercise of modesty on both sides is often required to prevent conflict, and (5) there must be freedom in carrying out the interaction of science and theology.

K. J. Howell (IV.2.15) considers the interaction between science and theology in the historic case of Galileo. Galileo adapted the hermeneutical principle of accommodation that was believed to be reflected in Scripture by Augustine and the church fathers. Concerning whether Scripture taught physical science, Augustine argued that the purpose of Scripture was to lead to salvation, and that misinterpretations of the Bible are often caused by not understanding this purpose. Galileo was convinced that physical propositions and the Bible must always agree as discussed by the church fathers. "To use the Bible to argue against a specific scientific theory is as much an abuse of the Bible as it is an abuse of science."

The following paper by K. J. Howell (IV.2.16) deals with the problem of biblical interpretation in the debates on Copernicanism in the sixteenth and seventeenth centuries. The dominant metaphor was that of God's two books: the book of nature, and the Book of Scripture. Both books served to increase the knowledge of God; they could never contradict one another. As a result of a consideration of specific issues, Howell draws two guiding principles: (1) "the clear commitment to truth that must be held in balance with a respect for the distinctive methods and procedures of individual disciplines, and (2) the recognition of the tradition-based character of the resolution of conceptual conflicts."

H. G. Geertsema (IV.2.17) undertakes a detailed fundamental analysis of the nature and interaction of faith and science. He starts with a consideration of human vocation and responsibility according to the Bible, and then of the implications of this view for the evaluation of scientific research. A useful summary of his major points are given in van der Meer's introductory remarks. "Although faith and science have their independent grounds, they interact primarily by limiting each other. First, Christian faith prohibits competing religious interpretations of nature and keeps science from assuming a religious role. For instance, naturalistic science is criticized not by proposing a creationistic science, but by rejecting its religious pretensions manifest in its naturalism which is seen as foreign to science ... Second there are norms for knowledge implicit in creation. ... These norms prohibit attributing absolute certainty and generality to scientific knowledge. That is, they rule out a religious status for rationality as a dimension of creation."

Geertsema argues that the Christian tradition has been strongly influenced by the Greek concept of

absolute knowledge linked to absolute truth, and of knowledge as a single rationally cohesive system. This Greek philosophical view of truth has affected the understanding of the authority of the Bible in two main ways: (1) the Bible comes to be regarded as a source of knowledge of unchanging truths, rather than as a call to respond to God's love with our whole self, and (2) all of the knowledge contained in the Bible comes to be regarded as being of equal value, with the loss of appropriate distinctions between the religious significance and the historical information given there. One consequence is that scientific knowledge should be judged by its own standards, not by the models and understanding of the human authors of the Bible. At the same time, Geertsema is careful to point out that he is not suggesting the adjustment of theology to fit with science, and that science cannot be totally separated from religious understanding since science functions in a total worldview that is guided by faith. While emphasizing that "naturalism" (in the sense of a worldview eliminating God) is actually a faith and should be challenged as such, he also concludes that "in its explanations science cannot refer to God."

M. Goheen considers the neo-Calvinist tradition of Reformed theology involving the metaphor of "the organism of revelation," (IV.2.18), and reviews the relation between Scripture and creational revelation as developed in the continental Dutch Reformed tradition, contrasting this with natural and Barthian theology (IV.2.19). His use of the term "organism" emphasizes the unity in diversity of God's revelation, in which there are many different parts that work together for the same purpose. The unique authority of Scripture is related to the Spirit's witness, its redemptive function, and its theological and christological focus. Recognition of the difference between the discourse of science and of Scripture leads one not to expect that Scripture will provide data for science. When the Bible speaks of "the sun going down," this is not an *un*scientific nor a *primitive* statement, but a *non*-scientific statement. Also the author indicates that he would expect fewer themes and norms in Scripture that are *immediately* applicable to scientific theorizing in the natural sciences than in the human sciences.

In his second paper, Goheen addresses the question of how we should respond when we find that the findings of natural science conflict with an interpretation of Scripture. His purpose is to describe the relationship between creational revelation, scriptural revelation, and science. If science conflicts with an established Scriptural interpretation, it must be remembered that both are human responses to divine revelation. Goheen gives a useful definition of scientific law: "a human endeavor to theoretically formulate a description of that (creational) revelation." This leads to the conclusion that "All scientific formulations are partial, historical, human endeavors and therefore fallible. God's word in creation is divinely authoritative, but our human reception and articulation of it is not." Ultimately "there can be no conflict between creational revelation and scriptural revelation." Or again, "scriptural and creational revelation function on entirely different levels ... They presuppose and complete each other. They function and contribute in unique and complementary ways." With this perspective in mind, it follows that conflicts between science and Scripture "must result from a clash between interpretations." Two extremes must be contested: the attempt to read from Scripture the details of the creational revelation appropriately investigated through science, and the attempt to rewrite the Scriptures into a modern scientific worldview.

The final paper in this lengthy work is by A. Wolters (IV.2.20) who proposes that consideration of creation as "separation" offers a link between the Bible and scientific theory. He echoes some of the suggestions of Goheen when he says, "There seems to be a perennial pull which draws Christians to one of two poles in reflecting on this issue: either to adopt the position which takes Scripture to be directly answering scientific questions (which we may call biblicism), or to espouse the position that the Bible and science must be kept strictly separate (which we may call dualism)." Emphasizing the frequent use of the concept of *separation* in the biblical creation narrative, Wolters suggests that a fundamental characteristic of a scriptural worldview would be the "conception of creation as God-ordained differentiation." The concept of separation can then be linked to "a pre-scientific worldview that emphasizes the discreteness and irreducibility of various kinds of created reality" and can serve as a "biblical antidote to the kind of historicism according to which any kind of thing can, over time, turn into any other kind of thing."

This four-volume set is clearly a rich resource for those who are interested in exploring perspectives on the relationship of faith and science, particularly from the worldview of the Dutch Reformed position, which is dominant in many of the papers. It is probably not suitable for informal reading, since the scholarly involvement of the authors makes a detailed understanding of the text a time-consuming occupation. Hopefully this review will at least pinpoint the papers and discussions of primary interest to any prospective reader so that a beginning could be made with them. ✦

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Neal J. Redmond
Stephen K. Remillard
Carl L. Resler
Curtis N. Rhodes
Dean E. Richardson
W. Frank Richey
Richard Rickard
Ronald E. Ringenberg
W. Bryce Roberson
Eliot & Beverly Roberts
Frank H. Roberts
David A. Rogers
Richard J. Rommer
Martin M. Root
Norman A. Ross
L. Evans Roth
Willard H. Roundy
Richard L. Ruble
Craig Rusbult
Steve B. Rush
William L. Ryder
Carolyn R. Samec
David A. Saunders
Robert B. Scheidt
Robert J. Schier, Jr.
Thomas W. Schipper
Bruce W. Schweitzer
T. Gordon Scott
Norman E. Shank
Frederick D. Shannon
David F. Siemens, Jr.
Jeff Singley
Robert J. Slocombe
Roger L. Smalling
Albert J. Smith
Lee M. Smith
Thomas S. Smith, 3rd
Timothy Jay Smith
Thomas F. Spethmann
Charles H. Stagg
John A. Stamper
The Stewardship Foundation
Ralph A. Stone
Mark A. Strand
The Stratford Foundation
Albert C. Strong
Robert A. Styer
Robert E. Sundell
William O. Swan
Melvin J. Swanson
Dale Swartzendruber
Jack C. Swearengen
Dennis E. Sweitzer
Susan B. Swint
Sho Takagaki
Nicholas J. Tavani, Sr.
Robert B. Taylor
Albert R. Tebo
The John Templeton Foundation
C. R. Terman
Dale S. Thomson
Gary Thorburn
Patricia Thorburn
Walter R. Thorson
Frederick D. Trexler
Ide P. Trotter
Donna F. Tucker
Daniel R. Tucker
James M. Turner
David W. Tweeten
Alan E. Van Antwerp
J. R. Van De Fliert
Kenneth J. Van Dellen
David A. Van Dyke
Amelia G. Van Engen
Nolan A. Van Gaalen
Donald O.Van Ostenburg
Howard J. Van Till
Mary Vander Maten
Timothy L. Vander Molen
Gordon J. VanWylen
John B. Vanzytveld
John M. Vayhinger
Pamela R. Veltkamp
William H. Venable
Peter J. Vibert
Ruy Carlos DeCamargo Vieira
Roger G. Vieth
Dennis P. Vik
Clarence J. Vos
Robert T. Voss
Timothy P. Wallace
Frank Walmsley
Ray D. Walton, Jr
Bryan D. Webb
David E. Weldon
C. Bruce Wenger
Wesley J. Wentworth, Jr.
Robert J. Werking
Norman G. Wheeler
Reuben B. Widmer
Erik A. Wiedman
John L. Wiester
David L. Wilcox
Leland H. Williams
David L. Willis
Charles H. Willits
William Witherspoon
Enno Wolthuis
W. Raymond Womack
Dorothy W. Woodside
Seung-Hun Yang
David Yee
L. William Yoder
Chuk-lam Yuen
Fred Zeisler
Robert G. Ziegler
Elizabeth Zipf ✦

Book Reviews

BLAISE PASCAL: Reasons of the Heart by Marvin R. O'Connell. Grand Rapids, MI: Eerdmans Publishing Company, 1997. 202 pages, index. Paperback; $16.00.

Written from the viewpoint of a Catholic theologian, this biography spends little time on Pascal's philosophical and scientific accomplishments, focusing instead on the factors which led him into his fervent Christian convictions. When Pascal's sister, Jacqueline, wrote in 1647, that he was "no longer a mathematician," she meant by this that while Pascal might still pursue the sciences, those pursuits no longer defined him; he now found his primary identification as a Christian. Seven years later, on November 23, 1654, Pascal experienced a second conversion, a "night of FIRE," and much of this excellent book centers around that experience.

Blaise Pascal wrote a testimony on that pivotal night in 1654; he later recopied it on parchment, and carried both copies with him to the day of his death. O'Connell writes, "The paper text—written hurriedly, smudged crowded with excisions and insertions, scarcely legible in places—was composed first, composed indeed at the very moment of illumination ... the words tumbled forth with a fiery intensity." Part of these words follow (O'Connell's book has the full text): "The year of grace 1654. Monday, 23 November ... From about half-past ten in the evening until about half past midnight. FIRE. The God of Abraham, the God of Isaac, the God of Jacob. Not of the philosophers and intellectuals. Certitude, certitude, feeling, joy, peace ... joy, joy, joy, tears of joy ..."

One of the most challenging of all Pascal's *Pensees* was "le pari," the *Wager*, elements of which appear throughout his work. Many scholars, William James among them, have criticized this discourse. But, in the words of O'Connell: "Pascal's retort was that the wager embodied a moral decision, not an intellectual demonstration or even an argument" (p. 188). *Pensees* 418 and 835 expand on this point.

Lives of great people are inspirational. Pascal's life is so uplifting that it is difficult to think of any other person within the last five hundred years with whom to compare him. This biography looks at his life from a narrow view—yet a view which Pascal, himself, would certainly say was primary. Powerful stuff. I recommend the book highly. When you purchase a copy, you will, I believe make it a "keeper" in your personal library.

Reviewed by John W. Burgeson, IBM Corporation (Retired), 6715 Colina Lane, Austin, TX 78759.

Upcoming ASA Conferences

Aug. 2–5, 1998: Churchill College, Cambridge, England

July 30–Aug. 2, 1999: John Brown University, Siloam Springs, AR

THE INFINITE VOYAGE: A Metaphysical Odyssey by Martin Ernst-Woffgang Luther. Minneapolis, MN: Marwolf Publishing, 1996. 243 and xii pages, bibliography, subject and name indexes. Paperback; $19.95.

Luther is a science writer who writes about linkages of science with natural theology. Part I of this book deals with physics; Part II with metaphysics. In Part I, he discusses the discoveries and theories of modern physicists Bell, Aspect, Einstein, Bohr, Bohm, Schrödinger, and others. Part I ends with mentioning non-locality and the theories of Bohm, whose views on physics and metaphysics are discussed in Part II. Aspect proved non-locality when he set up a system of polarized mirrors. He showed that photons influenced each other though the distance between them was so large that no signal at the speed of light could be given. The mutual influence could not be localized, hence the term non-locality.

