PERSPECTIVES on Science and Christian Faith

JOURNAL OF THE AMERICAN SCIENTIFIC AFFILIATION

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

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Perspectives on Science and Christian Faith

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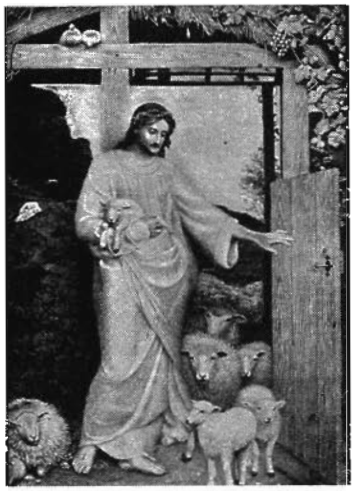
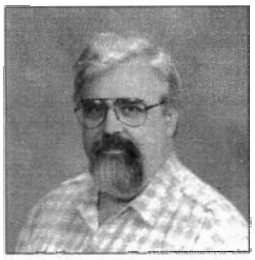


The View from Shepherd's Knoll ...



Lambing Ethics

As I write this editorial in April, it is lambing time on Shepherd's Knoll. Our small flock of ewes are birthing lambs – mostly twins, a few singles, and a few triplets. One ewe, Big Girl, birthed a set of quadruplets! Although one died at birth, Big Girl is raising the other three. Observing young lambs prancing around and playing "king of the mound" while their ewe mothers are contentedly grazing in a lush green pasture field is one of the joys of shepherding.

As a shepherd, I provide for my sheep. I get up at night to check on them when they are lambing. I trim their hooves and arrange for their yearly shearing. I vaccinate them against sheep maladies. I provide feed, hay or lush pasture in season, fresh water, mineral supplements, and shelter from the elements. My shepherding relationship reflects both my adherence to accepted practices of sheep management as well as my genuine compassion for the welfare of the sheep.

Scenes are not always so blissful. Eighty-nine, an elderly ewe, had trouble birthing. So, as a good shepherd, I aided her by repositioning her large lamb in utero and then pulling on the lamb's front feet as she pushed her offspring out through her cervix. Soon lamb was nursing ewe and all seemed well in the flock. A day or so later, while I was away on a business trip, my wife went out to feed the sheep. She found that this lamb had managed to get its head caught between two upright boards in a barn gate and had died from strangulation. Sorrow reigned on Shepherd's Knoll for several days as Eighty-nine continually called for her missing lamb while the shepherd grieved because he was not present to rescue the lamb from a poorly constructed gate which had become a death trap.

From a Christian perspective, I maintain that the example and teaching of Jesus Christ, the Good Shepherd, provides the foundational basis for an honorable ethical praxis. The prophet Isaiah foretells the ethical practice of Jesus by writing:

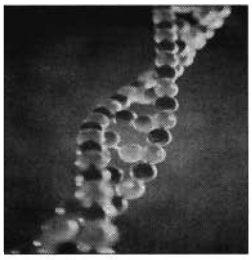
> *"He tends his flock like a shepherd: He gathers the lambs in his arms and carries them close to his heart; he gently leads those that have young"* (Isaiah 40:11, NIV).

The example of Jesus in the Gospels illustrates this shepherding heart of compassion that finds expression in demonstrative love even in difficult situations. The late bioethicist Paul Ramsey described "obedient love" or *agape* as a Christian approach to the ethical dilemmas of life. I see merit in that way of living, since it embraces both deontological as well as consequential ethics. Such an approach can provide guidance for our response to the tough ethical questions. How should we use the resources entrusted to us? Does it matter if soil is polluted or if some obscure species becomes extinct? Should we use in vitro fertilization to conceive a child? What should we think about cloning and stem cell research? Dare we permit passive euthanasia or should we be more aggressive in fending off the end of life?

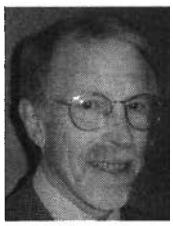
In this issue, several authors discuss ethical issues. Jack Swearengen and Edward Woodhouse caution against our overconsumption as affluent communities. Gareth Jones argues for a cautious biomedical manipulation. Steven Hall describes an ethical approach to sustainable agriculture. In News & Views, Joseph Carson urges our society to be more proactive in professional ethics. Why not write me a letter that reflects your response to the varied recommendations of these authors? ✻

Roman J. Miller, *Editor*

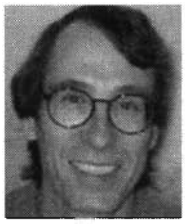
The late bioethicist Paul Ramsey described "obedient love" or agape as a Christian approach to the ethical dilemmas of life. I see merit in that way of living, since it embraces both deontological as well as consequential ethics.



Overconsumption: An Ethical Dilemma for Christian Engineers



Jack Swearengen



Edward Woodhouse

One of the most important and yet most difficult of the ethical challenges facing technological civilization is "excessive" consumption in the affluent nations. This includes dissipative use of raw materials and production of waste at rates higher than sources or sinks regenerate. Ethics-driven decisions about working on toxic products or in the defense industry are familiar to engineering students; but are engineers who design new products ethically compelled to resist "overconsumption"? Should engineering curricula be targeted toward avoiding overconsumption? Technical professionals may be uniquely positioned to work against some aspects of overconsumption, and it is worth inquiring into whether and how the topic might be incorporated into engineering education and practice. Christian engineers perhaps should be concerned especially if and when they determine that the products and processes they help develop and distribute will abet overconsumption. Arguing from this premise, we attempt to establish a theological foundation for Christian engineers and educators to guide their responses to the issue. The nascent field of Industrial Ecology provides a promising beginning.

We believe Industrial Ecology offers a good start at combining Christian caring, environmental stewardship, and ordinary prudence.

Do Christian engineers and others who develop and distribute new products have any special responsibilities to resist environmental degradation and other harms stemming from technological innovations? We begin to analyze this question by summarizing the case advanced by those who perceive excessive production, consumption, and waste in affluent societies. The ensuing section then considers two possible responses by Christians: an optimistic one, emphasizing human ingenuity as a boundless means of overcoming physical limits; and a pessimistic approach, perceiving the earth as irredeemable and expecting that the second coming of Christ will moot any necessity to deal with environmental and other earthly problems. Finding neither of these responses entirely reliable as a guide to prudent Christian coping with the effects of modern technologies, we then examine the promise of an emerging field known as Industrial Ecology. Although the approach has certain shortcomings, we believe it offers a good start at combining Christian caring, environmental stewardship, and ordinary prudence. Finally, we discuss some of the implications of our analysis for Christian engineers and for others interested in a spiritual approach to technological innovation and consumer society.

We are neither acscetics nor Luddites. Neither of us is willing to give up antibiotics, mosquito abatement, or the printing press. A significant portion of the research for this article was conducted on the Internet, and collaboration was carried out at opposite sides of the country, simultaneously employing word processing, e-mail, and speaker telephones. But we do believe that the Bible warns of a never-ending (until the kingdom) struggle for balance in our earthly lives.

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Edward Woodhouse *teaches science and technology policy in the Science and Technology Studies Department at Rensselaer Polytechnic Institute, Troy, NY.*

What is Overconsumption?

"Overconsumption" is an emotionally and politically charged term referring to types and quantities of goods and services that exceed some level perceived by the speaker as constituting "enough." The term sounds pejorative—and based on the context of usage, that often is exactly the intent of those who use it; indeed, the term hardly can be used in a meaningful way without taking a critical stance toward the activity being discussed. Overconsumption is a syndrome more than a particular act, but those who criticize the phenomenon seem to believe they know instances of it when they see it. This section describes elements of the syndrome, and briefly summarizes some of the consequences for the environment and society that appear to accompany high levels of production, distribution, use, and disposition of materials and energy.

Overconsumption sounds like a recent phenomenon, but it may actually have played a role in the sudden decline and disappearance of Sumer and other early civilizations via resource exhaustion or poisoning of the environment.[1] The term entered the English language in 1879 as part of an economic argument about the causes of recession.[2] Consumption was perceived to be a problem only if it exceeded production and thereby caused shortages of goods. For economic growth, according to Hooper's model, consumers must consume as much as industry can produce, which requires stimulation by advertising.[3] Thus by 1999, $215 billion per annum was spent in the US on advertising, and $450 billion on packaging—of which perhaps $200 billion was to make items look more appealing.[4] Estimating world expenditures at three times the US total, over $1.2 trillion is spent annually to stimulate consumption!

As the term now is used, overconsumption refers to a set of technological activities that have one or more major environmental effects. Thus, the following activities are examples of overconsumption.

- Natural resources such as fossil fuels are consumed at a rate greater than they can be replenished.[5]
- Environmental "sinks" or repositories (land, water, or atmosphere) are loaded with waste products (such as greenhouse gases) at a faster rate than they can regenerate.[6]
- Chlorinated compounds and other chemicals have toxic effects on living organisms.[7]
- Human habitation, roads, and other activities encroach on the habitats of many species, with one or more species extinguished daily.[8]

The leading consumers, North Americans, "each directly or indirectly use an average of 125 pounds of material every day, or about 23 tons per year ... For every hundred pounds of product we manufacture in the United States, we create at least 3200 pounds of waste."[9] Some of this is done directly by end users, including not only households but also businesses and governments, but much of it is enabled behind the scenes by engineers, who develop designs, select materials, choose manufacturing processes, and otherwise prepare goods and services. Often it is technically feasible to design less environmentally damaging ways of doing things, as when chemical engineers create alternative synthesis pathways that produce the same final products with less hazardous waste.[10]

However important the environmental aspects of consumption, the ethical issues raised by consumer society are broader than that. As shown in Figure 1, those concerned about consumption also need to be concerned about three other categories of risks: aesthetic, social, and spiritual. These may be less tangible than environmental problems, but are no less real. Physicians, psychologists, and public health officials provide statistics demonstrating widespread and prolonged stress, coupled with too little sleep for many American adults.[11] The symptoms appear to be caused partly by overwork, necessitated by credit card debt and patterns of spending intended to keep pace with the lifestyles of the upper-middle class depicted on television. Maintaining large homes, yards, and other material possessions also requires many hours of unpaid work. The disease Juliet Schor terms "Affluenza" appears to be spreading to other parts of the world.[12] Further exploration of the social and political impacts of overconsumption is available in several recent reports.[13]

Some of the social symptoms of consumer society also show up in very personal realms, including the spiritual (broadly construed). Though some Christians have sufficient trust in God's plan for their life that they interpret whatever happens in a positive way, others fall prey to insecurity and anxiety occasioned by lack of medical insurance, layoffs and underemployment, high levels of

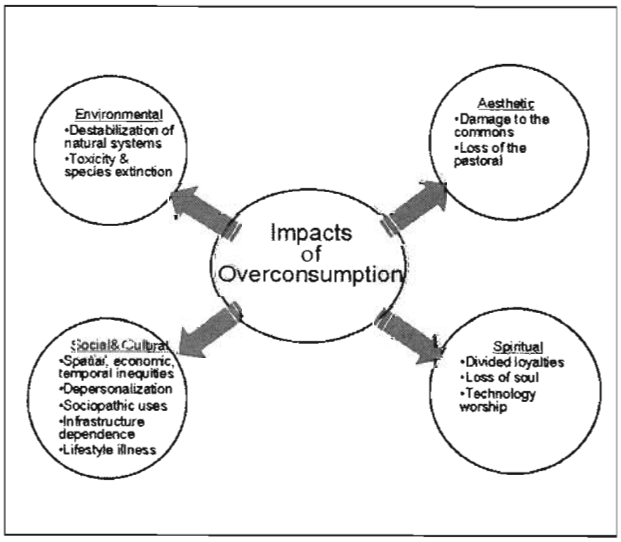
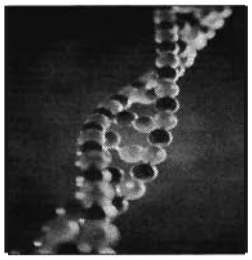


Figure 1. The impacts of overconsumption are more than environmental.



Article

Overconsumption: An Ethical Dilemma for Christian Engineers

debt (leading to more than a million bankruptcies per year), and other factors associated in complex ways with contemporary economic life. Rates of psychological depression are high, and studies in many different affluent nations indicate that happiness has not increased with a higher standard of living in the second half of the twentieth century. In fact, it appears that there has been a worldwide *decline* in happiness in recent decades.[14] Once people are above the poverty level, increased possessions do not contribute much additional life satisfaction; yet television and other cultural cues stimulate us to try to buy happiness and we end up disappointed. (Certain job roles can help to give a more satisfying life by enhancing self-esteem, personal development, and a sense that one is valued as a person.[15])

At the heart of the over-consumption syndrome, we believe, are speed, quantity, and proliferation of variety.

Materialism has been critiqued by numerous Christian writers.[16] Most develop their insights from biblical cautions regarding dividing loyalties between God and possessions. Some also appeal to biblical teachings about distributive justice.[17] Jesus repeatedly warned that material well-being has an *inexorable propensity* to distract believers from wholehearted pursuit of God. Our search of the literature of technology and society revealed only sparse analyses of the association of materialism with technology per se, and *no* analysis specifically focused on the contributory role that engineers play. Treatments of engineering ethics have not considered materialism an ethical concern for engineers to consider.[18] We believe that materialism does present an ethical dilemma for engineers because they have become "the enablers, the agents of change, and de facto social experimenters in industrial society."[19]

The Psalmist(s) wrote of wilderness as a place of inspiration, solitude, and refreshment (Pss. 23, 65, 68, 121) where "the trees will sing for joy" at Jesus' return (Pss. 95, 96). Jesus made retreats to places of solitude a regular practice (Mk. 6:46; Lk. 22:39). Though environmental legislation has resulted in cleaner air and groundwater in the US, population growth and the individual mobility cherished by Americans have covered vast areas of open country and seacoast with homes, highways, malls, and industrial parks. Many new homes are 3500-plus square foot "McMansions." Forests are clear-cut for lumber because economic incentives favor the practice, and increasing energy consumption gives rise to strip mines and power plants whose produce must be transported to distant urban areas. New roads are carved into remote areas to provide access to "wilderness" recreation, and commercial enterprises follow—ski resorts, golf courses, vacation homes and lodges, together with the essential supporting services and infrastructure. Airplanes over-fly the parks and wilderness, bringing sightseers or commercial travelers. Each increment in development brings loss of wetlands, wilderness, and scenic vistas. The Grand Canyon is frequently veiled in a blanket of haze, and Yosemite Valley smells of vehicle exhaust.

Gradual replacement of the pastoral and peaceful countryside with "development" is nearly impossible to stop because it embodies another example of "the tragedy of the commons."[20] Each incremental development brings immediate tangible rewards to the developers (the few) while the aesthetic losses are small in proportion to the whole and are borne by the general public. Inexorably, the very peace, beauty, and solitude that drew people in the first place is disappearing. Inspiration and solitude are much harder to find today than when the Psalmist wrote and Jesus sought solitude to pray.

Of course it would be plausible to discuss individually each of these and other environmental, social, aesthetic, and spiritual issues. But we find it more instructive to look at them as facets of consumer society, as elements of the way of life characterized by high levels of production/consumption/disposal. And we find it convenient to label the syndrome as "overconsumption." One great advantage of the integrated approach is that it allows us to see more holistically—to probe for common roots to the disparate problems and to look for responses that might deal with sizeable chunks of the syndrome rather than just with pieces of it.

At the heart of the overconsumption syndrome, we believe, are speed, quantity, and proliferation of variety. Thus, the average life of a product is about three years, with even some expensive items such as computers being useful for less than five years. So unless a company frequently upgrades and replaces its line of products, competitors will

move in and the company may go out of business.[21] Innovative features provide a market advantage, but only for a time, until competitors catch up. Thus there is pressure on design teams to bring products to market ever faster. Today's features quickly become standard, a new "quality" level is sought via further design innovation, and the cycle repeats. Equally important is the huge quantity of stuff that moves from computer-aided design (CAD) to computer-aided manufacturing (CAM), then into retail channels, households, and eventually landfills. Mass production depends on engineers and other product designers doing their jobs well—in particular, designing and producing for low cost, together with making consumer items appealing via design features, packaging, and advertising.

This proliferation of designs and products has at least six problematic effects.

1. To stock a wider variety of items, "big box" Wal-Marts and other retail outlets of comparable size emerge—with construction, maintenance, lighting, heating/cooling, land use, and other requirements growing accordingly.
2. Increasing variety leads to proliferation in the number of different types of stores, such as specialty stores for electronic games.
3. Proliferation and scale greatly increase management and data processing tasks. Point-of-sale scanning and printing, software for inventory control, and automatic teller machines help with certain tasks and simultaneously become part of the consumption machine.
4. Businesses have a hard time keeping spare parts on hand, making it difficult for consumers to find repair parts, decreasing the likelihood of repair and indirectly leading manufacturers to put even less emphasis on serviceability.
5. Diversity of products increases the information burden on consumers, consumer watchdogs, and government regulators.
6. For many product lines, increasing variety and quantity has correlated with reduced durability.[22]

Still, not everyone would agree that the tangible and intangible problems cohere into an overall problem that deserves to be labeled "overconsumption." The real problem, some say, is maldistribution—for just as many in the world have too little as have too much—a perspective we find partly persuasive. Others believe that appropriate technological and other changes can replace natural resources in short supply, cut down on pollution, and otherwise allow much higher levels of production and consumption than now are occurring.[23] In fact, the latter is the dominant view behind most discussions of sustainability by government officials and business executives, in which the emphasis is rarely on limiting consumption. Whereas some intellectuals and environmental advocates speak of sustainability as including a reduction in consumption per capita together with population stabilization, the focus is usually limited to greater resource efficiency and less pollution per unit of production.[24] During his final month in office, President Clinton expressed his endorsement of this boundless, technocratic approach to sustainability, stating: "People are not going to be willing to give up becoming wealthier—and they shouldn't."[25]

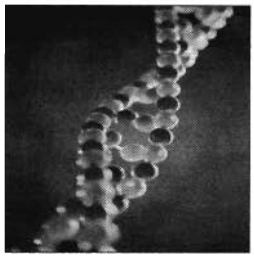
[Bishop John Taylor] went so far as to say that the "blind worship of growth" in western economies is symptomatic of "second degree materialism," by which he means that we are not just hooked on having, but on getting more [things].

A contrasting view, one worthy of consideration by Christians engaged in technology-based production and consumption, is that of Bishop John Taylor of Winchester. He went so far as to say that the "blind worship of growth" in western economies is symptomatic of "second degree materialism," by which he means that we are not just hooked on *having*, but on *getting more*—i.e., the acquisition of things.[26] Thus the stock market now responds not to earnings, or even earnings growth, but to the *rate* of earnings growth! Taylor understands the biblical model as an *equipoise society*—where economic equity is combined with balance between human and natural systems. Our analysis in subsequent sections follows Taylor more than Clinton.

We close this section on overconsumption with a methodological suggestion for readers. Even those who do not find the case against overconsumption compelling may acknowledge that contemporary consumer society may be risking a variety of tangible and intangible problems, some potentially quite severe. Just as nuclear power reactors merited precautionary design even though considered acceptably safe by a majority of relevant experts, might it be sensible to protect against the "maximum credible accident" from consumption?[27] Is it an engineer's professional responsibility to contribute to such protections—perhaps especially a Christian engineer's responsibility?

Searching for an Alternative

If one accepts the two-fold premise that overconsumption is a problem and that design engineers are *enablers* of the process, how might design practitioners be motivated to take a different approach? More specifically, how might Christian engineers and other Christians respond to the risks and actualities of overconsumption and attendant



social and spiritual ills? Ethics-driven decisions about working on toxic products or in the defense industry are familiar to engineering students.[28] We now argue that a new ethical dilemma for Christian engineers arises if and when they determine that the products and processes they help develop and distribute will abet overconsumption.

For the Christian, moral reasoning bereft of a transcendent basis quickly reduces to utilitarianism or personal preference.

In his classic *The Existential Pleasures of Engineering*, Samuel Florman proposes that "[e]ngineers derive pleasure from helping others, to the extent that the main existential pleasure of the engineer will always be to contribute to the well-being of his fellow man."[29] However, Florman also argues that "professionals have the task of meeting the expectations of their clients and employers. Professional restraints should be laws and governmental regulations rather than personal conscience."[30] Thus the concerned engineer—Christian or not—may face a dilemma because there are no laws or regulations regarding overconsumption.

Ethics, except revealed ethics

The ethics literature does not provide a sufficient motive to empower a Christian designer's decision to resist overconsumption. This is because secular ethicists (not surprisingly) discount religious bases for ethics and morality, though they acknowledge that religious convictions have strong motivational qualities. According to ethicists, one's ethics are determined by one's level of moral development. Kohlberg identified three such levels: *pre-conventional*, thinking that right conduct is whatever benefits self; *conventional*, adopting the norms of family, group, or society; and *post-conventional*, acting on principles that are not reducible to self-interest or social convention.[31] Gilligan adopted Kohlberg's definition for the pre-conventional level of development but substituted self-sacrifice for the benefit of others at the conventional level, and revised Kolberg's post-conventional ethics to require balancing one's own needs with the needs of others while maintaining caring relationships.[32] For these modifications, Gilligan has been credited with developing the "ethics of care" and thereby establishing a moral foundation for environmental care.[33]

Martin and Schinzinger identified seven possible ethical models for engineering practice, as follows: (1) *Virtue ethics*, having desirable character traits; (2) *Utilitarianism*, avoiding bad consequences; (3) *Duty ethics*, self respect and self care; (4) *Rights ethics*, liberty or welfare emphasis; (5) *Ethical egoism*, maximize personal good; (6) *Ethical relativism*, acting by law or custom; and (7) *Religious or divine command*.[34] They believe that divine command ethics "has things backwards" because moral reasons are not reducible to religious matters and a morally good deity would command on the basis of moral reasons.

Consistent with Martin and Schinzinger, Haws insists that "professional codes, like religious dogma, are effective primarily at the pre-conventional level of moral development ... and will restrict our students' ability to reason through their own values and select ethically appropriate courses of action."[35] To each of the foregoing authors—educators all—human moral reasoning is superior to revelation as a guide for engineering practice. But for the Christian, moral reasoning bereft of a transcendent basis quickly reduces to utilitarianism or personal preference.

Possibly cognizant of the need to establish a sufficient motivational basis for responsible design, Papanek[36] and Graedel[37] invoke a "spiritual" dimension ad hoc, carefully avoiding any recourse to transcendent values. Papanek states: "If beauty and high utility exist simultaneously and are furthermore clear expressions of the social intent of the designer, it is possible to speak of the spiritual in design."[38] For Christians this must be a point of departure because—in the absence of a God who can be known (revealed knowledge)—Papanek's concept of spiritual lacks foundation. However, his three "elements of the spiritual in design" should be acceptable to a biblical world view. They are:

1. The design releases transcendental feelings (hints of the sacred).
2. The designer intends a social good—namely, a service to our fellow humans and/or the planet.
3. The intended use of the product will nourish our soul and help it to grow. (Here Papanek introduces the term "soul" but in the absence of explanation we assume he intends for the term to be interchangable with "spirit.")

Thomas Graedel, a principal in the field of Industrial Ecology, invokes four "Grand Objectives" that he believes are required "for life on earth, its maintenance, and its enjoyment." They are:

The Ω_1 Objective: Maintaining the existence of the human species.

The Ω_2 Objective: Maintaining the capacity for sustainable development.

The Ω_3 Objective: Maintaining the diversity of living things.

The Ω_4 Objective: Maintaining the aesthetic richness of the planet.[39]

Graedel uses these Grand Objectives to derive guidelines for an environmentally conscious design. We will return to the topic of Industrial Ecology in a subsequent section. As we shall show, the Objectives can be derived from Scripture and do not need to be invoked ad hoc.

Technological optimism and the religion of technology

One way forward would be to assume that *all perennial human problems – whatever their manifestation – can be corrected with technical solutions, given enough time and resources.*[40] This is technological optimism. Technological optimists do not fret about the environmental, social, or spiritual effects of technology.[41] They remind us of Mr. Macawber, Dickens' character in *David Copperfield,* who – when the situation looked most grave – would proclaim that "something will surely turn up." Ardent technological optimists admit no limits on innovation, production of goods, or consumption of resources, and dismiss pessimists' warnings about the "Faustian bargain" of complex technologies.[42] Edward Teller, the developer of the H-bomb, wrote that "technology has opened the possibility of freedom for everyone."[43] Economist Julian Simon, a principal spokesperson for the optimistic economic view, argued that physical limits are illusory because human intellect provides an unlimited resource.[44]

In the optimism of the Enlightenment, technology assumed a high position in the secular realm, and subsequently has at times been so exalted as to become essentially a religion.[45] Certainly the Christian church has not hesitated to employ the latest technologies to help spread the message of the Gospel: airplanes, radio, computers, sound systems, movies, and television. Cautions from within the Christian church against uncritical application of technology are relatively sparse; Jacques Ellul and Donald MacKay are well-known exceptions.[46] Technology issues that have been addressed from within a biblical framework are by and large limited to environmental impact, genetic engineering, and artificial intelligence.[47] The evangelical community has been rather silent about technology, most likely as a consequence of the discontinuous eschatological view discussed below.

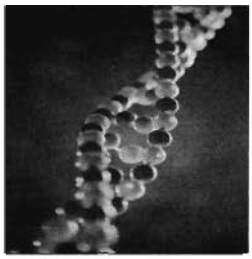
Technological pessimism

The optimist's hopes have some plausibility; but unfortunately, so do many pessimistic arguments. Technological pessimism is *the belief that technology is destroying human freedom, corrupting our social process, and degrading our natural environment.*[48] According to this view, in the process (of optimistically pursuing technology) "we have robbed ourselves of our freedom and authority by projecting our alleged autonomy onto our machines, methods, and systems. While wrestling nature for our freedom, we have subjugated ourselves to our *technique* (which is) the sum of technology and rational methodology."[49] Ellul has argued that technical means have become more important than the search for truth;[50] and technology has not spawned a heaven on earth, but a gulag.[51] The technological prison that surrounds and defines us, according to Ellul, is totalitarian, autonomous, demonic, and insidious in character.[52] Pessimists see technological progress leading us into a predicament like the one faced by the sorcerer's apprentice in Goethe's poem *"Der Zauberlehrling."*

Technological pessimism is typified by radical ecology groups such as Earth First or Earth Liberation Front. These groups advocate a less "developed" way of life, arguing that "[i]t is time to re-create vast areas of wilderness in all the planet's ecosystems: identify key areas, close roads, remove developments, and re-introduce extirpated wildlife."[53] From some radical ecologists' perspectives, humans either occupy no special status among the created order, or worse, are the source of earth's travails. In biblical terms, this could be interpreted to mean that the creation was pristine prior to the advent of humans and has been cursed by human activity.[54] As far as it goes, this idea is consistent with biblical exegesis; but it does not leave room for the special *imago Dei* status given to humans. And since the earth's 6.5 billion humans depend on technology for support, many could suffer or die if radical ecology were suddenly adopted, because of the reduced carrying capacity.

Technology and eschatology

A curious blend of the pessimistic and optimistic approaches is found among those emphasizing "end times" in their interpretation of biblical passages. According to the dispensationalist end-times model favored by many evangelicals, the earth's fate is complete destruction in the not-distant future. Since, in this view, destruction is God's plan and is inevitable, it is to be accepted and even anticipated; environmental, social, and spiritual consequences of technology are interpreted as precursors of the coming destruction. Truesdale refers to this model as "discontinuous eschatology."[55] One discontinuity arises when God destroys (or allows destruction of) the cosmos, then creates a new heaven and new earth. Rather than *re*-creation or *re*newal, this eschatological model has more in common with the original creation *ex nihilo.* Another discontinuity



Article

Overconsumption: An Ethical Dilemma for Christian Engineers

According to the dispensationalist end-times model favored by many evangelicals, the earth's fate is complete destruction in the not-distant future. Since, in this view, destruction is God's plan and is inevitable, it is to be accepted and even anticipated; environmental, social, and spiritual consequences of technology are interpreted as precursors of the coming destruction.

would occur if believers are removed from the earth during the tribulation, then returned to rule with Jesus during the millennium. The discontinuous eschatological model is usually combined with a utilitarian interpretation of Genesis 1 and 2; that is, intrinsic value of the creation is discounted relative to the value that nature can obtain through its productivity for the human race.

Because negative consequences of technology are interpreted as portents of God's plan for destruction, discontinuous eschatology provides no basis for critiquing misguided technological innovation. Discontinuous eschatology is paradoxical because while advocates expect a monotone descent into chaos and apocalypse (culminating in destruction), at the same time they maintain an eager and uncritical view of technology. Thus Christians who hold the discontinuous eschatological world view not only lack a basis for sustainable living, they are inclined lackadaisically to identify environmental degradation with the approach of the end times and, in extreme cases, actually embrace it as evidence of the trustworthiness of Scripture. Lynn White's oft-cited article castigating the Christian faith for insensitivity to environmental degradation was based primarily on evangelicals' (mis-) interpretation of the dominion mandate in Genesis 1 and 2.[56] Even though White did not address it directly, discontinuous eschatology seems especially vulnerable to his critique.

A More Satisfactory Model

None of the above approaches is absurd, given certain assumptions, but each embraces grave risks thoughtful people ought to be wary of assuming unnecessarily. What if Simon and other optimists are wrong, and crucial substitute energy sources and raw materials turn out to be grossly inadequate? For example, what if it proves impossible to grow enough biomaterial sustainably to simultaneously provide food, fuel, and feedstocks for the chemical industry as a replacement for fossil fuels? What if there is no feasible way to return to radically less technological ways of living without horrible suffering? We do not see how anyone embracing Christ's tenets could in good conscience urge consigning billions of persons—and other living creatures—to such fates.

What if discontinuous eschatology is an erroneous interpretation of end-times prophesies? An intriguing alternative to the dispensationalist model, not widely considered in the evangelical church, holds that instead of the creation's destruction and subsequent replacement by a pristine new heaven and new earth, corruption will be removed. More generally, the *whole creation* will be purified and the edenic state restored.[57] This purification eschatology is consistent with amillennialist concepts of the kingdom of God on earth; and it precludes an escape from human responsibility. Because human understanding became impaired by the fall from grace and because God has placed limits on human knowledge, is it not an act of hubris to claim that one has the definite key to interpretation of biblical prophesy? Since the time of Christ, the world has been subjected to many "concordist" identifications of current world events with particular end-times prophesies from Scripture, most of which proved false (yet the prophets were not stoned as required by Mosaic Law). To believe in one's interpretations of end-times Scriptures to the degree that one can turn his or her back on the known and certain environmental problems of today is incompatible with the teachings of Christ. This does not mean that there are no tradeoffs to be made (e.g., the primacy of evangelism over environmental activism), but to behave as if the Creator values only the human spirit among all that he created is simply unbiblical. Fortunately, a much less risky strategy appears to be available.

To overcome the difficulties with discontinuous eschatology, one might adopt a "theology of technology" that assumes technology can (and should) be employed to help relieve suffering caused by the fall from grace. Such a view apparently prevailed for the first millennium of the Christian church.[58] During the early years of the second Christian millennium, and adjunct to the millennialist movements that periodically surged through Europe, the idea gradually emerged that technology could be used to help recover the pristine conditions that Adam and Eve enjoyed in the garden.[59] Although the envisioned recovery that was to be facilitated by technology was primarily

physical, no distinct separation between physical and spiritual realms was made.

To a certain extent "environmental sustainability" is one manifestation of such a theology of technology. However, the term has been bandied about by so many people with such differing interpretations that it has almost lost its meaning. But the spirit of the term retains significance: Rearrange human consumption within sensible limits. A promising approach for doing this—and thus for addressing overconsumption as an ethical issue in engineering design—comes from the nascent field of industrial ecology (IE).[60] Advocates of IE see themselves engaged in "the engineering of sustainability," and we believe IE also can be practiced as an application of Christian engineering. It must be noted, however, that thus far IE has focused more on lessening the impacts of production and consumption than it has on reducing consumption per se.

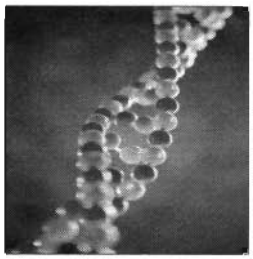
An intriguing alternative to the dispensationalist model, not widely considered in the evangelical church, holds that instead of the creation's destruction and subsequent replacement by a pristine new heaven and new earth, corruption will be removed.

The first goal of IE is minimizing anthropogenic perturbations to natural cycles, especially cycles of the key elements for biological life (carbon, nitrogen, phosphorous, and sulfur). A corollary goal is to avoid releasing new substances into the environment that are not found in nature and thus, because they are unfamiliar, are not readily assimilated or broken down by nature. Such new substances tend to be toxic.