In view of research in quantum mechanics, non-locality is an important topic. New perspectives are opened. Luther talks in that connection extensively about Bohm's writings. However, Luther's writing leads us in the wrong direction. For example, on page 199 he says that there is a higher-dimensional reality or ground which we have always called God. On page 205, he quotes Baggott who offers the possibility of accepting the idea of God without religion. If that is so we can ask the all-important questions with something approaching intellectual rigor, he says. Luther paints a caricature of our relationship to God when he suggests that many who regularly attend Sunday services do so because they are motivated by simplistic notions of reward and punishment. I am sure that the Christians I know do not fall in that category. He says that we don't need priests; each of us must discern for himself "the true nature of our relationship to the eternal ground in the privacy of the inner sanctum of the soul." That is a philosophy which has more in common with pagan religions than with Christianity. It becomes even more clear on page 208, "... we are children of the universe, reflections of an Eternal Spirit, not orphans in a hostile world."

Luther writes in a popular style, though the reading is not always easy. The metaphysics in Part II is closely connected with New Age thinking. Luther mentions Christ, but he appears to reject Christ as the Messiah. We read: "... the world cannot have been made for us alone; it must have been made for all of us as embodiments of a universal spirit which is self-consciously aware and which represents the idealization of the self in each of us" (p. 207). This conclusion is not relevant to Christians, who realize that there will be an end to this sinful world. This world will be renewed when Christ returns, but it will not be the realization of the self in us. I do not recommend the book for further study.

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

IMPACT: The Threat of Comets & Asteroids by Gerdt L. Verschuur. New York: Oxford University Press, 1996. 237 and xii pages, bibliography, name and subject indexes. Hardcover; $25.00.

In this book, Verschuur explores the possibility of an asteroid or comet hitting the earth. Lately many scientists have accepted as fact that a large asteroid hit the earth in the Yucatan area 65,000,000 years ago. It caused a massive extinction of life on earth. Verschuur claims, however, that it was not the largest one. Two hundred fifty million years ago an asteroid extinguished 90% of life on earth. He also points to the 1908 comet-like explosion in the Tunguska Valley in Siberia. It flattened trees for 20 km. in all directions and killed a thousand reindeer. If it had hit in a heavily populated area, it might have killed more than a million people. Can it happen again? What are the odds? Can we prepare to defend ourselves? Did an asteroid or comet cause the Flood? Verschuur discusses these and related subjects in this book.

To arrive at a coherent story Vershuur does not limit himself to a particular science, but mentions geology, biology, physics, astronomy, myths, and even astrology. As an astronomer, however, he is hesitant to use givens outside his own area of competence (p. 106), and he points to the debacle of Velikovsky in the 1950s. Yet, he dares to refer to a paper written in German by Edith and Alexander Tollmann. They claim that the extinction of the mammoth 10,000 years ago was due to the impact of an asteroid or comet. They also refer to the Flood as chronicled in the Bible.

Verschuur also mentions the fact that native myths in many places of the world talk about "fire from heaven" and floods. He discusses the possibility of defense against these invading objects. Tom Gehrels runs the Spacewatch Project for the University of Arizona (p. 194). He says that they are finding about thirty-five interesting, near-earth objects a year—in 1995 they found one hundred. The odds are one in ten thousand that one is on its way to the earth. How do we find that one? How can we defend life on earth against the possibility of being annihilated? Verschuur mentions nuclear power, but is afraid that the time to prepare for a defense will be impossibly short due to the enormous speeds of these objects. Before we can do anything, we must discover more about asteroids. Are they solid, metal or stone, or are they gaseous? How would one impact the earth, if it hits the earth at a certain angle? Are all asteroids made of the same material? Then he suggests that we need to land an astronaut on an asteroid. That is so expensive, however, that governments would have to supply the money. Right now, he says, the interest in doing such a thing is missing in political circles. Still, we know that about 10,000 tons of space debris falls on the earth each year, mainly in meteoric form.

Although we may be skeptical about some of his proposed theories, I think that we can fill some gaps in our theories by studying the ideas presented in this book. It is not written as a scientific book. Since life is a unity, we need to be reminded that the subjects we are studying are related to our complete existence. When we know something about other areas, we may find that unexpected connections shed light on our difficulties.

Verschuur, a radio astronomer in Memphis, TN, has an easy style, which makes reading a pleasure. He wrote the book without footnotes or endnotes, but he did include a bibliography. I checked several names mentioned in the book and found an article or book written by these people listed in the bibliography. I recommend the book for reading and studying to see if the facts mentioned fit in with the knowledge in your own field.

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

ALONE IN THE UNIVERSE? The X Files, Aliens, and God by David Wilkinson. Crowborough, England: Monarch Publications, 1997. 160 pages, index. Paperback; £7.99.

Wilkinson, an astrophysicist and Methodist chaplain at Liverpool University, has written three other books on astrophysics and Christianity. They are: *In the Beginning, God; God, the Big Bang and Stephen Hawking;* and (with Bob Frost) *Thinking Clearly About God and Science.* The book under present review is his latest and was launched at the same time as he embarked on an 11-town speaking tour called "The Truth about Science" in England.

Numerous books, reports, and articles have been written about extraterrestrial life and intelligence. Many of them are pure science fiction; yet some are serious scientific investigations. *Alone in the Universe?* provides an excellent summary review of them (but the United States Air Force's *The Roswell Report: Case Closed* was too late to be included in the book). The author critically examines various aspects of the search for and portraits of extraterrestrial life and intelligence throughout history in scientific studies, speculations, and even entertainment. The topics of his discussions cover, among others, unidentified flying objects, the television series *The X Files* and *Star Trek,* the crop circle hoax, alleged alien contacts and abductions, space exploration, the chemical origin of life, the definition of consciousness and intelligence, and, of course, the SETI (Search for Extraterrestrial Intelligence) project.

What should make *Alone in the Universe?* appealing to Christians in general, and members of the American Scientific Affiliation in particular, is its emphasis on God's relationship with humans on this planet Earth. The author points out, however, that this relationship, though unique, may not be exclusive. That is, if there were intelligent life elsewhere in the universe, God would be in relationship with that life, also. Wilkinson goes on to comment on what that relationship may be and whether or not aliens sin. He thinks that extraterrestrial life, if and when found, should enhance and enrich our Christian faith in God. Therefore, Christians ought not to be afraid of aliens from outer space, but should be prepared to meet and welcome them.

Here we see once more that religion accommodates science (science does not go after religious teachings). When a scientific discovery or theory seemingly threatens the foundation of Christianity, Christians should re-examine the biblical passages and try to resolve the conflicts between science and Scripture. Christians have done that with Galileo Galilei's discovery of the heliocentric system and Charles Darwin's theory of biological evolution, neither of which had destroyed Christianity but, instead, made us appreciate God's creation better than ever before. Now, Wilkinson has shown us a way to do it again with extraterrestrial life, even ahead of its detection and verification. We will most likely accommodate abiogenesis into the Christian doctrines when it can be demonstrated. The latter two issues will challenge those who insist that we must be alone in the universe, as they believe that God's original creation of life on Earth was unique in space and time according to Genesis 1 and 2, and, therefore, is not or cannot be duplicated elsewhere or at other times.

An interesting error I found in this book is in the Foreword by Sir Robert Boyd: "The Universe is perhaps 15,000 billion years old" (p. 11). The British (and German) definition of "billion" is *a million millions*, and the American (and French) definition of "billion" is *a thousand millions*. Either definition in Boyd's statement makes the age of the universe way too old.

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

FULL HOUSE: The Spread of Excellence from Plato to Darwin by Stephen Jay Gould. New York: Harmony Books, 1996. 244 pages, index. Hardcover; $25.00.

Gould may be the most widely read scientist of our time. He has written a column in *Natural History* for many years. A one-sentence summary of that column is that it is about the history of paleontology, but that summary is far too simple. Many of Gould's books are compilations of these columns. This one definitely is not. *Full House* is an argument that there is no general trend toward complexity in evolution.

In an ideal world, no one would use the word evolution without defining it carefully. In the world in which we live, Gould assumes that all organisms—living or dead—have arisen solely by natural selection operating on chance variations, and that the definition is scientific fact, or very close to it. In an ideal world, he would acknowledge that the evidence that new classes and phyla/divisions have arisen from pre-existing common ancestors is not nearly as strong as the evidence that new varieties and species have arisen. In an ideal world, he would acknowledge that there might have been a Designer. He does neither, although you may have missed this statement from his column of March 1997:

> I am not, personally, a believer or a religious man in any sense of institutional commitment or practice. But I have enormous respect for religion ... If religion can no longer dictate the nature of factual conclusions properly under the magisterium of science, then scientists cannot claim higher insight into moral truth from any superior knowledge of the world's empirical constitution.

Gould does know Scripture as literature, and the very first sentence mentions Jesus respectfully, but this book does not examine questions at the interface of science and Christianity. Nonetheless, this should become an important book. This book says something that all of us, and all those who think about origins, should read and digest. I believe that although Gould's thesis (the last sentence in the first paragraph above) is contrary to prevailing cultural belief, it is so sensible, and presented well enough, that readers will be forced to agree partly or wholly with Gould, and, eventually, Gould's ideas will influence textbooks.

Before going on, I must state that the book has over fifty pages on the question of why major league baseball players no longer have .400 batting averages. This could have been left out, but it is present for two reasons. First, Gould loves baseball. Second, it illustrates his main idea, which is that it is necessary to consider the "full house" of variation, not just the extremes. He claims that fielding and pitching have improved so much that being able to hit .400 has become less likely than it was decades ago. Hitting ability has not declined, he says.

Gould's thesis says the following. Life had to begin simply. It began at the "left wall" of the range of variation—as simply as possible. Bacteria are still simple, and are the mode of living things. Most biomass is bacteria. Random variation moves some organisms away from the left wall. This would be expected, if random variation exists. "I do not challenge the statement that the most complex creature has tended to increase in elaboration through time, but I fervently deny that this limited fact can provide an argument for general progress as a defining thrust of life's history" (p. 169). Study of a few groups is presented. Combining these groups does not reveal any overall trend toward complexity or increase in size. Some exceptional organisms do show these, but this would be expected, if organisms started at the left wall of variation and changed randomly.

As would be expected of Gould, the book is well written. It has appropriate illustrations and an adequate index. What does Gould's idea, namely that complexity is not an innate trend in living things, have to do with a Christian view of origins? I see no reason why Christians cannot accept his thesis, as applied to groups of organisms. However, if we can accept his thesis, we cannot accept his worldview. There was a Designer. Perhaps he used random processes, but he had a design. Humans are unique, and that uniqueness is not just the result of a random walk away from the left wall of bacterial simplicity.

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

BEYOND THE COSMOS by Hugh Ross. Colorado Springs, CO: Navpress, 1996. 235 pages, index. Hardcover; $20.00.

Hugh Ross holds a Ph.D. in astrophysics and has done research on quasars and galaxies as a postdoctorate fellow at the California Institute of Technology. He is presently the director of Reasons to Believe, a nonprofit organization providing research and teaching on the harmony of God's revelation in the words of the Bible and in the facts of nature. His previous books include *The Creator and the Cosmos* and *Creation and Time.*

In this, his latest book, Ross proposes an approach to addressing some of the toughest paradoxes in Christian theology by assuming that God has access to more dimensions than our spacetime reality. This is an idea that certainly could be traced back to Edwin A. Abbott's nineteenth century novel, *Flatland,* though Ross should certainly be credited with making it a working thesis. Ross does not make this assumption without support, for he begins the book by taking us through a brief, but fascinating, tour into some of the most recent and interesting discoveries in theoretical physics, which indicate that at least 11 dimensions are involved in our physical reality. Ross then demonstrates that this perspective is further bolstered theologically by examining many supporting passages in the Bible.

With this perspective in place, Ross proceeds to tackle such theological paradoxes as free will versus predestination, God's ability to address a multitude of prayers at once, the triune nature of God, and the problem of evil. For example, to tackle the problem of how God can hear a million prayers at once, Ross's suggested extra-dimensional solution is that God has access to at least two dimensions of time. Thus God can address all these prayers simultaneously by following a timeline perpendicular to our own. This perspective is not new. Stephen Hawking, in *A Brief History of Time,* speculated that the existence of extra time dimensions is involved in some version of the grand unified field theories. Hawking concludes, though, that God is irrelevant to creation as our universe would have no beginning in complex time.

Beyond the Cosmos has 18 chapters, a bibliography, and several illustrative charts. The first four chapters deal with recent scientific discoveries that point toward the existence of higher spatial dimensions. The next three chapters handle how God accesses these extra dimensions and the biblical support for this perspective. The remaining chapters show how this ability by God to access these dimensions assists in solving several complex paradoxes in Christian theology.

This book is both focused and easy to read. His description of how the recent scientific results strongly support the existence of extra spatial dimensions involved in our physical reality effectively conveyed the excitement that is occurring in this area of research (it certainly is exciting to much of the mathematics community, as this reviewer can personally attest). His use of Scripture to support his claims is quite extensive and, at times, the extradimensional perspective does help remove some of the conundrums that occur in several passages of the Bible. The solutions that are offered to the various theological paradoxes should all be taken very seriously. Some of them may be found a little wanting, though, such as the explanation for the problem of evil. Also, in some places, his use of extra dimensions to solve one paradox seemed to leave openings for other paradoxes to occur. Overall, though, Ross presents a compelling perspective on how God interacts with the universe that is consistent with both the Bible and science. His closing chapters on the promised new creation were particularly inspiring.

As with Ross's other books, this one should appeal to Christians who hold to the integrity of science and seek to understand how science can integrate with their faith. It should also appeal to any scientist who is seeking to determine the validity of the Christian faith.

Reviewed by James M. Turner, Research Instructor in Mathematics, University of Virginia, Charlottesville, VA 22903.

DEFEATING DARWINISM BY OPENING MINDS by Phillip E. Johnson. Downers Grove, IL: InterVarsity, 1997. 132 pages. Hardcover; $15.99. Paperback; $9.99.

Johnson is one of the most audible/visible members of the Intelligent Design (ID) movement. He is a lawyer, a member of the faculty at the University of California at Berkeley, and the author *of Darwin on Trial* and *Reason in the Balance.* Johnson speaks and writes often, usually on origins. He is a frequent contributor to *Books and Culture,* sister publication to *Christianity Today.* The ID movement does not claim that the earth is of recent origin, or that there have been no changes in living things. Its main claim is that the prevailing scientific paradigm, which Johnson calls naturalism, rules out (by definition, not because of evidence) the possibility that life is here because of an Intelligent Designer. The ID movement also claims that those thinking within the naturalistic paradigm take microevolution, which the ID movement accepts, as proof that macroevolution, which the ID movement does not accept, has happened. (Microevolution, if it really occurred, results in new races and species, macroevolution in new phyla or divisions.)

Besides the two Johnson books mentioned above, the most important ID book is Michael Behe's *Darwin's Black Box.* It argues that the biochemistry of living things is so complex and interrelated that it could not have arisen a little at a time by chance but must have appeared basically all at once. *Christianity Today* named it book of the year.

Perhaps you are wondering, "What is new and different about this book?" My answer: the intended audience. The intended audience is high school students. The intended goal is to arm students against naturalist arguments. How does Johnson arm his readers? In a sentence, by pointing out, in many ways, that naturalists' belief in macroevolution by chance is a species of faith, and not

based on sufficient evidence. He also describes some case studies of students or teachers who were supernaturalists and have been attacked by naturalists.

The first chapter deals with three common mistakes made about differences on origins: (1) that such differences are only about time, when actually the question of whether there is or is not an intelligent designer is more at issue; (2) that such differences are about whether God started things, when actually the question of whether God is still involved in his creation is important; and (3) the belief that science is all about facts, and not about belief, whereas religion is all about belief, and not about facts.

The second chapter, "Inherit the Wind," uses that play and movie as an illustration of how biased the media are on the issue of origins. Johnson tries to show that the fundamentalists in Dayton, Tennessee, where the Scopes trial was held, were no more closeminded than naturalists in New Haven, Connecticut are today. The third chapter attempts to expose "baloney" (Johnson's word) in the thinking of prominent naturalists, such as Carl Sagan and Richard Dawkins. It is also an introduction to some of the technicalities of arguing.

The fourth chapter exposes some of the problems of naturalists, and also of supernaturalists. The fifth chapter explains and gives evidence for ID. The sixth chapter requests Johnson's readers to forsake accommodation with naturalists, and to stand up for supernaturalism, individually, in classes, and in schools. The seventh is entitled "Modernism: The Established Religion of the West." The eighth is a retelling of the sixth, using the background of the seventh. There are 12 pages of notes, and no index or illustrations. Probably none were needed.

I agree with Johnson on many things, especially his main claim. For instance, during the time I was reading his book, I was also reading David Quammen's *The Song of the Dodo*, one of the most fascinating biology books I have ever read, and one which will probably have considerable influence. It is about biogeography, not origins, but of course there is much about how island species came to be. Quammen seems to assume that naturalism is true, and he presents plenty of information that supports the notion that new species have arisen—who doubts it? But he presents no evidence for macroevolution. My guess is that he would be amazed if anybody doubted naturalistic macroevolution. Most biologists also would be. They shouldn't.

However, I have two concerns. Johnson does not include a serious weakness of the ID movement in his fourth chapter—that there is basically no positive evidence for ID. There is evidence which casts grave doubt on the notion that phylogeny was naturalistic, and that complex biochemical mechanisms arose as a result of nonguided chance processes. If Thomas Kuhn was right about scientists and how they act, the naturalist paradigm will not be abandoned until there is somewhere else to go, and shooting holes in that paradigm doesn't automatically produce another one. Also, Johnson is a lawyer, apparently a very good one. Not everyone is as equipped by training or nature as he is to take up ID, or any other cause, and argue it publicly, however right the cause, and however strongly one believes in that cause.

Reviewed by Martin LaBar, Professor of Science, Southern Wesleyan University, Box 1020, Central, SC 29630.

LIFE BEFORE MAN by Zdenek V. Spinar. New York: Thames and Hudson, Inc., 1996. 256 pages, index, glossary, diagrams, and color plates. Paperback; $16.95.

This is another lavish picture book by Thames & Hudson. Spinar, professor of Zoopaleontology at Charles University in Prague, has provided the basic commentary to a sumptuous array of 233 illustrations, including drawings, diagrams, and color reconstructions of plants, animals, landscapes, and seascapes. The original 1972 edition has been thoroughly revised "to introduce the reader to the incredible and fascinating panorama of life on Earth as it has unfolded from its earliest beginnings more than 3000 million years ago to the arrival of *Homo sapiens* and the introduction of settled farming, a mere 5000 years ago" (p. 6). This purpose, broader in scope than indicated by the title, is achieved in an admirable manner.

The graphic material is clear, sharp, and well designed. The 180 color plates are beautiful and clear. The full "Classification of Living Things" puts things in proper perspective, with one problem: Superkingdom Eukaryota is listed under Kingdom Prokaryota on an equal footing with two subkingdoms, instead of over the kingdoms of Protoctista, Plantae, Fungi, and Animalia. That is not the only place where editing was less than admirable. Contrary to the chronological table on page 9, the Precambrian stops with the Cambrian, not with the present day as indicated! Also, on page 159, the pictures of two Mesozoic dinosaurs are mixed in with Cenozoic life. Perhaps the statement on p. 12, "Molecules with the high degree of complexity needed to form living matter took a long time to develop—some 4600 million years, the age of the Earth itself," arose as the author's ideas were being transferred into English, but it will be misleading to the intended neophyte audience of this book. One might quibble that more terms should have been added to the useful three-page glossary, but those admitted are well defined.

While books covering broad sweeps of time and immense quantities of subject matter primarily for untrained readers are, of necessity, oversimplified, one has to wince at such mistakes as declaring that *Australopithecus* contains the oldest human (instead of hominoid) fossil. I would have liked to have seen a warning to the uninitiated regarding the amount of analogical reasoning and downright imagination that is inevitably involved in artistic reconstructions of most long extinct forms of life. A prime example would be the Triconodon, completely reconstructed in living color on page 132 from nothing but fossil teeth and jaws. The reviewer is delighted to have the reconstruction, but he also understands the kinds of supporting evidence and their limitations.

This book will be welcomed by anyone wanting a lot of artistic reconstructions of what paleontologists think the fossilized remains looked like when alive in their natural habitat. In spite of the sloppy editing, it is a good buy at a very modest price.

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

DESTINATION: Creation by Hugh Ross and Rick Bundschuh. Reasons to Believe, P.O. Box 5978, Pasadena, CA 91117. 34 pages. Paperback.

This book is subtitled "A Scientist Looks Back At How The Universe Began," and because it is intended for children, it is presented in comic book format. The book's science information comes from Hugh Ross while Rich Bundschuh has produced the story and art. Material on creation, evolution, UFO's, and extraterrestrials is presented in an elementary and authoritative way. Also included are some simple paper and pencil games, short explanations for hefty words (a lexicon of scientific terms), brainstorming questions from kids, a biographical introduction to Hugh Ross and a list of some of the products offered by the publisher (including Hugh Ross's *The Creator and the Cosmos).* This book provides an inexpensive, entertaining, and informative way to introduce children (and young people) to some of the current issues in science.

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

EYEWITNESS TO DISCOVERY by Brian M. Fagan, Ed. New York: Oxford University Press, 1997. 493 pages, bibliography, photographs, and index. Hardcover; $39.95.

Fagan is professor of anthropology at the University of California, Santa Barbara. He recently served as general editor of *The Oxford Companion to Archaeology* and is widely respected as a top scholar in his field.

Eyewitness to Discovery includes fifty-five first-person accounts of the world's greatest archaeological discoveries. Fagan certainly does offer, "a well-balanced selection of writings, which convey the essence, the excitement of archaeological discovery" (p. 7). The book is divided into three parts. Part II, "Great Discoveries," comprises the bulk of the book, and includes first-person accounts from such writers as Austen Henry Layard, Howard Garter, George Reisner, John Allegro, Kathleen Kenyon, and Heinrich Schliemann.

Fagan includes discoveries from the Near East, Greece, Europe, Africa, Asia, and the Americas. *PSCF* readers interested in discoveries related to the Bible will enjoy selections on Ur of the Chaldees, Jericho, Egypt, Assyria, Jerusalem, and Carchemish.

Perhaps the most important archaeological accomplishment was achieved, not by an archaeologist, but by a linguist. Jean Francois Champollion's story is told in the selection, "The Decipherment of Egyptian Hieroglyphs." Another linguistic advance is discussed in the selection, "Cracking Cuneiform's Code." Fagan states:

> Henry Rawlinson copied and deciphered the Old Persian, Elamite, and Babylonian texts, establishing that Babylonian was a Semitic, polyphonic language ... Rawlinson excavated on his own account but once, at Borsippa near Babylon in southern Mesopotamia in 1853, where he unearthed the commemorative cylinders that recorded how Nebuchnezzar, king of Babylon, had rebuilt and repaired the temple in that city in the early sixth century B.C. (pp. 100–1).

"Excavating Under Jerusalem" is the most intriguing selection. Fagan writes:

> A small team of British army engineers under Captain Charles Wilson surveyed the topography and hydrology of Jerusalem in 1864. Wilson and his men were obliged to carry out much of their work underground, examining channels and cisterns deep beneath the modern city (p. 141).

Lieutenant Charles Warren was sent out three years later, and he excavated the underground water channel that Hezekiah constructed under Jerusalem (II Kings 20:20). Recently, Philip Davies and John Rogerson of the University of Sheffield suggested that Hezekiah's tunnel was not dug by Hezekiah's men but was constructed centuries later. However, several eminent archaeologists put this re-interpretation to rest ("Defusing Pseudo-Scholarship," *Biblical Archaeology Review*, March/April 1997, pp. 41–50).

Part III, "Archaeology Becomes a Science," approaches "archaeological discovery from a different perspective: that of the excavators who turned the investigation of the past from a casual pastime into a science" (p. 380), and includes such writers as Leonard Woolley and Mary Chubb. This section not only gives the reader an education on what to look for in an archaeological dig, but also a discussion on the philosophy of archaeology. For instance, Lane Fox Pitt-Rivers points out that "... next to coins, fragments of pottery afford the most reliable of all evidence" (p. 398). However, he warns that "... it is next to impossible to give a continuous narrative of any archaeological investigation that is entirely free from bias; undue stress will be laid upon facts that seem to have an important bearing upon theories that are current at the time ..." (pp. 395–6).