A second goal of IE is to move from linear throughput of materials in the economic system to cyclic flows—thereby reducing the need for virgin materials and also reducing quantities of waste. Progress toward cyclization, therefore, can be measured by the rates of extraction of raw materials: in a fully sustainable economy, raw materials would be extracted only to replace material lost during extraction and production, as well as from oxidation, corrosion, friction, and wear during the use phase. Environmentally concerned designers can minimize unavoidable losses through judicious materials selection; dissipative uses of scarce elements are especially to be avoided. A related way of reducing raw material use is through "dematerialization," which means accomplishing design objectives with less material, replacing scarce materials with plentiful materials, and making products last longer. It also means designing so that at the end of their functional lives, products and components can readily be refurbished, because less energy is required than to produce wholly new products. Only when refurbishment is impossible should the product be de-manufactured for recovery of materials.[61]

To achieve these objectives, the entire life cycle of a product—and its materials—must be evaluated. For example, pollution prevention in the manufacture of automobiles is desirable but clearly does not begin to address the major environmental implications of that technology system, which occur in raw materials extraction, vehicle use, and eventual disposal. For either a proposed new product or a design improvement, environmental impacts must be forecast for the entire life cycle, beginning with raw materials extraction and proceeding through primary materials production, manufacture, packaging and transport, product use, and disposition. All significant material and energy flows are inventoried at every stage, then each impact is assessed. The assessment includes secondary materials such as by-products of extraction and refining, use of solvents and lubricants during manufacture and use, packaging materials and shipping, and dissipative losses during use or disposition. Only after these steps are complete can "greenness" be determined—even in a relative sense—in a way that permits design for environment (DFE) to be incorporated into engineering design practice. Thus the discipline of IE offers the designer a methodology for assessing overall impacts of the design alternatives under consideration.

How well does IE take care of the concerns that a Christian engineer ought to have? The impact assessment phase of the life cycle analysis actually seeks to include social and political concerns regarding the materials used, including regulatory and legislative status, impacts on labor and community, "social" impacts, and significant externalities.[62] These less tangible impacts are not yet nearly as well developed, however, as the direct and familiar environmental impacts. Even if one accepts Graedel's Grand Objectives for life on earth, considerable interpretation is required to derive specific design choices from them. Thus Ω_2 might be interpreted by a technological super-optimist not as calling for energy conservation but for intensive research and development (R&D) to create substitutes to replace resources that become scarce. Might Ω_3 require returning prairies to their natural state and preserving maximum genetic diversity, or is it sufficient to maintain mixed-use wilderness areas with some protection of endangered species, or should humanity rely on genetic engineering eventually to re-create species made extinct in the current relatively backward era? Does Ω_4 refer to nature primarily, or to the art, architecture, and other aesthetics created by humans? And whatever one's interpre-



tations, how do the objectives map onto a biblical stance?

It is not possible to begin with the four Grand Objectives and reason our way to a biblical world view; however, the reverse process may prove illuminating. First, even though Ω_1 is anthropocentric as written, and consistent with materialistic naturalism, it also is consistent with the biblical *imago Dei* (Gen. 1:26–27) and the command to be fruitful and multiply (Gen. 1:22, 24, 28). Because this command was given to all the creatures, Ω_1 and Ω_3 are each derivable from Scripture. However, a biblical derivation of Ω_1 would add that the purpose of the human species is more than propagation; it is to worship God and honor him (Ps. 8).

Scriptural foundations for Ω_2 include Ps. 104:27–30; Jer. 2:7; Ez. 34:17–18; Hos. 4:1–3; Rom. 8:22; Heb. 1:3; and Rev. 11:15. In Gen. 1:11–12, God assigned to the land the "duty" to produce vegetation. Today land, water, and atmosphere are under stress from human activity; and some of the stresses are global in extent and perhaps irrecoverable. The stresses on the land have damaged its productive capacity in some areas and destroyed it in others. Spaling and Wood, in deriving a biblical ethic for land use, conclude that "Stewardly care of farmland means that humans may enjoy the fruit of the land, but they may not diminish its fruitfulness."[63] This ethic should also include the seas.

The biblical concept of limits also supports Ω_2. Limits to human endeavor is a familiar theme in Scripture, beginning with the commandment about eating from the off-limits tree (Gen. 2:16–17) and proceeding to limits for technology (Gen. 11). There are many admonitions against focusing on acquisition in the forms of greed, covetousness, aggrandizement, unjust gain (Mk. 7:22; Jer. 22:13–17; Prov. 30:15–16; Hab. 2:9–11; Col. 3:5; Ex. 20:17) and materialism (Lk. 12:15; Matt. 6:24, 19:23–24; Mk. 10:21–22; Acts 2:45); conversely, voluntary self-restraint is emphasized (reinforced in the Old Testament by rules regarding tithing, gleaning, and the Sabbath). Jeremiah asks: "Does it make you a king to have more and more cedar?"—i.e. a bigger and fancier house (Jer. 22:15). In addition to Jesus' many warnings about material things, Paul equates greed with idolatry (Col. 3:5).

The Ω_3 Objective to maintain biodiversity upholds the biblical portrayal of God cherishing the diversity of his creation (Gen. 1:22, 6:19–20, 7:7–10; Job 12:10; Hos. 2:18). In Job 39–41, God takes delight from creatures that have no apparent usefulness—thereby discrediting a purely utilitarian world view. God's intent regarding biodiversity is codified in the Noahic covenant (Gen. 9:8–10, 12–13, 16–17). Human activity that results in extinction of species is not only a biological concern for the ecosystems that support human life, it is in opposition to God's intent. The Ω_3 Objective is sufficient for a biocentric ethic,[64] but a biblical basis elevates maintenance of biodiversity to obedience to God.

The Ω_4 Objective regarding aesthetic richness can be derived from the many passages about the beauty of the creation (Pss. 8, 19:1–6, 66:4, 96:11–12; Neh. 9:6; Job 37:14–24; Isa. 55:12; Rom. 1:20). Some of these passages describe a time when the earth will be restored: mountains and hills will sing, trees will clap hands, the earth will be glad, the seas will roar, and fields will be joyful in praise of the Creator. A contravariant set of passages can be found expressing God's anger toward and punishment of those who defile the land (e.g., Jer. 2:7; Rev. 11:18). Prophesies on restoration require recovery from past departures from sustainable development. Scriptures teach that *all creation* will be reconciled (2 Cor. 5:19; Eph. 1:10; Col. 1:15–20). When we understand that God called the creation "good," maintains ownership, and loves his *entire creation*, we derive additional motivation. (Evangelicals are sometimes startled to learn that the Greek word *cosmos* translated *world* in Jn. 3:16 refers to all of nature at least, and more likely to the entire universe.)

In sum, a biblical world view holds neither technology nor nature as sacred. Neither is to be worshiped; humans must learn to operate within revealed constraints. We must maintain a distinction between creation and Creator (Rom. 1). In addition, nature (natural resources) and technology are to be used for human benefit, but usage must be constrained. Achieving sustainability requires self-assessment, the outcomes of which then are used to guide the collective self-limitation that will permit civilization to operate within constraints set forth in Scripture.

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Application

A general biblical response to overconsumption

None of the individual Grand Objectives speaks directly of overconsumption. Taken collectively, however, they are clearly consistent with biblical mandates for creation care and an equipoise society. A biblical platform is not *essential* for their derivation, because biocentric or pantheistic world views also are able to support them. However, a biblical exegesis will produce *more than* Objectives Ω_1–Ω_4; some additional conditions emerge. First, humans are to live within their means. Moreover, we are to live within our means *after* tithing and setting aside resources to help those in need.[65] The Greek word *oikonomia* can be understood as stewardship—living within our means—which requires sustaining God's creation and therefore precludes overconsumption (1 Tim. 6:6; Lk. 12:15, 23–24). Bishop Taylor draws attention to the Hebrew word *betsa*—meaning overweening greed and the hubris that underlies it (Ex. 18:21; Job 27:14–18; Prov. 30:15–16; Isa. 56:10–11, 57:17; Jer. 22:13–17; Hab. 2:9–11) and the Greek *plexonia*—meaning having in excess and still wanting more (Mk. 7:21; Col. 3:5). This mandate leads to stewardship and precludes a purely utilitarian view of nature. Taylor's vision of an *equipoise society*—requiring both equity among people *and* equilibrium between humans and nature—seems to capture much of the biblical guidance. Referring to 2 Cor. 8:13–15, Taylor explains that "God's gifts, and man's happy dependence upon them, are the grounds of the 'theology of enough.'"[66]

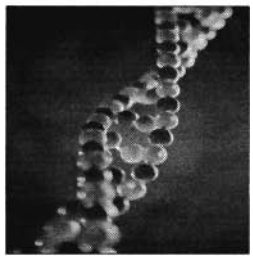
A Christian understanding of the meaning and place of technology in our lives would be neither pessimistic nor optimistic, but ... balanced between the two extremes.

God's directive on human endeavor recorded in Genesis 1 and 2 does not preclude technology as a legitimate response to the dominion mandate. The directive is supplemented, however, by certain constraints. Chief among these, according to Psalm 148, is that the purpose of development is the glory and service of the Lord.[67] Use of technology to relieve suffering and drudgery consequent to the fall from grace is consistent with this framework, as far as it goes. A Christian understanding of the meaning and place of technology in our lives would be neither pessimistic nor optimistic, but rather—as so often turns out to be the proper biblical exegesis—balanced between the two extremes. Using Wauzzinski's definitions, a Christian approach to technology must not be *pessimistic* because through the liberating, redemptive work of Jesus Christ we gain the ability to manage the creation responsibly rather than just for our personal benefit. We are (or more precisely, we can be) freed from the grip of *technique* just as we can be freed from enslavement to other sinister forces. Neither should the Christian approach be *optimistic*, because taken to an extreme, exaltation of technology as our *savior* becomes idolatry and enslavement to a master other than Jesus Christ.

Specifics for Christian engineers in the design profession

Most of our development here applies to all believers, but some guidance is particular to engineering design practice. When underpinned with the biblical basis for the Grand Objectives, Industrial Ecology (IE) moves from a purely utilitarian methodology (or *technique*) to becoming a moral foundation for responsible engineering design. The foundation should satisfy most environmental world views, but three probably are not satisfied: (1) technological optimism; (2) radical ecology; and (3) discontinuous eschatology. One might argue that IE is in fact an optimistic technique because it looks to science and engineering to provide the tools to achieve sustainability. However, its thesis is that the present path of technological civilization is not sustainable, and deliberate technical, social, and political action must be taken to preclude catastrophic decline in population and/or quality of life. This thesis separates IE advocates from the pure technological and economic optimists, who believe that market forces will induce solutions when they are needed. Radical ecologists agree that present civilization is not sustainable, but will reject the tenants of IE simply because IE accepts technological civilization as a given and discounts radical ecology as "attempts to return to anti-technology pastoralism."[68] Discontinuous eschatology is paradoxical: it is optimistic in the sense that technology is embraced, but pessimistic in that the global outcome is expected to be environmental catastrophe.

The biblical standard of *equipoise* that we have adopted from Bishop Taylor calls for equity plus balance, and the concept applies to technology as well as to economics. Unrestrained adoption of technology that damages nature and leads to social and physical decline is excessive, or imbalanced. We absolutely do not oppose technology per se. Rather we believe that the adoption of technology has progressed with inadequate assessment, and imbalance manifested in overconsumption is the result. The most common response of the Christian church to the issue of overconsumption consists of one of the following extremes: willing, usually unexamined, complicity with the process; or opting out, i.e. separating from mainstream culture into small faith communities that seek to adopt simple lifestyles. We understand the biblical mandate as a call for Christians to live within the culture without overconsuming and to work to redirect culture toward a



[Jesus] challenges [designers] to voluntarily assume risk of monetary or physical loss in the pursuit of ethical ends.

different destination. This alternative might involve the Christian engineer in three endeavors.

First, using the biblical perspective we have provided, assess the risks of technology at the individual and systems levels, and then take appropriate action. Effective actions might include efforts to influence public policy by means of letter writing, speaking, teaching, and working through professional societies.[69] One of us (JS) has used the Grand Objectives as an apologetic in a senior-level engineering elective class called "Industrial Ecology and Sustainable Manufacturing." The students frequently encounter issues facing contemporary Western culture—such as globalization, energy supply, green standards, environmental impact of consumer preferences, and reducing time to market. Because the topics are value-laden and controversial, they provide opportunities for discussing biblical perspectives, in class or after class. At the very least, the class provides numerous opportunities to initiate dialog on world views. Some of the segues from IE to biblical themes are summarized in Table I. The correspondence is not surprising because, as we showed in the preceding section, Graedel's Omega Objectives are derivable from Scripture.

Biblical Theme	Segues from IE
Voluntary self restraint • Tithing • Gleaning • Sabbath/Jubilee • Simplicity	Constraints on society • Living sustainably • Sustainable design • Environmental justice • Free trade vs. environmental protection
Dissipation • Wasted lives • Dominion mandate to bring order from chaos	Dissipative use • Irrecoverable loss • Nonrenewable resources
Living more simply • Equipoise society • The theology of enough	Dematerialization • Materials productivity • Per capita GDP vs. quality of life
Irreducible complexity • Intelligent design	Complex systems • Emergent properties
Theism • The purposeful hand of God in history	Guided evolution of complex systems • Toward sustainability

Table 1. Segues between biblical themes and industrial ecology principles

Second, the Christian design engineer might need to search for sustainable alternatives on his or her own time while working for his or her employer on the project that has emerged from the design definition process.[70] Such action would be consistent with a biblical conviction about overconsumption or its environmental impacts. In the long term, however, if the employer remains unresponsive, the designer may have to make a decision about remaining on the payroll. This is but one example of a larger set of choices that a Christian must make in order to work out a biblical relationship to creation.

Third, every Christian should be seeking to establish "prototype kingdom communities."[71] This does not mean separation from culture, but rather living as a sub-culture that displays redeemed three-fold relationships: humans with the Creator, humans with the creation, and humans with other humans.[72] We believe that an authentic prototype kingdom community would seek to practice sustainability. The lessons learned should be made available to the rest of society.

Jesus' teaching of "extra mile lifestyle" in the Sermon on the Mount and the Parable of the Good Samaritan asks even more of Christian designers. He challenges them to voluntarily assume risk of monetary or physical loss in the pursuit of ethical ends. At first this may sound a little like *Erin Brockovich* except for the sensationalism in the movie, and it could also include "whistle blowing" or even "tree sitting." However, those illustrations are negative in the sense that they have as their goal to stop something that is perceived to be damaging. In contrast, the application to design ethics is positive in that it seeks not opposition and blockage, but redirection.[73]

Whatever actions the Christian designer chooses, one option precluded by Scripture is passive compliance. One who "sees the sword coming and fails to warn the people" fails in his or her duty as a watchkeeper (Isa. 21:11; Jer. 16:1; Ez. 6:17–19, 33:2–10). Nor would it be adequate, in our opinion, for technical professionals merely to work quietly to increase the efficiency with which industry and its products operate. Instead, taking overconsumption seriously would

lead to more fundamental reconsideration of technical professionals' work—and all of our lifestyles.

Conclusions

We have identified eight conclusions. They are:

1. There undeniably is a risk that current and projected levels of consumption may be unsustainable, and that further increases in consumption may pull the world into a deeper environmental predicament.

2. Some aspects of consumption pose threats not just to environment but also to aspects of culture, psyche, and spiritual life.

3. Engineers and other technical persons abet the extension and spread of overconsumption.

4. Christians could avoid having to deal with the overconsumption problem if they could be confident that the second coming of Christ would moot environmental and other concomitants of consumption. But absolute certainty regarding biblical end-times prophesy is impossible to achieve, and therefore cannot be used by Christians to evade responsibility.

5. Christians likewise could avoid dealing with overconsumption if they could be confident that technological improvements would bail humanity out, and that the global ecosystem would prove forgiving (as by avoiding calamitous climate changes from greenhouse gases). However, there is considerable dispute about such matters among scientists and technologists who know the most, and the balance of informed opinion is more pessimistic than optimistic about the present trajectories. So while a Christian may hope for a never-ending string of technological solutions, it would be imprudent to bet on it—and certainly unbiblical to assign to technology the role of savior.

6. Christians have special responsibilities in how they live everyday life. Considering how central consumption behaviors are in everyday life, would it not be surprising if Christians had no spiritual responsibilities in regard to consumption?

7. If that is true of Christians who function as ordinary consumers, does it not make sense that it would apply with special force to Christian engineers and others who make some of the key R&D and production decisions in the civilization's overall approach to (over)consumption?

8. The emerging field of Industrial Ecology offers an approach to environmental sustainability that seems to us to deserve thoughtful consideration as one element of a perhaps much broader Christian practice of engineering.

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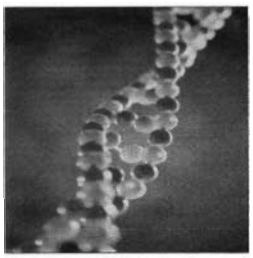

Biomedical Manipulation: Arguing the Case for a Cautiously Optimistic Stance

The world into which we have moved is dramatically different from all previous ones, since human beings can be controlled and manipulated biologically in ways once considered impossible. This raises bioethical, social, and theological issues of untold proportions, with numerous ramifications for the relationship between science and Christianity. The knife edge along which we walk can be illustrated by a variety of examples in biology and medicine, one of which is to determine what should or should not be done to human embryos. While the central direction theologically is provided by our understanding of God's image in humans, we have to work out how much control and manipulation this allows over our biological makeup. It also raises the query of what theological evidence exists to suggest that the structure and functioning of the human body reflect a divinely ordained pattern.

The merest glimpse into the rapidly changing world of modern biology and molecular medicine reveals a plethora of scientific and clinical possibilities. The excitement in scientific circles is palpable, as an increasing array of clinical conditions will apparently succumb to the inroads of genetic and molecular therapies. From this one might conclude that everyone would welcome these developments with unabated enthusiasm. Such, however, is far from the case. Many are deeply uneasy at the directions in which experimental science appears to be heading, and are pessimistic about what future genetic science may hold for the human race. For these, biomedical science has been too successful as it ploughs relentlessly on into an arena in which human well-being will be subject to ever-expanding control by an increasingly manipulatory form of science.

Fears of this ilk fuel much contemporary bioethical debate, and tend to dominate such debate in Christian circles, where it is not unknown for theologians and scientists to be pitted against one another. Stances on some bioethical issues have taken on the significance of dogma—certain approaches are applauded, others are condemned. This has made productive dialogue exceedingly difficult, and may be having consequences for Christian attitudes towards science.

Manipulation and control of cellular processes are the stuff of biological science, including events at the beginning of life and at the earliest stages of embryonic development. Should scientific curiosity be curbed in this realm but not in others? The objective in asking this question is not to suggest that anything that scientists want to do should be done, but to clarify what it is we are doing if we attempt to limit scientific investigation in these areas. In the Christian arena, is there theological justification for doing so?

Biomedical manipulation is no longer the realm of science fiction. We are the manipulators and the manipulated. For Christians, the tension inherent within this dichotomy is an exceedingly uneasy one. On the one hand, it points to technologies

Biomedical manipulation is no longer the realm of science fiction. We are the manipulators and the manipulated.

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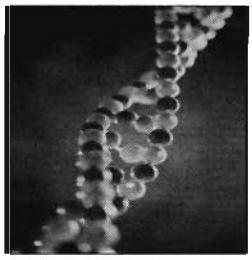

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that appear to be bestowing upon humans a burgeoning control over themselves and others, and yet, on the other hand, we get the profound feeling that this is threatening God's control. Should this creeping control by humans be stopped before they actively usurp realms which should rightly be left exclusively to God?

This is both a theological and ethical question, because it forces us to ask what should or should not be done from a Christian standpoint. It also touches on two prevailing themes—control and manipulation. What makes the task of assessing these themes so difficult is that both are the province of scientists, who wish to understand biological processes as a prelude to controlling them and then, if necessary, manipulating them. And yet, the control and manipulation of human beings (or human tissue) especially at the beginning and end of life, pose immense problems for Christians.

The view that human embryos are inviolable has profound repercussions for whether particular research procedures are or are not regarded as allowable.

A Manipulated Community

Problems arise because certain areas of scientific exploration are deemed to lie outside the legitimate bounds of human interference. At the beginning of human life, these problems focus on the human embryo, which is regarded as a person, bearing the image of God from conception onwards.[1] Consequently embryos are inviolable, and should never be knowingly destroyed.[2]

From this it follows that there is no place for research procedures on embryos not directed at benefitting the embryos in question.[3] Since no research at present can achieve this, human embryo research becomes off-limits to developmental biologists. This, in turn, has implications for the artificial reproductive technologies, since their original development and subsequent refinement depend upon ongoing embryonic research.[4] Stem cell technologies starting from embryonic cells are regarded as unacceptable because of the inevitable destruction of embryos. Also unacceptable is the stem cell research linked with somatic cell nuclear transfer (SCNT), since blastocysts (very early embryos) would be momentarily produced as part of the process. Other scientific procedures that also may be considered of dubious ethical status include human reproductive cloning, genetic manipulation, the production of transgenic animals (especially using human genes), germ cell gene therapy, and xenotransplantation (the transplantation of organs from one species to another). While the rationale in some of these cases extends beyond the embryo,[5] it is the embryo and early human development that emerge as central concerns.

The view that human embryos are inviolable has profound repercussions for whether particular research procedures are or are not regarded as allowable. Since this view is driven in large part by theological considerations, research on human embryos becomes antipathetic to Christian aspirations; it is something in which Christians should not indulge.[6] Hence, whatever scientific knowledge can be gleaned from such research is illicit knowledge and should not be obtained; neither should any of the clinical developments that may stem from it be utilized. At present, these include many of the artificial reproductive technologies, and in future they may well include many examples of genetic modification and an array of stem cell technologies.[7]

This is the knife edge along which science and Christianity are moving in the uneasy world of biomedical technology. The issues I have touched on are generally regarded as bioethical ones, and are usually approached from an ethical perspective. What I have done is turned the debate around, to ask how scientists (rather than consumers or societies) are to tackle these issues. From the perspective of a scientist interested in understanding cellular differentiation, striving to understand the control of very early developmental processes and cloning constitutes the driving force and the context for the work. This applies as much to scientists who are Christians as to any other scientists. While the material on which the research is to be conducted is to be obtained ethically, the avenues opened up by the research (such as clinical application and therapy) are of considerable importance. This does not mean that the two perspectives inevitably lead to different end-results, but that both have to be taken into account in decision-making.

It is here that Christians with a scientific training and perspective may come into conflict with their Christian peers; and conflict is probably greater today in the biomedical

realm than in any other. This is because the nature of the investigations appears to intrude into the inner recesses of the human "soul"—into what makes us the sort of people we are. What shines through is a fear at the possibilities opened up by human control, particularly where the object of that control is the human person.[8] Biomedical scientists are portrayed as power hungry and out-of-control, as they want to dismantle the last remaining bastion of human dignity. Surely, it is argued, there must be some inner sanctum of the human person that is forever beyond the reach of other human beings.

God's Image in Humans

One of the fundamental tenets of Christian theology is that humans are created in the image and likeness of God. It is this that is seen as distinguishing human beings from all other creatures and plants. There is something special about humans, and this is one way of expressing it. The concept of the image of God has been interpreted in a variety of ways historically. It can refer to the spirituality, rationality, and morality of human beings, to their dominion over creation, to their capacity to enter into relationship both with God and with other humans in human community, and to physical attributes such as their physical bodies and upright posture. It is these capacities taken together that in Christian thinking bestow upon humans their uniqueness.

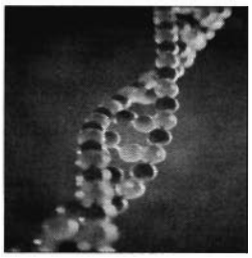
The phrase "image of God" occurs principally in the early chapters of Genesis (1:26, 27; 9:6), as well as in a small number of New Testament passages (1 Cor. 11:7; 2 Cor. 4:4; Col. 1:15). There is also reference to people being in the likeness of God (Jas. 3:9). Other New Testament passages refer to the transformation of Christians into the image of Christ (Rom. 8:29; 2 Cor. 3:18; Col. 3:10). The picture suggested by these phrases is of God as the original and human beings as copies of that original (at least in certain respects). God, in making us, gave us something of himself, imparting to us some of his own characteristics. In other words, human beings have many God-like attributes. We are persons; we make choices and act upon them; we have values and value systems; we are aware of ourselves and of others; and we are held responsible for our actions. In a nutshell, we have some of the personal features of a personal God.[9]

Implicit within these concepts is the moral agency of human beings. In the Genesis account of the creation of humankind, God treated Adam as someone capable of deciding issues morally and rationally (Gen. 2:16,17). There is no hint of God treating human beings in any other way, even when it would lead them into serious strife. The moral responsibility characteristic of humans is an echo of the moral responsibility of God, enshrining as it does the capacity to act wisely and lovingly. Human beings have been given a mandate to heal and restore God's creation.

Therefore, humans are to exercise responsible dominion over the world (Gen. 1:26–28; Ps. 8:6–8). They are to preserve and protect it by being stewards of the whole environment (Gen. 2:15), utilizing their capacities and abilities for the good of all—other creatures, the physical world, and the human community. Humans have been placed in control of everything else, and also over the weaker and dependent members of our own species. They have been given immense responsibility under God, including the onerous privilege of making decisions and choices affecting other human beings, other species, and the environment.[10] In this, we are driven to restore and improve the world, rather than accept it and its fallen state in some fatalistic manner. We are to understand, protect, care for, develop, nurture, and manage the earth for God and ourselves. Humans are to change their world for good, although we are all too conscious that self-centered changes can be detrimental and can work against the interests of others. Either way, there is no escape from both the privilege and responsibility of decision-making.

Human beings have many God-like attributes. We are persons; we make choices and act upon them; we have values and value systems; we are aware of ourselves and of others; and we are held responsible for our actions.

But is this not dangerous, since we live in a fallen world, where our actions and aspirations are so frequently marred by selfishness, foul motives, and rank incompetence? As we reflect on these dangers, we are reminded of two principles: (1) God is to be placed firmly at the center of human existence; and (2) God does not readily abrogate human freedom. When these are ignored in the technological realm, either we end up replacing God by technological achievement and human prowess, or we seek to limit human freedom by imposing arbitrary rules and regulations. While the driving forces in these instances are different, the end-result is remarkably similar: the loss of an elevated view of human dignity and of the freedom centered on a relationship to God. Consequently, implicit within all human achievements, including those in the technological realm, is a tension between expecting too much of them and attempting to limit them unduly. This is the choice between realizing their exciting possibilities and facing up to the necessity of imposing limitations upon them. Nevertheless, the transformation of which they are capable is always limited, and their possibilities are finite.



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Medicine traditionally has done its best to cope with [genetic] conditions, and the concern normally expressed has ... been ... whether it will enhance or diminish the human condition. This reflects a Christian emphasis upon caring for people and restoring them ... to wholeness and a state of well-being.

None of the above would be possible were it not for human creativity, mirroring as it does God's creativity. From this it has been argued that human creativity is designed to "preserve what God has given and to build on it through further creative ventures using the resources that God has provided."[11] It is in this sense that humans are sometimes referred to as being co-creators with God, although this designation may be hazardous since humans do not create *ex nihilo*. Nevertheless, there can be no doubt that humans are co-workers with God since human work is needed if God's full purposes in the universe are to be realized. In view of this, humans can be referred to as "pro-creators,"[12] not just in the reproductive sense, but across all aspects of our existence.

Another approach is to recognize that humans "are called to mitigate the Fall's effects and thus improve human and planetary life."[13] It is this creativity that is of such profound significance for every area of human life, from the arts to science and commerce, and yet its thrust is to break down old barriers, to explore unexplored territory, and to establish new frontiers for investigation and development.

Human Intervention and Human Responsibility

Ancient as these concepts are, they serve as a foundation for thinking about what may or may not be appropriate when human action is directed at modifying the bodies and brains of human beings. As artificial devices move from the external environment to the internal environment, from the world around us to the world within us, are we being forced to see ourselves differently? When the artificial takes precedence over the natural, is there a sense in which our likeness to God is diminished, and even God's role in bringing us into being is usurped?

As we look back throughout human history, we find that people have tinkered endlessly with nature. These intrusions into nature have taken many forms: building houses to protect people from the weather, draining swamps infested with malaria-bearing mosquitoes, undertaking surgery, and using antibiotics. Time and again, the Christian Church has backed these ventures with its investment in hospitals and clinics and its efforts to make communities self-sufficient with adequate clean water supplies. People are confronted by genetic combinations that lead to Huntington's disease, diabetes, and heart disease, but few would argue that these particular combinations reflect God's will, and should not be combated by the most effective means at one's disposal. Medicine traditionally has done its best to cope with these conditions, and the concern normally expressed has not been whether intrusion is justified, but whether it will enhance or diminish the human condition. This reflects a Christian emphasis upon caring for people and restoring them as far as possible to wholeness and a state of well-being.

Efforts such as these depend upon the creativity and compassion of fellow humans. In this way, human societies have been transformed. For example, the human life span has been extended, infant mortality rates have decreased dramatically, and the overall quality of people's lives and experiences have improved. The significance of this transformation becomes only too apparent when healthy communities in developed countries are compared to the misery and limited expectations of communities living at bare subsistence levels. Human interventions like these are illustrations of biomedical manipulation, although some may be relatively technologically unsophisticated. Their effects, however, are no less dramatic for that. What criteria do we have by which to judge their acceptability in Christian terms?

While accepting that there is no ideal in human efforts, the examples just quoted are all characterized by attempts to diminish suffering and remedy defects. They all have plausible therapeutic goals, which are Christian goals, as they seek to bring wholeness and purpose to real human beings contending with a broken, fragmented world. Goals such as these are not exclusively biological ones; sometimes the spiritual dimension is far more important. Nevertheless, the biological is generally not too far from the surface. What we should be aiming for is improvement of the human condition, as long as the bottom line is an

enhancement of people's capacities to relate better to God and to one another. There is no virtue in being complacent with the alterable, since this denotes sloth and an acceptance of mediocrity. On the other hand, we have to learn contentment with the unalterable, that which is currently beyond our ability to change for the better.[14] The balance between the two is a matter of judgment and discernment, depending in part on the current state of the relevant science.

The world in which we live is not an unchanging given; neither is it to be elevated to some untouchable status as if it were fixed and immutable. The context for determining what human stewardship of the created order amounts to is provided by our ever-changing environment and also by the constant changes affecting what we ourselves are. The crucial issue is to decide what sort of interference with nature will advance human welfare, while at the same time respecting the dimensions of what it means to be human.

We have every reason to be cautious over the directions of technology, but our caution has to be balanced against the immensely destructive forces of nature out of control. Christians would do well to examine the effects of both, and then direct their efforts at seeing that the good of the interference outweighs the evil of both interference gone wrong and of nature unrestrained.[15]

The ground covered so far has been relatively noncontentious, since if diseases can be overcome by public health measures or by applying antibiotics or by surgery, all we seem to be doing is making life better for people by allowing them to live more fulfilled lives. This is surely what medicine at its best is all about; it is straight-forward therapy. However, in practice, life is not usually this simple and agonizingly ambivalent decisions have to be made.[16] Not only this, what may seem straight-forward today was experimental and very unclear just a short time ago, besides which the borderline between treatment and enhancement may be a decidedly blurred one.

Control

Cloning, genetic manipulation (especially genetic targeting), and the whole of the human genome project (HGP), point toward an ever-increasing precision of control over what we are biologically as human beings. Numerous examples of precise control and of a new dimension to biotechnology and molecular medicine are available. They include the ability to: (1) pinpoint genes and what they do and how they go wrong, (2) reprogram a genome, (3) switch on genes that under normal circumstances would have been switched off during differentiation, and (4) utilize simple cells like fibroblasts as the source of cloned animals and a vast panoply of tissues and even organs. Should techniques like these eventuate, they will liberate biology in ways that once seemed unimaginable, having the potential to transform medical practice and human expectations.[17]

In turn, these techniques present immense challenges to theology, because it has to be determined where God's hand can be recognized. According to one scenario, God appears to be sovereign over only the uncertain and uncontrolled parts of human existence, because his presence and influence are recognized mainly (perhaps only) in the ill-defined and the mysterious. If one follows this line of reasoning, every biological advance becomes a threat to his sovereignty. Since cloning and genetic engineering offer the prospect of removing much randomness and uncertainty from the early stages of human existence, God's territory inevitably shrinks and a time may come when it becomes invisible (this parallels what has been referred to as the weightlessness of God—his unimportance[18]). As a result, do the controlled parts of human life become some sort of human domain over which God has neither interest nor concern, let alone control? In other words, does it make sense to speak about divine control over processes ostensibly under human control?