In Part I, "The Discovery of Human Origins," Fagan demonstrates his evolutionary bias when he fails to note that many scientists have offered re-interpretations of these "missing links." In the other sections, Fagan pointed out when re-interpretations had been made by modern scholars. For instance, concerning R. E. Mortimer Wheeler's selection "The Battle of Maiden Castle," Fagan noted: "On the whole, it has stood the test of the years well, and recent excavations have confirmed many of Wheeler's conclusions. But it is only fair to say that they have cast some doubt on his interpretation of the assault" (p. 417).

In sum, Fagan lets the reader experience the excitement of archaeological discovery. *Eyewitness to Discovery* is a must read for serious students of archaeology and is clear enough to be enjoyed by "wannabe-archaeologists," too.

Reviewed by Everette Hatcher III, P.O. Box 23416, Little Rock, AR 72221.

THE GREENING OF FAITH: God, the Environment, and the Good Life by John E. Carroll, Paul Brockman, and Mary Westfall, Eds. Hanover, NH: University Press of New England, 1997. 225 pages. Paperback.

This book is a collection of essays by religious people from a variety of persuasions. The authors include Catholics, a rabbi, an evangelical Protestant, a Presbyterian minister, a Native American religious person, an ecofeminist, an ecopsychologist, a Buddhist, and numerous Ph.D.s who teach this topic at colleges and universities. All of the authors are well qualified to write on this topic.

The book is divided into four sections, each varying from three to four chapters in length. The book does not have an index, which affects its usefulness; but it does have excellent section introductions. In the first section, "A Call To Awaken," the thrust is on the environment as a religious question. The authors suggest that scientists and others are joining with those of religious persuasion in the necessity of seeing that there is more to life than the accumulation of wealth and material goods. The next section, "Old Paths, New Ground," asserts that western religions need to rediscover what their traditions have always taught, namely that the good life is both environmentally responsive and worshipful of God the Creator. In the third section, "In a Different Voice," we are challenged by the Buddhist, the ecofeminist, and the Native American to reclaim the interdependence that characterizes all life. In the last section, "Broadening The Scope," we are called to go beyond earth, to see the magnificence of all creation and therefore to love the Creator and the creation more fully.

The book's main strength is that it illustrates that the solution to the world's environmental problems is a religious one to which all the major religions—and even some of the minor ones—speak with a common voice. More is not better and God wants us to take care of this planet. It is also useful as a reference for the variety of religious views expressed on the environment. After all, where else could one go to find all these different views expressed?

The book's weakness is that it has no consistent approach to any other issues. If you're not a pan-en-theist, you'll disagree with S. C. Rockefeller. If you think that technology will provide some of the answers, you'll not like the ecofeminist view. As an indication as to how fuzzy it can get, on page 205 we are told that traditional western religions are dying, in opposition to statistical trends. Then we are told that "Alcoholics Anonymous is the most significant spiritual movement in the world today" (p. 206). While the editors tried to group the material around themes, there is not much you can do if you have all spiritual viewpoints expressed and see them all as having validity.

This book illustrates some of the problems of post modernism. It is nice to respect all traditions, but it is next to impossible to get simple action policy statements out of them. Readers of this journal are much better served in this area by knowledgeable Christian authors, such as Al Gore in his book, *Earth in the Balance.*

Reviewed by Fred Jappe, Professor of Chemistry and New Testament, Mesa College, San Diego, CA 91911.

RELIGION & MEDICAL ETHICS: Looking Back, Looking Forward by Allen Verhey, Ed. Grand Rapids, MI: Eerdmans Publishing Co., 1996. 160 pages. Paperback; $18.00.

The Institute of Religion (Houston, Texas) sponsored a conference in 1993 to celebrate the twenty fifth anniversary of the first Houston Conference on Medicine and Technology. This book contains the papers of seven eminent moral theologians working in the field of bioethics today: James M. Gustafson, Stanley Hauerwas, Stephen E. Lammers, Karen Lebacqz, Warren T. Reich, David H. Smith and Allen Verhey. The editor, Allen Verhey, is Professor of Religion at Hope College in Holland, Michigan.

In the first chapter, David H. Smith, Indiana University, surveys the "bioethics revival." He shows that theologians were important to that revival, and he proposes a dialogue between religious and secular perspectives in the future. Stephen E. Lammers, Lafayette College, discusses the "marginalization" of religious voices in the past (the lack of a public voice for persons with religious convictions), but looks forward to renewed engagement between theology and medical ethics in the future. He advocates the three activities of humility, listening, and patience as the place to begin to have influence in the clinic.

Two papers look back at particular theologians who took part in the 1968 conference: Helmut Thielicke, as discussed by Karen Lebacqz, Pacific School of Religion, and Paul Ramsey as discussed by Stanley Hauerwas, Duke University. James M. Gustafson, Emory University, describes the relationship between religious ethics and other sources of moral insight. He sketches three "ideal-types": the autonomy of religious ethics, the intelligibility of religious ethics, and the dialectic of religious ethics. These provide a pattern for comparing religious traditions in conversation with others about medical ethics. In the final main chapter, Warren T. Reich, Georgetown University, describes "A New Era for Bioethics: The Search for Meaning in Moral Experience," and argues for the importance of a "sustained search for meaning in the context of ethics."

Two additional chapters report the conclusions of two working groups: (1) different contexts for medical ethics:

the academy, the medical center, the religious community, and the law or public policy; and (2) particular issues: abortion, genetics, assisted suicide, and access to health care. Concluding the book is the text of a worship service at the conference led by Allen Verhey.

The general emphasis of the book is strongly theoretical with discussions in general terms. In the final paragraph of his chapter on Paul Ramsey, Stanley Hauerwas writes: "Where has all this gotten us? Not very far, I'm afraid." It is only in the second report of one of the working groups that the specific issues mentioned above appear for discussion. But even there it is more a case of "talking about the issue" than coming to grips with defensible resolutions.

An exception is the chapter by Karen Lebacqz, summarizing the impact and significance of Thielicke's concept of "alien dignity," a phrase used by Thielicke to emphasize the worth that human beings have because they are created in the image of God, rather than for some utilitarian reason. The author shows how this concept of "alien dignity," rightly understood, plays a key role in protecting people, equalizing people, requiring personal response, requiring structural response, and emphasizing the importance of relational living.

This book will probably be of most interest to those for whom the issues of religion and medical ethics are intellectual and philosophical areas of concern, but of less interest for those desiring informed theological input to deal with specific issues in medical ethics which confront us more and more each day.

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

RELIGION AND THE CLINICAL PRACTICE OF PSYCHOLOGY by Edward Shafranske, Ed. Washington, DC: American Psychological Association, 1996. 640 pages. Hardcover; $59.95.

The four parts of this volume are divided into 21 chapters written by 26 authors. Some of the authors are associated with religiously oriented schools. The editor is professor of psychology at Pepperdine University and serves on the faculty at Southern California Psychoanalytic Institute. He is also active in the American Psychological Association (APA), the world's largest organization of professional psychologists. Extensively published in the psychology of religion, Shafranske focuses on the relationship between religious affiliation and clinical psychology.

In this book, religion is considered as a variable in the fields of mental health and psychotherapy. The authors consider religion from several perspectives including its cultural context and operational definitions, its relationship to clinical psychology and mental health, its history, and its parameters as shown by research. A concluding chapter is written by the editor and H. Newton Malony of Fuller Theological Seminary.

The preface, written by the editor, sets the context for the articles: "This book is an attempt to address the chasm between ... religion ... and the seeming lack of focused attention given to religion within most graduate education and clinical training programs." The editor believes that psychotherapy cannot be values neutral because values are inherent in the therapeutic process. The fact that this volume is published by the APA indicates that the historic antagonism between science and religion need not preclude dialogue. This book shows that religion is increasingly being viewed as an important force in human adjustment.

A 1992 Gallup poll demonstrates the extent to which a religious orientation prevails among Americans. Ninety-five percent say they believe in the existence of God, seventy-seven percent in the divinity of Jesus, and seventy-five percent in an afterlife. Seventy-one percent are members of a church or synagogue. Contrast this with the orientation of psychologists, about half of whom have no religious affiliation. Nevertheless, most psychologists hold some religious beliefs and think religion is important in human affairs.

After surveying the evidence, the editor concludes that religion, with its many varieties of beliefs and practices, should be included in the clinical practice of psychology. This, he adds, requires a commitment within the profession. For those interested in the interface between religion, mental health, and psychotherapy, this volume provides valuable and current perspectives and information. Readers can gain insights on the problems as well as the potential associated with integration and synthesis between religion and psychology.

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

CONNECTED KNOWLEDGE: Science, Philosophy, and Education by Alan Cromer. New York: Oxford University Press, 1997. 221 and xii pages, bibliography, index. Hardcover; $25.00.

Anyone who has taught first year courses in natural sciences or mathematics in a college lately has noticed the low level of knowledge of incoming students. Cromer, Professor of Physics at Northeastern University, was part of several attempts to improve the system. He mentions project SEED (Science Education through Experiments and Demonstrations) and project RE-SEED (Retirees Enhancing Science Education through Experiments and Demonstrations.) In the Preface, Cromer writes: "... science education in the United States fails to develop in students the unique habits of mind that constitute scientific thinking." On page 169, he writes: "Optimism begins by recognizing the enormous inefficiency of the U.S. educational system. Indeed the word 'system' is an unfortunate euphemism that disguises the disarray and incoherence of instruction from middle school through college. By comparison to education in other western countries, education in America is simply shameful." Near the end of the book

Cromer describes the modern Greek system as an example of an educational system that works better than the United States' system.

Noting the bad results of pre-university teaching in the natural sciences, Cromer criticizes the American system of education. Language is over emphasized (p. 102). He is especially critical of science textbooks in secondary schools which act as if language can express everything. As an example, he mentions a textbook which introduces the concept of energy by asking students for examples of things that have energy. How can they? Only after that exercise the students come to a "definition" of energy. To suggest improvements, Cromer studied the education system, its goals, its methods, and the background of its educational theories. Assuming that these theories were founded on social situations and theories, he studied the background of social sciences. Cromer claims that "many social scientists are leading the postmodernist attack on the natural scientists" (p. 57). He then asks: "Can we call these disciplines really sciences?" According to Cromer, the characteristics of real sciences are repeatable phenomena and strong inferential theories, because science is the struggle for a universal consensus. He goes on to explain what "repeatable" means as he wants to make sure that "sciences" include the historical sciences.

After Cromer has established that the historical sciences are sciences, he looks for a pure case of human development. To find a pure case of human development of which all real scenarios are modifications, Cromer looked at members of a New Guinea tribe. Leahy and Dwyer "discovered" this tribe in 1930. It had had no contact with other human beings for at least 9,000 years. Cromer assumes that their way of life was closest to the way original man lived. This part of the book clearly shows the necessity of having a basic philosophy of life. Because Cromer is not a believing Christian, he does not believe in the fall and its disastrous consequences for humankind. The fall had consequences for the study of scholarly subjects too. It makes Cromer's treatment of the history of education suspect.

At the Free University in Amsterdam, a Calvinist Christian university, students in all disciplines have to take a course in Christian philosophy. It may help them in recognizing backgrounds of theories they will encounter. If it works properly, the result will be a true university where all disciplines can work together. As it is now, in most universities each discipline is on its own. I believe that the disagreements about the background of scientific theories among Christians are the result of not knowing philosophic backgrounds. The book under review reenforced my belief that having such a course is necessary, even for natural scientists.

Any teacher from kindergarten to university can benefit from critically studying this book. Several of his practical suggestions are worth applying.

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

THE EDUCATED MIND: How Cognitive Tools Shape Our Understanding by Kieran Egan. Chicago, IL: The University of Chicago Press, 1997. 299 and x pages, bibliography, index. Hardcover; $24.95.

Egan is Professor of Education at Simon Fraser University in Burnaby, BC. I recommend his book for critical study by teachers from kindergarten to university. Egan is not a Christian and it shows. My reason for recommending it is that, according to Egan, we have difficulties teaching in our schools because we have only three educational ideas. Unfortunately they are incompatible. These three ideas are: (1) We must shape the young to the current norms and conventions of adult society; (2) We must teach them the knowledge that will ensure that their thinking conforms to what is real and true about the world; and (3) We must encourage the development of each student's individual potential. Egan claims that with so few ideas terminal staleness will set in.

The first idea Egan calls "socialization." Children need to learn how to become members of the adult society. Since he talks about his first communion in his "distant Catholic past" (p. 70), I concluded that he is not a Catholic. I found no other reference to his religion. That explains why he suggests that teachers tell fairy tales in the elementary grades. In those stories, we usually find a strong division between good and bad behavior. My experience in a Christian elementary school was that Bible stories accomplish what Egan wants to accomplish with myths. I believe that religion is all important. It influences all parts of our life. Therefore, if we want our children to be Christians, we need Christian schools. Bible stories are a real part of the large story of God's redemption of man. I must immediately add that later in the book (p. 213) Egan, following Northrop Frye, recommends that Bible stories *and* the central stories of Greek and Roman literature be part of the elementary curriculum. All these "stories" form our social milieu.

To be good citizens in society children must obtain "knowledge," said Rousseau. Egan wants to replace the word "knowledge" with "kind of understanding" (p. 23). Then he divides understanding into five parts, starting and ending with somatic understanding. The other four understandings are: mythic, romantic, philosophic, and ironic understanding. Egan spends a chapter on each in Part One of the book. In Part Two he talks about implications for curriculum and teaching.

The book glorifies the invention of the alphabet by the Greeks. It led to a conceptual revolution in ancient Greece and generated the philosophic, scientific, historical, descriptive, legal, and moral forms of discourse that make up what we call the modern mind (p. 75). My question is: Is that really true? Did the Mesopotamians, Hebrews, and Egyptians have no great influence on the modern mind? Some claim a Christian influence on certain forms of modern thinking. Even Egan uses biblical quotations without acknowledging the source. He does not want to give Christian religious influences more than passing attention. On p. 80 we read: "What was dramatic was the eradication of magic and gods as explanatory devices and

the new focus on an autonomous reality; what has received much less attention is the persistence of myth as a subterranean, or, at what we might today call a structural level." It is no wonder that we read (p. 102) that schooling stimulates a sense of autonomous reality.

As a Christian, I believe that talking about an "autonomous reality" is dangerous and wrong. God made the natural laws. If students learn that reality is autonomous, we will hear more often that what we believe as Christians is not really true, and we can dismiss it. We know that in the end times not many will be found believing in Jesus Christ as the real ruler on earth. When Egan talks about philosophic understanding and the school's influence on students, he mentions how this leads to a closer comprehension of the self. He quotes from the French *Encyclopedie:* "Reason is to the philosopher what grace is to the Christian." Students will find the truth about themselves. Egan notices a decay in a promised true account of reality (p. 139). He is very pessimistic about our ability to describe "truth" after Nietzsche's announcement of the death of God. I believe that when the school excludes our Christian beliefs, true reality, which describes creation as reality created and ruled by God, will not be taught. Teaching wants only to show how life "really" is and how we should see the world around us. I am thankful for Christian schools and colleges which counter this type of thinking. We want our children to view reality as the Bible sees it.

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

NO NEUTRAL GROUND: Standing by the Values We Prize in Higher Education by Robert B. Young. San Francisco: Jossey-Bass, Inc., 1997. 231 pages. Hardcover; $31.95.

Young, professor of education at Ohio University, believes higher education must emphasize core values in order for it to impact American society. The core values (service, truth, freedom, equality, individuation, justice, and community) are the key ingredients administrators, faculty, and trustees must incorporate in their recipe if they are to positively impact students and the larger community.

The academy is facing increased pressure to conform and follow rather than transform and lead. Higher education's core values run the risk of coming into conflict with society, free enterprise, and religion. Young examines the seven core values at length and shows that to be successful institutions of higher education must nourish and apply them.

Young divides his discussion into three parts: values we prize; challenges to our values; and advancing the values we prize. Educators and students alike will agree with about everything Young says. He presents his viewpoints with some illuminative illustrations and creates a few good quotes in the process. "The value of the good life has become more important than the value of a life of good." "Serving the public ... makes the academy moral instead of just material ..." "When all of society's heretics are quieted, the academy is no longer free."

Everyone interested in education will applaud Young for calling the academy to recognize the reasons for its existence. In an age of relativity, a book which stresses that there are foundational values is a breath of fresh air. And Young includes in his discussion the importance of intellectual and scientific values. He writes: Science "is the starting point in the discovery and transmission of truth." He acknowledges the value of both pure and applied science. He believes that "science and technology have made people collectively powerful but individually weak."

Young is to be commended for including a chapter on "Spirituality: The Challenges of Ultimate Meaning." He thinks the modern, secular university has moved away from seeking to foster good character. Any spirituality which the student picks up is a by-product rather than an espoused goal. "When they look up to the stars, students (in public institutions) will not have heaven pointed out to them." Young praises colleges of character, small religiously oriented liberal arts institutions which offer an alternative to large universities. He believes these are the kind of eccentric institutions America needs, but that they are disappearing.

This book is highly recommended, not only for those who work in the academy, but also for those who are eager that the academy stand by and exalt the values prized in higher education.

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

CHRISTIANITY IN THE PUBLIC SQUARE: Law, Gospel & Public Policy by C. E. B. Cranfield, David Kilgour, and John Warwick Montgomery. Edmonton: Canadian Institute for Law, Theology & Public Policy, 1996. 320 pages, appendix, index. Paperback; $17.50.

This book is a collection of essays compiled from a variety of sources including *Christianity Today* and the *Christian Legal Journal* by historian, theologian, and legal scholar John Warwick Montgomery. The essays span a period of thirty years during which Montgomery held academic posts in Canada, the United States, and England. This prolific author is dedicated to integrating law and theology with public policy.

Twenty essays are gathered in a section called "The Larger Perspective." They address a variety of issues, from the career of Adolf Hitler to the relationship between law and justice. In one essay, the author comes out against school prayer not only on the basis of First Amendment considerations, but because "Evangelism thrives on true freedom and is crushed by social conformity" (p. 83).

Three smaller sections, containing four essays each, address bioethical issues, the truth of Christianity, and

the relevance of Scripture in today's world. In all cases, the author blends biblical, historical, legal, and political evidence in a readable way to support his contention that our understanding of public issues and our behavior as citizens must take place within the light of God's revelation.

Two essays are added to the collection. The first, by David Kilgour, a member of parliament in Canada, talks about the desperate need for Christian politicians in the 1990s, as we face moral decline and increased uncertainty. A closing essay by C. E. B. Cranfield, a New Testament scholar, presents an examination of the biblical evidence that calls for the acceptance of political responsibility on the part of every Christian.

This book would appeal to all those interested in the relationship between Christian faith and political life, and who advocate a more active public role for all believers. It also provides Christians with an excellent source from which to set out exploring a variety of social issues.

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GOD, PHILOSOPHY AND ACADEMIC CULTURE: A Discussion Between Scholars in the AAR and the APA by William J. Wainwright, Ed. Atlanta: Scholar's Press, 1996. Hardcover; $20.00. Paperback; $14.00.

At the 1992 convention of the American Academy of Religion (AAR)/Society of Biblical Literature, David Tracy (University of Chicago) gave a lecture on "The End of Theism and the Re-naming of God." He simply asserted without argument that traditional theism was no longer a viable option and that there are many names for the unknown Reality—a claim for which he received hearty applause. After the lecture, someone aptly commented, "We just heard a lecture on the end of theism, and nobody looks worried."

This scenario highlights one of the AAR's distinctives—which is in contrast to the seriousness with which philosophers in the APA (American Philosophical Association) take theism. Philosopher William Wainwright has edited an important book for all who are interested in the place of the philosophy of religion in American culture. In light of the unfortunate lack of interaction between the AAR and the APA, Wainwright has brought together thinkers from these two philosophically-divergent camps (Nicholas Wolterstorff, Merold Westphal, Walter Lowe, Stephen Crites, Philip Quinn, Stephen Evans, Wayne Proudfoot, and Robert Adams) in an attempt, at least in part, to "heal this breach" (p. 3). Wainwright's excellent introduction offers a succinct summary of the book's contents and lays out the differences between these guilds.

At the risk of oversimplification, I shall list below four key differences between these camps:

1. AAR philosophers (who tend to be housed in "fragile" departments of religious studies—a fairly recent phenomenon) are usually not theists whereas many APA philosophers of religion (who are housed in departments of philosophy) are. Given the cross-cultural nature of religious studies departments, there tends to be pressure to avoid any kind of proselytizing or dogmatism; thus these philosophers of religion tend to keep their own religious views out of their teaching and research so as to appear more "objective" (pp. 52–3). Moreover, AAR members often *assume* that theism is abstract and irrelevant (e.g., Crites: "'theism' is of very limited importance," and to speak about it in philosophical terms consigns it to "religious and existential irrelevance" [p. 44]). Such is not the case in the APA, where even if philosophers are not theists, they tend to take theism seriously. (The essays by Crites [AAR] and Evans [APA, although a member of AAR] epitomize the deep differences of this first point. Evans rightly takes Crites to task for his depreciation of the theistic tradition.)

2. While the AAR approaches the study of religion from a sociological and historical point of view, the APA focuses on rationality, truth, and falsity: "APA philosophers [tend to] view those in the AAR as insufficiently rigorous in logic and argumentation, while those in the AAR view their counterparts as insufficiently historical" (p. 71). (Incidentally, Lowe characterizes the heart of the AAR guild as being ethically-oriented: "Religion deepens the ethical; the ethical validates religion" [p. 32].)

3. Westphal observes that "among philosophers of religion the AAR/APA division tends to correspond with a continental philosophy/analytic philosophy division" (p. 24). The AAR's philosophers tend to ignore the *pre-Kantian* thinkers of the medieval and early modern periods, who were usually theistically inclined. The APA philosophers of religion, however, usually bypass *post-Kantian* Continental thinkers.

4. Wolterstorff's essay points out that most analytic philosophers tend to be *perspectival particularists* whereas those in the religious studies departments have an *interpretation-universalism* orientation. Though they both reject the naive foundationalism of Descartes, the analytic tradition's post-foundationalism is "*post*-Kantian" (only in that it is "possible to recover from Kant" [p. 20]!) whereas the Continental tradition's post-foundationalism is Kantian (in which Reality is never present to us).

The general consensus of the book's contributors is the importance of greater interfacing between the two camps. Quinn especially emphasizes this in his essay (pp. 54–6). (1) The AAR, with its emphasis on ritual and myth in religion, should not ignore the APA's emphasis on the rationality or truth of theological doctrines—and vice versa. (2) The religious studies departments should be more cautious about embracing continental European philosophy and accepting social scientific explanations of religious phenomena just as the APA guild should not

ignore Continental philosophy or be so hostile toward social scientific discussions of religious phenomena. (3) The AAR guild should come to more fully appreciate the intellectual resources of pre-Kantian theological and philosophical (theistic) thought while the APA philosophers of religion should more conscientiously examine post-Kantian Continental thought. (4) While the AAR tends to relativize religious truth-claims on the basis of socio-cultural factors, the APA should not ignore the socio-cultural dimensions of religion. On the other hand, the AAR should not assume that simply because there exist social constructs in religion, there can be no "religious knowledge of nonrelativistic truths." So simply staying at the respective extremes of "relativism" and "Platonism" will not promote a healthy mutual understanding. Thus Quinn recommends that "the two tribes should get better acquainted" (p. 55) as they have much to learn from one another. In this way, they can help overcome their mutual hostility.

As Christians, we should affirm that we can have limited, yet objective, knowledge. While the AAR rightly reminds us of our limitations, we cannot accept its dismissal of the Christian worldview or its considering Christianity to be just one of many legitimate ways of attempting to understand the Ultimate Reality.

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INEVITABLE ILLUSIONS: How Mistakes of Reason Rule Our Minds by Massimo Piattelli-Palmarini. New York: John Wiley & Sons, 1994. 242 pages, index, bibliography. Hardcover; $27.95.