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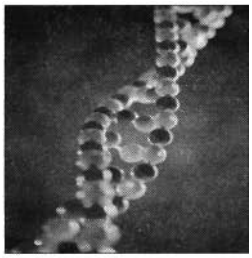
This dilemma can be illustrated by what some writers refer to as the genetic lottery and its importance for human dignity in the reproductive realm. The significance of the lottery element within human reproduction is that it imparts to the whole of sexual reproduction an unknown and uncontrolled aura, which some view as having Christian significance. For instance, in discussing human cloning, Meilaender contrasts the mystery of the genetic lottery with the predictability of cloning, which, according to him, would convert any resulting children into products of human will.[19] The latter leads to the "making" of children, as opposed to their "begetting," the essence of "making" being deliberation and mass production against "begetting" with its uncertainty and unpredictability (at least within limits). For many Christian writers, "begetting" is congenial to Christian thinking and practice whereas "making" is antipathetic to it.[20]

Biologically, the randomness of genetic inheritance is basic to sexual reproduction with the redistribution of



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Humans, as those who image God, are creative, rational beings, who long to go beyond that which they previously have achieved, especially when this involves overcoming that which is evil and destructive.... We are to seek to transform what needs to be transformed while gratefully accepting much else as given.

characteristics that goes to make-up the emerging individual. Consequently, any process having major repercussions for this redistribution would be foolhardy, since it would take us well beyond human abilities—now and perhaps at any time in the future. But does this also mean that the occasional deviation would be catastrophic? It appears not, since identical twins are deviations, and everyone lives remarkably easily with these deviations. Cloning on a vast scale probably would have detrimental consequences genetically, but if cloning were on a very limited scale this probably would not be the case.

Why should we look to mystery rather than understanding? When the genetic lottery goes seriously wrong, resulting in distressing diseases, we attempt to rectify what has gone wrong. Conventionally, this is done indirectly, by manipulating the results of the genetic errors using conventional medical approaches. But is there any difference *in principle* between this and directly influencing genetic combinations? Both are forms of control, although one form (the genetic) is far more efficient than the other (conventional medicine). Surely efficiency is not the issue theologically. If it is, what we are saying is that incomplete control is compatible with God's actions and purposes whereas complete control (if there is such a thing) is not. This is a god-of-the-gaps position, the gaps in this instance being provided by inefficiency.

Underlying all such niceties is a more fundamental query, and this is whether or not we are prepared to accept what the genetic lottery turns up. The history of medicine and medical intervention suggests that we are not prepared to do this. Diseases galore have been tackled, though many of them have genetic bases. Consequently, to accept whatever the genetic lottery doles out is genetic fatalism, and a rejection of the wholeness of human existence. To glory in such determinism is a strange irony for Christian thinkers.

One of societies' greatest problems is obsession with the normal, and this is something that could be accentuated by any of the current biomedical technologies. On the other hand, as far more becomes known about individual genes and their consequences, we may come to learn that there is no genetic or other ideal to be approximated. Genetically, we are all flawed in various ways, and the interaction between combinations of genes that seem to be beneficial and those that seem to be deleterious may be an intimate one. Even if there were a human ideal, it would be unattainable, since reproduction brings constant genetic variation. To look for a genetically perfect human ideal is not only to treat humans as unchanging, but to ignore our human creatureliness and the randomness of all new genetic combinations.

Outside the genetic realm, we can ask whether it is arrogant to work toward attaining a level of technology sufficient to overcome, let us say, extensive brain damage. Or is the longing to do this part of a legitimate desire to overcome the evil of accidents and illness, themselves part of the greater desire to subdue destructive forces within God's created world? Humans, as those who image God, are creative, rational beings, who long to go beyond that which they previously have achieved, especially when this involves overcoming that which is evil and destructive. Underlying much of modern medicine is an immense degree of human control, without which there would be no sophisticated medicine as we know it.[21] It is control that can be used to good effect; it is control that can go abysmally wrong. However, at no point does control like this shut God out of the picture for it is humans acting like him and utilizing their abilities to good effect. The givenness of the created order and our ability to transform it are both limited pointers to how we act in the biomedical arena. We are to seek to transform what needs to be transformed while gratefully accepting much else as given.

An important starting point is provided by the stance that God is sovereign over all. He is sovereign over the genetic realm, just as he is over human life, human community, and the ecosphere. Divine grace and creativity are evident in all these realms, and human creativity is to follow suit. If we can say that God works through creation and, therefore, through what we describe as the natural world, there is no reason to say that he does not also work through the basic processes described by biology and,

therefore, through genetic mechanisms. For theologian Cole-Turner, treating DNA as matter is not in itself sacrilegious, and hence is not beyond the legitimate reach of science.[22] Neither is there any reason in principle why God should not work through humans to achieve intentional genetic change, and therefore make use of appropriate genetic technologies.

If this is true, the next step is to affirm that genetic modification has the potential for extending the work of God, who routinely seeks genetic change as an integral part of his creative activity. One can go even further and state that now God has more ways at his disposal to bring about fulfillment and harmony. One example of this is through the medical and pharmaceutical advances that will undoubtedly flow from the HGP over coming years.

What is beginning to emerge is that the Christian's major task is not that of objecting to scientific developments, but of seeing them as one way in which God is demonstrating his grace through his creation.

The new factor of alarm for some Christian writers is the advent of the ability to modify human nature at the genetic and cellular levels. Some feel that this is an intrusion into a sacred mystery of genetic givenness, a givenness that should be received with gratitude and never manipulated.[23] Thus, they react negatively to cloning in its various forms, and even to some extent to the HGP. But is it any more sacrilegious to cut DNA than to cut living tissue as in conventional surgery? On what grounds does this become a sacred realm open only to God? Why should genes be any different from the proteins they produce, or the tissues and organs to which the proteins contribute? All are essential constituents of living organisms.[24]

This is not giving humans carte blanche to do anything in the genetic realm, since whatever is done there has to be consistent with the nature and purposes of God, who renews the whole creation in anticipation of a new creation. What is beginning to emerge is that the Christian's major task is not that of objecting to scientific developments, but of seeing them as one way in which God is demonstrating his grace through his creation. Daunting as this is, it brings together theological, scientific, and ethical considerations—a task that becomes feasible for those with an understanding of these three dimensions.

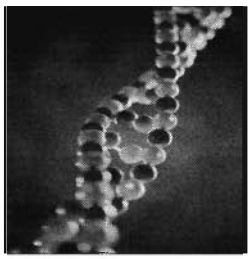
Although much thinking about control revolves around genetic control, people and their bodies do not exist in a social vacuum. Different as these factors are, both can have considerable repercussions for the wholeness of human existence. Compare the quality of life of the following: (1) those with potentially excellent health but living in a malnourished community where their efforts are devoted to mere survival; (2) those brought up in abusive homes and characterized by behavioral problems as adults; (3) those with cystic fibrosis or some other equally debilitating condition but brought up in loving and supportive homes and communities; (4) in the future, those brought into the world by cloning or following genetic modification of some description but raised in a loving environment where they are cherished for all they represent as individuals in their own right.

These illustrations point to different forms of control: social in (1) and (2), and biological in (3) and (4). The outcomes are not inevitable and depend as much upon social pressures as biological ones.[25] While no factors can be dismissed as unimportant, what shines through as of immense importance is the ability to be oneself and to relate productively to others within the human community. This is a crucial facet of being made in the image of God. While there may be biological limits to what should or should not be done to humans, these have to be viewed within the broader context provided by human relationships. The manner in which people are treated is crucial, since it epitomizes the thrust of any Christian perspective.

Christian directives are clear, whether the control is behavioral or biological in character. In both cases, the Christian way emphasizes the equality of all people no matter how diverse their abilities, the acceptance of the unlovely and unconventional, the looking after the interests and welfare of others, and humility on our part (Lk. 14:7–14; Rom. 12:3; Phil. 2:3–8). Our service to others in love is an outcome of God's self-giving love in Christ (Eph. 4:32), and underpins our aim to be agents of reconciliation. This is linked with the hope Christians have of a better world, and that God's kingdom will come (Matt. 6:9–13). As these elements guide our relationships, any potential for control over others will be directed toward their well-being and benefit. In this way, genetic control as much as behavioral control will resonate with new meaning.

Manipulation

Human control leads inevitably to discussion of manipulation: changing that which has gone wrong, attempting to rectify pathology, and redirecting processes. I have argued a case for this already, but now we need to go further and inquire whether it is possible to identify a boundary between being images of God and not being images of God. Such a boundary may correspond to some forms of radical genetic modification, multi-organ replacements, or the transplantation of brain cells from other species to



Article

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humans. Could manipulation of this order actually alter the moral status of those who have been manipulated? Instead of reflecting God will they reflect their human creators? Instead of being able to live as moral agents will they be the handmaidens of their manipulators? These are disturbing possibilities, and it is hardly surprising that they elicit strong repugnance in many people, including many Christians. The difficulty here is that we are moving in uncharted territory, and future scenarios of this ilk are always troubling.

If this freedom [to be human] remains and if individuals retain the capacity to be themselves and to express themselves, no matter how technologically manipulated they may be, they will continue to reflect the crucial relational features of a personal God.

First, let us ask whether the motives of the manipulators are significant? If these procedures are being carried out with the intention of benefitting the person being manipulated, if they have been subject to rigorous scientific assessment, and if fully informed consent has been provided for the procedure, there seems to be no good reason for objecting in principle. On the other hand, if none of these strictures holds, they are unacceptable scientifically, ethically, and theologically.

Second, would these modified individuals still be able to respond to their world, to other people and to God? Would they still be capable of understanding and of having meaningful relationships with others in the human community, of having values and hopes, of planning for the future, of demonstrating love and compassion, of making choices, of worshiping, and of enjoying pizzas? These capacities and many others like them make up the repertoire of human behavior, and point in some measure to what it means to be "in the image and likeness of God." Even now human beings vary enormously in their capacities and limitations, mostly due to natural variation, some to pathological conditions, and some to technological manipulation; but we do not doubt their humanness and their oneness with others in the human community.

Many individuals are currently manipulated in quite radical ways, although very few if any objections are raised to them. Artificial body parts are commonly used, especially joints and limbs; many operations involve removing some pathology and replacing it with an unphysiological way of functioning, such as by way of colostomies. However, if these improve the quality of life of the patients, there appear to be no ethical or theological objections to employing them. Nevertheless, the patients have been manipulated and from this point onwards will function unnaturally, something only made possible by considerable degrees of human control. Within a Christian perspective, the end-result is to be welcomed and God is to be thanked for working through what has been made possible by the God-like creativity and abilities of human beings.[26]

On the other hand, if individuals were to be modified to a degree that they could no longer function in genuinely human ways, their status would indeed have been imperilled. Any procedures or practices that take from individuals the capacity to make choices and act upon them, and that restrict their value systems or their awareness of themselves and others, seriously throw in doubt the essence of what it means to be human. This is because they impinge on the freedom to be human, something that is central to the capacity of humans to act as God's agents. Nevertheless, if this freedom remains and if individuals retain the capacity to be themselves and to express themselves, no matter how technologically manipulated they may be, they will continue to reflect the crucial relational features of a personal God.

Third, should we be concerned if an individual's abilities were capable of being enhanced, as opposed to rectified? Is the notion of enhancement antipathetic to Christian goals? In order to work through this question, let me take enhancement genetic engineering as an example. This would involve the insertion of a gene into an individual in an attempt to improve on a particular trait. In this instance, the genetic engineering would be employed, not in the treatment of a disease, but in an attempt to improve a perfectly healthy individual. This is similar to providing a growth hormone to normal individuals in order to improve their sporting prowess. Christian concerns emerge forcibly here, since any attempt to improve upon what is given may simply demonstrate rebellion against a bodily pattern ordained by God. In acting in this way, we may be setting ourselves up as creators of a new pattern rather than as stewards of God's creation. Alternatively, if

we are able to enhance human characteristics, perhaps we should do so as God's agents. The basic thought in this instance is that the present human form is not perfect, but is eminently capable of what could be viewed as God-ordained improvement.

Our responsibility is to ensure that any transformation is worthy of our status as beings in God's image, and will enhance the dignity of those involved.

Underlying these different perspectives is a fundamental query: What theological evidence do we have that the structure and functioning of the human body reflect a divinely determined pattern? In the New Testament, references to the human body fall into three major areas: (1) It is the temple of the Holy Spirit (1 Cor. 6:12–20); (2) It is used as a model of what the church is to be like (1 Cor. 12:12–31; Eph. 4:11–16); and (3) The body we now experience will ultimately be changed into a resurrection body (1 Cor. 15:35–57). From these references, we emerge with a number of principles:

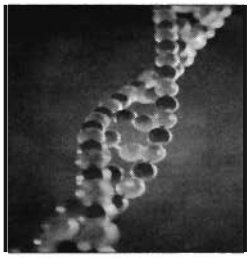
- The body (including the mind/brain) is an integral part of our lives as human beings, and hence is to be taken seriously in both spiritual and biological terms (Rom. 6:12–13; 12:1–2; 1 Cor. 6:20).
- Exercise and self-control of the body are essential for healthy living (1 Cor. 9:25–27).
- Misuse of the body has spiritual as well as biological consequences, whether this is brought about by sloth and indulgence or sexual impropriety (Rom. 1:24; 1 Cor. 6:13–18).
- There is a wholeness to the body, every part of which is essential for its optimal functioning (1 Cor. 12:12–31; Eph. 4:11–16).
- There is an intimate connection between what we are as people and the manner in which we utilize our bodies (Jas. 3:6–10).
- Since the body is central to what we are, it will be built upon in some way following death (1 Cor. 15:35–57; Phil. 3:20–4:1).

Clearly, the biblical writers did not have in mind ways in which one might be able to modify the human body, although they had a high view of its worth. Neither can one argue from these principles that there is a divinely determined pattern to the human body. On the other hand, there is no room for mistreatment of the body. While it is dangerous to argue categorically for any particular position, it is feasible to contend that whatever promotes human well-being and health (including spiritual well-being) is to be encouraged. In this sense, there is room for improvements to the human body, on condition that these promote the all-round wholeness and integrity of the individuals concerned. Our responsibility is to ensure that any transformation is worthy of our status as beings in God's image, and will enhance the dignity of those involved.

Let us imagine we could improve an individual in the sense that they will not suffer from heart disease in fifty years' time. When the genetic enhancement is carried out, the individual, albeit possibly an embryo, is healthy, and in the absence of the enhancement would continue to be healthy for many years. Is the avoidance of heart disease at the age of fifty years an improvement? The answer has to be "yes," since disease is being replaced by health. What grounds would there be for condemning such enhancement? Apart from the inevitable scientific uncertainties (and one has to admit it may turn out to be far easier speculating about this than actually carrying it out in a safe and relatively inexpensive manner), it is difficult to see why this form of enhancement would in any way challenge basic Christian aspirations. A person's life is being enhanced, so that they can live more fully than would otherwise prove possible.

But what if one could improve an individual's athletic performance by gene replacement? This is improvement in the sense that good exercise and coaching constitute enhancement. Ill-health does not come into this, but by the same token is there anything wrong with exercise and coaching? Not in principle, although there may be when the exercise and coaching become excessive. What emerges here is that the genetic approach may amount to little more than a highly efficient way of achieving what we do at present. Of course, the science itself may have numerous limitations and drawbacks, and it may prove far more cumbersome and problematic than intensive training, but the principle remains. This may be an unlikely illustration, and it may be wise not to take it too seriously, but as enhancement it is less troublesome than some might think.

What emerges is that even the issue of genetic enhancement is not as clear-cut as sometimes envisaged. Although there may be substantial reasons to be wary of it, it cannot be lightly dismissed. What are the reasons for attempting it? Do the anticipated changes amount to improvement in any meaningful sense, or are they ephemeral? Are they directed at benefitting the individual or at serving someone else's interests? What requires careful assessment are the motives and goals of those who advocate any form of enhancement, the societies in which this occurs, and whether the context is a God-centered one.



Article

Biomedical Manipulation: Arguing the Case for a Cautiously Optimistic Stance

The Christian–Science Interface

Biomedical manipulation raises many penetrating questions. These include the repercussions of scientific advances for our appreciation of human nature, the motives of scientists (including those who are Christians) for delving into highly sensitive areas, and the dynamics of the Christian-science interface. It also prompts us to look at the way in which God works in the world, the extent of legitimate human dominion, and the nature of human stewardship.

A stewardship ethic recognizes that technology is a gift to be used to benefit some, while not degrading or devaluing others.

My argument has been that we should not be afraid of the power of biomedical technologies. There is no inner sanctum of the human person that is to be protected at all costs from the inroads of technology. These forms of technology are expressions of human creativity, and when used to restore and improve the human condition, are to be welcomed. Nevertheless, their use is tainted, and their drawbacks are as palpable as their potential. A stewardship ethic recognizes that technology is a gift to be used to benefit some, while not degrading or devaluing others. Reichenbach and Anderson write:

> To recognize that someone is in need biologically and to develop ways to meet those needs is not to demean their personhood; it is to recognize that they are persons for whom God has given us stewardship responsibility ... We are to act on behalf of God, not out of human hubris.[27]

This approach enshrines a mix of openness to future possibilities (based squarely on a theological base) and an awareness of our responsibilities for the welfare of human beings. Such an approach should lead to extreme care and caution about where science might lead, to a skepticism stemming from the limitations and misuse of our abilities, but also to a restrained optimism about the prospects opened up by biomedical research. *

Notes

[1]T. Iglesias, "What Kind of Being Is the Human Embryo?" in N. M. de S. Cameron, ed., *Embryos and Ethics* (Edinburgh: Rutherford House Books, 1987), 70; and J. H. Channer, ed., *Abortion and the Sanctity of Human Life* (Exeter: Paternoster Press, 1985), 61.

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[3]D. G. Jones, *Manufacturing Humans* (Leicester: Inter-Varsity Press, 1987).

[4]Human Fertilisation and Embryology Authority, *Eighth Annual Report and Accounts* (London: HFEA, 1999).

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[7]The Center for Bioethics and Human Dignity, "Human Cloning: The Necessity of a Comprehensive Ban," July 2001, http://www.cbhd.org/cloning.

[8]L. Kass, *Towards a More Natural Science* (New York: The Free Press, 1985); and ——, "The Wisdom of Repugnance" in G. Pence, ed., *Flesh of my Flesh: The Ethics of Cloning Humans* (Maryland: Rowman and Littlefield, 1998), 13–37.

[9]Jones, *Manufacturing Humans*; and ——, *Valuing People* (Carlisle: Paternoster Press, 1999).

[10]Jones, *Manufacturing Humans*.

[11]W. Kirkland and A. Mackenzie, "Work and Worship in a Fallen World," in D. Mathieson, ed., *Faith at Work* (Auckland: Castle Publishing Ltd., 2001), 19–31.

[12]P. Stuart, "Thinking Biblically About Work" in Mathieson, ed., *Faith at Work*, 33–48.

[13]D. P. Gushee, "A Matter of Life and Death," *Christianity Today* 45 (2001): 34–40.

[14]D. M. MacKay, *Human Science and Human Dignity* (London: Hodder and Stoughton, 1979).

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[16]Ibid.

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[18]D. Wells, *God in the Wasteland: The Reality of Truth in a World of Fading Dreams* (Grand Rapids: Eerdmans, 1994), 200.

[19]G. Meilaender, "Begetting and Cloning" in G. Pence, eds., *Flesh of my Flesh: The Ethics of Cloning Humans* (Maryland: Rowman and Littlefield, 1998), 39–65.

[20]Ibid.; and D. G. Jones, "The Human Embryo: A Reassessment of Theological Approaches in the Light of Scientific Developments," *Stimulus* 8 (2000): 38–45.

[21]Jones, *Valuing People*.

[22]R. Cole-Turner, "At the Beginning," in R. Cole-Turner, ed., *Human Cloning: Religious Responses* (Louisville: Westminster John Knox Press, 1997).

[23]Kass, *Towards a More Natural Science*; and ——, "The Wisdom of Repugnance."

[24]R. Cole-Turner, *The New Genesis* (Louisville: Westminster John Knox Press, 1993).

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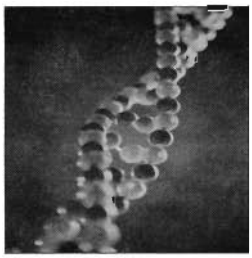

Toward a Theology of Sustainable Agriculture

Sustainable agriculture provides for present food and fiber needs, gives fair compensation to those entrusted with caring for the land, encourages healthy communities, and can continue far into the future. Few Christians have yet tackled this daunting field. The benefits to Christians and others may be great. Christians must recognize the biblical imperative of good stewardship of God's creation, and the special issues of agriculture, so common in biblical themes. Secular companies, governments, and other institutions can gain from the wisdom and values of the Scriptures, still highly esteemed by many, and tied closely to our collective roots.

In North America, discussion of sustainable agriculture per se has been ongoing since the 1980s, and sustainability issues have been significant since the dust storms of the 1930s. Modern agriculture is highly automated, fossil-fuel driven, and chemical intensive. Among challenges produced by these methods of agriculture are unsustainable erosion rates, groundwater pollution by pesticides and fertilizers, and increasing resistance of pest species to chemical methods of control. The use of fossil fuel has been shown to contribute to atmospheric carbon dioxide and to related changes in global and regional climate. Recent works have focused on what has become a recognized triad of concerns in sustainable agriculture: environment, economics, and community.[1] I would add to this triad some of my own perceptions, primarily from the view of an ecosystem modeler and engineer. I am very interested in *transitions* and how we manage transitions in dynamic natural and engineered ecosystems.[2]

We are in a period of rapid change both in our nation and in the world. We are experiencing high levels of affluence and long life in some places and population growth at explosive rates in other places. Consequently, the impact on the environment probably is greater than ever before. In the United States, mechanization of agriculture, recognized as one of the "greatest engineering achievements of the twentieth century" according to a recent National Academy of Engineering Survey, has contributed to a radical shift in demographics.[3] This has allowed our agricultural workforce to drop from about 70% of the population in 1900 to approximately 7% (involved in all aspects of food growth, processing, and distribution) in 2000. Only about 2% of our population remain "on the farm." This dramatic change in demographics has contributed to further social changes and challenges.[4]

It is in this context that the secular writers of North America have viewed sustainable agriculture in recent years. Thus, concerns have focused on the shrinking farm communities, loss of farmers, and conversion of farmland to either "development"—e.g., real estate, roads—or to forests.[5] Other problems that have become clearer and, in some cases, more focused have been environmental concerns.

Increased use of fossil fuels and rising energy costs along with acid rain and atmospheric carbon dioxide buildup have

I am very interested in transitions and how we manage transitions in dynamic natural and engineered ecosystems.

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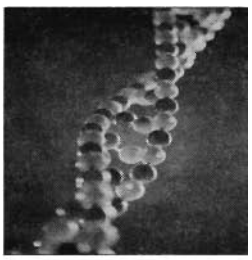
Steve originally presented part of this paper (01-07-0058) at the CEC roundtable, Timber Lee Conference Center, Wisconsin, October 20–22, 2000. *To contact Steve, email him at: shall@bae.lsu.edu*



caused people to question the intense mechanization of agriculture.[6] Immense animal holding facilities have increased the severity of waste management and runoff problems. In the dairy industry, for example, the number of cows on farms has increased from about twenty-five to around five hundred on average in the last few decades. Pig operations and poultry operations have also increased dramatically in size with concerns over ownership, waste management, odors, and animal welfare all appearing as major issues. Aquaculture—the raising of aquatic species such as fish, algae, reptiles, and crustaceans—has grown dramatically in recent years, partly in response to the need for less expensive protein sources. However, the ecological impacts of aquaculture have been increasingly questioned in recent years.[7]

We have achieved, in large part, the "dominion" that is spoken of in Genesis, but have failed in many ways to "keep" our land.

Many of these pressures have forced farmers to "get bigger or get out." Many farmers who are in business today have millions of dollars invested in land and equipment, and the average farm size in many states is well over one thousand acres. Economic pressures have grown along with community concerns and environmental issues. Hence, the triad of concerns is well documented in the secular arena.

Additionally, a vague sense of ethical or values issues has emerged. Some of these issues deal with our cultural values that are derived mostly from Judeo-Christian ideologies with a largely European influence. Animal rights, rights of laborers, environmental concerns, concepts of community and neighbor, and concerns over long-term land tenure have all been addressed to some extent in the sustainable agriculture literature.[8]

The Challenge of Ethics in a Postmodernist World

These issues, I believe, have been a challenge. They are issues that deal with basic values, and they are being discussed in a largely postmodernist context of which many authors are unaware. The interesting juxtaposition of a historical and somewhat active Judeo-Christian ethic with a postmodernist or "relativistic" ethic has led to some interesting discussions, but mostly to much confusion. Most North American churches and Christians, with some notable exceptions,[9] are largely unaware of the considerable controversy over environmental issues in general and sustainable agriculture in particular.

Starting from the secular sphere, I construct an argument from present definitions and future possibilities of sustainable agriculture. Then, using Scripture, I clarify these issues that are, at heart, heavily value-laden. Referencing Scripture in considering the future of food sources is quite relevant since the United States is a country highly influenced by Jewish and Christian ethics from its millions of practicing Christians and Jews. Judeo-Christian values based in Scripture have remained consistent despite changes in our society. These consistent and time-tested values, which many in North America and around the world still hold, can inform and improve the process of creating a more sustainable food system. I will discuss the following areas: environment, economics, community, system dynamics or transitions, and intergenerational equity.[10] Figure 1 shows a biblical vision of sustainability in agriculture. The triad of creation care, the great commands to love God and love your neighbor, and the themes of stewardship and provision derived from biblical principles roughly parallels the secular sustainable agriculture triad of environment, social, and economic concerns and adds the Christian themes of redemption and restoration as central to sustainability.

Being Good Stewards of the Environment

Maintaining the health and productivity of the environment is essential for many of our human needs, including air, water, and food produced from the land and sea. I maintain that we have achieved, in large part, the "dominion" that is spoken of in Genesis, but have failed in many ways to "keep" our land. Genesis 1 speaks of God's creation as "good" and of there being an order in which the plants are to be "food for the animals" and later food for humans. Psalm 19:1 reminds us that "the heavens declare the glory of God and the firmament showeth His handiwork."[11] The basic concepts of these Scriptures is that God's creation is "good," i.e., it has some inherent value, and that we are to view the creation in such a way that it

reminds us of God. We recognize that we live in a fallen world. We also recognize the concept of redemption that points to a great hope. This basic Christian concept will be discussed later.

A second theme in the environment area is humans as stewards. According to Scripture, God created humans to "serve and keep" the land (Gen. 2:15). Some authors have explored the stewardship concepts implied by these Hebrew words.[12] Exodus 23:11 and Leviticus 25:4 each speak of the land being allowed to rest and recover. Leviticus says that "during the seventh year the land shall have a Sabbath rest, a Sabbath to the Lord; you shall not sow your field nor prune your vineyard" (25:4). Land is viewed as valuable but we are to allow it recovery time, an ancient form of fallow. Leviticus 25:6-7 refers to a Sabbath "for ... cattle and ... animals," which seems to imply that some wild animals are expected on the farm. These animals are allowed rest and space in the farmscape. Precisely how much land or habitat is to be preserved for wild animals (and plants) is not clear, but this passage and others provide biblical support for caring for God's creation, wild and domesticated.

I suggest that allowing recovery time in agricultural systems is a wise concept.

As for the concept of Sabbath, Matthew, Mark, and Luke each record the story of Jesus picking grain and eating it on a Sabbath. His response to the Pharisees who questioned him about breaking the law was that "[t]he Son of Man is Lord of the Sabbath" (Luke 6:5). So we find that the Sabbath, while a basic biblical principle, is to be considered with regard to God. There may be cases where variations on the Sabbath theme are appropriate, but nevertheless, I suggest that allowing recovery time in agricultural systems is a wise concept.

We also see warnings of excess. Exodus 23:11 suggests that the harvesting should allow "the needy of your people to eat and the beast of the field to eat." Isaiah 5:8 warns: "Woe to those who add house to house and join field to field, until there is no more room, so that you have to live alone in the midst of the land!" What does this interesting statement mean? If there are many houses and fields, there will likely be many people. What does this prophet mean by "alone"? Perhaps we are being warned to be fruitful, but also to allow the rest of nature to be fruitful. Perhaps we are being warned that if we destroy the nature we depend upon, we will eventually die out ourselves. Can and should we not only preserve but restore God's good creation that he has entrusted to us? These prophetic warnings and questions lead to the next theme—economics.

Economics in Sustainable Agriculture and Scripture

Economic themes are common throughout the Old and New Testaments. Interestingly, if one tracks certain words, we see shifting perspectives on those ideas. Money is one of these concepts. In the Old Testament, we see money almost inevitably equated with the value it represents. Hence, it is seen as a good thing. David received a crown "and its weight was a talent of gold and in it was a precious stone." This is seen as a positive value. Money was used in the Old Testament to buy land (thus, land has value), goods, and even slaves (Ex. 12:44).

However, even in the Old Testament, we see warnings against the abuse of money. "If you lend money to My people, to the poor among you, you are not to act as a creditor to him; you shall not charge him interest" (Ex. 22:25). By Jesus' time, "He found in the temple those who were selling (goods) and the money changers seated at their tables." This abuse of money, people, and God's house enraged him and "he drove them all out of the temple" (John 2:14-15). Money still had value but it was being worshiped and used in ungodly ways. Acts 8:18-20 relates the story of Simon trying to "buy" the Holy Spirit and Peter responding, "May your silver perish with you because you thought you could obtain the gift of God with money!"

Later in the New Testament, money is seen in a very negative way. "The love of money is the root of all sorts of evil and some, by longing for it, have wandered away from the faith and pierced themselves with many griefs" (1 Tim 6:10). I suggest that economics is important in sustainable agriculture in the sense that the farmer needs to be paid for his work and must be paid enough to care for the land and the creatures over which he has dominion. However, the *love* of money, which seems to gain the upper hand at times—and, in fact, is the driving force for many of our large corporations—is to be resisted. When money is used to give or show value it can be a good thing. When it is worshiped or abused or used to coerce people into

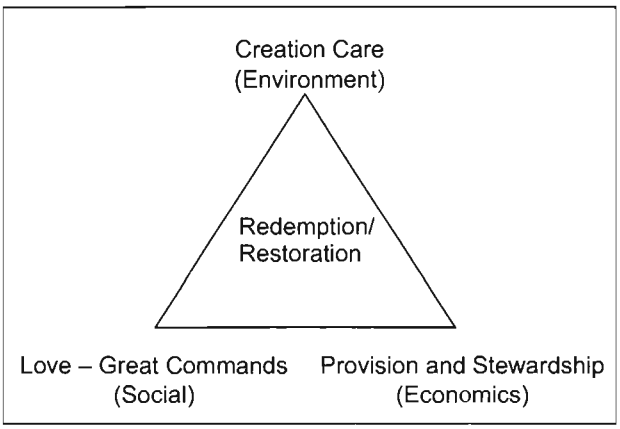
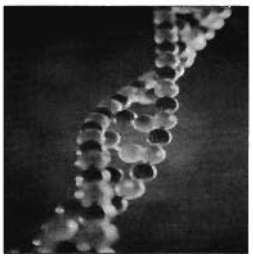


Figure 1. A Biblical View of Sustainability in Agriculture. The triad derived from biblical principles roughly parallels the secular sustainable agriculture triad of environment, social, and economic concerns (shown in parentheses), and adds the Christian themes of redemption and restoration as central to sustainability.



ungodly actions, it is dangerous. We must speak up and say so. Clearly, the Bible has much to add to this discussion. These are social values, which are also relevant in communities.

Agricultural Communities: Healthy and Godly

The Scriptures have much to say with regard to human relationships and community. The Ten Commandments and the two great commandments (to love God and to love our neighbor) speak directly to social and community concerns. The concepts of respecting and caring for one's neighbor are so basic that no society can survive long without them. Including these basics is essential in any community, but despite them, changes may occur, as they have in many parts of agricultural America. Dealing with these changes is essential, and we may glean some wisdom from the Bible.

We should make certain the poor are fed, be wise with our resources, and be godly in our actions. In addition, we are called to be merciful, and we are called to redemption and to new growth.

Managing Transitions

In Jeremiah's time, the removal of many of Judah's people to Babylon was a cause of suffering, but Jeremiah bought a field (Jer. 32). This purchase was a statement of faith; he believed God would redeem his people. God has indeed redeemed his people (John 3:16), and we now live by grace. Our communities will change. But by following God's commandments, we can have hope for the people and for the land as Jeremiah did. Much more could be said on social values in the Bible since that is a central biblical theme, but I will leave the discussion here and continue with other relevant topics.

I would like to suggest that we are not talking about mere survival here, but that we should also consider the concept of redemption and restoration. A sustainable agriculture will not only maintain present status, but will actively seek to restore those lands, waters, soils, ecosystems, people, and other creatures that have been harmed in the past. We look forward to a future in which agriculture will be an integrated, restorative, healthy, and flourishing enterprise for people and for God's creation.

Intergenerational Equity and Justice for the Poor

Intergenerational equity—leaving a good legacy for our children—is a theme of Scripture and of sustainability. The Bible speaks of intergenerational equity, of the consequences of our forbears. It is said that the "sins of the father will be visited unto the fourth generation" (Ex. 34:7), but the "good deeds unto the thousandth" (Deut. 7:9). This directs us with Nehemiah to acknowledge that "I and my fathers have sinned" (Neh. 1:6), to repent, and then by God's grace, to rebuild and to restore in order to provide for future generations. This is a strong theme in the Bible where the concept of "eternity" is common. I suggest that we consider the long-term implications of our actions and be accountable for them.

Justice and fairness to the poor (Isa. 60) are also essential. Justice is another theme in the Bible and one we need to consider in our actions. We should make certain the poor are fed, be wise with our resources, and be godly in our actions. In addition, we are called to be merciful, and we are called to redemption and to new growth. This is where I hope we are headed with our agriculture.

Redeeming and Restoring Creation and Agriculture

We are called to build healthy communities, not to love money, and to be good stewards of the land. We are to be fruitful and to allow fruitfulness of the land and other creatures. We are not to build "until we are alone in the land" (Isa. 5:8). I would add one more concept: redemption over time. We are redeemed, paid for by the sacrifice of God's Son, according to Scripture (John 3:16). We are to live that way—to forgive, to redeem, and to restore those people and things around us. I suggest that this is an essential part of our work. We are not merely to see ourselves as negative agents, consuming and polluting, but as redeemed agents (2 Cor. 5:18–19). We can be agents of positive change. We have been redeemed, and, submitting our collective sins to God, we can become agents of positive change in "regrowing His garden."

We can not only reduce erosion but also improve the soil, helping it to rebuild faster than it would otherwise. We already bring "streams to the desert" by irrigating. There are certainly arguments about how much of this to do, but there are so many places where we have collectively destroyed ecosystems that we have much work to do in rebuilding and regrowing. If our agriculture can be productive, in tune with the rest of creation, and friendly to the other creatures, this can be one way in which we can redeem our world.

Specific groups of people will have different roles. Farmers need to care for the land, and perhaps there is a necessary density of farmers on the land to assure its continued care. Society needs to make sure that the efforts of farmers are appreciated and that farmers and farm communities are cared for so that they, in turn, can effectively steward the land and resources for which they are responsible. Engineers need to consider agriculture less mechanistically and more biologically. Aquaculturists need to consider how their production impacts the water, native fish stocks, and other aspects of their environment.[13]

We need to be more nurturing and visionary. We need to consider not only efficiency and effectiveness, but also other humans, the environment, and our motives. Companies and governments, as well as individuals who grow, process, and eat food, need to put the love of money second and recognize the real value behind money. In all things, we need to consider healing and restoration (Rev. 22:1). Christians should envision the day when the "River of Life" and the "Tree of Life" provide food every month and the leaves are "for the healing of the nations" (Rev 22:2). Non-Christians can gain insights into cultural values deeply rooted in Judeo-Christian belief systems. These beliefs suggest that we start the healing process now, by God's grace, by making our entire food and fiber system not just more sustainable, but more just and merciful, while we become wise stewards of the resources God has provided. *

Notes

[1]Miguel A. Altieri, *Agroecology: The Science of Sustainable Agriculture* (Boulder, CO: Westview Press, 1994); R. H. Caffey, R. P. Romaire, and J. W. Avault, "The Sustainability of Crawfish Aquaculture," in *Proceedings of the International Association of Astacology*, 587–99; S. Gliessman, *Agroecology: Ecological Processes in Sustainable Agriculture* (Chelsea, MI: Sleeping Bear Press, 1998); John E. Ikerd, "Healing and Creativity: A Whole Vision for Rural America" (paper presented at the National Catholic Rural Life Conference, Des Moines, IA, Nov 5–6, 1999); and David Pimentel and Marcia Pimentel, "Population Growth, Environmental Resources and Global Food," *Journal of Sustainable Forestry* 9, no. 1 (1999): 35–44.

[2]Steven G. Hall, *Temperature Feedback and Control Via Aeration Rate Regulation in Biological Composting Systems* (Ph.D. diss., Cornell University, 1998).

[3]"Greatest Engineering Achievements of the Twentieth Century," National Academy of Engineering Survey (2000). Available from www.greatachievements.org/greatachievements.

[4]Wendell Berry, *What Are People For* (San Francisco: North Point Press, 1990); and Wes Jackson, Wendell Berry, and B. Colman, eds., *Meeting the Expectation of the Land* (Berkeley, CA: Northpoint Press, 1986).

[5]Ibid.

[6]Pimentel and Pimentel, "Population Growth, Environmental Resources and Global Food."

[7]Caffey, Romaire, and Avault, "The Sustainability of Crawfish Aquaculture"; Boyd and Tucker, "Sustainability of Channel Catfish Farming," *World Aquaculture* 26 (1995): 3, 45–53; Naylor, et al., "Effect of Aquaculture on World Fish Supplies," *Nature* 405 (29 June 2000): 1017–23; and Stickney, "Aquaculture on Trial," *World Aquaculture* 19 (1988): 3, 16.

[8]Altieri, *Agroecology: The Science of Sustainable Agriculture*; Caffey, Romaire, and Avault, "The Sustainability of Crawfish Aquaculture"; S. Gliessman, *Agroecology: Ecological Processes in Sustainable Agriculture*; Jackson, Berry, and Colman, eds., *Meeting the Expectation of the Land*; and Boyd and Tucker, "Sustainability of Channel Catfish Farming."

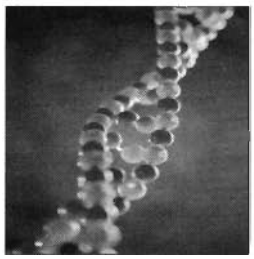
[9]Lionel Basney, *An Earth Careful Way of Life* (Downers Grove, IL: InterVarsity Press, 1994); and Wayne D. Roberts and P. E. Pretiz, eds., *Down to Earth Christianity: Creation Care in Ministry* (San Jose, Costa Rica: AERDO/ESA/EEN, Ediciones Sanabria, 2000).

[10]Altieri, *Agroecology: The Science of Sustainable Agriculture*; Caffey, Romaire, and Avault, "The Sustainability of Crawfish Aquaculture"; Gliessman, *Agroecology: Ecological Processes in Sustainable Agriculture*.

[11]Biblical references are from the Revised Standard Version of the Bible, ©National Council of Churches of Christ in America.

[12]Roberts and Pretiz, eds., *Down to Earth Christianity: Creation Care in Ministry*; and Calvin DeWitt, *Caring for Creation: Responsible Stewardship of God's Handiwork* (Grand Rapids, MI: Baker Books, 1998).

[13]Roberts and Pretiz, eds., *Down to Earth Christianity: Creation Care in Ministry*; and Jackson, Berry, and Colman, eds., *Meeting the Expectation of the Land*.



Humor, Spirituality, and Well-Being

The National Institute of Health has created a National Center for Complementary and Alternative Medicine (NCCAM) with five major sections for research, including a mind-body section. Mind-body research is included under the umbrella of psychoneuroimmunology (PNI). Significant progress is being made in mind-body research around the world with the field of psychoneuroimmunology expanding at a rapid rate. The areas of humor and spirituality, as each relates to well-being and quality of life, are the focal point of this paper.

"A merry heart doeth good, like a medicine."

"Every year, more and more studies demonstrate that your thoughts, moods, emotions, and belief system have a fundamental impact on some of the body's basic health and healing mechanisms."[1] The basis for this assumption is a growing body of scientific evidence that corroborates the health benefits of mind-body activities as diverse as laughter, prayer, meditation, play, imagery, biofeedback, hypnosis, acupuncture, massage, and spiritual quests. Complimentary and alternative medicine is being taken more seriously as patients and physicians alike are becoming more aware of the healing possibilities.

The National Institutes of Health (NIH) created a National Center for Complementary and Alternative Medicine (NCCAM) dedicated to exploring complementary and alternative medicine (CAM) healing practices in the context of rigorous science; training CAM researchers; and disseminating authoritative information. By taking CAM seriously, NIH is adding its support to research into the effectiveness of alternative healing methods. The major domains for NCCAM include the following:

- **Mind/body interventions:** meditation, biofeedback, distant or psychic healing, hypnosis, psychotherapy, prayer, art, music, humor, and dance.
- **Alternative medical systems, which may include traditional and ethnomedicine:** acupuncture, herbal medicine, ayurveda, homeopathy, natural products, Native American approaches, and Oriental medicine.
- **Manipulative and body-based methods:** acupressure, massage, chiropractic, reflexology, Rolfing, and therapeutic touch.
- **Biological-based therapies:** anti-oxidizing agents, chelation, cell treatments, and metabolic therapy.
- **Energy therapies:** electromagnetic fields, biofields, Qi gon, Reiki, and therapeutic touch.

Mind-body interventions fit well under the umbrella of psychoneuroimmunology (PNI). PNI is the study of the complex interrelationships between the immune system, the central nervous system, hormones, and one's psychological make-up. This growing field is concerned with the interactions between the brain and the immune system at the molecular, cellular, and organismic levels, and encompasses mind-body interactions in a variety of ways. In an interview with *Psychiatric Times*, Ronald Glaser, a noted authority in the field, defined PNI as follows:

> a field that studies the interactions between the central nervous system, the endocrine system and the immune system; the impact of behavior/stress

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on these interactions; and the implications for health of these interactions.[2]

Scholarly journals such as *Brain, Behavior, and Immunity; Neuroendocrinology Letter; New England Journal of Medicine;* and the *Journal of the American Medical Association* feature current articles related to PNI. The establishment of PNI research centers and the publication of scientific research, provides the foundation for this growing field.[3]

Two areas of research under the mind-body domain that are now receiving serious consideration by the scientific community are the areas of spirituality and humor. It has been suggested that spiritual seeking, spiritual-disciplines or spiritual endeavors contribute to good health. Research on prayer, meditation, and spiritual seeking and their relationships to healing is included under this heading.

Humor, with all its modalities, may augment healing, promote health and well-being, as well as help us deal with psychosocial pressures. Mirth, laughter, celebration, festivity, hilarity, and joking—in the proper context and setting—may be the catalyst for reducing the negative effects of living a stress-filled and stressful life.

Psychosocial Pressures

Research articles documenting the negative effects of stressful living on the human body and mind abound in the literature.[4] The variety and devastation of the negative effects of psychosocial pressures on the mind and body, from the pressure of taking medical exams[5] to the stress of being the sole caregiver for a spouse who is dying from Alzheimer's disease,[6] are substantive and convincing.

Stresses, both physical and emotional, help people stay active and alert and more prepared to face obstacles. Dehydroepiandrosterone (DHEA) and cortisol are some of the body's main hormones for coping with stress. The balance of these two hormones affects how people handle the overwhelming feeling that stress can bring. When the mind and body feel stress, cortisol is essential for maintaining energy levels during the stressful period. DHEA and cortisol work together to provide an optimal stress response. Elevation of the cortisol level is an indicator of a stress response, while a drop in the level of cortisol indicates a movement away from a stress response.

Research indicates that some diseases may be reflections of the psyche. It appears that bereavement causes a depression in lymphocyte count, that there is a depression in the quality of the immune system during marital disruption, and that there is a relationship among immunity, emotions, and stress.[7] Our minds and our bodies are designed to respond to negative or positive stress, and to perform the work of protection, escape, action, alertness, and healing. Although some people seem to thrive on deadlines and situations, long-term stressors or repeated peak stressors can weaken the immune system.[8]

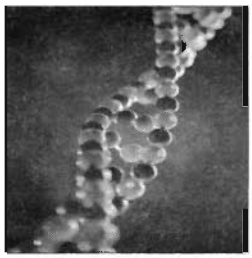
Since the negative effects of psychosocial pressures are well documented, the question becomes one of how our minds and bodies respond to positive experiences, or positive stress. Some of those experiences are associated with humor and spirituality. Healthy humor may move people in the direction of health or healing and away from the negative effects of pressures and stresses. Prayer, meditation, and spiritual seeking may contribute to improved health and well-being.[9]

Healthy Humor

For many years, we have heard that humor and laughter are good for us and that humor promotes healing. Norman Cousin's writings promoted the idea that humor had a positive influence on the return to wellness.[10] Within a few years of his publications, the idea that laughter increases a sense of well-being by causing the body to produce internal opioids, particularly enkephalins and endorphins, came into vogue. These internal chemicals were said to increase a sense of well-being and make a person feel good, contributing to positive human experiences such as sneezing, having a sexual orgasm, listening to great music, and getting a "runner's high."

Much of the material quoted by those who promoted humor, laughter, and mirth as a healing balm was speculative and anecdotal. Solid scientific research on the benefits of incorporating humor into a regimen for healing, or even to promote well being, was in short supply. All that is changing. Studies presented in 1989 by Berk and Tan, showed an attenuation and down-regulation of multiple parameters relating to the adrenal corticomedullary activity in relation to mirthful events.[11] These authors in association with others laid the foundation for our understanding of stress hormone changes, the alteration of immune system components, and the modulation of natural killer cells during mirthful laughter and a recovery phase.[12]

In the same laboratory, it was shown that serum cortisol levels decrease during the laughter phase of the study and remain depressed during the recovery phase. Plasma immunoglobulins IgM, IgG, and IgA all increase in response to mirthful laughter. The elevation of immunoglobulins indicates the strengthening of the immune system in general. Additional positive findings include the rise in the percentage of natural killer cell activity and an increase in the body's level of T-cells in response to mirthful laughter. The increase in these cellular immune components indicates that the immune system is strengthened. In addition, the group's work indicates that laughter increases the production of enkephalins and beta-endorphins.[13]



Article

Humor, Spirituality, and Well-Being

Humor work, – i.e., the use of healthy humor to promote wellness, healing, and recovery – is complex in nature and individual in application.

A recent pilot project, studying cardiovascular responses to laughter, found that laughter caused significant increases in stroke volume and cardiac output as well as significant decreases in arteriovenous oxygen difference. Peripheral vascular resistance decreased as well and immediately following laughter there was a significant decrease in oxygen consumption.[14] Laughter may help fight allergens. Even though the exact mechanism is not known, the induction of laughter may play some role in alleviating allergic diseases.[15] This careful study looked at the effect of humor on allergen-induced wheal reactions and documented the decrease in the diameter of wheals following laughter.

A sense of humor is tied to psychological health. The development and administration of the Multidimensional Sense of Humor Scale (MSHS) provides one instrument for measuring a sense of humor. The MSHS has four subscales that distinguish among humor production (overt use of humor in social situations), coping humor (trying to see the funny side of things), humor appreciation (liking humor), and humor attitude (approving of humor). Administration of this instrument in a variety of settings indicates that a sense of humor relates positively to a number of factors associated with psychological health, such as optimism and self-esteem, and reacts negatively to factors associated with signs of psychological distress, such as depression.[16] Other studies concur that humor and laughter have positive psychological and physiological outcomes. It is suggested that laughter has a role in improving mood, enhancing creativity, and helping to reduce pain.[17]

The importance of the use of humor in the doctor-patient relationship is becoming more apparent. Winder documents how humor plays a positive role in enhancing the doctor-patient relationship.[18] In his article "Humor in Medicine," he provides a guide to help physicians use their own sense of humor to enrich patient care. Showalter and Skobel discuss the universal and often healing effectiveness of humor in hospice care. Their article describes the use of humor as a therapeutic mechanism for coping and surviving loss.[19]

Some research is suggesting that there may be a predisposition toward shyness or extroversion tendencies. Some children may have a genetic predisposition to looking at life through optimistic lenses while other children are predisposed to look at life negatively. It is not clear whether these traits can be overcome, reversed, or otherwise altered. Jerome Kagan of Harvard University points out that just because a person may be predisposed to a particular trait, does not mean that he or she must act upon that predisposition. It is still an adult choice.[20]

Since humor is beneficial to us, how do go about doing "humor work"? Humor work, – i.e., the use of healthy humor to promote wellness, healing, and recovery – is complex in nature and individual in application. In order to do humor work, we must each consider our own background, our understanding of humor, and our sense of humor.

Each individual, I believe, comes from a unique childhood background in terms of his or her permission to participate in humor events. If, for example, a child is reared in an atmosphere of devastation; mental, physical or sexual abuse; cruelty; mean-spiritedness; pessimism; drug abuse; or other combinations of negative parenting, it is likely that this child will not have an appreciation for healthy humor or a positive view of lighthearted living. Humor will be foreign to his or her experience. This youngster did not have a happy childhood and therefore may not appreciate humor in its various modalities, even when he or she reaches adulthood. On the other hand, a happy, well-adjusted home where humor and laughter are abundant gives children permission to participate in humor events. A child from such a home will be familiar with harmless practical jokes, laughter, joke-telling, story-telling, and mirth. A child raised in this environment is likely to take himself or herself less seriously. This child is more likely to have a good sense of humor, to participate readily in laughter, and to understand humor. Humor, laughter, and playfulness, however, may also be used as an avoidance mechanism. Families may also use humor to avoid dialogue on serious matters, to avoid confrontation, or to hide pain.

These two extremes of upbringing provide the opposite ends of a continuum, from very little permission to be mirthful to the overuse of mirth as an avoidance mechanism. The "Humor Index" is being developed to

assess one's background and upbringing in terms of permission to be lighthearted.[21]

The first twelve questions of the instrument are as follows:

During my childhood and adolescent years:

1. _____ *I had permission to laugh out loud.*
2. _____ *I can remember specific incidences when I laughed out loud.*
3. _____ *My mother or adult female caretaker laughed out loud.*
4. _____ *My father or adult male caretaker laughed out loud.*
5. _____ *Our family had a sense of humor, either noisy or quiet.*
6. _____ *There was a sense of optimism in our family.*
7. _____ *We celebrated birthdays, anniversaries, or other significant milestones.*
8. _____ *We had a pet in our home.*
9. _____ *I enjoyed harmless practical jokes.*
10. ____ *We sang, danced or played together, either as a partial or whole family.*
11. ____ *Mealtime was a fun time at our house.*
12. ____ *We ate ice cream or other comfort foods.*

Total this section (1–12) _____

Participants mark the instrument as follows:
1 for NEVER or RARELY, **2** for OCCASIONALLY, **3** for SOMETIMES, **4** for QUITE OFTEN, **5** for VERY FREQUENTLY or ALMOST ALWAYS.

Scores will range from 12 to 60 as a total for this section. The instrument has been administered to a number of workshop participants throughout the United States. Since the index is in its preliminary testing stages, it is premature to present statistics. However, the informal results of this index suggest that in a given population, people are scattered along the continuum, from "little appreciation and incorporation of humor" to "a great deal of appreciation and incorporation of humor" in their childhood years.

A caregiver wishing to use humor as part of his or her recommendations for healing, should not only recognize his or her own understanding of and background in humor, but also the client's humor quotient or specific style of humor. It is important to know that a rubber nose and a funny video may not be the best prescription for a particular patient at a particular time. It is also important to understand that laughter is just one of the many kinds of humor work that can be utilized in promoting health. Celebration, festivity, mirth, playfulness, hope-building, story-telling, and hilarity can each be selected at appropriate times to facilitate healing through humor.

Spirituality

At a recent conference on "Spirituality and Healing in Medicine," seven hundred professional health-care caregivers, were alerted to three recently published findings:

1. Open-heart surgery patients are twelve times more likely to survive if they depend on their social support and religious faith.[22]
2. The mortality rate for people who are frequent attendees of religious services is almost twenty-five percent lower than for people who attend on a less regular basis. Surprisingly, for women the figure is nearly thirty-five percent.[23]
3. People who attend religious services at least once a week have stronger immune systems.[24]

Harold G. Koenig of Duke University's Center for the Study of Religion/Spirituality and Health, at Duke University Medical Center, provides a comprehensive overview of the current literature as well his own research.[25] Koenig's own search for the meaning of religion in medicine led him on an extensive research path. At a recent conference of the Mennonite Health Assembly during which Koenig presented some of his findings, he related his own journey and his understanding of how his patients coped with very difficult circumstances. His comments in *The Mennonite Health Journal* indicate that his journey has taken him from being marginalized for his ideas and convictions to gaining a fair amount of acceptance. "Now it is fun to watch colleagues change their minds and begin speaking on religion themselves," Koenig says.[26]

Studies relating to physical health indicate that greater religious involvement is associated with lower blood pressure, lower rates of death from heart disease, fewer strokes, and longer survival in general. A strong religious faith and active involvement in a religious community appear to be the combination most consistently associated with better health. Religious involvement helps people prevent illness, recover from illness, and—most remarkably—live longer. The more religiously committed you are, the more likely you are to benefit.[27]

In studies relating to mental health, people who are more religious demonstrate a greater sense of well-being and satisfaction with life. Actively religious people tend to have less anxiety and less depression, and they are much less likely to commit suicide. Therapies for depression and anxiety that incorporate religious beliefs result in faster recovery from illness than do therapies involving traditional methods.[28]

Cost-benefit studies reinforce the efficacy of paying attention to the spiritual concerns of the patient. According to the summaries presented by Koenig, heart-surgery patients who are religious have twenty percent shorter post-operative hospital stays than non-religious patients,

and hospital stays are nearly 2.5 times longer for older patients who do not have a religious affiliation. Chaplain intervention for heart-surgery patients results in an average of two days shorter length of stay, or about $4,000 cost savings per patient.[29]

Caution is always in order when new therapies, new approaches to healing, and other complementary or alternative approaches are considered. Members of a variety of disciplines, including psychiatry and the chaplaincy, voice this caution. Dr. Richard Sloan and chaplain Larry VandeCreek state:

> Linking religion with medicine may seem intuitive. But, as we argue along with a group of healthcare chaplains and biomedical researchers in a report in the June 22 *New England Journal of Medicine*,[30] this movement oversimplifies two very complex and different realms of human experience. It oversteps the boundaries of medicine and diminishes the power of religion.[31]

Other authors expand on the critique of science that is being conducted to bolster the firepower of the religious. Their critical views are stated in the article, "Mixing Religion and Health: Is it Good Science?" in *The Scientist*.[32]

Research is being expanded in the area of humor and spirituality. It is interesting to speculate that our religious healing communities may, in the end, have scientific legitimacy for their approach to healing. It is inspiring to see that, for a change, science is beginning to pick up on what persons of faith have known all along; that is, that there is much more to healing than simply fixing a broken body.

It is inspiring to see that, for a change, science is beginning to pick up on what persons of faith have known all along; that is, that there is much more to healing than simply fixing a broken body.

Anecdotally, people of faith have long known that they are members of healing communities. *Healing as a Parish Ministry* asserts that each of us is a potential healer as we promote the mending of the body, mind, and spirit.[33] Karin Garnberg-Michaelson, in *Healing Communities*, quotes Dr. Eric Ram, director of international health at World Vision as saying:

> Whenever we offer acceptance, love, forgiveness, or a quiet word of hope, we offer health. When we share each other's burdens and joys, we become channels of healing. No matter how timid or tired, selfish or crazy, young or old, we all have something important to offer each other. Each of us is endowed by God with that gift of healing.[34]

Website Resources for Humor & Healing and Spirituality & Healing

Web sites abound that are related not only to healing and spirituality but also to humor and healing. Many sites are promotions for a given approach to healing while other sites quickly link to scientific research. For those who are interested in further investigation of PNI, or any of its many sub-fields, a listing of web sites follows.

Duke University Center for Integrative Medicine
www2.mc.duke.edu/depts/medicine/intmed/

Duke University Center for the Study of Aging and Human Development
www.geri.duke.edu/people/koenig.html

International Institute of Humor and Healing Arts
www.hahainstitute.com/

The Humor Institute, Inc.
www.humorinst.com/healing.html

American Association of Therapeutic Humor
http://aath.org/

International Center for Humor and Health
www.humorandhealth.com/

Laughter research conducted
www.llu.edu/news/today/mar99/sm.htm

Laughter—Still the Best Medicine
www.heylady.com/rbc/laughter.htm

Laughing out loud to good health
http://library.thinkquest.org/25500/index2.htm

The National Center for Complementary and Alternative Medicine
http://nccam.nih.gov/

The Humor Project
www.humorproject.com/

Medscape: Humor and Medicine
www.medscape.com/Home/HumorLeisure/HumorLeisure.html

Ed Leigh's Humor & Happiness Catalog
http://speakers-podium.com/edleigh/internetorder3.html

Journal of Nursing Jocularity
http://gort.ucsd.edu/newjour/j/msg02255.html

Jest for the Health of It
www.jesthealth.com/

The Laughter Remedy, Paul McGhee
www.laughterremedy.com/

Therapeutic benefits of humor
http://holisticonline.com/humor-therapy-benefits.htm

Loretta LaRoche: The Humor Potential
www.stressed.com/

A former director of Indian Creek Haven of Harleysville, Pennsylvania, observes: "Twenty years ago, Mennonites were considered weird. A faith-based group home that had expectations about life-style was marginalized and stigmatized, but people are seeing that what we do works." Perhaps the healing communities, found in many religious settings, may be more a factor of sensible living, community support, and spirituality than pharmaceuticals. *

Notes

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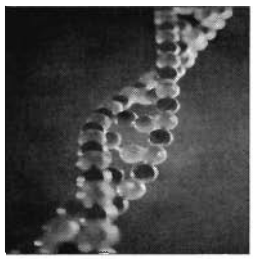
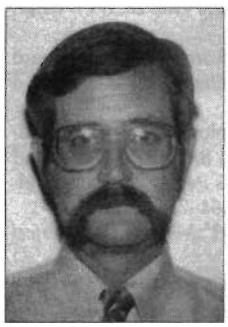


The Problem of Epistemology and Cosmic Models



Cosmic models are themselves not accurate depictions of the universe but humanizations of it.

In 1975 Gunther S. Stent, then professor of molecular biology at the University of California at Berkeley, published in *Science* an article in which he argued that (a) the influence of positivism which informed the first centuries of the natural scientific enterprise is waning; that (b) structuralism (of which conceptualism is a type) has become a plausible alternative to positivism; and that (c) the theory of evolution can resolve the dilemma inherent in structuralism's assertion of innate ideas.[1] He then concluded that because the brain has evolved as a survival organ to process information in a particular way, its innate structures are not particularly adept at scientific inquiry insofar as that inquiry attempts to grasp reality on scales much beyond the brain's immediate experience, and that certain areas will be forever closed to the scientific method.[2]

While Stent focused primarily on questions revolving around the human self, I will attempt to expand his insight to include all cosmic models. I will argue that such models are not based primarily on objective evidence but instead project the innate substructure of human consciousness. Ludwig Feuerbach once argued in *The Essence of Christianity* that theology is really anthropology. In the same way, I will argue that cosmic models are themselves not accurate depictions of the universe but humanizations of it. Indeed, as creations of the human mind from the perspective of the conceptualist or the structuralist, they can express nothing beyond sense perceptions manipulated by innate ideas and cultural presuppositions. Thus current scientific models, including models of origin, share more with ancient models, including models of creation, than they do with any actual events. They are merely the tales we tell ourselves when confronted with that great mystery. They are the way we make an alien universe seem human.

In the west, subsequent to Plato, reason served an architectonic function. It was generally assumed that knowledge was made possible by forms, whether those forms existed apart from God or in the mind of God, and that the forms were universal. In the later Middle Ages, however, this general consensus began to break down in favor of alternative positions. One of these alternative positions was what we know as conceptualism or structuralism. The conceptualists or structuralists argue that knowledge is made possible not by universal forms but by mental structures that either are peculiar to a species or even peculiar to a subgroup within a species. Thus in the view of the structuralist, knowledge of the world is particularized. Creatures see a world that is appropriate to them and their needs, but there is no reason to assume that various creatures see the same world. For example, a robin and a human being might see a car, but when they see that car, they do not see the same thing. From the perspective of the structuralist or conceptualist, this presents no problem to the species since each species survives quite well in its version of the world, but it would present a problem if species tried to claim exclusive validity for their versions. Of course, robins are not inclined to debate with humans on the nature of a car, but humans are inclined to assume that the world they see is the world as it is. The structuralist or conceptualist would insist

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that there is no reason to assume that the human sees the world as it is. All that can be assumed is that the human sees a human world. In the popular mind, this perception finds expression in the parlor debate, based upon the enumeration of rods and cones, as to whether cats and dogs see color.

In a nutshell, structuralism subverts the architectonic function of reason since from a structuralist standpoint there is no rationale for assuming that the mind, as it constructs its models of reality, employs perceptions that have universal validity. The most influential modern structuralist/conceptualist was Immanuel Kant.

The Kantian Critique

In his *Critique of Pure Reason* published in 1781, Kant maintained that reason, unassisted by experience, would eventually generate contradictory conclusions.[3] Logic, he argued, is successful only insofar as it is limited to exhibiting and proving formal rules of thought.[4] It teaches nothing regarding the content of knowledge.[5] That content must be provided by the empirical sciences.[6] But empiricism or, as Kant called it, "sensuous knowledge" is an incoherent manifold unless structured by reason.[7] To forge coherent knowledge, reason and empiricism must be employed together, each correcting the other's deficiencies.

Kant understood knowledge as the result of a synthesis of various representations given either a priori or empirically.[8] Since knowledge is not possible without a concept, a general something that could serve as a rule,[9] this general something must be given a priori.[10] Kant called this a priori given "pure intuition."[11] It was not itself an object, but the formal condition for perceiving an object.[12]

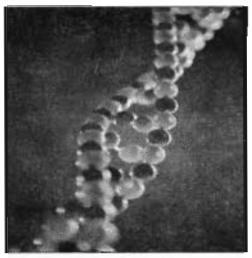
To account for pure intuition, Kant introduced the idea of Categories. These Categories he defined as pure concepts of the understanding, by which he meant that they were given to the mind not empirically but a priori.[13] Kant discussed these Categories at great length. For our purposes, it is not important to look at them in detail, but we should note the following point. The Categories were roughly analogous to Platonic Forms but with this difference: In Plato's system of knowledge, the Forms were universal and made universal knowledge possible whereas in Kant's system, the Categories existed solely in the human mind. There is no way to know for certain if they correspond to objective reality, but we can know for certain that they correspond to subjective reality.[14] Thus Kant embraced a type of conceptualism, a philosophical tradition that goes back at least as far as Abelard. The Categories (or pure knowledge) made it possible for the mind to receive representations (or sensuous knowledge).

The faculty in the mind for receiving representations, Kant called "sensibility"; the effect it produced, he called "sensation"; and intuitions about the objects of sensation, he called "empirical intuitions."[15] Discussing sensuous knowledge, Kant argued that all intuition was the representation of phenomena.[16] The phenomena themselves cannot exist apart from our knowing them. Hence, we do not know what they are in themselves. We know them only as our mind, through our senses, constructs them for us.[17] They are sensuous representations only and must not be confused with the object apart from that representation, that is, as the object is in itself.[18] Kant then argued that intuition and the concepts associated with it are the basis of all our knowledge.[19] Indeed, he believed that the faculty of imposing an a priori unity upon the manifold of given representations was the highest principle of human knowledge.[20] Thus, the synthetic unity of consciousness is the objective condition of all human knowledge and all human thought.[21]

According to Kant, the world we see is a fundamentally human world, and therefore a limited one. Other beings might perceive and interpret it differently and just as validly.

Knowledge, of course, makes judgments possible. Judgments, according to Kant, are generalizations that compass the many under a single representation. They are expressions of the mind's ability to think in terms of concepts. They make explicit the mind's understanding.[22] Understanding, in Kant's view, is the ability to perceive patterns, categories, and order.

Thus Kant constructed a critical epistemology which, though fundamentally subjective, allowed for the apprehension of objective reality in terms of that very subjectivity.[23] Such an epistemological model can be diagramed this way: *the event itself/the event as perceived/the event as interpreted.* Perception structures the event, making it accessible to the mind, but perception, by structuring the event, also alters it, investing it with the structure of consciousness itself. Thus, according to Kant, the world we see is a fundamentally human world, and therefore a limited one. Other beings might perceive and interpret it differently and just as validly. As long as we are dealing with practical questions, that limitation on our knowledge is of no particular consequence. We learn by trial and error, by tests that produce predictable results. We apply what we learn. We adopt those applications that produce the results we seek. However, when we attempt to expand our knowledge from those practical issues to metaphysical ones, when we attempt to answer ultimate questions, such as "What is the universe really like?" then those limitations



become extremely important. They mean that all we can do is construct a picture of what the universe might look like to a cosmic human limited by the kind of knowledge we possess at any particular moment in history. The principles under which we operate may be quite sound. After all, we use them because they prove serviceable in our daily lives. But the world view we derive from those principles may not be valid because our way of knowing means that we cannot apprehend a thing as it is, we can only apprehend it in human terms.