Piattelli-Palmarini has compiled an extraordinary collection of problems to demonstrate that intuition and reason are not always reliable. Various examples are given in 11 chapters that roughly progress from visual illusions, to statistical illusions, and ending with the "Grand Finale"—an illusion that is hard to believe even when you know the answer! The text is not referenced but an extensive bibliography is provided at the end of the book.

This book is a fascinating catalogue of illusions of the mind. Most "Science Centers" have collections of visual illusions where straight lines seemingly bend and our sense of perception is shown to be wrong (e.g., Escher's drawings). The author begins with several visual examples (Chap. 1–2) but moves on to show that these are only one type of cognitive illusion. Certain routine mental calculations involving assumptions or approximations, made from our experience, do not give an accurate mental picture. In contrast, the mind's rational component triggers an innate response to correct the problem. Chapter 3 demonstrates that people are usually unable to make use of knowledge present in another of the mind's compartments. Here is an example:

> A normal die has been painted in such a way that it has four green faces and two red. After being shaken in a cup, the die is thrown repeatedly onto the table, and the reader is invited to guess which one of the following sequences represents the actual one ... (R is for red and G is for green).
>
> 1. RGRRR
> 2. GRGRRR
> 3. GRRRRR
>
> On which do you bet? (p. 50).

The usual preferences, in order, are 2, 1, 3. The "typical" sequence 2 is actually less likely than 1 since sequence 1 is the same as 2 without the first throw. "What is more extraordinary is that some 65% of all subjects (exception made of expert statisticians and people whose business is probability) show a strong propensity to vote for sequence 2, even when it is explicitly pointed out that one can obtain sequence 1 from sequence 2 by eliminating the first throw of the die."

The "flaming" of a problem may also create mental illusions. Piattelli-Palmarini cites a survey of clinical doctors who "if they were told that there was a mortality rate of 7 percent within 5 years for a certain operation, they hesitated to recommend it; if, on the other hand, they were told it had a survival rate after 5 years of 93 percent, they were more inclined to recommend it to their patients" (p. 56). Several similar cognitive illusions are presented in the same chapter to support the claim that there are trends to the types of mistakes that people are prone to make. Additional examples commonly encountered in everyday life are presented in chapter 7, "The Seven Deadly Sins."

Many of the cognitive illusions involve probabilities, and a qualitative argument is given for both Bayes' Law (for calculating "unknown probability from known data," [Chap. 5]) and "The Fallacy of Near Certainty" (Chap. 6). The latter is particularly well treated using examples from diagnostic tests: for a patient that tests positive in a test that is 79% reliable (a false positive rate of 21%) and affects 1% of the population, the probability that the person actually has the illness is only 8 percent (p. 80). Piattelli-Palmarini discusses this example by focusing on necessary and sufficient conditions to show that "an intuition that is correct at the absolute level of 100 percent is *no longer* correct in cases that lie 'close' to that 100 percent limit" (p. 111).

Inevitable Illusions is a fascinating book, highly readable, with many insights on how people think. The main criticism, for this reviewer, is that the book does not include strategies for preventing cognitive illusions. Chapter 8, "How to Emerge from the Tunnel of Pessimism," provides a summary of the science of cognitive illusion rather than providing what the title suggests. Perhaps this is an unfair criticism since the author stresses that this is an emerging area of research.

One of the most interesting aspects to this book is the possibility that learning science involves developing a mindset to avoid cognitive illusions. This reviewer posed several of Piattelli-Palmarini's problems to colleagues and found many instances where the problem was solved correctly *because the problem was known to need treatment according to a specific protocol.*

Inevitable Illusions is an excellent introduction to errors in perception with significant ramifications for anyone involved in scientific interpretation and discovery. This book is highly recommended for all ASA members interested in the hermeneutics of science.

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DIMENSIONS OF THE SACRED: An Anatomy of the World's Beliefs by Ninian Smart. Berkeley, CA: University of California Press, 1996. 320 pages, glossary, references, index. Hardcover; $29.95.

What is religion, and how does it manifest itself? These enduring questions can be approached in varied ways such as through abstract theories or through empirical comparisons, usually based on a classification of religion (Eastern and African, perhaps, or shamanistic and polytheistic). Smart takes the unusual, and I think, effective approach of describing religion through seven "dimensions" which encompass the basic ways religion manifests itself; the doctrinal/philosophical, the ritual, the mythical/narrative, the experiential/emotional, the ethical/legal, the social, and the material.

Smart describes his work as a "morphology of religion, incorporating a theory." It does incorporate a theory, as any organized comparison must, most broadly that however much religions vary, they manifest themselves in patterned ways in each of these dimensions. A more specific element of Smart's theory is that certain secular worldviews have much in common with religions. Yet on the whole this is not a very theoretical book. Smart does not *explain* religion as much as he *describes* it. Indeed my strongest impression is of the extraordinary amount of pertinent information Smart has managed to convey within this framework—and within some three hundred pages. This should not be surprising, for Smart is one of the world's leading scholars of religion and is known for his wide-ranging knowledge of the world's religions. A J. F. Rowny Professor of Comparative Religions at Santa Barbara, he has written many books, some thirty of which are currently in print. He has written on Buddhism, Christianity, the philosophy of India, and worldviews. He also writes poetry. But he is probably most widely known for several popular introductory texts in comparative religion.

Dimensions begins with a lengthy introduction in which Smart describes what he hopes to accomplish by this approach. He continues with chapters on each dimension. Throughout, Smart emphasizes what have been called the world religions, in particular Buddhism, Hinduism, and Christianity, as well as secular ideologies and nationalisms, which are often expressed in strikingly "religious" ways. Similarly, his orientation is toward the civilizational context of these religions. Thus in his chapter on the social dimension, Smart begins by reviewing the varied kinds of religious specialists (or roles), then moves on to social structures, emphasizing states and nation states. But this is just an emphasis—he does make some reference to religions of small-scale societies, particularly shamanisms—and I bring it up by way of description, not criticism. I believe, however, that an exploration of traditional and ancient religions in this framework would be a valuable extension of Smart's work.

I found the chapter on the experiential and emotional dimension particularly stimulating. Without sacrificing the richness of concrete examples, which may be the greatest strength of this book overall, he develops a very interesting and persuasive model of religious experience. This he calls his "two-pole" theory in which he distinguishes the "numinous experience of the holy as *a mysterium tremendum et fascinans*, the Other" from the mystical, contemplative religious experience "which does not postulate an outside Other and which feels the disappearance of the subject-object distinction" (p. 167). I have sympathy for Otto and the many others who have sought a single core of religious experience. But particularly by drawing on his extensive knowledge of Buddhism (as he does throughout the book), Smart presents a good case for the view that these two kinds of religious experience are genuinely basic and irreducible. He also develops from this an idea concerning the early history of religion. Since shamanic religions seem to exhibit both the poles, he argues, they may represent "a vital early form of spiritual experience which may have helped to develop the twin poles of religious experience" (p. 192).

Smart is quite sympathetic to his subject. This is not a work pervaded by metaphysical naturalism, as is so common, at least in anthropological discussions of the subject. Smart argues vigorously for a phenomenological method by which he means, in part, what anthropologists often call the emic approach of trying to present things from the practitioner's perspective. In this he very often succeeds, though, of course, his opinions sometimes come through, as when he chooses to call the evangelical revival a *backlash* against secularization (p. 124), compared to the more positive appraisal of the reinvigoration of other religions.

This is not a book that is easy to read straight through, and this is primarily a byproduct of the positive characteristics already described—the largely unobtrusive theoretical perspective, and the richness of empirical detail. It often takes on a compendium-like character and can seem fragmented, or at least a little jumbled, as Smart piles example upon example. But what is lost by not having a continuous, building argument, is made up for by the value of this work as a reference for studying individual aspects of religion. This book is also a wonderful source for teaching. Do you need an example of divine kingship? Just read three sections in the social dimension chapter—"Monarchies as civilizational areas," "Greece and Rome as differing systems," and "A variant in the case of Buddhism." Within these eight pages can be found a dozen well-chosen examples, each concisely summarized and well referenced. These are not superficial summaries either, but pithy distillations, clearly representing an immense amount of research.

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THE BEAUTY OF THE BEASTLY: New Views of the Nature of Life by Natalie Angier. New York: Houghton Mufflin Company, 1995. 260 pages, introduction, index. Paperback; $12.95.

The title's play on words sums up the tone for this anthology by a Pulitzer Prize-winning *New York Times* columnist. Based on articles appearing from 1989–1994, the essays are more natural history than rugged biological sciences. A journalistic heritage is apparent in the catchy quirks of each opening through the elaboration of scientific detail to the closing, as idiosyncratic as the subject phenomena. While mostly chronicles of animal behavior, there is more to enlighten the armchair biologist or the specialist outside the disciplines represented. One section describes how scientists work while it explores the character of each, the pun on "character" quite intentional. The book is for those who enjoy their science with a dollop of humor or who believe the most intricate phenomena can and should be rendered accessible for the public. Readers may find the contents either an amusing take on the fascinations and oddities of life or shamelessly anthropomorphic.

The contents are distributed among categories ranging from "Loving" to "Dying," and including "Dancing," "Slithering," "Adapting," "Healing," and "Creating." Representative titles include "Female Choice: An Eve-olutionary Force," "What Makes a Parent Put Up with It All?" "Parasites and Sex," "The World's Most Endangered Primate," "From Madness to Masterpiece," "Cell Death as the Key to Life" and "The Other Side of Suicide." In keeping with the content, the tone ranges from the silly to the somber.

Angier successfully pursues the mission of inspiring "an appreciation for diversity, for imagination, for the twisted, webbed, infinite possibility of the natural world," every story "gorgeous." Her selection serves "the preservation of nature on her own terms, complete with the golems and creeps and ogres ... , the roaches, the snakes, the bloodsuckers, the lowlifes, and the brutes" (p. xi, Introduction). With scientists she grasps that "nothing is as it seems. Instead, things are as they seem *plus* the details you are just beginning to notice. New truths rarely overturn old ones; they simply add nuanced brushstrokes to the portrait" (p. xiii, Introduction). Angier conveys the constraints on the scientific endeavor: while a less reductionist, more holistic approach to understanding life might be preferable, "we must be sympathetic with" the effort "to parse nature into knowability" (p. xvi, Introduction). Angier is advancing knowability.

The opening of the first essay establishes the style: "It is just the potion for a bellicose world." "It" is the hormone oxytocin, "nature's way of ushering in joy" (p. 10). Following a description of oxytocin's biochemistry and physiological role, Angier closes with the image of a ewe, stimulated by the hormone, allowing her newborn to nurse "and otherwise behaving like a model mother" (p. 14).

The reader can smile wryly with the account of poets and artists, promptly followed with a nod to the inescapable social critics observing "that an awful lot of these creative types are mentally unsound," (p. 205), echoing Aristotle's reference to the melancholia of greatness. Serious reflection accompanies the humor throughout, and the reader can share in Angier's delight upon considering migration a mechanism for evading parasites or play as one affecting quality of life, the difference "between merely surviving and truly thriving" (p. 134), or muse with her as she grasps the medical *and theological* accuracy with which Michelangelo's *Pieta* portrays the crucified Christ. "The Wrapping of DNA" and "Chaperoning Proteins" may move some readers to a deeper appreciation for the profound subtlety, intricacy, and complexity of the Lord's ongoing acts of creation. It is a delightful serendipity to discover that the "language" of the DNA molecule is akin to Hebrew texts.

The Beauty of the Beastly is a "fun" exploration of biological phenomena with the charm of the articulate naturalist blessed with a sense of humor and armed with a feeling for the bizarre and a gift for clarity of description in taking on the most complex science—with only the occasional lapse. This anthology is not for everyone, nor is every essay amusing. Certain portions can be annoying or even offensive. A certain glibness and an irreverent tone—comparing a laboratory to a shrine and pointing to characteristic marks on the floor "as one might to the signs of a weeping Virgin Mary" (pp. 57–8)—may go too far. In keeping with the original publication over a period of years, the essays read in rapid succession can become repetitive for the most entranced reader. With these caveats in mind, Angier's anthology is a delight for anyone fascinated with the life sciences, up close or from a distance.

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THE PUZZLE OF EVIL by Peter Vardy. Armonk, NY: M. E. Sharpe, 1997. 205 pages. Paperback; $17.95; Hardcover; $59.00.