The Kantian Critique Today

In his Whidden Lectures delivered in January 1975 at McMaster University, Noam Chomsky argued that human knowledge was founded on the mind's "innate capacity to form cognitive structures,"[24] and that such a property could be accounted for in terms of "human biology."[25] The use of the term human biology is significant here since Chomsky suggests that although such structures doubtless evolved, it is a mistake to believe that some universal capacity for learning unites the various species. Instead he seems to see species as having abilities that are distinct.[26] Of course, as one who accepts evolution, he imagines that complex mental abilities developed over time in the same way that complex organs did.[27] Thus he argues: "The human mind is a biologically given system with certain limits and powers."[28] He also notes that there is no evolutionary pressure leading humans to possess minds fitted to abstract theorization and that when human cognitive capacity is well matched to a particular field of inquiry, it is purely accidental.[29] He writes:

> Among the systems that humans have developed in the course of evolution are the science-forming capacity and the capacity to deal intuitively with rather deep properties of the number system. As far as we know, these capacities have no selective value, though it is quite possible they developed as part of other systems that did have such value.[30]

Thus Chomsky is supposing a kind of Kantian epistemology that, by the very structure which makes human intellectual achievement possible, sets limits on that achievement. He believes that Darwinism offers a "biological underpinning" for such an epistemology.[31] He writes:

> [T]here is no reason to suppose that the capacities acquired through evolution fit us to "fathom the world in its deepest scientific aspects."[32]

Nor is he alone in this assessment. Steven Pinker writes:

> Given that the mind is a product of natural selection, it should not have a miraculous ability to commune with all truths; it should have a mere ability to solve problems that are sufficiently similar to the mundane survival challenges of our ancestors. ... [R]eligion and philosophy are in part the application of mental tools to problems they were not designed to solve.[33]

Indeed, he appeals specifically to Chomsky when he writes:

> Maybe philosophical problems are hard ... because *Homo sapiens* lacks the cognitive equipment to solve them.[34] ... [T]here are indirect reasons to suspect this is true. ... [T]he species' best minds have flung themselves at the puzzles for millennia but have made no progress in solving them. [T]hey have a different character from even the most challenging problems of science.[35]

And while Stephen Hawking is critical of Kant's argument that theories about the origin of the universe are self-contradictory[36] and contends that the reasoning abilities bequeathed to us via evolution should at least prove sufficient to develop "a complete unified theory that will describe everything in the universe,"[37] he is also aware that scientific theories are no more than mathematical models existing only in our minds,[38] and that our sense of time's direction is a psychological phenomenon based in the fact that "we must remember things in the order in which entropy increases."[39] But this twin admission, it seems to me, robs Hawking's original reason for dissent of much of its power. After all, if our sense of time is purely psychological, purely a creation of the way we remember events, then Hawking's thesis—that the reasoning abilities we inherited through evolution should be sufficient to develop a theory explaining everything in the universe—collapses. If our sense of time

Chomsky suggests that although [cognitive] structures doubtless evolved, it is a mistake to believe that some universal capacity for learning unites the various species.

is circumscribed by the structure of our psychology, how can we be sure that the same is not also true of our grasp of reason? Thus how much credit can we assign to those mathematical models that (as he says) exist only in our minds? And with this question, the limits imposed by Kant's critique of all such models reemerges as forcefully as ever.

Science [for Kant] had validity as a vehicle for addressing specific issues that could be resolved via direct observation and experimentation. It was not to be a vehicle for building cosmic models, for such models would inevitably draw science into the transcendental realm.

Plainly when Pinker raises the epistemological issue, he applies it to intractable philosophical problems, and when Chomsky discusses the possible limits on what human intelligence can achieve, he refers to specific kinds of problems, like in-depth accounts of our normal use of language.[40] After all, both men are evolutionists and would not see evolution, because it is "scientific," as falling under the purview of a Kantian critique. Hawking seems more aware of the problem but does not address it adequately.

The problem is this: Kant understood his epistemology to exclude cosmic questions and to invalidate the models we construct when attempting to answer such questions. For example, he writes:

> Human reason is by its nature architectonic, and looks upon all knowledge as belonging to a possible system. ... The propositions of the antithesis, however, ... render the completion of any system of knowledge quite impossible.[41]

Kant points out that transcendental philosophies assume that reason is qualified to answer those questions that occur to it, but that all such questions to which transcendental philosophy leads are cosmological.[42] He then analyses such questions and concludes that the *"cosmical idea"* which gives rise to them "is either too large or too small for the empirical regressus, and therefore for every possible concept of the understanding."[43] This is the fault not of the empirical regressus but of the cosmological idea itself since it cannot be resolved by an appeal to experience. After all Kant argues: "It is possible experience alone that can impart reality to our concepts; without this, a concept is only an idea without truth, and without any reference to an object."[44] Kant's purpose, as we noted above, was to defend empirical science against Hume's radical skepticism. To do this, he limited the scope of human inquiry to immediate practical problems instead of abstract and ultimate ones. Science had validity as a vehicle for addressing specific issues that could be resolved via direct observation and experimentation. It was not to be a vehicle for building cosmic models, for such models would inevitably draw science into the transcendental realm. Evolution, of course, is a cosmic model.

Conclusion

Here is the dilemma: If a mind grasps its world by means of mental categories that have evolved solely to ensure the survival of that mind, there is no reason to assume that the world the mind grasps is the world as it is. Many minds survive in this world, yet see the world in fundamentally different ways. There is robin-world, bullfrog-world, woodchuck-world, and housefly-world. And there is human-world. The world of each of these creatures is validated insofar as it ensures the survival of the creature, but no further. The positivist assumes that a human mind grasps the world as it is, but from an evolutionary standpoint, there is no reason to make such an assumption. Instead there are many reasons to assume an observed world differs from the world as it is.

The observer is neither neutral nor passive. Rather, the observer, by the very act of observing, participates in and structures the world. For the positivist, this dilemma is fatal. Yet from a Darwinian perspective there is no reason to assume it is not true. Ironically Darwinism leads to a logical cul-de-sac. If the Darwinist is right, there is no reason to assume that the Darwinist can accurately model the world. If the Darwinist is wrong, there is no reason to assume that the Darwinist can accurately model the world.

*

Notes

[1]That dilemma being, how do those innate ideas happen to match so well with the world in which we find ourselves?

[2]Gunther S. Stent, "Limits to the Scientific Understanding of Man," *Science* 187, no. 4181 (March 21, 1975): 1052–7. *Structuralism* embraces any theory that embodies structural principles. In philosophy, structuralism posits the brain as possessing innate structures which, by processing information, make knowledge possible. *Conceptualism*, of which there are several varieties, is a branch of structuralism that attempts to forge some common ground between nominalism and realism and regards universals as concepts rather than Platonic forms.

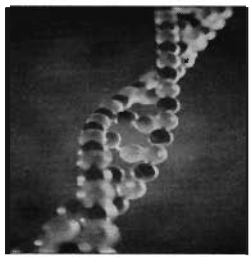
[3]Immanuel Kant, preface to *Critique of Pure Reason*, 1st ed., (1781), xxiv.

[4]Ibid., preface to 2d ed. (1787), xxix.

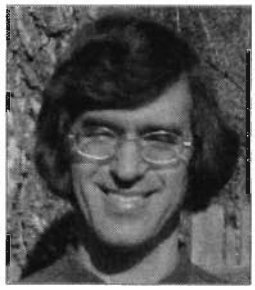
[5]Ibid., I. "The Elements of Transcendentalism," second part, sub-part IV, "Of the Division of Transcendental Logic into Transcendental Analytic and Dialectic," 50; first division, bk. I, chap. 1, section 3: "Of the Pure Concepts of the Understanding, or of the Categories," 60; Book II: "Analytic of Principles," 117–8.

[6]Ibid., preface to 2d ed., xxx; I. "The Elements of Transcendentalism," first division, bk. I, chap. 2, section 1: "Of the Principles of a Transcendental Deduction in General," 79.

[7]Ibid., first division, bk. I, chap. 1, section 3: "Of the Pure Concepts of the Understanding, or of the Categories," 60.
[8]Ibid.
[9]Ibid., bk. I, chap. 2, section 2, subsection 3: "Of the Synthesis of Recognition in Concepts," 104.
[10]Ibid., 102.
[11]Ibid., I. "The Elements of Transcendentalism," first part, "Transcendental Aesthetic," p. 22; Ibid., subsection 3: "Of the Synthesis of Reproduction in Imagination," 102.
[12]Ibid., I. "The Elements of Transcendentalism," bk. II, chap. 3, appendix, "Of the Amphiboly of Reflective Concepts, owing to the Confusion of the Empirical with the Transcendental Use of the Understanding," 219.
[13]Ibid., first division, bk. I, chap. 1, section 3, 60.
[14]The debate as to whether the Categories are universally human, or cultural constructs, or some mixture of both is a debate we need not get into here.
[15]Kant, *Critique of Pure Reason*, I. "The Elements of Transcendentalism," first part, 21.
[16]Ibid., Part I: "The Elements of Transcendentalism, General Observations on Transcendental Aesthetic," 35–6.
[17]Ibid., p. 36; I. "The Elements of Transcendentalism," bk. II, chap. 3, appendix, 217.
[18]Ibid., first division, bk. I, chap. 2, section 2, subsection 3, 103.
[19]Ibid., Part II: "Transcendental Logic," introduction, "The Idea of Transcendental Logic," 44.
[20]Ibid., I. "The Elements of Transcendentalism," first division, bk. I, chap. 2, section 1, 79.
[21]Ibid., 81.
[22]Ibid., chap. 1, section 1: "Of the Logical Use of Understanding in General," 54–5.
[23]It is worth noting here that Popper, though he sharply distinguishes his own "critical rationalism" from Kant's epistemology, claims that, when applied to the philosophy of science, his approach completes the critique Kant began (*Conjectures and Refutations*, Introduction, section xv, 26–7). Kant was correct, Popper believes, when he argued that the human intellect imposes laws upon nature rather than discovering laws of nature, but Kant was wrong, Popper thinks, to believe that the laws humans imposed are necessarily true (Part I, chap. 1, section v, 48; chap. 2, section x, 95). Here, Popper argues, Kant proved too much and that to glean the truth in Kant's idea, the problem he addressed must be reduced to its proper dimensions. Popper believes that instead of asking with Plato: "How do we know?" Kant should have asked: "How are successful conjectures possible?" Later Popper affirms in agreement with the idealist that theories are not forced upon us but are human creations, conceptual instruments we design for ourselves to assist us to think about things (chap. 3, section 6, "The Third View: Conjectures, Truth, and Reality," 117). Thus Popper modifies Kant in the following way: Believing that Kant's assertion that we impose laws upon nature is too radical, Popper argued that it must be modified to stress that our impositions are free creations of our minds and meet with varying success (chap. 8, section 1, "Kant and the Logic of Experience," 191).
[24]Noam Chomsky, *Reflections on Language* (New York: Random House, 1975), 23.
[25]Ibid., 32.
[26]For example, he points out that white rats are better than college students at learning to negotiate mazes (pp. 18–9, 158–9), a phenomenon that suggests to him that, given the obvious superiority of human intelligence to rat intelligence, there is no general theory of learning that applies to rats as well as humans. He also argues that the mental structures enabling humans to learn languages are unique to humans (p. 40), that they are "a species-specific, genetically determined property" (p. 79). Also see p. 11 for more on language as a species specific property.
[27]Ibid., 10.
[28]Ibid., 155.
[29]Ibid., 25.
[30]Ibid., 58–9.
[31]Ibid., 123–4.
[32]Ibid., 124.
[33]Steven Pinker, *How the Mind Works* (New York: W. W. Norton & Company, 1997), 525.
[34]Ibid., 561.
[35]Ibid., 562.
[36]Stephen W. Hawking, *A Brief History of Time* (New York: Bantam Books, 1988), 7–8. He challenges Kant based on Kant's unspoken assumption that time is distinct from the universe and continues backward forever whether or not the universe has existed forever. Hawking agrees with Augustine that the concept of time apart from the universe has no meaning (p. 8). He has a point in that Kant does distinguish between space and time, claiming, "Time is the formal condition, a priori, of all phenomena whatsoever. Space, as the pure form of all external intuition, is a condition, a priori, of external phenomena only" (*Critique of Pure Reason*, I. "Elements of Transcendentalism," First Part, second section, subsection 5: "Transcendental Exposition of the Concept of Time," p. 31). However, in saying this, Hawking implies that Kant thought of space and time as objective realities. He did not (see footnote 38).
[37]Ibid., 12–3.
[38]Ibid., 139. Hence Hawking concludes there is no distinction between real and imaginary time, a judgment with which Kant would have had no fundamental argument. Kant says: "Time ... is ... the real form of our internal intuition. Time therefore has subjective reality. ... Time is nothing but the form of our own internal intuition. Take away the peculiar condition of our sensibility, and the idea of time vanishes, because it is not inherent in the objects, but in the subject only that perceives them" (*Critique of Pure Reason*, I. Elements of Transcendentalism, first part, second section, subsection 5, p. 33).
[39]Ibid., 147. Such a realization, he notes, means that the Second Law of Thermodynamics is trivial.
[40]Chomsky, *Reflections on Language*, 25.
[41]Kant, *Critique of Pure Reason*, I. "Elements of Transcendentalism," second division, bk. II, chap. 2, section 3: "Of the Interest of Reason in these Conflicts," 336.
[42]Ibid., section 4, "Of the Transcendental Problems of Pure Reason, and the Absolute Necessity of their Solution," 338.
[43]Ibid., section 5, "Sceptical Representation of the Cosmological Questions in the Four Transcendental Ideas," 344 (italics in the original).
[44]Ibid.



The Similarity of Theory Testing in the Historical and "Hard" Sciences



Frequent claims appear in the Christian science/faith literature, and in popular discussions of science, that the historical sciences (cosmology, astronomy, geology, evolutionary biology, anthropology, archaeology) are fundamentally different from the "hard" sciences, and that their scientific conclusions are less rigorous and less testable.[1] It is argued that the historical sciences deal with unrepeatable events and are therefore not experimental.[2] Furthermore, because past events and processes are not directly observable, theories of origins are deemed inferior or less certain than studies of present processes. This view commonly finds expression in statements like: "No one was there so we can never know what really happened."[3] Scientific claims about Earth and biological history are then dismissed as untestable speculation. These various perceptions of historical science represent serious misunderstandings of both the nature of experiment and theory testing, and the character of scientific "proof." It is my hope that this brief essay will serve both to expose widely held misconceptions about the nature of science and to demonstrate that historical science is rigorously testable.

Science does not employ a simple inductive reasoning strategy as assumed by many who dismiss the claims of historical science. The inductive method was proposed by Francis Bacon at the beginning of the seventeenth century. The "Baconian method" argues that scientists should gather and combine all relevant facts, and from these facts derive general laws.[4] However, since the middle of this century, philosophers of science have recognized that science actually proceeds by the "hypothetico-deductive method."[5] Observations are made, and a hypothesis is proposed to explain those observations. A new set of observations not yet made is inferred deductively from the hypothesis. The hypothesis can then be tested against these new observations, and modified or rejected if necessary. Although hypotheses can be rejected by the methodology of science, they cannot be positively proved. No scientific theory can be proven in the sense of a mathematical or logical proof. Any accepted scientific theory is simply the best existing unfalsified explanation for the observations already made. This is as true for physics as it is for evolutionary biology.

The historical sciences follow the same methods and rules as the "hard sciences" and are no less scientific. The historical sciences follow the hypothetico-deductive method in the same manner as does chemistry or physics. Predictions made by hypotheses in these fields are continually being tested by new observations. If the predictions deduced from a hypothesis are not supported by new observations, then that hypothesis is modified or rejected. Scientific research proceeds by an almost continual process of hypothesis creation and testing. Many past theories in the historical sciences have been discarded with the accumulation of new observations and the development of new theories of greater explanatory power.

In "hard" sciences such as chemistry or physics, no less than in the historical sciences, the actual phenomena or processes

Any accepted scientific theory is simply the best existing unfalsified explanation for the observations already made.

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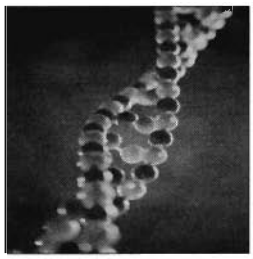


Communication

The Similarity of Theory Testing in the Historical and "Hard" Sciences

In "hard" sciences such as chemistry or physics, no less than in the historical sciences, the actual phenomena or processes being studied are rarely directly observable.

being studied are rarely directly observable. The process of formation of atomic bonds during a chemical reaction, for example, is rarely directly observed; it must be reconstructed from the data collected during the reaction as interpreted by present theory. Likewise, subatomic events are reconstructed from the data obtained from instruments designed to record those signals which current theory predicts. What is available for analysis are the products or results of experimental events, not the events themselves—whether those events occurred in a test tube or a high-energy accelerator. The chemist or physicist examines the records of past events to infer unobservable processes. In addition, only a limited amount of data can be collected from those events. The investigator must select the data to be recorded. The recorded data thus will be constrained by existing theory, the specific objectives of the experimenter, the limitations of measurement technology, and the practical limitations of time and money. As a result, critical conditions or factors may remain unknown and unrecorded. This unrecorded data is lost irretrievably with each experimental event. Unless the products of an experiment can be retained for future analyses (as in chemical products or cell and tissue cultures), the only preserved record is the data collected—and this data is incomplete and subject to bias.

In the historical sciences, the records of past events are also examined to infer causal processes not directly observable. But, in this case, the preserved record is controlled, not by the investigator, but by nature. What is preserved are the products (e.g., minerals, fossils, rocks, faults) of past processes and events. The available record of past events is determined not on the basis of human bias, but by the preservational processes of nature that produce their own bias. The investigator then must select from this preserved record those data deemed significant for the problems being addressed. Data collected from the available record of ancient events by one scientist can be confirmed by the analyses of others. Scientists can return to this same record repeatedly and look at it in new ways—utilizing new technologies or simply focusing on previously ignored or unrecognized aspects of the record. Nature also commonly provides multiple records of the same or similar events. The geologist or paleontologist thus has "natural experiments" that provide multiple repeated trials. There are, of course, some historical events that are singularities, such as the origin of the universe, for which there is only one trial.

Other areas of research in the historical sciences in which the direct observation of past events occurs routinely are in the fields of astronomy and cosmology. Because of the finite speed of light, we are able to directly observe astronomical events dating back to very early in the history of the universe. We can observe the actual birth and death of stars that occurred millions to billions of years ago. The blackbody curve of the cosmic microwave background radiation, dating from about 300,000 years after the Big Bang, is one of the most thoroughly documented of physical observations.

Experiments in the nonhistorical sciences can be repeated under closely similar, though rarely identical, conditions. The more complicated the system, the less all conditions with possible impacts on the experimental outcome can be controlled. This is particularly true when designing experiments to study living systems—whether single organisms, populations, or ecosystems. Events and processes occurring in such systems are not strictly repeatable, yet scientists can make useful predictions of future behavior by studying them. Although unique, each new event or experimental outcome in a complex system increases the understanding of the causal processes involved. Strict repeatability is thus not a criterion for the testing and revision of hypotheses. The repeated occurrence of very similar, though not identical, events in Earth's history likewise provides the basis for the testing of theories and the prediction of future observations.

Historical sciences are just as predictive, and testable, as the "hard" sciences.[6] Like all scientific disciplines, geology and paleontology proceed by testing the predictions of existing models and theories. Predictions are tested against each new observation or analysis. Obtaining data from a newly analyzed sample or newly described locality is no different methodologically than obtaining data from a new experimental trial. In both cases, the new observations can be tested against expectations based on previous experience and theoretical predictions. In stratigraphy or sedimentology, for example, the measurement and description of each new rock

outcrop or subsurface core is a test of working hypotheses based on present understanding. If a specific rock unit is interpreted to be part of a coastal barrier island complex, then specific predictions can be made concerning the geometry of this rock body and the characteristics and distribution of associated sedimentary rocks. In modern barrier islands, a whole complex of environments are present—shoreface sands, beach deposits, coastal sand dunes, backbarrier lagoons, tidal inlets with ebb and flood deltas, tidal channels, and so forth. Each of these environments has its characteristic spatial relationships, sediment types, depositional features, and associated biota. If the original hypothesis of a barrier island was correct, then further exploration and sampling of the area should reveal the predicted geologic features and their predicted spatial and temporal relationships. If the new observations are contrary to these predictions, then the hypothesis must be modified, or if necessary, abandoned.

Another testing methodology used by both the "hard" and historical sciences is the reconstruction of inferred conditions to see if they produce the predicted result.

Geological theories rise and fall based on their ability to explain previous data and to predict new observations. All practical applications of geological research (mineral and oil exploration, groundwater management, pollution control and abatement, assessment of human impacts on global change, etc.) are contingent on the ability to predict future observations based on theoretical models. These models are based on the observation of current geological processes, and on the reconstruction of past geological events and processes from the geological record.

Another testing methodology used by both the "hard" and historical sciences is the reconstruction of inferred conditions to see if they produce the predicted result. This may be done through actual experimentation or by numerical or computer modeling. The conditions may be highly simplified in order to understand the components of a naturally complex system, or they may be more or less realistic. Geologists thus construct flume or watertable experiments to model hydrologic systems, use pressure and temperature "bombs" to reproduce conditions in the Earth's interior, and construct geophysical computer models of the mantle and core to understand plate tectonics. The results of these models can then be compared to theoretical predictions and to real world observations. Similarly the physicist, chemist, and biologist commonly use simplified models to test the behavior of causal factors predicted to underlie much more complex real-world situations. Experiments may be constructed and data collected to test predictions of proposed models or theories, or to gather information on a system that is not well understood. The relationship between theory, data collection, and data interpretation is complex. Present theory and available technology affect what data are collected and how they are interpreted. The doing of science is always constrained by its historical context and the biases of its practitioners. There is no such thing as a pure objective Baconian science of unbiased observation.[7] This is true of both the "hard" and historical sciences. Biased data are not wrong, just incomplete, and as the body of accumulating data increases, scientific theories must be modified to be useful as explanatory and predictive tools. As a Christian scientist, I have confidence in the advancement of scientific understanding because I believe that our data, however incomplete, reflect an objective physical reality.

All theories are accepted based on their predictive and explanatory power, for their ability to make diverse observations intelligible. The validation of a scientific theory is not like a legal proof in which truth must be established beyond a reasonable doubt. No scientific theory will be without unresolved problems, inconsistent evidence, or unexplained phenomena. Comprehensive theoretical constructs or paradigms, such as macroevolution or plate tectonics, not only provide broad explanatory power but also serve to highlight those observations not easily accommodated, thus providing direction for further research. Some theories are ahead of the evidence and others struggle to accommodate the data already assembled. However, it is the generation of new questions that is the foundation of scientific research. Both the "hard" and historical sciences are on equal ground here. Scientists are driven to construct better and better models of the universe, of how physical reality really is. Thus science pursues truth, but never claims to have it fully within its grasp. *

Acknowledgment

Thanks are due to three anonymous reviewers who provided useful suggestions and helped me clarify my arguments.

Notes

[1]This dichotomy appears in its most extreme form in young Earth creationist literature as the distinction between "origins science" and "operational science." Duane Gish has stated: "Thus, for a theory to qualify as a scientific theory, it must be supported by events or processes that can be observed to occur, and the theory must be useful in predicting the outcome of future natural phenomena or laboratory experiments. An additional limitation usually imposed is that the theory must be capable of falsification; that is, one must be able to conceive some experiment the failure of which would disprove the theory. It is on the basis of such criteria that most evolutionists insist that creation be refused consideration as a possible explanation of origins. Creation has not been witnessed by human observers, it cannot be tested scientifically, and as a theory it is

nonfalsifiable. The general theory of evolution (molecules-to-man theory) also fails to meet all three of these criteria, however" (D. T. Gish, "Creation, Evolution, and the Historical Evidence," *The American Biology Teacher* 132 [1973]: 40. Reprinted in Michael Ruse, ed., *But is it Science?* [New York: Prometheus Books, 1996], 266–82).

[2]The view that the historical sciences are neither testable or experimental was expressed by many of those opposed to inclusion of macroevolution and Earth history in the Kansas science standards. "As to the specific editing of evolution related content in the Science Standards by our BOE, evolution-related concepts having precise, testable definitions were retained. Thus, Mendelian genetics, DNA structure and variability, mutations in DNA, natural selection and genetic drift were all retained. Evolution related content in the domain of historical reconstruction rather than experimental testing was generally removed, however. Historical science questions such as the age of the earth or whether dinosaurs evolved into birds cannot be experimentally tested in the manner of, say, whether a particular vaccine will prevent a disease. Such historical issues need to be treated more in the manner of a jury trial. Evidence is accumulated and alternative reasoned interpretations of the evidence explored" Paul Ackerman (ICR news release, Aug 20, 1999).

[3]The "no one was there" argument was frequently used during the debates over the Kansas science standards. "'I can't understand what they're squealing about,' Bacon said of scientists who oppose the board's action. Millions or billions of years ago, Bacon said, 'I wasn't here, and neither were they. Based on that, whatever explanation they may arrive at is a theory and it should be taught that way'" ("Science vs. the Bible: Debate Moves to the Cosmos," *New York Times* [October 9, 1999]).

This argument also figured prominently in the textbook disclaimer that was considered but ultimately rejected by the state of Oklahoma. The text of that disclaimer read in part: "No one was present when life first appeared on earth. Therefore, any statement about life's origins should be considered as theory, not fact. The word evolution may refer to many types of change. Evolution describes changes that occur within a species. (White moths, for example, may evolve into gray moths.) This process is microevolution, which can be observed and described as fact. Evolution may also refer to the change of one living thing into another, such as reptiles into birds. This process, called macroevolution, has never been observed and should be considered a theory" (Quoted in Kenneth R. Miller, "Dissecting the Disclaimer," *Reports of the National Center for Science Education* 20, no. 3 [2000]: 30–3).

Note that these arguments also presuppose the commonly held fallacy that "theory" means untestable speculation.

[4]It is interesting to note that a "Baconian" approach was extended to Scripture by the leaders of fundamentalism in the late 1800s. See George M. Marsden, *Fundamentalism and American Culture* (New York: Oxford University Press, 1980).

[5]See discussion of scientific methodology in Ian Barbour, *Religion in an Age of Science* (San Francisco, CA: HarperCollins Publishers, 1990) and in Nancey Murphy, *Reconciling Theology and Science: A Radical Reformation Perspective* (Kitchener, Ontario: Pandora Press, 1997).

[6]A recent article making the point that historical sciences are not inferior to experimental science in testing hypotheses is Carol E. Cleland, "Historical Science, Experimental Science, and the Scientific Method," *Geology* 29 (2001): 987–90.

[7]An interesting discussion of the nature of science is given by Henry H. Bauer, *Scientific Literacy and the Myth of the Scientific Method* (Urbana, IL: University of Illinois Press, 1994).

Books Received and Available for Review

This is a partial list of the books available for review. Please contact the book review editor if you would like to review one of them or receive a copy of the complete list. Richard Ruble, Book Review Editor, *Perspectives on Science and Christian Faith*, 212 Western Hills Dr., Siloam Springs, AR 72761. richard@tcainternet.com

Joe Ator, *Darwinism and the Creation Science Movement*, Star Bible Publications, 88 pages, 2000

Connie Barlow, *The Ghosts of Evolution: Nonsensical Fruit, Missing Partners, and Other Ecological Anachronisms*, Basic Books, 220 pages, 2001

Wendell Berry, *The Art of the Common Place: The Agrarian Essays*, Counterpoint, 325 pages, 2002

S. Bonting, *Chaos Theology: A Revised Creation Theology*, Novalis, 104 pages, 2002

Joseph Campbell, *The Inner Reaches of Outer Space: Metaphor As Myth and As Religion*, New World Library, 150 pages, 2002

G. S. Cootsona, *Creation and Last Things: At the Intersection of Theology and Science*, Presbyterian Publishing Corp., 110 pages, 2002

J. Davis & H. Poe, *Designer Universe: Intelligent Design and the Existence of God*, Broadman & Holman Publishers, 252 pages, 2002

Jim Denney, *Answers to Satisfy the Soul: Clear, Straight Answers to 20 of Life's Most Perplexing Questions*, Quill Driver Books, 275 pages, 2001

David Downing, *The Most Reluctant Convert: C. S. Lewis's Journey to Faith*, IVP, 192 pages, 2002

Robert C. Fuller, *Spiritual But Not Religious*, Oxford Univ. Press, 210 pages, 2001

Norman Geisler, *The Battle for God: Responding to the Challenge of Neotheism*, Kregel, 336 pages, 2001

Adrian Gilbert, *Signs in the Sky: The Astrological and Archaeological Evidence for the Birth of a New Age*, Three Rivers Press, 328 pages, 2001

M. L. Greenhut & J. G. Greenhut, *Science and God: Our Amazing Physical and Economic Universe ... Accidental or God Created*, University Press of America, 180 pages, 2002

J. A. Hobson & J. A. Leonard, *Out of its Mind: Psychiatry in Crisis*, Perseus Publishing, 290 pages, 2001

James E. Huchingson, *Pandemonium Tremendum: Chaos and Mystery in the Life of God*, The Pilgrim Press, 230 pages, 2001

Stephen Kellert & Timothy Farnham, *The Good in Nature and Humanity: Connecting Science, Religion, and Spirituality with the Natural World*, Island Press, 280 pages, 2002

John Mason, *The Human Family and the Creator-God*, Vantage Press, 250 pages, 2000

Ric MacHuga, *In Defense of the Soul: What It Means to be Human*, Baker Book House, 204 pages, 2002

Clif Matthews, *When Worlds Converge: What Science and Religion Tell Us*, Open Court, 400 pages, 2002

Susan Quinn, *Human Trials: Scientists, Investors, and Patients in the Quest for a Cure*, Perseus Publishing, 295 pages, 2001

Jim Schicatano, *The Theory of Creation: A Scientific and Translational Analysis of the Biblical Creation Story*, Writers Club Press, 278 pages, 2001

Richard Schlagel, *The Vanquished Gods: Science, Religion, and the Nature of Belief*, Prometheus Books, 349 pages, 2001

Trent Stephens, *Evolution and Mormonism: A Quest for Understanding*, Signature Books, 240 pages, 2001

Should ASA Defend and Advance Professional Ethics in Science and Technology Professions?

by Joseph P. Carson, ASA Member, President of the Affiliation of Christian Engineers (ACE) <www.christianengineer.org>, 10953 Twin Harbour Drive, Knoxville, TN 37922
jpcarson@ mindspring.com

I am a licensed professional engineer (P.E.), nuclear safety engineer, and "eight-time prevailing and still aggrieved" whistleblower in the U.S. Department of Energy (DOE).[1] I am also a member of ASA. Is there a clear nexus between being a member of ASA and being willing to risk and suffer to uphold and defend a profession's code of ethics in one's employment? If so, does ASA have a collective responsibility in such a situation and how can it be discharged?

ASA defines itself as "a fellowship of men and women of science and disciplines that can relate to science who share a common fidelity to the Word of God and *a commitment to integrity in the practice of science* (emphasis added)."[2] ASA's Statement of Faith captures this, to some extent, in its fourth statement:

4. We recognize our responsibility, as stewards of God's creation, to use science and technology for the good of humanity and the whole world.[3]

I contend this statement does not adequately capture ASA's identity and mission. I suggest that ASA's Statement of Faith should be amended by adding a fifth statement to include:

5. "We will model and advocate, individually and collectively, the trustworthy—ethical, competent, and accountable—practice of our chosen professions."

ASA is a hybrid organization containing elements of a both a professional society and a learned society. Professional societies exist for two basic reasons: (1) advance the interests of its members and (2) advance greater societal interests by advancing the ethical, competent, and accountable practice of that profession. Professional societies generally advocate a variety of positions in a variety of ways. Learned Societies exist to further the increase and dissemination of knowledge in a given area.

ASA's policy that, "as an organization, the ASA does not take a position when there is honest disagreement between Christians on an issue," reflects the learned society part of its nature. Obviously, there can be (and is) a tension between ASA's policy of neutrality and its recognized collective responsibility to use science and technology for humanity's good.

In my opinion, ASA's policy of neutrality has been misapplied in the area of professional ethics. I do not think there can be an honest disagreement between ASAers about the proposition that, "We (ASA and its members) will, model and advocate, individually and collectively, the trustworthy—ethical, competent and accountable—practice of our chosen professions."