Let me tell you right away: if you are looking for the solution to the puzzle of evil, you won't find it in this book. However, if you are looking for some of humankind's best efforts to unravel the puzzle, this is the place to start. Vardy does an outstanding job of distilling a lot of information into a concise and informative survey of the major approaches to explaining the puzzle of evil. What is the puzzle of evil? The ancient Greek philosopher Epicurus (c. 342–270) has stated it precisely: "Is God willing to prevent evil, but not able? Then he is impotent. Is he able but not willing? Then he is malevolent. Is he both able and willing? Whence then is evil?"

Vardy divides his discussion into two parts. In the first part he discusses the strengths and weaknesses of what the major thinkers of the world have said about evil. In the second part he gives his own view which he describes as "a new path, a new way of understanding the old problems." The Thomas Aquinas (Roman Catholic) view seeks to solve the problem by looking at creation

from a theocentric rather than anthropocentric view. If we do this, according to the Thomist tradition, we will conclude that the universe is good and perfect because it is made by a good and perfect God. Vardy faults this view for not taking into full account the world's suffering and God's love.

The Free Will Defense (FWD) says that moral evil results because God has given his creatures free will. The FWD is not a very satisfactory solution to suffering resulting from natural evil—such things as tornadoes, hurricanes, and floods. The FWD explanation says natural evil results because God has set into motion laws which operate in such a way as to sometimes cause suffering. Why such extreme suffering results from moral and natural evil is difficult for the FWD to explain.

The greatest challenge to suffering, according to Vardy, comes from Dostoyevsky's *The Brothers Karamazov*. In it, Ivan Karamazov uses examples to conclude that nothing God could intend justifies the extreme suffering of innocent children. Richard Swinburne writes that Ivan is asking for a "toy world" and says that God sets limits on human suffering by allowing people to faint or die. Vardy considers this view "obscene."

What is Vardy's approach to this puzzle? It is one based on faith, not reason, although reason is not totally abandoned: "If human reason is master, there seems to be no way of combining belief in an all-good and all-powerful God with the existence of extreme evil and suffering in the world." After considerable discussion, Vardy arrives at the conclusion that "God could not have created a better universe given his ultimate purposes ... Because of my belief in and love for this God, I refuse to accept that a world with less suffering due to physical evil could have been created ..."

That Vardy has thought about the predicaments of human existence is evident by his other books including *The Puzzle of Ethics*, *The Puzzle of the Gospels*, and *The Puzzle of God*. He is a lecturer in the philosophy of religion at London University's Heythrop College. His extensive knowledge and insights make him a helpful guide to those seeking answers to the puzzles of life, including the questions of "why."

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

Letters

Response to David S. Siemens, Jr.

David Siemens, in his letter (*PSCF* 49 [June 1997]: 140), questions whether the solutions I discuss in my paper are necessary, when the preconditions for the difficulties I assume are examined.[1] He contends, in particular, that neither Time 1 nor Time 2 are relevant for consideration of a personal God.

Temporality or the state of relating to time is what marks a person existing in the spacetime continuum. There we become aware of our temporality through our memory which implies a sense of what we call the past. This ties us squarely to Time 2. The physicist Davies argues that if God were to communicate with us he would have to assume our temporality which would make him subject to the physics of the universe.[2] He acknowledges the seriousness of his conclusion for the faithful Christian by quoting two well-known theologians. Paul Tillich writes: "If we call God a living God, we affirm that he includes temporality and with this a relation to the modes of time." Karl Barth states similarly: "Without God's complete temporality, the content of the Christian message has no shape."

Equally relevant is Time 1 for consideration of an eternal and personal God. Tillich emphasizes that "eternity is neither timeless nor the endlessness of time."[3] Proclus, whom I quoted in my paper goes a step further: "As often remarked, things have a twofold nature: the one invisible ... and unworldly, and the other visible ... and distributed throughout the world. If this is so, then time is also twofold, There is a time for heaven and one for earth." The "time for heaven" is what I call Time 1. Its concept in the context of physics is discussed in my paper.

According to Siemens it has not been established that the type of personality I relate to Time 2 "exhausts the limits of personhood." This is true. There is certainly more to a person than just his/her time dependent existence. But to keep the paper at a reasonable length, I focused only on those attributes which stem from a person's bondage to the physical world. Davies uses them for his denial of a personal God.

Siemens further suggests an analogy where the word "number" can have various meanings, among them numbers which are transfinite. He continues that theism "requires at least a 'transfinite' being." I assume that his quotation marks indicate a symbolic use of this word. It actually relates to Cantor's theory that certain sets with even infinitely many elements could be denumerable or countably infinite. He introduced a new "transfinite" cardinal number, which represents the number of items in a denumerable set. "Transfinite" thus is a type of mathematical infinity, which differs from God's transcendental infinity.

I appreciate Siemens' comment that my article "presents an interesting solution to some problems raised in recent discussions on the nature of the deity." One of the problems is voiced by Davies, who denies the existence

of a personal God on the basis of God's timeless eternity.[4] I am refuting this claim. Even if my solution were debatable by taking another viewpoint, it still could provide a reasoned reply to a reasoned statement by one of "those who have constructed a deity in their own image."

Notes

[1]Karl M. Busen, "Eternity and the Personal God," *Perspectives on Science and Christian Faith* 49 (March 1997): 40–9.
[2]Ibid., 47, Note 15.
[3]Ibid., 45.
[4]Paul Davies, *God and the New Physics* (New York: Simon & Schuster, 1984).

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God's Action in Nature

With the publication of several papers from the "Conference on Naturalism, Theism, and the Scientific Enterprise" in the September 1997 issue of *PSCF*, I thought it timely to express some of my concerns with the recent efforts to include arguments from design or hypotheses of God's "direct action" as part of the scientific enterprise. My first, and most serious, concern is that a truly biblical understanding of God's action in creation and human history will be lost. God actively participates in all the processes of nature, not only upholding creation in being, but directing it to his providential purposes. As Plantinga clearly stated in his article on methodological naturalism, "... natural laws are not in any way independent of God, and are perhaps best thought of as regularities in the ways in which he treats the stuff he has made, or perhaps as counterfactuals to divine freedom."[1] And further, "the whole interventionist terminology—speaking of God as intervening in nature or intruding into it, or interfering with it, or violating natural law—all this goes with God-of-the-gaps theology, not with serious theism." Such interventionist thinking undermines the theology of God's continuously active involvement in all of creation.

The concerted efforts by many Christians to identify gaps in our causal explanations of natural events (especially in the history of life) seems to me to indicate a view of creation in which God is perceived as only distantly involved in secondary causes. God's immanent action through natural processes seems to be thought by many to be an inadequate expression of divine involvement in creation, and equivalent to deism. Any significant creative act is thus assumed to require God to break causal chains. Similarly, the identification of only specific well-defined events or structures as evidence of "intelligent design" in effect places all the rest of the richness, beauty, and power of creation into the category of the merely natural. The argument from design is thus weakened, not strengthened. The forcefulness of the testimony of creation is that the hand of the Creator is visible throughout the natural universe for those willing to see. Everything in creation gives glory to God—the trees, the animals, the mountains and seas, the very rocks reveal God's majesty and power (Job 38–41; Psalm 148). God is apprehended in creation by faith. If a person cannot see God in a sunset or a thunderstorm, he or she will not see him in a strand of DNA or a mitotic spindle.

My second concern springs from the nature of scientific exploration and our present level of scientific understanding. As Plantinga correctly observes, appeals to God's "direct action" are "science stoppers" that cut off any further scientific inquiry.[2] He further states that this does not enable us to rule out that God did not "directly act" in such a way. This is also quite true. Plantinga, however, is incorrect in thinking that such explanations can be part of scientific description. Science can identify areas of inquiry in which no demonstrated cause-and-effect explanations presently exist, but that is all. To establish that a given process or event has, in principle, no possible causal explanation would require essentially complete understanding of all relevant factors and historical contingencies. Such knowledge has not been even remotely obtained in any field of scientific inquiry, nor is it likely in any foreseeable future. The danger in using presently inexplicable aspects of creation as evidence of intelligent design or direct divine action, is that future discoveries have the potential to fill those gaps and undermine the foundation of sand upon which the case for divine action was built.[3]

The proclamation of the Christian community should be that God is the Author and Sustainer of all created reality, and that he is no less active in a thunderstorm than in any miracle. Furthermore, God is presently creatively active in his creation (see Psalm 104: 27–30) and in human history and human lives. Let us not compromise the theology of creation for short term, and probably fleeting, apologetic advantage.

Notes

[1]A. Plantinga, "Methodological Naturalism?" *Perspectives on Science and Christian Faith* 49 (September 1997): 149.
[2]Ibid., 152.
[3]See D. F. Siemens, Jr., "On Moreland: Spurious Freedom, Mangled Science, Muddled Philosophy," *Perspectives on Science and Christian Faith* 49 (September 1997): 196–9.

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Response to Adam Drozdek

In his Communication "Time and Eternity" (*PSCF* 49 [September 1997]: 192–5), Adam Drozdek refers to my citation of Nelson Pike's findings as an example for the incompatibility of an eternal with a personal God.[1] I am actually more concerned with Paul Davies' denial of a personal God.[2] There he argues that because space and time are inseparably intertwined, a God who is in time is then tied to space thus "in some sense caught up in the operation of the physical universe ... Clearly, God

cannot be omnipotent ... nor can he be considered the creator of the universe, if he did not create Time."[3] He concludes that God is timeless and cannot be personal.[4] Implicit in his discourse are two assumptions: (1) that there is only the time of the physical universe and (2) that eternity has no time.

Drozdek notes that there seems to be "at least a terminological dissonance." He refers to my wording of a "timeless" eternity.[5] Taken out of context this concept seems to be disputable indeed. But I also said the following: "First we suggest that eternity, as comprehended by the ancient philosophers is "timeless" in the sense of not comprising Time 2 ... Because the equation of dynamics contain time as devoid of modes, the 'timelessness' of eternity may be pictured alternatively as the idea of Time 1."[6] I then entered "timeless" in the call-out on page 45 in the above context where the quotation marks indicate that the word here takes on a special meaning.

Drozdek raises the question: "Can Time 1 be considered timeless, or can any time, for that matter be timeless?" Of course not! Time 1 has no modes but it can be measured by a clock. It appears as a variable, for example, in the equation $x = vt$ as "objective time," as von Weizsäcker calls it.[7] The words physical or real do not apply here. This could imply modes. Even instantiation does not change its nature: my digital watch tells me it is 11:30 a.m. as my plane departs. A few seconds later I fall soundly asleep. The flight attendant wakes me up at 1:00 p.m. upon arrival. I know that the average speed of the plane was 500 mph. That means my trip covered 750 miles. What do I have here? Just numbers! They may take on a special meaning when I compare them with the time I need to walk 3.5 miles in my favorite park. But then I am already experiencing Time 2. (See also my Note 20 as another example for the nature of Time 1 and Time 2).

Can Time 1 be considered at best an image of timeless eternity? The answer is "No!" According to an analysis by Proclus (410–85) Plato already implied the idea of two times, one of them belonging to eternity:

> As we have often remarked, things have a twofold nature: the one invisible ... the other one visible. If this is so, then time is also two fold. There is a time for heaven and one for earth.[8]

Park quotes two other thinkers who elaborate on time. Parmenides asserted that the "idea of the world includes all its history: present, past, and future taken at once." Heraclitus said that the world is process, and we are immersed in it. Later commentators saw the opposing views of the two. One was thinking in terms of Time 1, the other one in terms of Time 2.[9] According to Plato, Forms or Ideas are transcendental realities which can serve as an intelligible model or blueprint of the sensible world.[10] Proclus' analysis is an example for Plato's teaching. Time 1 is the Idea and Time 2 is part of the sensible world, the model.