I do not fit the standard ASA demographic. I have neither a Ph.D. nor a career in academe or research. I am a licensed professional engineer. Engineering is complimentary to science, but quite distinct. Science exists to determine objective truth about the physical world. Engineering exists to apply science to the world's resources for the practical betterment of humankind. Science ethics focuses on truth. Engineering ethics focuses on public health, safety, and welfare. That is why many engineers, but few, if any, scientists, are licensed by the State. The code of ethics for engineers, implemented on a "strict honor code" basis, explicitly requires whistleblowing in situations involving public/workplace health and safety.

Consider the following relevant observations:

- Christians, who are members of a recognized profession, will spend the greatest portion of conscious hours in life preparing for or pursuing their career in their chosen profession.
- Becoming a member of a profession is one of the least fungible aspects of such a person's life—it takes too many years of academic training and experience to join a profession and too much money is usually involved to leave one's profession to join another. In today's society, it is probably easier to change jobs, homes, churches, and marriages than to change one's standing as a professional.
- A member of a profession probably has the greatest influence in life in his or her family and career or profession.
- Professions exist for the well being of their members and to advance the well being of society at large by advocating advances in the ethical and competent practice of that profession. In that way, they differ from trade unions that exist for solely for the benefit of their members. In America, professions have a great deal of autonomy and are, largely, self-regulating.
- Professions have codes of ethics. An explicit condition on membership in a profession is adherence to that code of ethics. In a sense, professions exist to advance and defend their codes of ethics. Without a viable code of ethics, a profession becomes a trade.
- While professions are secular, as are their codes of ethics, a Christian in a profession has a compelling spiritual reason to uphold and defend them that is not present for a non-Christian.
- An employed Christian in a profession has five distinct loyalties: (1) country, (2) employer, (3) profession, (4) self and family and (5) church and faith community.
- The church, including organs like ASA, is near silent about how Christians in a profession should be salt, light, and leaven in that profession and about how they should resolve tensions that can arise among the differ-

ent loyalties. Consequently, much of the institutional evil that exists in today's world is enabled by Christian (and other) members of professions who frequently shirk their professional obligations to "go in harm's way," out of economic fear or greed. The stakes are frequently quite high when one places oneself "in harm's way" out of professional obligation—loss of career opportunities, if not loss of job, and blacklisting are all too frequent occurrences.

In Luke 3:10–15, John the Baptist gives some guidance on professional ethics, which reduces to "do the right thing by your professional obligations." As the protagonist in *Carson v. DOE*, I argue that my "offense" has been placing my professional obligations for public/workplace health and safety, as described in the code of ethics for engineers and the "rules of professional conduct" for P.E.'s, before my self-interest, something for which DOE apparently will neither forgive nor forget.

ASA has been generous in reporting my case in its newsletter, *Newsletter of the American Scientific Affiliation & Canadian Scientific and Christian Affiliation*. However, because its policy of neutrality trumps its stewardship mandate in matters of professional ethics, ASA perceives no collective responsibility to use *Carson v. DOE* (or similar situations) as an opportunity to collectively defend or advance the code of ethics for engineers.

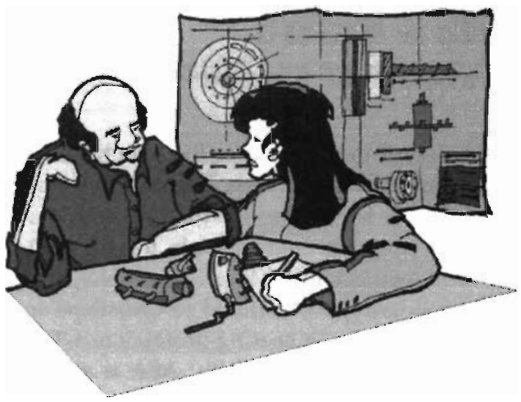
Despite ASA's general policy of neutrality, limited resources, and legal realities, it can advance the professional code of ethics of its members in the workplace in three ways if ASA revises its Statement of Faith:

1. File (or join) explicitly neutral *amicus curiae* briefs (i.e. friend of the court briefs) that clearly disavow any knowledge on any contested particular in nonfrivolous workplace discrimination cases involving professional ethics but that uphold and defend the importance of professional codes of ethics and a professional's adherence to them in his or her employment.[4]

2. Contact the employer in instances when the professional is legally vindicated, and formally express concern that the employer not only offended the particular employee, but also the entire profession's code of ethics. Furthermore, urge the employer to restore the offended employee and address its workplace culture that contributed to the unlawful discrimination.

3. Call for the most severe professional sanctions (up to permanent expulsion) in cases where one member of a profession engages in workplace reprisal against another who has adhered to professional obligation.

In my opinion, ASA should clarify its neutrality policy with its stewardship and integrity mandates in matters involving professional ethics. Adherence to professional ethics, even in obedience to Jesus' calling to be "salt, light and leaven," can cost a professional quite dearly. While one's life and liberty are not called into play, in America at least, just about everything of value—one's job, career, personal reputation, professional reputation, savings, and family—are "in-play" all too often in these cruel situations.



After sixty years of existence, ASA does not see itself as having a "salt, light, and leaven" role that includes actively upholding/defending/advancing the codes of ethics of the science and technology professions. Obviously, I think ASA should be more active and thereby consistent with its "commitment to integrity in the practice of science," and its responsibility to "use science and technology for the good of humanity and the whole world."

I fault the broader "religion-science" dialogue for its lack of focus on professional ethics. "Physician heal thyself" seems to apply, particularly as broader ethical statements seem to regularly emanate from the dialogue. I also fault ASA and the broader "religion-science" dialogue for its general silence to the reality of religious persecution in the world. It is self-evident that religious freedom is fundamental to ASA's existence and the religion-science dialogue in general. Thus, ASA should actively work to advance, defend, and uphold religious freedom in the sciences and engineering professions. I contend that ASA needs to become an agent of change.

ASA can become an effective agent of change in the following three ways:

1. Corporately call upon America's major scientific and engineering professional societies to amend their constitutions, by-laws, and policies as necessary to incorporate the standard "anti-discrimination" language (i.e. the societies will not discriminate in membership on basis of sex, age, nationality, color, race, religion, etc).

2. Corporately call upon these major professional societies to establish policies requiring similar "anti-discrimination" language in the constitutions, by-laws, and/or policies of major professional societies in other countries with which they establish formal ties.

3. As individual members, advocate the same proposal within the major professional societies to which they hold membership. If my experience is illustrative, positions of leadership and influence in these professional societies go begging, and these organizations are quite responsive to the expressed interests of their membership.

My proposal may not seem like much in light of the religious persecution and other human rights issues in the world, but it is something worthwhile and feasible that might help persuade more people to join ASA and/or retain their membership. More importantly, it would be a sign of solidarity/brotherhood to Christians and others in the sciences and engineering professions who face persecution for their religious faith. ASA is a membership organization, everyone's voice counts, so please give the ASA Council (and others ASAers) the benefit of your thoughts by email, telephone call, and/or letter. *

Notes

[1]www.carsonversusdoe.com
[2]www.asa3.org/ASA/aboutASA.html
[3]www.asa3.org/ASA/faithASA.html
[4]www.carsonversusdoe.com/amicus.htm is an example derived from the 1977 BART brief of the IEEE

Intelligent Design and Metaphysics

by Donald O. Van Ostenburg, ASA Fellow, Emeritus Professor of Physics, DePaul University, Chicago, IL
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One of the unresolved questions in the contemporary Intelligent Design (ID) movement is, "How does divine action take place in the world?" George L. Murphy in his recent article says: "We must begin with the affirmation that God does indeed act in the world and in fact that God is involved in everything that happens in the universe."[1] When we speak of the universe, we must grasp the scale of sizes involved—distances much smaller than atomic nuclei to greater than the farthest galaxy.

John 1:1-3 tells us that before anything existed there was Christ with God and he created everything there is—nothing exists that he did not make. How did he do it? He did this by speaking his Word. In Col. 1:15-20, we are told that through Christ all things continue to exist and are held together. Thus, creation/evolution is not only a historical event, but a continuing present reality.

How is one to merge this with the ID concept of mind-like action (designing) with hand-like action (building)? As is known from special relativity, we live in a world of four dimensions—three of space and one of time—or in a space-time continuum. Recent string theories say the universe has eleven dimensions—that is, a hyperspace. We live in a multidimensional universe. The world we see, hear, and feel is the three-dimensional surface of a vast four-dimensional sea, with time as a fourth coordinate of the hyperworld.

As early as 1893, Arthur Willink suggested that God lives in the ultimate infinite dimensional space—a Hillbert Space.[2] More recently, Martin Gardner's article in *Scientific American* investigated the concept of the fourth spatial dimension,[3] and was reviewed by Rudy Rucker in *The Fourth Dimension*.[4]

In summary, what lies outside our four-dimensional, space-time continuum is the world of God, a world of five or more dimensions. In this world, no longer is theology embarrassed by the contradiction between God's immanence and transcendence. Hyperspace touches every part of three-dimensional space. God is closer to us than our breathing. He can see every portion of our world, touch every particle without moving a "finger" through space. Yet the Kingdom of God is completely outside three-dimensional space, in a direction we cannot even point.

To an eye in God's space, whatever higher dimension this may be, there is a perfect revealing of hidden and secret things.[5] Thus, God is omniscient and has a perfect view of our being. In this sense, in him we live, move, and have our being. He is continually creating and holding things together by his Word. God can always be designing and building for the purpose of his own glory as we read in Col. 1:16. Why not let metaphysics, spirituality, etc. be more prevalent in our thinking for, as it says in Acts 17:27, "God is not far from us"?

H. J. Van Till has enlarged the ideas of Augustine and Basil and has suggested that God has given to inert matter "Robust Functional Integrity."[6] In this scenario, the creation has been equipped by its Creator to do whatever the Creator calls upon it to do. A hyperworld would put creation where it is, directly in God's "hands"—not in the matter he created.

Throughout the billions of years of earth's history, Christ designed and created the first irreducibly complex life forms from the simplest to the more complex. We see a timeline of his creation in this history of our world as we view fossil remains from the Precambrian to the present. *

Notes

[1]George L. Murphy, "Chiasmic Cosmology and Creation's Functional Integrity," *Perspectives on Science and Christian Faith* 53, no. 1 (March 2001): 7-13.
[2]Arthur Willink, *The World of the Unseen: An Essay on the Relation of Higher Space to Things Eternal* (New York: MacMillan, 1893).
[3]Martin Gardner, "An Adventure in Hyperspace at the Church of the Fourth Dimension," *Scientific American* (Jan. 1962): 136-43.
[4]Rudy Rucker, *The Fourth Dimension: A Guided Tour of the Higher Universes* (Boston: Houghton Mifflin Co., 1984), 59.
[5]Ibid., chapter 11.
[6]H. J. Van Till, "Is Special Creationism a Heresy?" *Christian Scholar's Review*; see Science and Religion Resource CD-The John Templeton Foundation: 400-16.

Book Reviews

ETHICS

GOD'S COVENANT WITH ANIMALS: A Biblical Basis for the Humane Treatment of All Creatures by J. R. Hyland. New York: Lantern Books, 2000. 126 pages. Paperback; $14.00. ISBN: 1930051158.

Hyland is an ordained minister who has worked in prison ministry and currently works with migrant farm workers. She edited *Humane Religion*, a bimonthly journal, for several years, and has contributed numerous articles to religious periodicals. She is actively engaged in supporting issues of female equality and animal rights. Her previously published book, *Sexism Is a Sin: The Biblical Basis of Female Equality*, addresses the first of these two issues while this book addresses the second issue, that of animal rights.

As the title of the book suggests, the Hyland's goal is to provide biblical support for the thesis that all living creatures should be treated humanely. Much of this support is taken from the writings of the Old Testament prophetical books. Hyland suggests that the teachings of the latter prophets emphasized several themes including the importance of social justice, a rejection of ceremonial and sacrificial religion, and the inclusion of the animal kingdom in God's Kingdom of the future. Several passages are cited as evidence for her thesis that the man-made sacrificial system of the Old Testament, which flourished under the supervision of the priesthood, was an abomination in the sight of God and needed to be abolished. According to Hyland, the prophets not only condemned the practice of animal sacrifice, but also tried to reestablish the teaching contained in the book of Genesis regarding God's care for and covenant with the entire animal kingdom.

In addition to passages from the prophetical books of the Old Testament and the book of Genesis, other evidence is cited from the life and ministry of Jesus Christ. Jesus reminded the Jewish people that the prophets had called for an end to sacrificial worship and he also predicted that this system of worship would end with the destruction of the temple in Jerusalem. According to Hyland, Jesus continually revealed a God of compassion whose concern extended to all creatures. This is supported by the comparison of his role to that of a good shepherd who is continually concerned about the welfare of the flock. The author also uses the incident of Jesus cleansing the temple as evidence for the need to abolish the Old Testament sacrificial system, a system based upon the use and abuse of helpless animals. One additional line of evidence from the New Testament is derived from the book of Revelation, which records the fact that all kinds of God's creatures will be represented in heaven.

After supporting her main premise from selected passages of Scripture, the author describes several ways in which the humane treatment of animals can be directly applied to our contemporary lives as Christians and to our society as a whole. Hyland condemns the wearing of furs, the practice of recreational hunting, and the use of animals in medical experiments. She also strongly suggests that a vegetarian diet is preferable from a biblical perspective as well as from a human health perspective and that many of the books listed in her recommended reading section deal with this theme. For Hyland, the Kingdom of God come to earth is a kingdom in which justice, compassion, and love for all creatures should be a reality. In this kingdom, humans and nonhumans are to live in peace with their own kind and with all other species as well.

The author is to be commended for writing about a subject that is rarely discussed among Christians or addressed from the pulpit. Her explanations of various biblical passages are both interesting and thought provoking. One criticism, however, concerns the selectivity of the biblical material used to support the book's main thesis. The author makes that assumption that the entire sacrificial system of the Old Testament was an invalid form of worship. While it is certainly true that this system was abused during the time of the prophets and needed to be reformed, the book of Leviticus claims that the system was instituted by God, and a number of laws were included to ensure that this system of worship was properly maintained. The only place where a passage from Leviticus is mentioned is in the appendix, where it is argued that sacrificial religion was initiated by humans to legitimize their desire to consume animal flesh. There is no discussion of the dietary laws listed in the book of Leviticus, the observance of the Passover in the book of Exodus, or the Old Testament justification for the doctrine of the atonement.

Another criticism centers upon the author's treatment of the doctrine of the atonement in the New Testament. According to Hyland: "The God whom Jesus came to earth to reveal was nothing like the God of Paul's understanding" (p. 71). Hyland argues that Paul constructed his own theory of Christ as the sacrificial victim for the forgiveness of sin and that the Christian church has erroneously propagated this theory. By suggesting that Paul's understanding of Christ's death was flawed, the author calls into question the authority and teaching of the Pauline epistles as a whole. In choosing to regard any biblical passage which poses a challenge to the book's premise as false teaching, the author undermines her own "biblical basis" for the humane treatment of all creatures.

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FAITH & SCIENCE

CAN A DARWINIAN BE A CHRISTIAN? The Relationship Between Science and Religion by Michael Ruse. New York: Cambridge University Press, 2001. 242 pages. Hardcover; $24.95. ISBN: 0521631440.

Ruse's parents were Christian believers for whom he had the greatest respect. Nevertheless, Ruse is an agnostic. But that is not the point of this stimulating book. Ruse wishes to establish what it is to be a Darwinian and to be a Christian, where the positions agree and where they are in

tension, whether it is possible to hold both views simultaneously, and on what terms.

Many people will not be happy with Ruse's argument that some form of Darwinism is true, and if Christianity cannot be harmonized with it, Christianity must be discarded. However, Ruse bends over backwards to be fair to Christianity, using the work of Christian thinkers – particularly Ronald Fisher and Theodosius Dobzhansky – whenever possible. And he delights in using the work of E. O. Wilson and Richard Dawkins to support a Christian position within Darwinism.

I did not find Ruse's discussion of miracles satisfying. Ruse enunciates the liberal Christian's theological objection, that anything extra-natural makes God a conjurer. But Ruse only scratches the surface of the conservative Christian position, noting that, in this view, extra-natural miracles fit into the *super*natural regularities of God's plan for us and for the universe. To be fair, none of this is Ruse's concern; he simply wants to point out that acceptance of supernatural miracles is intellectually defensible. "There is nothing in Darwinism, or in the notion of science that it supports, which says that your commitment is wrong or stupid. Yours is not a scientific commitment, but you knew that already."

Ruse has much to say on the problem of natural and human evil. "Darwinism stresses the natural evil in the world ... [opening] the way to the Christian response ... if you are a Darwinian looking for religious meaning, then Christianity is a religion which speaks to you. Right at its centre there is a suffering god, Jesus on the Cross. This is not some contingent part of the faith, but the very core of everything."

Furthermore, Ruse points out that God cannot do the impossible: it may be that the existence of free, intelligent creatures requires the universe to be as it is. "The Darwinian supports this argument; ... you cannot get adaptive complexity without natural selection." And you cannot get natural selection – or perhaps even a knowable universe – without pain.

Ruse is not sure that the exchange – autonomy, intelligent sentience and hope, for pain and suffering – is worth it. But Darwinism supports the legitimate Christian position that we cannot know as God knows; "as a Darwinian you ought to be dubious about thinking that your selection-based attributes and powers ... give you total insight into ultimate metaphysical reality."

Nevertheless, there are tensions here. Sociobiology, which allows us to explain both original sin and our moral conscience, leads to relativism: what is moral in one time and place might be immoral in another. Furthermore, Ruse does not address how Darwinist explanations could be used to make sense of the Christian's realization that the universe is fallen, imperfect: if the universe must be what it is, how can it be fallen? Here John Haught's *God After Darwin* – to which Ruse does not refer – is helpful: creation is a work in progress, unfinished until God's purposes are fulfilled.

Ruse concludes that the answer to his question is affirmative, and yet ... "Is the Darwinian obligated to be a Christian? No, but try to be understanding of those who are. Is the Christian obligated to be a Darwinian? No, but realize how much you are going to foreswear if you do not make the effort, and ask yourself seriously (if you reject all forms of evolutionism) whether you are using your God-given talents to the full."

This book has received high praise from both Christians and non-Christians working in the science-and-religion field. It has its limitations and disappointments; a few of them are pointed out above. A non-Christian himself, Ruse does not present a fully coherent Christian position within Darwinism. But he points to many ways in which such a position may be defined. This book is highly recommended for all serious Christians, especially those who also wish to take science seriously.

Reviewed by Daniel J. Berger, Professor of Chemistry, Bluffton College, Bluffton, OH 45817.

WHEN SCIENCE MEETS RELIGION: Enemies, Strangers or Partners? by Ian G. Barbour. New York: HarperCollins Publishers, 2000. 204 pages, index, notes. Paperback; $16.00. ISBN: 006060381X.

In 1991, Barbour published *Religion in an Age of Science: The Gifford Lectures, 1989–1991*, Volume 1. So well received was this book for persons concerned with science/religion boundary issues that he issued a revised, retitled *(Religion and Science: Historical and Contemporary Issues)*, and expanded edition of it in 1997. The second of these holds a place of prominence on my own library shelf.

Religion and Science is a difficult read, however, and its 366 pages (of very small text) have turned away many readers. *When Science Meets Religion* is Barbour's attempt to summarize and make clearer his arguments on a somewhat less scholarly level. He has succeeded admirably.

Barbour is retired from Carleton College where he was both a professor of physics and a professor of religion. Among his other well-known publications are *Ethics in an Age of Technology* and *Myths, Models and Paradigms*. He was the recipient of the Templeton Prize for Progress in Religion in 1999.

Those who have read my book reviews in *PSCF* before know that I often refer to significant publications as "keepers." This one is beyond that designation. For all ASA members, who are presumably interested in science/faith issues, this book is a requirement. I cannot recommend it too highly.

Barbour's masterpiece can be described best structurally. He posits four wholly separate ways of thinking about science and religion: Conflict, Independence, Dialogue, and Integration. In chapter 1, he discusses each of these. In chapters 2, 3, 4, and 5, he considers four areas of study which each view must necessarily consider: astronomy/creation, quantum physics, evolution, and genetics. In each chapter, he discusses each model, so one can visualize this book as setting forth, in clear and persuasive prose, each of the four ways of viewing science/religion for each of the four issues, a very neat 4 x 4 matrix. It may be of interest to those familiar with his earlier works that his previous subcategory, "nature-centered spirituality," is omitted entirely in this volume. It is not clear if he has abandoned it or has left it out for reasons of space.

Barbour treats fairly the claims of the Conflict model, but argues against it. He accepts some of the insights of the Independence model, but, in the end, casts his lot with the proponents of Dialogue and Integration.

In a concluding chapter, "God and Nature," having argued that both the Conflict and the Independence models are unsatisfactory, Barbour discusses how God's actions in this world can be seen as consistent with a universe of apparent causality. Here he treats the models of Murphy, Polkinghorne, Whitehead, and others; having done so, he leaves the evaluation of these models to the reader. He concludes:

> All models are limited and partial, and none gives a complete or adequate picture of reality. The world is diverse, and differing aspects of it may be better represented by one model than another ... the use of diverse models can keep us from the idolatry that occurs when we take any one model of God too literally. Only in worship can we acknowledge the mystery of God and the pretensions of any system of thought claiming to have mapped out God's ways (p. 180).

The $16.00 cost for this book may well be the best book money you have ever spent.

Reviewed by John W. Burgeson, Stephen Minister, First Presbyterian Church, Durango, CO 81301.

GODFARING: On Reason, Faith, and Sacred Being by Francis Clark. Washington, DC: Catholic University Press, 2000. 229 pages. Paperback; $24.95. ISBN: 0813209595.

Godfaring is the author's lifetime ruminations on faith and reason, particularly as relating to natural theology. Francis Clark uses his prowess as a former theology professor from the Pontifical Gregorian University, to show how Catholicism harmonizes with natural theology, views the role of non-Christian religions, and addresses one of the grand questions of Christianity, i.e., the problem of evil.

Clark has written a dense text requiring some determination to uncover the nuggets buried within complicated sentence structures and obscure terms such as otiose, regnocentrism, and ecclesiocentric. Clark's discussion of universal salvation provides an example of both the prose and theological persuasion that pervades the writing.

One may distinguish two different senses in which the non-Christian religions are said to be communities of salvation. In the second sense, which is more questionable theologically, the proposition is interpreted to mean that the non-Christian religions serve, each in its own pattern of creed and cult, as divinely sanctioned pathways of revelation and salvation in their own right, parallel to—yet independent of—that of Christianity, leading their adherents to the ultimate union of all believers in the eschatological Kingdom of God, towards which all religions converge (pp. 82–3).

Clark draws heavily from the Catholic catechism and papal writings to develop an overly optimistic natural theology and role for human reason. "Thus the age-old and sternly exclusivist interpretation of the Christian doctrine of salvation has been finally discredited as a historic misinterpretation" (p. 70). Several of the early chapters examining the possibility of salvation through a natural theology or non-Christian religions are at odds with arguments presented in later chapters, particularly in "The Dark Mystery of Evil" (chap. 11). However Clark provides valuable insight into the human condition and asks several penetrating questions. He writes: "We are all children of the same Father, all bearing his lineament. In all faces is glimpsed the face of God. Why is it, then, that the company of those kinsfolk in God's family does not lead us more easily to him? Why, rather, do contemplative souls often find deeper awareness of God's presence in solitude, away from human beings rather than in the midst of them?" (p. 178).

Godfaring is a synthesis relating Catholic thought to reason, faith, and natural theology. The book has a distinct niche for Catholic scientists and provides a valuable summation of natural theology from a Catholic perspective.

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

THE HEALING CONNECTION: A World-Renowned Medical Scientist Discovers the Powerful Link Between Christian Faith and Health by Harold G. Koenig with Gregg Lewis. Nashville: Word Publishing, 2000. xii + 211 pages. Hardcover; $21.99. ISBN: 0849916224.

Geriatric psychiatrist Koenig, founder of the Center for the Study of Religion/Spirituality and Health at Duke University Medical Center, has spent one-quarter of a century doing research related to religion and health and analyzing the findings of his own and others' studies. This autobiographical study for the first time narrates events and experiences of his own life, interweaves accounts of his research with clinical experiences, and points to applications for Christians in medical practice, research, and ministries.

Details of the story of his early life include tribulations and hardships associated with his education, the use of drugs, experiences at Jane Goodall's Chimpanzee Project in Tanzania, climbing Mt. Kilimanjaro, searching for truth and meaning through Eastern and New Age religions, physical injury, divorce, expulsion from medical school and later readmission, and stages in his career that are better read than summarized. Along the way, a Christian spiritual awakening brought inner peace and strength, especially through The Living Bible. Isaiah 61:1–3, a growing knowledge of "the plight of the elderly" in America, and Matt. 25:34–40 gave him a deep sense of God's calling to serve the elderly and people suffering from depression. Medical practice "was no longer just my profession; it became a ministry to others. And it would become my way to serve Jesus" (p. 73).

His commitment was deepened through participation in an influential congregation and a personal pilgrimage to Rome and Israel during a break from his third year of residency. "Just a week spent walking in Jesus' footsteps had such a profound impact on me that I determined to spend the rest of my life trying to follow him" (p. 80). Marriage to a committed Christian, growth in spiritual maturity, learn-

ing the significant role of personal spiritual experiences in the lives of elderly patients, a fellowship in geriatric medicine, a residency in geriatric psychiatry, appointment to Duke's faculty, and finding that nearly one-third of patients surveyed had spiritual experiences similar to his own were elements of preparation for the conviction that he should publish God's glorious acts (Psalm 96:34, Living Bible). The result has been fourteen books prior to this one, forty book chapters, over twenty-five research projects, and some 150 professional articles examining the effects of religious faith on physical and mental health (p. 93).

Chapters 9–11 summarize twenty-three generalizations from the findings of some 1,200 studies. "The pile of evidence is growing and showing that spiritual faith has a very real, scientifically measurable, and positive association with mental and physical well-being" (p. 125). The only negative discovery is that those who frequently attend religious services are more likely to be overweight. On average, people with negative religious beliefs and behaviors have worse health than others (p. 148).

Chapter 12 summarizes and critiques the "red flags" thrown up when faith does not heal, an experience Koenig himself is now familiar with, for he suffers from a slowly progressive disabling arthritis. Then Chapter 13 summarizes what the research means—religious faith and practice are connected to mental and physical health, and God can and will use illness to heal us more completely and at a deeper level than could be possible in any other way. How Christians ought to respond to the research findings (with encouragement, hope, concern, and compassion) is the focus of Chapter 14. Among other things, we need to help those who are ill and disabled to identify their particular gifts or talents and give them opportunity to use their gifts to serve God by serving others.

The book concludes with "The Call to Care" (chap. 15), which emphasizes the importance of ministering to three categories of twenty-four psychological and spiritual needs—those related to self, to God, and to others. "What amazes me ... is how the Christian faith addresses each of these needs so directly. ... the Great Physician's example and his admonitions about caring for those who are sick have never been more relevant than they will be in the years ahead" (pp. 210–1).

This is Koenig's first account of the ways in which his personal life experiences and especially his faith in Christ interact with his medical research. It is not a bibliographical resource and is not even indexed, but it is a powerfully moving testimonial to the power of God and the fact that careful scientific research affirms the truth of Scripture.

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WHO IS GOD? Integrating Faith and Learning to Address This Question by Robert B. Fischer. Bloomington, IN: 1stBooks Library, 2000. 168 pages. Paperback; $9.95. ISBN: 1588202429.

Fischer, with a Ph.D. from the University of Illinois, is a longtime member of the ASA and many readers may be familiar with his book *God Did It, But How?* He has spent much of his life in academics at both secular and Christian universities.

This book addresses the challenge of the integration of faith and learning through a discussion of the nature of God. The discussion is framed by the answer given in the Westminster catechism. Scientific findings and theories are used to illustrate explanations of the catechism's answer. Though the book contains numerous discussions of physical systems and phenomena, there are no illustrations (except the one on the cover), notes, or supplementary materials other than a single page summary that appears at the end of the text.

The book begins with a brief discussion of the meaning of God from various religious perspectives and then focuses on the Christian definition as provided by the Westminster catechism. The author discusses how special and general revelation can both provide insight into this definition. The nature of special revelation is discussed with respect to inspiration and interpretation. The nature of general revelation is discussed with respect to the scientific method and scientism. A methodological discussion of the catechism's answer is then given using references to both special and general revelations. The references to general revelation range from cosmology to subatomic particles. The wonder and breadth of the general revelation are used to illustrate such concepts as infinite as a descriptor for God.

The theme of this book is that both general and special revelations contribute to learning and to faith and that faith and learning contribute to our understanding of both special and general revelation. This idea is nicely illustrated on the cover of the book where learning and faith appear in a column on the left and general and special revelation appear in a column on the right. Lines are drawn from each of the items on the left to both items on the right. The author explains these concepts in his usual clear and readable manner. Fischer does not present anything new in the way of theology or scientific theory. What is unique is his example of how the study of science can be integrated into a discussion of the Christian faith.

This book would be a supporting text for those who hold to the reformed tradition of the integration of faith and learning. The book is also valuable instruction for those in academics who are endeavoring to integrate faith into the content of their discipline. Unlike many books that may address apparent conflicts between faith and science, this book exemplifies the integration of faith and learning. What is notably lacking in the book, and what could significantly improve and expand upon the desired impact of the scientific discussion, are illustrations. Illustrations, such as the one on the cover, would have been very helpful to explain the concept of the integration of faith and learning and to accompany the scientific discussions of such topics as cosmology and subatomic physics. The lack of effort to provide illustrations, references, notes, or a bibliography is disappointing.

Though the book has its shortcomings, it is still a book that can be read both for its intellectual discussions and for its meditative value. The book is edifying for those who know God and may be a revelation for those who do not.

It clearly presents the Gospel of Christ in a unique manner that makes use of both special and general revelation.

Reviewed by Gary De Boer, Assistant Professor of Chemistry, LeTourneau University, Longview, TX 75607-7001.

CAN SCIENCE BE FAITH-PROMOTING? by Sterling B. Talmage. Salt Lake City, UT: Blue Ribbon Books, 2001. 253 pages. Paperback; $18.95. ISBN: 0963473239.

Sterling B. Talmage (1889–1956), son of James E. Talmage, was a teacher, geologist, and writer. Both Talmages taught geology with Sterling teaching at the University of Utah. The Talmages were both spokesmen for old-earth geology and evolution as faith promoting. They were members of the Church of Jesus Christ of Latter Day Saints (LDS) and their writings are specifically addressed to science-related theological issues within the LDS. Much of the work of Sterling B. Talmage is archived at the University of Utah Marriott Library.

This book is a reprinting of the original written in the 1930s. It is introduced with several essays describing the historical setting of the original publication. In addition, it contains a section of correspondences. These are correspondences from LDS clergy and both Talmages. Taken together, these three parts—the introduction, the book itself, and the correspondences—make for a far more dramatic reading than one would expect for a book of this genre.

The body of Talmage's book is arranged into four parts. The first part discusses the question of whether science can be faith affirming. In this section, Talmage first defines several terms such as science, faith, creation, natural, supernatural, dogmatism, open mindedness, scriptural, fundamentalism, modernism, and evolution. With these definitions, he introduces the idea of science versus faith as a pseudo-issue and prepares the reader to engage in a productive discussion of the science and theology to come. He then continues with a discussion of the findings of science in the areas of astronomy, physics, chemistry, paleontology, and biology. The summation of this presentation is to state that the evidence for an old earth and an older universe is overwhelming and that the idea of an old earth is not unscriptural.

The second section of the book discusses creation based on the scientific evidence presented in the first section and a theological discussion that includes references from the Bible and other works that are part of the LDS. Much of this discussion relates to methods of interpretation: literal, figurative, and how to make the judgment of which method should be applied. Talmage strongly states that a literal interpretation of some scriptural passages does a disservice to the reader. He relates these discussions back to the definitions he offered earlier in section one.

The third section of the book is devoted to the discussion of evolution and whether it can be faith-promoting. Talmage discusses the principles of evolution, the geological record, and the evolution of humans. He protests the idea that the evolution of humans is unscriptural. He says it may be nonscriptural, but it is not unscriptural. Talmage states the study of natural law is faith-promoting. He says we must think of God not as a magician wielding miracles but as "the great engineer, the designer, and operator of the universe." Talmage defends the methods of science in determining the natural processes involved in the creation of the universe and states that such efforts do not undermine faith, but affirm faith. He continues his discussion of human evolution in the fourth section of the book with respect to the evolution of Adam, and the existence of "Pre-Adamites." Much of his theological discussion of human evolution comes from the LDS book *Doctrines and Covenants*.

Talmage makes a strong argument that science can be faith-affirming. Although the book was written in the 1930s, the discussion is not dated and the issues presented are still timely. Talmage writes as a geologist and as a person who is striving to better understand his faith and gain a closer walk with his God. The introductory essays and the collection of correspondences give a glimpse of the people and ideas of the time. The correspondences of Talmage with his father and with the leading clergy of the LDS are especially interesting. The book is not easily put down because of wanting to know what might happen next. Though this makes for exciting reading, it also illustrates the challenges of scientists who choose to confront anti-science ideas within their church and community. The book then becomes more than a scientific and theological discussion of science and faith. It becomes the personal story of scientists dealing with anti-science elements within a beloved church.

This is a book that can be read for its discussion of science and faith and for the story of Sterling B. Talmage. For these reasons, it is suitable for those who want to learn more about the issues surrounding the debate of evolution and "creation science" and for those who find themselves in a similar teaching role as Sterling B. Talmage.

Reviewed by Gary De Boer, Assistant Professor of Chemistry, LeTourneau University, Longview, TX 75607-7001.

CREATION AND THE ENVIRONMENT: An Anabaptist Perspective on a Sustainable World by Calvin Redekop, ed. Baltimore: Johns Hopkins University Press, 2000. 283 pages. Paperback; $19.95. ISBN: 0801864232.

A visit to the publisher's web site for this book states: "What the Amish can teach us about creating a sustainable world." Amish may be the most distinctive of Anabaptist groups but they are not the largest; Mennonites are the largest group of Anabaptists.

Identifying oneself as a Mennonite gives no clear indication of theology except for the requisite pacifism. This is one of the problems as well as one of the strengths of *Creation and the Environment*, an edited volume with fourteen contributors with a range of liberal and conservative views.

The first of the four parts of the book deals with human activities and their alteration of the creation. The chapter on population density mentions Garrett Hardin more than God and gives us little biblical reason to consider population control.

I was disappointed to find hints of syncretism in an article on the Amish view of the environment with such practices as honoring the god Donar and planting according to astrological signs. Remaining chapters in Part II deal with other aspects of Mennonite life in relation to the environment. Mennonites are one of the more active Protestant groups for environmental concerns in the political arena.

Section three of the book is "Anabaptists' Theological and Historical Orientation." Here, again, there is a diversity of theological views. Readers of *PSCF* would probably be most comfortable with the views of Thomas Finger. He states that the focal point of Anabaptist/Mennonite theological understanding is best expressed "... as the process that brings everything under the radical, living lordship of Jesus Christ." Amen! His chapter would make for good reading for *any* Bible-believing Christian interested in the environment.

This section of the book was also instructive for me to realize that the followers of Menno did not choose to be agriculturalists. Because of persecution, it was often the only option for them to survive.

Creation and the Environment concludes, appropriately, with challenges to care for the environment. Appendix A is a letter to the U.S. Congress from the Mennonite Central Committee (MCC) with the unabashed request to "... recommit government to preserving the beauty and diversity of creation ..." This is followed by the MCC statement on the environment, notes for each chapter, and a useful index.

Other denominations and groups of Christians have much to learn from the present work. For example, where is a Baptist view of the environment?

Creation and the Environment is a helpful, valuable contribution to the growing corpus of writing on Christianity and the environment.

Reviewed by Lytton John Musselman, Mary Payne Hogan Professor of Botany, Old Dominion University, Norfolk, VA 23529-0266.

HISTORY OF SCIENCE

GOD'S FUNERAL: A Biography of Faith and Doubt in Western Civilization by A. N. Wilson. New York: Ballantine Books, 1999. 354 pages + notes, bibliography and index. Paperback, $16.00. ISBN: 0345439597.

This title is bound to draw gasps from the Christian community, thinking that it advocates atheism. Nothing could be further from the truth. It is a comprehensive history of the rejection of God by nineteenth century intellectuals. The title comes from Thomas Hardy's poem by the same name—a sad ode to Hardy's own rejection of God's existence.

Wilson begins with the epistemological rejection of God by looking back at the effects Hume and Kant had on the Western World. Hume had removed the philosophical necessity for believing in God by questioning the idea that there is a mind behind the universe. Hume claimed that humankind anthropomorphized this Mind by making a human's mind the model or standard for the entire universe. Then came Kant's differentiation between noumena (things in themselves) and phenomena (that which we observe). Once it was admitted that the noumena could never be known in and of itself and that all we could actually observe were the phenomena, the entire nature of truth was changed. No longer was God the basis of truth, but phenomenalism became *the* sole determiner of truth. If it could not be observed, then it could not be discussed with any certainty.

Wilson then follows the effect of these issues on several notable nineteenth century intellectuals, many of whom are little known today. These include Jeremy Bentham, Hegel, Comte, Thomas Hardy, George Elliot, Swinburne, Marx and many others. Each came to the conclusion that God did not exist. Some of them came to that conclusion very reluctantly; others easily and enthusiastically.

Two extremely sad stories stood out, at least to me. The first was the contrast between the Newman brothers, John Henry, a well-known Catholic mystic, and his brother Francis, a man who rejected Christianity in the 1820s because of its bigotry toward other religions. Francis, the apostate, decried the bigotry, yet John, the better-known of the two, wrote that the Christian should be more bigoted! John, the Christian, spent his life breaking off relationships with those who disagreed theologically.

The other sad story is that of the atheism of Edmund Gosse, son of Phillip Gosse who wrote *Omphalos*. Edmund's story of his father's rejection of Christmas celebration as a pagan, popish affair extended to even the banning of plum pudding from the Gosse household. When a servant fed the young Gosse a slice of this forbidden fruit one Christmas, the elder Gosse violently disposed of the offending material, leaving a lasting impression on the young child which ultimately bloomed into full-blown atheism.

The one failing of the book is that it is too often without emotional impact. The subject screams for more description of these people's personal struggles in giving up Christianity and belief in God. Yet with few exceptions, the emotional impact is lacking. This may be in part because there is too little material preserved describing these struggles, or it may be that the author remained a bit too academic.

The book documents incredibly well the intellectual tenor of the nineteenth century. Modern Christian characterizations which focus on Darwin and Lyell as the chief culprits in the rejection of the Bible miss entirely the fact that on all levels of society and in all disciplines people were questioning the authority of God. Christians should read this if for no other reason than to clearly understand what happened.

But the reader should understand that Christians are not portrayed very kindly on the pages of this book. We should pay attention to how we appear to others. Examples from early and late include St. Simeon Stylites, whose main claim to Christian fame is not a charitable life, but the feat of living atop a column for thirty years, the young Christian woman who was convinced that the Crystal Palace was of the devil giving her license to smash sculpture there, and Carylyle's claim that Christians, who

ignore observational data, try to steal into heaven by sticking their heads, ostrich-like, into fallacies on Earth. There is a certain truth in all that. This sad book is one that should be read!

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THE SCIENCE OF MAN IN ANCIENT GREECE by Marta Michela Sassi. Translated by Paul Tucker. Chicago: University of Chicago Press, 2001. 224 pages, xxix, bibliography, index. Hardcover; $34.00. ISBN: 0226735303.

Anthropology is a broadly framed discipline that examines all aspects of human life and culture. In the US, the main subfields are archeology, cultural anthropology, linguistic anthropology, and physical anthropology. Europeans often use different terms to describe these subdisciplines (ethnology over cultural anthropology) or do not include them (archaeology and linguists) as disciplines of anthropology.

Sassi teaches at the Scuola Normale Superiore in Pisa. *The Science of Man in Ancient Greece* reminds us that the field has ancient roots. The Greek desire to make sense of the world included the studying of aspects of human nature that make us different, that is, men from women, slaves from freemen, etc.

This ground-breaking study of Greek texts (Homer, Aristotle, Plato, pre-Socratic, Hippocrates, Galen, etc.) is an English translation of the revision of her groundbreaking 1988 work. Sassi says:

> I show that something very broadly (but precisely) definable as an anthropological discourse did exist through an examination of a wide range of texts. I also identified some especially significant areas, such as physiognomics, ethnographic observations, and medicine, where it is possible to reconstruct a set of rules (no less influential for being unwritten) that guided the selection and assessment of the *signs* of difference offered by the human body and ordered them in a discourse on the passions and their psychophysical foundation and on a destiny of illness and death predicted on the basis of the individual's life history (pp. xi-xii).

The five chapters, "The Colors of Humanity," "The Physiognomical Gaze," "Reality and Its Classification: Woman and Barbarians," "Prediction and Norm," and "Framed by the Stars," offer a tightly woven and extensively referenced account of Greek attitudes. One is not shocked to find the Greek male at the top of the ancient pecking order.

Chapter Five, "Framed by the Stars" contains one of the few references to the place of religion in this study. Astrology fused science and religion in many ancient cultures. The gods that inhabited the sky "manifested themselves in a variety of signs ... that gave stellar divination enormous vitality and prominence over all other forms" (p. 162). Ptolemy had a large influence with his four-volume astrological treatise *Tetrabiblos*. Ptolemy said: "... the Sun [male] affects the right-hand side of the body (as well as the faculty of sight, the brain, the heart, and the nerves), while the Moon (female) affects the left (as well as the digestive organs and the uterus)" (p. 167). What had originally been a symbolic classification had been translated into physical properties.

The value of this fascinating work is enhanced by twenty-two illustrations drawn from the art of the period. It is a reminder that bias based on gender, race, and class is not a recent phenomenon. This work belongs in institutional libraries and in the hands of those who work in the field.

Reviewed by John W. Haas, Jr., Emeritus Professor of Chemistry, Gordon College, Wenham, MA 01984.

EVOLUTION'S WORKSHOP: God and Science on the Galapagos Islands by Edward J. Larson. New York: Basic Books, 2001. 243 pages, illustrations, appendix, endnotes and index. Hardcover; $27.50. ISBN: 0465038107.

ASAers who heard Edward Larson's Templeton Lecture at the 2001 annual meeting or read it on a listserv were introduced to major themes of this, his latest publication on science, religion, and evolution. To those whose curiosity was piqued to venture further, I recommend his book. *Evolution's Workshop* weaves exploration and specimen collecting, national and scientific rivalries, ecology and tourism, and conflict over interpretation and meaning into an engaging story about the history of an archipelago, the Galapagos, and their effects upon science and religious belief.

Larson divides this story into three sections. "Part One: Creationist Conceptions" traces the story of European and American visitations through the mid-nineteenth century. We see that Darwin saw the Galapagos through Lyell's eyes, but learn how, in the years following his 1835 visit, the creationism of his intellectual mentors Paley and Lyell gave way to his new conception of transmutation. He credited the species on the Galapagos as "the primary source 'of all my views'" (p. 77). However, those famous finches were not the birds that spurred his thinking, rather, the island's mockingbirds provided an early clue to evolution.

In "Part Two: Evolutionary Debates," Larson parades a cast of champions who entered the lists for or against Darwinism. Louis Agassiz used his journeys to the Galapagos to reinforce his special creationist and anti-Darwinist views. Disciples like David Starr Jordan accepted evolution but favored neo-Lamarkian mechanisms. Jordan sent out a number of American collectors, whose specimens for California museums sought to rival the immense and varied gatherings of Galapagos animals and plants funded by Englishman Walter Rothschild. Jordan favored geographical isolation as a primary factor in speciation and downplayed natural selection, and with his colleague Joseph LeConte "shared a sense of the divine in nature" (p. 125). The California Academy of Sciences' expeditions, like others around the turn of the century, made collecting finches from the islands a secondary objective to other species, especially tortoises which were driven nearly to extinction by those who hunted them for zoos or food. And while their publications of these expeditions raised no doubts about evolution, the authors "offered little theoretical analysis about the specimens they collected" (p. 140).

These great scientific expeditions were succeeded by others sent out before World War II by wealthy amateurs such as Harrison Williams, who enlisted popular journalist William Beebe; his numerous pieces on the Galapagos and their famous inhabitants did much to stimulate public interest in the islands. One of the most important visitors for science was Julian Huxley's *protegé* David Lack. In groundbreaking studies of the Galapagos finches both on the islands and in collections, Lack reconstructed the speciation of the birds he named "Darwin's finches" and argued that the islands' ecology played an important role in their descent through adaptive radiation. In Lack's work theoretical analysis about life's history on the islands resumed its central place.

"Ecology Matters" is the title of Part Three. Larson traces how during the post-war years collecting yielded to studies of Galapagos flora and fauna in situ. Surveying Huxley's successful efforts to create an Ecuadorian national park and scientific research station there, the rise of "ecological tourism," the activities of several research scientists on the isles, and visits by influential nature writers such as Annie Dillard, Larson brings his natural and human history of the Galapagos to the present. "The archipelago," he notes, "remains 'a perpetual source of new things' for scientists more than one and one-half centuries after Darwin first proclaimed it so" (p. 239).

This is an interesting tale, and Larson knows how to lay out a complex historical narrative with clarity. The research he devoted to his subject is admirable, and the story contains many surprising facts that may delight the reader. However, this banquet of expeditions proceeds as one course upon another, and the reader is advised to take them in portions to avoid becoming surfeited. I do raise a question about the subtitle, "God and Science on the Galapagos Islands," for Larson has much more to say about science than about God. The religious views of his subjects are more touched upon than developed. A greater degree of detail and reflection on their views of God and nature would have enhanced the narrative and made the subtitle fulfill its promise.

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THE PURSUIT OF DESTINY: A History of Prediction by Paul Halpern. Cambridge, MA: Perseus Publishing, 2000. 250 pages, photographs, illustrations, notes, bibliography, index. Hardcover; $25.00. ISBN: 073820096.

The Oracle of Delphi, Newton's Obsessions, Freudian Slips, and the Eyes of Nostradamus all show how *prediction* emerged during the birth of modern science in the seventeenth and eighteenth centuries. Halpern, a professor of physics at the University of the Sciences in Philadelphia, Pennsylvania, is the author of many trade science books including *The Cyclical Serpent, The Quest for Alien Planets,* and *Countdown to Apocalypse.* In this present volume, he ponders the age-old question, "Can we predict the future?"

As Halpern points out in the Introduction, "Man's desire to foretell, understand, and ultimately explore the future is an integral part of what makes us human." History is replete with stories of humankind's attempt to calculate the future. Halpern shows how breakthroughs in science, humankind's perceived understanding of the cosmos, and an instinctual awareness of human behavior have all contributed to humankind's quest to employ forecasting methodologies.

In ancient times, envisioning the future was far from being a precise scientific task. Humankind went from scanning the skies and examining the entrails of sacrificial animals to expounding upon Einstein's concept of relative time and space in attempts to foretell "what's next." Drawing on modern theories of complexity, chaos theory, quantum theory, and relativity, Halpern explores the latest methods of scientific, social, and technological prediction.

This incisive and revealing survey of *prediction,* both as it has been determined in the past and how we perceive it scientifically today, is a smartly compartmentalized analysis of an intriguing part of humankind. Halpern's book is an expressive and articulate testament to people's insatiable appetite to understand their existence, accept their limitations, and foresee their future.

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NATURAL SCIENCE

TRAVELS TO THE NANOWORLD: Miniature Machinery in Nature and Technology by Michael Gross. Cambridge, MA: Perseus Publishing, 2001. 254 pages. Paperback; $16.00. ISBN: 0738204447.

Gross has a Ph.D. in physical biochemistry from the University of Regensburg, Germany. He is also the author of *Life on the Edge* and *Non-Standard Computation.* Gross writes as a science journalist and has published many science related news articles in the U.K. and Germany. For more information on the author, his books, and other articles, you may visit his web site at: www.michaelgross.co.uk.

The book surveys a very broad spectrum of nanoscale technology. It is organized into four parts: an introductory overview, a survey of some biological models, descriptions of some current man-made macromolecular biological systems, and a discussion of the future of nanotechnology. The reader will also find biographies of scientists and descriptions of experimental techniques. The book contains black and white illustrations that clarify the text, a glossary of terms, a list of further readings and Internet links, and an index.

The author hopes to provide a realistic vision of nanotechnology through examples of nanotechnology in the biological world and a survey of current manmade nanoscale materials and machines. The book's uniqueness lies in its unbiased, yet engaging, journalistic style. Gross communicates the promise and the challenges of nanotechnology without any overarching thesis or theme. It is a fair and informative analysis. The book is well written and is readable by a general audience while still being informative to those with more formal training in the sciences.

In evaluation we may wish to compare this book to other books in its genre. For example, if you enjoyed the science in Behe's *Darwin's Black Box*, you will also enjoy the science in this book. But unlike Behe, Gross has no problem with attributing the systems of life at the nanoscale to evolutionary processes. Though Gross differs in perspective from Behe, he also differs from the new age themes that nanotechnology will lead to future godlike humans as described by such nanotechnology zealots as Drexler. Gross provides a fair analysis of nanotechnology making use of guidelines that have been used to evaluate other emerging technologies.

Though the book is strong in its clear, balanced approach, one might make a case that the title is somewhat misleading. Of the ten chapters that span the four parts, only two provide any technical information on current nanotechnology, the rest is biology, philosophy, and predictions. Given the heavy emphasis on descriptive biology, a better title might be "*Understandings in Molecular Biology and its Implications for Medicine and Technology.*"

Travels to the Nanoworld is a book of descriptive molecular biology with a discussion of the possible implications of biological models for design of nanoscale machines. An overview of current technology and predictions for the future are discussed. Though the book is not written from a Christian perspective, the content is still valuable for Christians who are examining the ideas of intelligent design and evolution. Also, anyone with an interest in nanoscale science and nanotechnology will find this book a beneficial read.

Reviewed by Gary De Boer, Assistant Professor of Chemistry, LeTourneau University, Longview, TX 75607-7001.

THE QUEST FOR IMMORTALITY: Science at the Frontiers of Aging by S. Jay Olshansky and Bruce A. Carnes. New York: W. W. Norton & Co., 2001. 254 pages. Hardcover; $25.95. ISBN: 0393048365.

Aiming to give readers a better understanding of how and why people age and an expanded awareness of the realities of the aging process, length of life, and death, two biodemographic scientists survey the broad sweep of scientific knowledge related to mortality, longevity, and promises of earthly immortality. An underlying theme is the fallacy of the "life extension industry," which profits from hopes built up by exaggerated claims about products and services that have little or no basis in science.

Ten well-written and interesting chapters cover early views of philosophers and alchemists, modern developments related to length of life, selective breeding, antioxidants, alternative medicine, the genetic frontier, current antediluvian legends, and many other topics. Since 1993 the authors have attempted to test Gompertz's 1825 "law of mortality," concluding that there is on average a doubling of the risk of death about every seven years after puberty and that similar age-related changes occur in other animals as well. They coined the phrase "manufactured survival time" to designate the days people live beyond their normally expected longevity potential, concluding that "medical science may have already pushed human survival beyond the limits implied by a law of mortality" (p. 124).

The first longevity revolution has nearly doubled life expectancy at birth by human interventions in public sanitation, controlled environments, and the development of vaccines and antibiotics to help control various diseases. They predict that, during the second longevity revolution now in its early stages, "science will be used to manipulate the genetic instructions that determine the structure and function of the internal processes which give biological meaning to life and place limits on its duration" (p. 118). But they warn against errors of the pro-longevity "fountain of youth legends," poorly grounded claims for anti-aging products, assumptions that gains in longevity from conquering specific threats to life are additive, beliefs that eventually everyone will live to age 120, and the like.

Their main deficiency is a lack of attention to recent research on religious variables in relationship to longevity, health, and quality of life. (The most comprehensive survey is the *Handbook of Religion and Health* by Harold G. Koenig, Michael E. McCullough, and David B. Larson [New York: Oxford University Press, 2001], which critiques 1,700 studies in terms of their rigor of methodology and strength of findings.) Their references to religion are in a sketch of "the religious legacy" on longevity in the Bible and early Christian history (pp. 32–4), the "spiritual approach" of spiritualists (pp. 208–10), and scattered sentences mentioning the Old Testament, Jewish Midrash, Taoism, and the like.

Otherwise this is an excellent, solidly based, well-indexed overview, even though no documentation is provided for specific studies they mention. Since life is lived one day at a time, they conclude that it "should be a never-ending search for new ways to appreciate each day that is lived" (p. 217). The penalty for a relaxed lifestyle diminishes with advancing age, so those who survive to old age can, with moderation, afford to indulge themselves without fear of damaging their health or length of life, provided they continue exercising and have a diet that avoids known aging accelerators like excessive quantities of animal fat and processed sugars.

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PAIN: The Science of Suffering by Patrick Wall. New York: Columbia University Press, 2001. 184 pages, index. Hardcover; $24.95. ISBN: 0231120060.

This book offers an insightful, educational, and delicate look at our current understanding of pain. Written for both the novice and expert, it blends history, sociology, psychology, neurology, and physiology in its analysis. Wall is one of the world's foremost experts on pain and the co-editor of several related books, including *Textbook of Pain*. As a medically trained physician, Wall speaks knowingly and with authority.

Wall gives detailed descriptions of clinical observations from patients he has treated over the years. These encounters convey the complexity of pain, illustrated by the many patients with similar disorders, but with vastly different

perceptions of pain. As a scientist, Wall describes the proposed theoretical mechanisms of pain, and he gives the research supporting or disputing these various theories.

In the chapter on the "Philosophy of Pain," he explores the concept of dualism (the idea that the mind and body are separate entities). Some scientists believe an understanding of the principles which control the mind are beyond scientific reach. At best, science may be able to describe some of the process, but little of the mechanisms behind the process. Here is Wall's intriguing comment on this conundrum:

> A more cautious group of dualists see mental processes as operating on principles that are entirely different from those of the body but that will eventually be understandable in materialist terms, including obeying the laws of physics. However, we will take the approach that the abrupt frontier between body mechanisms and mental processes does not exist. Instead, I will propose that mind, body and sensory systems exist as an integrated unity serving the biological needs of the individual with no abrupt shift of fundamental mechanism.

In eleven chapters, Wall deals with most of the relevant issues connected with pain, especially the philosophical, physiological, and treatment considerations. He discusses both acute and chronic pain from a mechanistic perspective, with the psychological and social focus on the latter. The discussion on treatment deals with the mechanisms for how it works, but also delves into the realm of the placebo effect, and how one person's pain subjectively differs from another. Two engaging chapters compare the two types of pain: (1) pain with an obvious cause; (2) and pain without an obvious cause.

Illustrations are used in the early chapters in support of the mechanisms of pain, but they are not a major part of the book. A disappointing feature of the book is its lack of suggested readings and a bibliography. However, further information is available by tracing the citations cited.

Overall, Wall does an admirable job blending a variety of centrally and peripherally related topics into a well-written, concise, informative, and entertaining book on pain. It will provide valuable insights to anyone who teaches the neurology, physiology, or psychology of pain. Furthermore, it will be of interest for those who suffer from acute or chronic pain, which eventually includes everyone.

Reviewed by Stephen Bennett Ruble, Associate Professor of Exercise Science and Sports Medicine, Samford University, Birmingham, AL 35229.

ORIGINS & COSMOLOGY

THE CASE AGAINST EVOLUTION by Randal L. Nyborg. Mannford, OK: University Publishing House, 2000. 152 pages + references. Paperback; $7.95. ISBN: 157002118X.

The back of the book says that Nyborg, a certified public accountant, is the author of several books but does not list them. That is a shame because the reader may be curious about the topics this well-published author has covered. The book is published by University Publishing House which I found to be a curious, if overreaching, name. Mannford, a town of 2,500 near where I grew up, has no university in it but seems to have a University Publishing House.

The book has nine chapters covering micro- and macro-evolution, the origin of life, mutations, the fossil record, the evolution of humans, the evolution of earth, media analysis, evidence for a Supreme Planner and a conclusion. Each chapter follows the well-worn path of the young-earth anti-evolutionist repeating the same arguments cited by almost all other books of this kind. It is a shame that not a single original thought is to be found in this book, and I looked for one. But I was always able to find his arguments in earlier books originated by earlier authors.

The number of factual errors in the books are legion. Biochemists will be amazed to learn of the claim from this CPA that DNA is a protein. Botanists are informed that plants cannot grow without organic matter in the soil. Microbiologists will be astounded at the claim that organic compounds are not food for microbial life! (What on earth do they eat?) Microbiologists will also be surprised to hear that microbes have "millions of genes" rather than the 600–6,000 that we observe. Naturalists (as well as the club-footed pigeon I saw in Amsterdam last week) will be surprised to learn that only perfect animals can survive in the wild. Nyborg claims that those which are less than perfect automatically die. Someone should tell the toad found in a Canadian garden with eyes on the roof of his mouth that he had no right to survive (*Nature* [Feb. 2, 1995]: 398).

English teachers will learn that the spelling "thru" has now entered the language as a replacement for "through." Anthropologists will find the claim that the common ancestor between humans and chimps is now at three million years ago rather than the five million they (and genetic data) held. And finally logicians will learn that logical contradictions are no problem with one part of the book clearly contradicting an earlier part.

With only twenty-nine references in this book, most of the anti-evolutionary arguments are repeated without any attribution to the earlier sources from which Nyborg must have taken them. But more disturbing is the average age of his references. It is a useful tool when evaluating young-earth material to look at the publishing dates of the books and articles the work cites. In this case, the average reference date is 1970, positively Paleozoic by modern scientific standards.

The reader must be warned of a manufacturing problem with the book. It has cheap color printing on the cover. After accidentally and unknowingly getting it wet, the ink smeared across the cover. Not knowing that this was what had happened, I tried to clean that smudge off the cover with a damp cloth only to find that I was about to wash the cover clean. The reader should be warned so as not to get ink on his clothing or hands as I did.

The book will only be useful to those who are aficionados of young-earth creationist literature but certainly not to those seeking modern scientific knowledge or an interesting philosophical discussion of the creation/evolution area.

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THE DRAGON SEEKERS by Christopher McGowan. Cambridge, MA: Perseus Publishing Co., 2001. 218 pages, notes, index. Hardcover; $26.00. ISBN: 0738202827.

This is the tenth book by McGowan, professor of zoology at the University of Toronto. It is a history of the discovery and early years of paleontology when the world was becoming aware that an extinct form of life currently known as dinosaurs had lived in the past. The book covers the period from the early 1810s to the 1860s and discusses the roles played by both greater and lesser lights during this critical time in paleontology. McGowan does a good job of uncovering the strengths, weaknesses, foibles, and frauds of those involved. This is an interesting book to read.

McGowan begins with a brief account of the intellectual landscape as it was in the early 1800s. He discusses the great debate that had taken place about whether God could have created creatures that would ultimately become extinct. Cuvier was the one who finally settled that question in the affirmative.

After this brief introduction, he turns to the person who found the first dinosaur, an unsung and often ignored woman who made her living finding, preparing, and selling fossils. This was Mary Anning. Due to the popularity of Lyme Regis as a holiday spot for the wealthy of Britain of the 1810s, Mary was able to earn a living as a fossil collector and seller. By age of eleven, she had already sold her first fossil, an ammonite. Being from the uneducated poverty-stricken lower class and a woman, she was unable to gain a formal education. However, she educated herself by borrowing everything she could get on paleontology and making copies, not only of the text, but also drawing the pictures in exquisite detail.

In 1811, Anning found the first Ichthyosaur that was recognized for what it was, an extinct form of life even though its reptilianness was not recognized for another decade. In 1821, Anning discovered the first Plesiosaur. She sold the specimen to a Colonel Birch who let William Conybeare describe it. In his paper, Conybeare gave no credit to this poor, lower class woman who actually discovered the fossil. This was the treatment that Anning was to receive throughout her career. She found the fossils and the men took the glory. This was an excellent arrangement for the men of the aristocratic Royal Society.

Others who feature prominently in this book are William Buckland, Thomas Hawkins, Gideon Mantell, Charles Lyell, Richard Owens, and Charles Darwin. McGowan describes how the theological views of Buckland and Owens prevented them from coming to scientific truth about the transmutation of species. Mantell was a medical doctor who earned a place in the Royal Society because of his interest in dinosaurs but lost his medical income and family in the process. McGowan describes how Darwin had to withhold his transmutational views in order to get Owen, the world's greatest anatomist of the time and a creationist, to examine the fossils he had brought back from his trip on the Beagle.

But Hawkins is the most interesting character. He was an excellent fossil preparator who illicitly manufactured the missing pieces of his fossils with such skill that when he sold his collection to the British Museum, Buckland and Mantell did not catch the fact that large parts of the fossil specimens were faked. This fraud, to the tune of 1250 pounds (a fortune at the time), went undetected by Buckland and Mantell who had been charged with evaluating the worth of the collection. This fraud was to shake the English government and is the reason today that fossils have missing parts reconstructed with materials differing in color from the bone. This episode is reminiscent of some recent frauds coming from Liaoning, China, where poor farmers can make a fortune (to them) selling perfect or manufactured fossils. Hawkins, while richer, went crazy in his later life, suing anyone who suggested that he had defrauded the government or whom he did not like. These activities actually led to the incitement of a riot.

The book is a fascinating account which spares no one, not even the reader who has religious sympathies. One is faced with the fact of Conybeare, Murchison, Buckland and Owen's rejection of observational data based solely upon their theological conviction. This book acts like a mirror to make one wonder what beliefs modern Christians have blinded ourselves to for the purpose of saving our theology.

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THE SPARK OF LIFE by Christopher Wills and Jeffrey Bada. Cambridge, MA: Perseus Publishing, 2000. 260 pages, notes, glossary, index. $17.00. ISBN: 0738204935.

This is the fifth book by Wills and apparently the first by Bada. Wills is professor of biology at UC San Diego and Bada is professor of marine chemistry at Scripps Institution of Oceanography. This book is a well-written review of the history and the current state of the origin of life research. Divided into eleven chapters, the book covers, among other things, spontaneous generation, Miller's primordial soup, the origin of the earth, and the subterranean life that has recently been discovered.

Numerous issues are raised by this book. Wills and Bada acknowledge that life appeared extremely early in the history of earth, citing the work of Bill Schopf who found photosynthetic bacteria in rocks dating to 3.5 billion years. This is immediately after the period of heavy meteorite bombardment which should have sterilized the earth of all life. But these bacteria were too advanced to be the first living creatures. So where did they come from? The creationist would say this is evidence of creation but Wills and Bada cover several different possibilities.

Observations have shown that life can be found deep in the subterranean earth, as deep as 3.5 km! Life could have hidden there during the bolide impacts and recolonized the surface when conditions were more favorable. Secondly, analysis of the Murchison meteorite which fell in Australia in 1969 has shown that it contains not only amino acids, but predominantly left-handed amino acids which are of the type used by living systems. Another suggestion is that life actually formed in space and then landed on earth. Many Christians will discount this idea, but then we discounted the idea that nonracemic amino acids could be created by nonbiological processes, something disproved by the Murchison meteorite.

One of the most fascinating aspects of the book is the data showing where life can actually exist. The subterranean unicellular life forms divide maybe once per century, live at temperatures up to nearly 150° C, live on methane, and may actually constitute the largest reservoir of biological materials on earth. If placed on the earth's surface, it is estimated they would form a layer of goo 1.5 meters thick. The desert varnish, a manganese rich coating on rocks thought to be due to abiogenic processes, is now known to be caused by bacteria living on the surfaces of the desert rocks—living almost without moisture. Such slow growing bacterial coatings which are found in the fossil record makes for an excellent argument against young-earth creationism.

One design argument that is weakened by the data in this book is the concept that the earth was created in a specially narrow habitable zone. Given all the places where life has survived and grown, one can no longer claim that the earth is in a very narrow habitable zone determined by the sun's energy. Life, it is now known, lives entirely separate from the sun's energy. It also lives on methane which comes from the earth's interior. Thus one cannot rule out life in certain other places in the solar system which have lots of methane—like the moons of Jupiter.

Wills and Bada, when discussing the origin of mitochondria, which are the energy producing organelles of the cell, cite the belief that they are the result of a free-living organism coming to live within the ancient cells, increasing the latter's ability to survive by giving the cells an energy source. Such a symbiosis, they report, was observed in Prof. Jeon's lab at the University of Tennessee, when bacteria invaded amoebas and eventually became necessary for the amoeba's survival. Facts like this give credence to the conventional views of how life originated.

There is much more in this book that is of great interest. Anyone who desires to get a good overview of the origin of life issues, the early history of the earth, or the wide range of habitations occupied by life should get this book. Christians cannot afford to ignore this area of research.

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THE EVOLUTIONISTS: The Struggle for Darwin's Soul
By Richard Morris. New York: W. H. Freeman and Company, 2001. 251 pages, index. Hardcover; $22.95. ISBN: 071674094X.

Veteran science writer Richard Morris has produced a highly readable introduction to contemporary evolutionary theory, with particular emphasis on the so-called "Darwin Wars." These are the internal debates that have become so animated and occasionally downright ferocious in recent years. This is an excellent analysis of why the mainstream scientific community continues to struggle with aspects of evolutionary theory. But lest critics of evolution take heart from these intramural controversies, Morris repeatedly asserts that there is no question that evolution happened. The theory of evolution with its mechanism of natural selection is "universally accepted among biologists." It is "the only possible interpretation of the numerous different kinds of evidence that scientists have been uncovering for well over a century."