I understand Drozdek's concern for endowing the physicist's tenseless time with a metaphysical dimension. In the equation $x = vt$, the velocity is assumed to stay constant. In the physical world, friction slows the motion down unless an acting force is applied for compensation. Yet, this equation—besides a host of others—is useful to obtain, under idealized conditions, numbers which describe events occurring in the world of Time 2. "The physical world is such that it can be described by the equations of dynamics."[11]

If Time 1 in my examples were understood as an analogy for the time which Tillich intimates as a quality belonging to God's eternity,[12] one could tentatively endow it with transcendental meaning. I did this and justified it in my paper by quoting Tillich as follows:

> [Any concrete] assertion about God must be symbolic, for a concrete assertion is one which uses a segment of our finite experience in order to say something about him. It transcends the content of this segment, although it includes it. ... [But] can a segment of finite reality become the basis for an assertion about which is infinite? The answer is that it can, because that which is infinite is Being itself, and because everything *participates* in Being itself.[13]

Tillich also intimates Time 1 in one of his essays:

> ... every moment of time reaches into the eternal. It is the eternal that stops the flux of time for us. It is the eternal "now" which provides for us a temporal "now." ... Not everybody, and nobody all the time, is aware of this "eternal now" in the temporal "now." But sometimes it breaks powerfully into consciousness and gives us the certainty of the eternal, of a dimension of time which cuts into time and gives us our time.[14]

Drozdek relates Cantor's number theory to the realm of time, which he sees as a tripartite division of reality—finite, infinite, and suprainfinite. He continues: "It seems, however, that eternity can be understood in three ways: (1) time without end, (2) truths valid always and everywhere, and (3) atemporal existence." A one-to-one correspondence would match the following elements: the finite, time without end; the infinite, truths valid always and everywhere; and the suprainfinite, atemporal existence. Let E_1, E_2, and E_3 be the eternities for the three different time concepts. Time without end means time from infinite past to infinite future. E_1 would be a "bad eternity" because according to Tillich eternity is neither timelessness nor the endlessness of time.[15] Nietzsche and Marx are using this time concept for their philosophies. Any finite being would then, following Nietzsche, become subject to the doctrine of eternal reoccurrence, that is, of the unconditional and infinitely repeated circular course of all things. Endless time constitutes also the basis for Marx's dialectical materialism. Both philosophies are untenable because Augustine, and later Einstein, taught that time began when the universe came into being. "Everywhere" means in every place or part and belongs thus to the physical universe where Time 2 is reigning. There are several types of cosmological models which can be classified by their spacial and temporal infinities and by Einstein's cosmological constant. Four of them depict the past as finite. They fit the Big Bang theory which can be thought of as the act of a Creator. Their eternity, E_2, does not reach beyond $t<0$. There is, however, a time concept, which can be associated with E_3. This is Time 1, which

Drozdek holds to be a faint reflection of God as a temporal being but I think, according to the above, can be used as an analogy for the time in God's eternity and thus becomes part of God's essence.

It should be clear by now that I am not espousing a God who is detached from time—neither from Time 1, nor Time 2. My reference to Aquinas served as an illustration of the problem he and others before him had with timelessness. They thought of time in psychological terms, of what we have called Time 2, and were not aware of the dynamical laws of physics that find their natural expression in terms of Time 1. Truly, Aquinas says in his reply to Objection (Obj.) 4 in the second article of Question (Q.) 10 that "Words denoting different times are applied to God, because His eternity includes all times." But what are these times? Obj. 4 defines them: "... words denoting present, past, and future time ... (Time 2!)." These cause us according to Reply Obj. 1, second article of Q. 10. to "apprehend the flow of the now; the apprehension of eternity is caused in us by apprehending the now standing still." The "now standing still" and the inclusion of "all times" leads me to suggest that Aquinas formulations could imply the concept of Time 1.

How and why do I reconcile God's eternity with his personhood? I started with the historical problem that by assuming God's eternity to be timeless one encounters logical contradictions for the existence of a God, who is also personal. If one introduces two concepts of time: one which is tenseless and belongs to eternity and another one which embraces past, present, and future, the problem can be resolved by using the principle of complementarity. This allows us to refute logically the reasoned denial of an eternal *and* a personal God.

Drozdek's question whether "temporality" constitutes humanness of humans is relevant. There is certainly more to a person than just his or her time-dependent existence in the physical world. Drozdek notes that "although mental processes are temporal, their role is to bring us into the extemporal" and that "a person should be eternity oriented" according to the admonitions of Aquinas and the Apostle Paul. I concur wholeheartedly. I also endorse Drozdek's reference to Pascal's complaint about divertissement. Tillich says similarly: "We remember experiences that, at the time, were seemingly filled with an abundant content. Now we remember them, and their abundance has vanished, their ecstasy has gone, their fullness has turned into a void ... They did not contribute to the eternal."[16]

But to keep the paper to a reasonable length, I focused on those attributes which stem from a person's bondage to the physical world. Davies uses them for his denial of a personal God. To be fair—he considers problems "not only from the perspective of the divine but also from that of the human" as Drozdek did in his communication. I can highly recommend reading Davies' fascinating chapters on "Mind and soul" and "The self," where he looks at problems from a higher dimensional vantage point outside of space-time.

Toward the end Drozdek writes that without eternity the human personality withers and that human beings turn into just beings. "Eternity is, therefore, no foe to human personality. Is it to God's as Busen is afraid of?" I am somewhat surprised. Why should I be afraid that eternity could be a foe to God's personality? It is Davies to whom an eternity without time is a foe to God as a person. It is I who refute this claim. Even if arguments against God's personality appear weak from Drozdek's viewpoint, one still has to weigh the proliferation of Davies' book, which has been translated in many languages and has its impact on the world. It is also Pike who concludes, after a lengthy search, that a timeless being contradicts the time-dependent definitions for a person. Finally, there is Pannenberg's question: "Is there any positive relation conceivable of the concept of eternity to the spatiotemporal structure of the physical universe? ... It is unavoidable if the reality of God is to be related in a positive way to the mathematical structure of the spatiotemporal world of nature."[17] I am not sure to what extent I am answering this question to the reader's satisfaction, but I hope that my attempt to find a solution may contribute to the debate on the theological impact of the concept of time which appears now at many places in the literature.

So far I could not assess sufficiently Drozdek's arguments about the tripartite division on reality, based on Cantor's theory of transfinite numbers. He meanwhile kindly provided me with a reprint of his paper "Beyond Infinity: Augustine and Cantor" and "Descartes: Mathematics and Sacredness of Infinity." I will evaluate them for a possible addendum to my reply.

Notes

[1]Nelson Pike, *God and Timelessness* (New York: Schocken Books, 1970), chapters 5 and 7.
[2]Paul Davies, *God and the New Physics* (New York: Simon and Schuster, 1984).
[3]Ibid., 133.
[4]Ibid., 134.
[5]Karl M. Busen, "Eternity and the Personal God," *Perspectives on Science and Christian Faith* (March 1997): 40–9, call-out on p. 45.
[6]Ibid., 43.
[7]Carl Friedrich von Weizsäcker, *Aufbau der Physik* (München: Deutscher Taschenbuch Verlag, 1988), 47–52.
[8]David Park, *The Image of Eternity: Roots of Time in the Physical World* (Amherst: The University of Massachusetts Press, 1980), 103.
[9]Ibid., 18.
[10]Anthony Flew, *A Dictionary of Philosophy* (New York: St. Martin's Press, 1979, 1984), 273.
[11]Park, *The Image of Eternity*, 110.
[12]Busen, "Eternity and the Personal God," 45.
[13]Ibid., 45.
[14]F. Forrester Church, *The Essential Tillich* (New York: Collier Books, Macmillan Publishing Company), 127.
[15]Busen,"Eternity and the Personal God," 45.
[16]Church, *The Essential Tillich*, 126.
[17]Wolfhart Pannenberg, "Theological Questions to Scientists," *Zygon* 16 (1981): 60–77.

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Corrections On McGrath's "Soteriology: Adam and the Fall"

I write to correct three editorial misunderstandings of my article, "Soteriology: Adam and the Fall" in *PSCF* 49 (1997): 252–63. Firstly, it is editorially described as "Concordistic" (p. 211). I consider that a broad context requires creation ex nihilo "in the beginning" and a geocentric model is isolated in Gen. 1:1–3, that human beings were created after the other things because they are made to "have dominion" over them (Gen. 1:26–28), and that God rested at the end of the Creation Week (Gen. 2:1–3). But I do not think that the events between Gen. 1:3 and Gen. 1:26 are arranged sequentially in some "concordistic" way.

Secondly, at p. 257 after "I note that beads made from meteoric iron dating from c. 3500 B.C. or earlier have been found in Egypt," my sentence "and surface deposits of copper were used in sixth millennium B.C. Asia Minor" has been omitted. Thus the following sentence, "This shows what may have been the source for such metals" gives the erroneous impression that I think copper may have come from meteors, whereas I only think that iron may have derived from this source.

Thirdly, on my chart (p. 255) "Homo Erectus" was inadvertently changed to "Homo Erecutus"; and finally, the reference to James Orr at the end of endnote 16 (p. 262), *The Fundamentals* "Vols. 4 & 6" was changed to "Vols. 486."

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On McGrath's and Morton's Speculations: Cogent and Strained

Gavin Basil McGrath, "Soteriology: Adam and the Fall," and Glenn R. Morton, "The Mediterranean Flood," both in *PSCF* (December 1997), illustrate more desirable and less desirable approaches to speculating about biblical problems with chronological aspects. The former faces the problems raised by the recorded genealogies; carnivory and death before, after, and during the Edenic period; the origin of Adam, whether involving or excluding evolution; and the Flood. Whether agreeing or disagreeing with his synthesis, one must admit that he has faced up to the chronological considerations.

In contrast, the latter builds his case on some physical similarities between a desiccated Mediterranean Basin and aspects of the Flood while neglecting the chronological problem which negates the entire speculative structure. Since the Mediterranean was dry only until about 5.5 million years ago (Mya), he needs to show that *Homo sapiens*, not just a hominid (p. 245), was living at the time. But the oldest known members of the genus *Homo*, those known as *H. habilis*, *H. erectus*, and *H. ergaster*, only go back to about 2 Mya. They were preceded by a number of australopithecines: *Australopithecus robustus* and *A. boisei*, contemporary with the earliest *Homo* species, *A. africanus*, 3-2 Mya, *A. afarensis*, ~3.75 Mya, and *A. ramidus*, 4.4 Mya. There were no australopithecines before the early Pliocene epoch, ~5.3 Mya. (This information comes from *Encyclopaedia Britannica CD*, 1997 edition.) On Morton's approach, Noah had to be a very primitive australopithecine precursor, with a brain smaller and less specialized than a modern chimpanzee's.

A related consideration involves the tools necessary to construct the ark. While unretouched stone chips were apparently used 3 Mya, the Acheulean tool kit is half that age. Did Noah and his sons, then, shape the timbers and planks for the ark with their teeth? Could they have trekked north into Europe to secure beaver teeth for the task? The possibilities are, at best, dubious.

One must grant that God could have created Adam 6–5.5 Mya and arranged that no trace of his descendants or their artifacts would remain until about 100 thousand years ago (Kya), when the first anatomically modern *H. sapiens* appeared, or even 30 Kya, the probable date of the first fully modern human beings. Adam could even have been created before the anthropoid/hominid split. But is there anything truly persuasive in this scenario?

May I suggest that, if one is going to speculate about a limited Flood, an appropriate time be a primary consideration? For example, if the human race about 100±70 Kya (excluding all contemporary *H. erectus*, *H. antecessor*, *H. neanderthalensis*, etc.) were restricted to the African rift valleys or some other depressed area similarly rimmed by hills, it seems possible that water could flow in rapidly enough to catch the residents and yet not leave obvious enduring evidence. Is there a reasonable mechanism for this? A specific location identifiable by subtle indicators? Such a scenario seems also to fit the mitochondrial, Y-chromosome, and dispersion data currently available. But are there fatal objections? I don't know. However, I note another temporal restriction, the date of the earliest presence of human beings in Australia and the Americas, for they cannot antedate Adam if they are included in the redemption provided by the last Adam, unless we adopt an unorthodox soteriology. Though Fischer has done so in "In Search of the Biblical Adam," (*PSCF* 45 [1993]: 241–51; 46 [1994]: 47–57), this seems too high a price to pay. McGrath notes this (p. 257). See also Siemens, "Is Fischer's Search Misdirected?" (*PSCF* 46 [1994]: 69).

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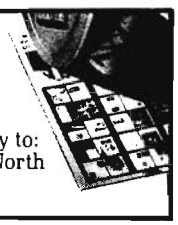

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