Evolution is not just a single theory. Following Ernst Mayr's typology, Morris provides brief sketches of the five main evolutionary subtheories: evolution as such (that change occurs over time), common descent, multiplication of species, gradualism, and natural selection. Much of the recent debates have surrounded the question of whether natural selection, recognized by virtually all evolutionary theorists to be the major cause of evolution, is its sole cause. Stephen Jay Gould and Niles Eldredge represent the evolutionary pluralist position, which holds that other phenomena beyond natural selection are operating at higher levels of complexity. They want to call attention to what happens at the levels of species and ecosystems. The so-called Darwinian fundamentalists—most notably Richard Dawkins, Maynard Smith, and Daniel Dennett—aggressively reject the pluralist view and reduce (in a non-pejorative sense; Morris reminds the reader that reductionism is a valid scientific method) evolution to natural selection at the genetic level. Morris is fair in his analysis of this debate, and the reader is treated to a very lively account of the whole Gould-Dawkins/Dennett war of words, one that develops the notions of radical contingency, punctuated equilibrium, species sorting, spandrels, selfish genes, and so forth.

After detailing the basic positions of the pluralists and fundamentalists in the first half of *The Evolutionists*, Morris devotes most of the remainder of the book to an assessment of whether newer approaches favor one side or the other. He has a wonderful chapter on the sciences of complexity in which he outlines the work of Stuart Kauffman and Thomas Ray. He follows this with a very serviceable chapter devoted to evolutionary psychology. Both complexity theory applied to evolution and evolutionary psychology are promising but highly controversial areas in their own right. For Morris' purposes, however, they are enlisted at least in part to show that neither resolves the pluralist-fundamentalist debate. Complexity theory does share with Gould and Eldredge a suspicion that reductionistic approaches do not fully capture the richness of the multiple layers of activity that may be occurring with evolution. And evolutionary psychology as it has emerged out of sociobiology certainly builds upon the gene-centered view of the so-called fundamentalists.

With the score seemingly tied, Morris assesses recent literature for other evidences supporting either side. While there is much exciting research going on, it is inconclusive. There is some corroboration that Gould and Eldredge were correct that evolution can occur at a more rapid rate than anyone had suspected. Recent fruit fly studies suggest that evolution may not always occur through the slow accumulation of small mutations. But these and other recent studies seem to confirm that natural selection alone is the most important evolutionary factor.

"Evolutionary biology is a science in ferment," Morris concludes. He wisely makes no attempt to crown a winner, but uses the intramural Darwin Wars to make a modest but nevertheless important point about the role of controversy in science. "Scientific controversy," he concludes, "is a healthy thing." Rather than viewing it as something to endure until a measure of tranquility and civility is restored, Morris sees the existence of controversy as a sign

of vitality that a scientific field is "very much alive." Science is a quest for knowledge, he notes somewhat triumphantly—or perhaps naively. And when new discoveries are made, "it is only natural that scientists should argue with one another about what they have found." What Morris does not consider adequately is the "vexed and troubled" question of whether scientific orthodoxies and those who represent them are in fact simply interested in the quest for knowledge.

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MODERN COSMOLOGY AND PHILOSOPHY by John Leslie, ed. Amherst: Prometheus Books, 1998. 352 pages, bibliography, glossary. Paperback; $21.00 ISBN: 1573922501.

Leslie, professor emeritus of philosophy at the University of Guelph, has edited this book of twenty-six readings on cosmology and philosophy. The book contains articles by many of the leading philosophical and scientific luminaries, including Ernan McMullin, George Gamow, Hermann Bondi, Martin Rees, G. F. R. Ellis, and William Lane Craig. The articles were written between 1954 and the present.

Leslie begins the book with a brief introduction, outlining the arguments contained in each article. I found it confusing. It is a rare book whose introduction is less understandable than the actual articles. That being said, that is truly the only weakness in the book.

The articles are engaging and fascinating, discussing all aspects surrounding the origin and cause of the universe, its purpose, its fitness for life, and its future. Concerning the ultimate origin of the universe, opinions in this book vary greatly. McMullen notes that an eternally existing universe is a better candidate for self-existence than one with a beginning, like the Big Bang. W. B. Bonnor sees no reason for putting down the tools of science and "handing things over to God."

Edward Tryon, in his classic paper, argues that the entire universe is uncaused as our universe is merely a long-lived quantum fluctuation. He argues that this does not violate the Heisenberg uncertainty principles because the universe's net energy is so small (gravitational energy is negative thus balancing the mass-energy) allowing a large survival time for the fluctuation.

Paul Davies takes a different tack and sees quantum mechanics as breaking the rigid link between cause and effect allowing the universe to come into existence uncaused via a quantum fluctuation. All of these points of view are profoundly thought provoking and a modern Christian apologetic needs to deal with them.

Part of the debate in this book revolves around the evidence for design because that issue is crucial to understanding the purpose of the universe. Stephen Jay Gould writes that the argument for design is "moth-eaten" and he cites an interesting historical example. Alfred Wallace, the co-discoverer of natural selection, published an argument for design in 1903, which by today's standard seems wacky. Wallace's universe was 3600 light-years big and perfectly designed for humans. It consisted of concentric rings of stars centered on a central cluster of stars, which cluster contained the sun. Wallace argued that human existence depended upon this arrangement as plants depended upon starlight to carry out their nighttime activities. And because he knew nothing about radioactivity, he held that the star for a life-giving planet must be at the center of the universe because the sun was supposedly powered by the gravitational energy released when matter from the outer parts of this universe fall into it.

Two articles are of particular note in relation to life in the universe. Michael Hart analyses the Drake equation (an equation that evaluates the likelihood of life in the universe) in respect to atmospheric evolution. He concludes that the likelihood of a planet evolving a technological civilization to be very, very small ($< 10^{-30}$). He thus believes that we may very well be alone in the universe but this loneliness would not be due to God creating us specially.

In trying to define what he means by life, Hart cites another paper published in this interesting volume, that of Shapiro and Feinberg. This second article examines the possibility of life forms vastly different than those carbon-based ones with which we are so familiar. They speculate about other life forms in solid hydrogen, plasma, radiant life forms and in liquid sulfur. Assuming that such life forms as these exist, the anthropic coincidences discussed often by apologists would be meaningless. Of course, they would need to demonstrate their existence for their argument to have weight.

The book is a fascinating mix of opinion and scientific/philosophic discussion. After the introduction, the volume is quite readable and enjoyable. It is a book that should be in one's library.

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PHILOSOPHY & THEOLOGY

SIGNS OF INTELLIGENCE: Understanding Intelligent Design by William Dembski and James Kushiner, eds. Grand Rapids, MI: Brazos Press, 2001. 224 pages. Paperback; $10.99. ISBN: 1587430045.

The thirteen essays presented here were first published in the journal *Touchstone* (July/August 1999). Dembski has added an introductory essay on what intelligent design is not. From the information given on the authors' backgrounds and affiliations it appears that five are scientists, four are philosophers, as well as a mathematician/theoretician, a publicist, a lawyer, a political scientist, a pastor, and a theologian. Half of the authors are connected with the Discovery Institute's Center for the Renewal of Science and Culture. Many of the authors have published books generally related to the subject. Dembski, Michael Behe, and Philip Johnson have published books in this same area.

Perhaps the simplest way to give the flavor of the book is to indicate some of the topics discussed: the intelligent design movement, challenging the modernist monopoly, the view of ordinary people, the apologetic value of intelli-

gent design, scientific materialism vs. intelligent design, irreducible complexity, DNA, fatal flaws of natural selection, the Cambrian explosion, fine tuning in the cosmos, signs of intelligence, and the future of design-theoretic explanations.

The main contentions of the essays are: (1) It is possible to recognize objectively in biology signs of intelligent design by quantitative measures and by recognition of irreducible complexity; and (2) By introducing these concepts into scientific explanation, the materialistic bias of science will be removed. Thus Darwinism, which is so much part of modern cultural thought, will be countered or rendered obsolete. The book is part of America's culture wars. It has the advantage of presenting how persons from a wide range of disciplines see the advantage of the concept of intelligent design.

The book lives up to its title in that it reveals what intelligent design means to many thoughtful persons who support what Philip Johnson calls a movement. It is not convincing to those who have difficulty with either the goals of the movement, or simply, with the implications of introducing intelligent design as an explanatory term for scientific use.

Other authors such as Donald M. MacKay (*The Clockwork Image*, IVP, 1977) have shown carefully why it is illegitimate for materialists to claim that their world view follows from scientific theories. The essayists take no account of such writers; rather, they appear to believe that if a scientist claims that the theory of biological evolution shows there is no God, then he derived his conclusion from the science. Thus it is the science that is at fault. The introduction of the explanatory concept of intelligent design will correct the science, by taking away its materialistic bias. MacKay and others have pointed out that the metaphysical claims of the materialist do not at all follow from the science. The science fits in with other types of world views including Christian ones.

This is an important question not discussed: If two different instances of intelligent design are demonstrated who may the designers be? Simply to answer, "God," assumes too much. If one stands above one's science, at the level of metaphysics, then talk of intelligent design is appropriate, and mandatory for the Christian. I believe employing this concept inside science will prove destructive. The essays, complete with notes, appear to be written for a well-read, American audience.

Reviewed by C. P. S. Taylor, Professor Emeritus of Medical Biophysics, U. of Western Ontario, London, ON N6A 5C1 Canada.

HOW BLIND IS THE WATCHMAKER? Nature's Design and the Limits of Naturalistic Science by Neil Broom. Downers Grove: InterVarsity Press, 2001. 220 pages, index. Paperback; $11.99. ISBN: 0830822968.

New Zealander Neil Broom, whose area of expertise is joint-tissue biomechanics and arthritis research, joins Phillip Johnson and others in challenging the assumption that scientific materialism represents the "sole pathway to objective knowledge" and that the materialist model of the universe is "alone consistent with the facts revealed to us by modern science" (p. 15). In clear prose with numerous helpful and entertaining illustrations and photos, Broom argues that a commitment to materialism impoverishes science and shuts it off from the "splendor of a living world that functions poised, as it were, in the presence of a transcendent, nonmaterial dimension—a dimension that both nourishes and imparts meaning to the processes of life" (p. 16).

Does he succeed? Broom covers familiar territory when he advances his case that scientific inquiry, despite the hyperbole of many prominent science writers, is fundamentally limited and is not capable of providing answers to "the really big questions concerning meaning and purpose" (p. 187). He is right to chastise the science popularizers who make extravagant claims about God and humanity based upon their own commitment to a materialistic world view and methodology. What would critics of reductive naturalism do, by the way, without Richard Dawkins? His gene-centered approach to Darwinism, saturated as it is with aggressive challenges to theism, has spawned a virtual cottage industry of response from Christian authors, let alone from anti-reductionists of various stripes within the Darwinian camp.

Broom is also correct to point out that science points to "a dimension that transcends the processes and systems in nature that this same science so successfully describes" (p. 188). The scientist's belief in a universe that should make sense is a fundamental assumption of successful science that cannot be accounted for by science itself.

But Broom goes much further. He contends that the entire living world "operates within a rich gradient of meaning. It is a world that expresses vast amounts of creativity, orchestration, goal-centeredness and ultra-sophisticated levels of communication. It is a world driven by an overwhelming 'urge' to live and to keep on living. It seeks to 'attain,' to 'achieve,' to 'improve.'" These "prolife" attributes are "completely outside and beyond the power of science to explain" (pp. 188–9). This conclusion draws Broom "beyond naturalism" into a call for a holistic science enriched by a recognition of the "purposeful dimension that transcends the material processes in nature" (p. 191).

This final point, which gets to the heart of Broom's project, is incredibly important, and I fear that all the attention paid to design as design has deflected attention from the issue of teleology in science. It seems that the human psyche resists the stark notion that there is no direction or point to the flow of natural, let alone human, history. Historian of science John C. Greene has noted that even prominent Darwinians cannot resist the temptation to smuggle into their discourse terms (e.g., more complex, development, progress) that are pregnant with telic implications. But must science itself, not merely its rhetoric, remain aggressively anti-teleological? Robert Wright is attempting to introduce a naturalized teleology based upon game theory into the Darwinian framework, and William Dembski admits that his objective is to enrich the discussion with the possibility of real, substantial teleology in science.

The rub comes when some scientists and theologians suggest that this teleological dimension belongs in contemporary science. Perhaps. But the jury is still out. To be

convincing, this case must be made from the standpoint of science, not theology. Broom believes he has done so. I, for one, will need more evidence and, for now, will argue that it is safer to suggest that science does indeed have severe limitations. We should not ask too much of science. The quest for the meaning of life and the cosmos can certainly be informed by science, but these matters beg for the insights and methods of the historian, poet, artist, philosopher, and theologian.

While I have focused on the philosophical dimensions of Broom's argument, the bulk of the book consists of fascinating vignettes into biology. Broom and InterVarsity Press are to be saluted for reminding the reader that science need not point to atheism and starkly nihilistic world views, or even a generalized sense of awe (in that sense, as Ernst Mayr has noted, almost all scientists are indeed religious). As was the case for the devoutly Christian nineteenth-century scientist Michael Faraday, seen through the eyes of faith, science also can evoke "a profound sense of wonder for God as Creator" (p. 216).

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GOD AND TIME: Four Views by Gregory E. Ganssle, ed. Downers Grove: InterVarsity Press, 2001. 252 pages. Paperback. ISBN: 0830815511.

This is a collection of four different views of time as experienced by us and by God. The contributions are by William Lane Craig, research professor of philosophy at Talbot School of Theology; Paul Helm, until recently professor of history and philosophy of religion at King's College, London; Alan G. Padgett, professor of theology and philosophy of science at Azusa Pacific University; and Nicholas Wolterstorff, Noah Porter Professor of philosophy at Yale Divinity School. After each presentation, the other three contributors give their comments and then the author gives his final response. This is one of a series of such books published by InterVarsity Press, and it provides a very attractive format.

You need to be interested in the philosophy of time and its theological implications in order to enjoy this book, and probably most readers will be theologians and pastors. There is much for a physicist, like myself, to get his teeth into as well. For instance, "What was God doing before the Big Bang?" I agree with Padgett that he was not, as Brian Leftow has suggested, eagerly anticipating the Creation. "What is God's relation to time?" Helm argues that he is absolutely timeless, with or without the existence of the Universe; and to think of God as temporal is to diminish him. Padgett considers several alternatives in the framework of either a dynamic or process theory of time (McTaggart's A-theory) or a static or block theory of time in which all times are equally real (the so-called B-theory). Padgett also gives due consideration to the implications of Einstein's Theory of Relativity and the difficulties associated with the concept of simultaneity. Craig's view is that God has been temporal since the creation, but before then, he was timeless. He discusses the notion of the Oxford group of philosophers, including Richard Swinburne, of an "amorphous" or nonmetrical time before creation. Finally, Wolterstorff argues, on the basis of biblical references, for the A-theory of time and a temporal God. For instance, the Scriptures affirm that God responds to the pleas of his people, and this can only be so if he exists in time.

I found the book thought-provoking, making me question things more deeply than I would otherwise have done. My own conclusion, after reading the book, is that God created time and space in the Big Bang and that subsequently he experiences time within the universe in the dynamic or "process" manner, a term introduced by the mathematician and scientist A. N. Whitehead. Though relativity hampers our ability to establish simultaneity, this is no problem for God who has a unique frame of reference. But in the spiritual realm, I do not believe that either time or space exist, but only information, and therefore the concept of "amorphous" time does not appeal to me. I agree with the four essayists that the "eternal-temporal" or ET-simultaneity idea introduced by Stump and Kretzmann is complicated and unhelpful. A spiritual God can be said only to exist, and we should not question where or when. Thus we can better appreciate Jesus' statement, *"Before Abraham was, I am."*

If, therefore, time was created together with space, I agree with Alan Padgett that "God must await the future of any and all objects in the universe in order to act directly upon future (nonexistent) episodes of that object." This is, of course, a process or A-theory of time. I agree with Padgett that it is not true that God exists only if time exists, but I depart from him when he writes about "God's own time, eternity." By analogy we would have to speak of God's own space independent of the universe, and this is meaningless. This book shows us again how very difficult it is to escape from spatio-temporal language and thinking.

I think you will see from my comments that the varied but clearly expressed views contained in this book, covering as they do ideas ranging from Augustine and Anselm to Hawking and Wheeler have proved to be very stimulating. You cannot help but take sides in the discussion, and it is one that is very important for us at the present time. It relates directly to the debate on openness theology currently taking place in evangelical circles. The concept of time and its origin, furthermore, is common to theology and science, like that of creation, and thus such debates bridge the two approaches. Give yourself time to enjoy this book!

Reviewed by Geoffrey Dearnaley, FRS, Vice President (retired) of Southwest Research Institute, San Antonio, TX 78200.

REALISM REGAINED: An Exact Theory of Causation, Teleology, and the Mind by Robert C. Koons. New York: Oxford University Press, 2000. 349 pages. Hardcover. ISBN: 0195135679.

In the Introduction, Koons writes that he aims to bring an end to dualism. Dualism came, he says, when Aristotle's metaphysics fell. Since then, the roots of dualism are reportedly in the dualisms of mind and body, of fact and value, of objectivity and subjectivity, and in the early separation of scientific fact and normativity. This is caused

by unnecessarily and disastrously rejecting Aristotle, says Koons. In my opinion, he is correctly rejecting dualist philosophies. This book is not easy reading because it requires an understanding of philosophy.

Words like "Causation," "Teleology," and "Mind" may have a slightly different meaning for Christians than they have for non-Christians, even when the terminology used is "scientific" rather than Christian. While "Causation" and "Teleology" are carefully defined, other technical words are used as if everyone knows their meanings. One example is the word "modality," a word used in the philosophy of the cosmonic idea as developed by Vollenhoven. Koons' use is sometimes close to that, other times its meaning is unclear. In general, though, Koons does his best to define words and expressions carefully.

The author recognizes that cause and result are not always in order of time. Sometimes the result comes before the cause. He points to recent interpretations of quantum mechanics that show the possibility of temporally reversed causation. For Christians, miracles are another area to consider. The book is worth reading and discussing.

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MY COSMIC PESSIMISM: A Philosophical Critique to the Existence of a Cosmic Almighty Mind by Luis A. Santander. Raleigh, NC: Pentland Press, 2000. 100 pages. Paperback; $12.95. ISBN: 1571972110.

This book will appeal to folks with a philosophical and apologetical bent. It examines religions, and finds them wanting. Santander's arguments against faith are as old as recorded history. They are based on "worldly wisdom," by which, according to Paul, the world knows not God. According to Santander, "those who possess blind 'faith' in God ... prefer the blind, brute, and subjective thinking instead of rational thought" (p. 34). With this pejorative statement, Santander maligns some of the most intelligent minds of all time!

While Santander rejects evidence for God's existence, he readily accepts the classical atheists' arguments against religions' validity. In the last chapter, the author summarizes his salient beliefs this way: "Life was the most unfortunate accident in the history of the universe" (p. 93). This statement supports the appropriateness of the word "pessimism" in the book's title.

Atheism and agnosticism are not outlooks noted for their positive view of life. The curmudgeon and Roman Catholic believer Malcolm Muggeridge observed that he would rather be wrong with Peter, James, and Paul than right with Ingersoll, Paine, and Nietzsche. In other words, Pascal's wager prevails!

So if you want to read a succinct presentation of atheism with its concomitant pessimism, this book will serve as a concise introduction. The author is a native of Argentina, so his English is stilted, but his ideas are generally discernible.

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

RELIGION & CHRISTIAN FAITH

CAN GOD BE TRUSTED? Faith and the Challenge of Evil by John Stackhouse. New York: Oxford University Press, 1998. 196 pages, notes, index. Paperback; $25.00. ISBN: 0195117271.

Stackhouse, a professor of theology at Regent College, has read widely in the area on the question of suffering. He quotes freely from many well-known authors including C. S. Lewis, Dorothy Sayers, G. K. Chesterton, and Philip Yancey. Stackhouse does not see the problem of suffering as a particularly Christian problem. Evil exists and human beings need some sort of faith to make sense of lives that suffer as a result of this evil. They can choose to align their hopes with the faith of the New Testament, or with some other faith, or with no faith at all. In light of these options, Stackhouse sees his role not as a giver of answers but as a challenger of logical responses.

First of all, since evil is part and parcel of the universe in which we find ourselves, the focus of the discussion should be, not on the question, "Why is there evil?" but on the question, "What will I do about the fact of evil?" In his introduction, he states his purpose in these words: "What I offer, then, is this: a description of what we are up against in our struggle against evil, and good reasons to believe in God even in the throes of that struggle."

He sets forth his argument for the Christian faith response under four themes: (1) there is an abundance of evil in our world and God does not stop it so perhaps evil has a necessary role in the way things should be; (2) there is also an abundance of good, and how could good exist at all if a good God is not behind it all; (3) Christianity teaches that God created human beings with free will which presupposes that there are choices; (4) for all people complain about the badness of the world they live in, very few of them show any desire to leave it. In developing his argument, Stackhouse draws heavily on arguments put forth by Alvin Plantinga, concluding with Robert Frost.

Finally Stackhouse reviews what the Bible tells us about evil, from Job and the Psalmist to Christ and the cross. No one knows everything perfectly and no one knows anything for sure. All faith choices are that—leaps into the unknown. "Amy has to decide whether to marry Matt. A seeker has to decide whether to commit himself or herself to God." For Stackhouse the best answer is found in the person of Jesus Christ. I recommend this book. Every ASA member should have it on his or her shelf to pass on to a young person dealing with doubts.

Reviewed by Elizabeth Hairfield, Staunton, VA 24401.

THE LIFE OF PRAYER IN A WORLD OF SCIENCE: Protestants, Prayer, and American Culture 1870–1930 by Rick Ostrander. New York: Oxford University Press, 2000. 232 pages. Hardcover; $39.95. ISBN: 0195136101.

In November 1857, George Mueller prayed to God to shift the direction of the wind blowing over the orphanage he operated in Bristol, England. He had scheduled repairs on

the orphanage's boiler at a time when very cold weather threatened the health of his wards. Mueller recorded in his journal that on the day of the boiler's shutdown, a "south wind blew: exactly as I had prayed." Millions of American evangelicals in the decades surrounding the turn of the century certainly believed, along with Mueller, that God answered petitionary prayers. Prayer could indeed convince God to change the weather.

But prayer, particularly petitionary prayer, was not so simple a matter for many other American Protestants who believed that modern science made asking God for things seem unreasonable and even problematic. As historian Ostrander puts it in his contribution to Oxford University Press's Religion in America Series: "Petitionary prayer, with its vision of a God rushing to the rescue of his children, did not seem very reasonable in a culture in which science had seemingly ruled out supernatural intervention" (p. 12).

Other historians have explored the attempts of Anglo-American Protestantism to come to grips with modernity. But while those studies have focused on the challenges of biblical criticism and Darwinian evolution, Ostrander explores the efforts of American Protestants to articulate both an intellectually and culturally satisfying ethic of prayer in the modern world.

Ostrander begins his study with a brief summary of evangelical Protestant efforts to justify prayer. The modern scientific world view did not significantly challenge nineteenth-century American evangelicalism's traditional notions of prayer. In fact, evangelicals were fascinated with "answered prayer narratives" like those of Mueller and Hudson Taylor. Evangelicals frequently used answered prayer as a practical apologetic, something Ostrander suggests reflected "a scientific, empiricist impulse that coexisted ... with ... [evangelicalism's] supernaturalist impulse" (p. 49).

The evangelical experience provides the backdrop for the bulk of Ostrander's book, which focuses on liberal, mainline Protestantism and its struggles to adapt traditional teachings on prayer to the modern scientific world view. It is an interesting story. Liberal Protestants, especially prior to World War 1, were keenly interested in prayer as they sought to undergird social betterment with spiritual sensitivity. But several factors worked together to push liberal Protestants away from traditional notions of prayer. Perhaps the most important of these was the emphasis on divine immanence, the presence of God in nature, which rendered traditional notions of God crudely anthropomorphic, with very significant implications for prayer. Asking God to intervene in the world made God into a capricious magician, who altered the created order for the benefit of some but not others. Moreover, liberal Protestantism showed an increasing unwillingness to be restrained by the authority of the Bible at the same time it gave great deference to science "as a determiner of what was and was not possible in the religious realm" (p. 87).

Ostrander argues that liberal Protestantism did not abandon traditional petitionary prayer overnight; "the liberal expurgation of the supernatural element in prayer occurred quite gradually" (p. 97). He uses the example of popular liberal writer Harry Emerson Fosdick to illustrate this. As late as 1915 in *The Meaning of Prayer*, Fosdick affirmed the viability of intercessory prayer, despite the fact that several of his fellow liberal Protestant theologians were restricting prayer to the personal subjective world, where it was efficacious only in that it benefitted praying individuals and energized them to change the world by personal effort. But by 1926, when Fosdick returned to the subject of petitionary prayer in his *Adventurous Religion*, things had changed. "Prayer will not alter the weather," Fosdick noted; furthermore, it was blasphemous to tell God "what we think he should do."

No longer could prayer be understood as ceaseless clamoring to "a mysterious individual off somewhere." What, then, was the liberal Protestant conception of prayer? According to fellow liberal, Protestant writer William Adams Brown, prayer was the means by which we produce "psychological wholeness by focusing on God as the unitive ideal" (p. 158).

Clearly, by the end of the 1920s, American Protestantism was deeply divided on the subject of prayer: liberals had expunged virtually all traces of the supernatural from prayer, while evangelicals still believed in a personal God who answered petitionary prayers. Ostrander makes this point effectively by referring to a symposium entitled "Does Prayer Change the Weather?" that ran in the *Christian Century* in the summer of 1930. For liberal Protestants participating in the symposium, harmonizing notions of prayer with the modern scientific world view was a matter of intellectual integrity. Many American Protestants, nevertheless, prayed for rain—not just for patience—during that hot summer when parts of the nation suffered through a severe drought.

Ostrander has produced a valuable history of Protestant thinking about petitionary prayer and devotional disciplines in America from 1870 to 1930. Apart from the light he sheds on an important aspect of the struggle of American Christianity to accommodate theology and to practice science, Ostrander has also provided important historical context for current research and discussion on the efficacy of prayer. In fact, readers are likely to be struck by how many of the issues that confront contemporary empirical and theological explorations of prayer were raised at the turn of the last century.

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THE FACE OF TRUTH by William Edgar. Phillipsburg, NJ: P & R Publishing Company, 2001. 136 pages. Paperback; $10.99. ISBN: 0875521789.

This book's ten chapters have short, pithy titles like "Lifting the Veil," "Collision Course," and "A Cloak of Decency." Each chapter, averaging just over ten pages in length, is a short and easy read. The index and endnotes (not as convenient as footnotes) assist the reader in locating information.

There are no ground-breaking insights or revelations in this book. But the author's ideas are expressed in succinct, yet nascent, language able to stimulate some dormant nerve-cell activity! The book illustrates Samuel Johnson's observation that there is a greater need to be reminded

than informed. Edgar's reminders include the following: we are God's image-bearers; God is knowable; Jesus never disappoints; believing is no leap of faith; the Scriptures provide basis for faith; faith and science are friends; Genesis points to the world's purpose; the Bible gives no acceptable, logical explanation for evil; Christianity is unique and those who accept its truths "have nothing to lose that is worth keeping, and everything to gain you'd never want to lose."

Edgar's touching dedication is to Edith Schaeffer "whose home led us to heaven." This present volume has elicited this comment from George Gallup, Jr.: "Speaks powerfully to the present times. An invaluable guide to those who seek a deeper faith, one that withstands intellectual challenge. Edgar writes to both the heart and head in a clear and winsome way." The book has both an apologetic and evangelistic tone; consequently, it would make an excellent gift to a seeker or young Christian.

Edgar is professor of apologetics at Westminster Theological Seminary and author of *Reasons of the Heart* and *Taking Note of Music*. He is also a professional jazz musician who has published articles on cultural apologetics, the music of Brahms, and African-American life.

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

WORDS OF GRATITUDE FOR MIND, BODY, AND SOUL by Robert A. Emmons and Joanna Hill. Radnor, PA: Templeton Foundation Press, 2001. 105 pages. Hardcover. ISBN: 1890151556.

The words of gratitude found in this book comprise eight inspiring chapters, many trenchant quotes, and a suggested reading list. One of the suggested readings is entitled *Gratefulness: The Heart of Prayer* by David Steindl-Rast, who provides this book's introduction. In it ("Proverbs As Words of Gratitude"), he quotes this proverb: "When you drink from a stream, remember the stream." He also points out that some noble words of gratitude have originated with the unwashed, nameless, and homeless. "Better a bush than an open field," said someone seeking shelter. "The sun is the poor man's blanket," said another cold from the night.

Pages fully devoted to quotes fill more than half the book's length. They include quotes from the ancient ("Gratitude is not only the greatest of virtues, but the parent of all the others," Cicero) to the recent ("To be grateful is to recognize the love of God," Thomas Merton); from the famous ("A proud man is seldom a grateful man, for he never thinks he gets as much as he deserves," Henry Ward Beecher) and the not so famous ("There is a calmness to a life lived in gratitude, a quiet joy," Ralph Blum).

Gratitude is a Christian virtue, and this book helps believers express it. It helps put into words those feelings which periodically swell up in thankful hearts for the gift of life, of salvation, of provisions, of fellowship, of opportunity, of hope. Gratitude is also found appropriately in the vocabulary of scientists, as it was in this one: "A hundred times a day I remind myself that my inner and outer life depends on the labors of other men, living and dead, and that I must exert myself in order to give in the measure as I have received and am still receiving," words spoken by Albert Einstein.

I am pleased to recommend this book which sees the thankful life as a natural part of the scholarly life: "Thinking and thanking spring from the same root—in the realm of language as well as in the soul realm." It will provide a devotional uplift to all Christians who deal not only with things seen, but things unseen, for both of which they are grateful to God and to others.

Robert A. Emmons, the author of many research articles, book chapters, and a recent book, empirically explores how core aspects of identity reflected by spirituality relate to personality. Joanna Hill, a graduate student at the Theological School of the Academy of the New Church, is director of Templeton Foundation Press.

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CAN ARCHAEOLOGY PROVE THE OLD TESTAMENT? by Ralph O. Muncaster. Eugene, OR: Harvest House Publishers, 2000. 48 pages. Paperback. ISBN: 0736903569.

Muncaster's conclusion in this short book parallels the one in his companion volume *Can Archaeology Prove the New Testament?* The author thinks "Archaeology provides one means of confirming the historical accuracy of the Bible" (p. 5). He believes there is more historical evidence for the Bible than for any other historical document. Archaeology cannot prove Old Testament events happened, but it can provide significant credibility. And, of course, archaeology does not prove the metaphysical truth imbedded in the event.

The method Muncaster uses is to provide historical and archaeological findings which support the information found in the Old Testament. This involves explaining how archaeology works, how it has uncovered biblical sites (a list includes fourteen key places), and how archaeology's findings confirm many biblical accounts. He divides archaeological discoveries into four chronological categories, from the time of creation to the first century.

Muncaster concludes on an evangelistic note, answering common questions and explaining the way of salvation. Other books the author has written include *Creation vs. Evolution, Science-Was the Bible Ahead of Its Time?* and *What is the Proof for the Resurrection?* Muncaster is the founder of Strong Basis to Believe, a frequent lecturer on biblical topics, and professor at Vanguard University of Southern California.

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

SOCIAL SCIENCE

WHY GOD WON'T GO AWAY: Brain Science and the Biology of Belief by Andrew Newberg, Eugene d'Aquili, and Vince Rause. New York: Ballantine Publishers, 2001. 320 pages. Hardcover; $24.95. ISBN: 03454483.

Is there really a God-shaped hole in each person? This popular sentiment has been used to explain the world-wide, cross-cultural prevalence of religious expression. This book posits a physical basis and an evolutionary benefit for this human activity. Newberg, Director of Clinical Nuclear Medicine and NeuroPET Research at the Hospital of the University of Pennsylvania, is a physician specializing in neuro-imaging as was the late d'Aquili. Ballantine Publishers calls them pioneers in the emerging field of neuro-theology, a discipline dedicated to understanding the relationship between spirituality and the brain. This book continues their writing collaboration, a relationship which most recently produced *The Mystical Mind: Probing the Biology of Belief.* Rause, the third author, is a journalist.

The book's premise is that the mystical experiences and altered states of mind associated with religious practices are observable neurological events that can be studied using scientific approaches. The authors use examples from their studies of meditating individuals to postulate that decreased activity in a particular region of the brain, the Orientation Association Area, is largely responsible for the sensations associated with these altered religious states of mind. The authors' original data is described in the first chapter. The remainder of the book is largely a hypothesis of how various brain activities may have promoted religious experiences and been evolutionarily beneficial.

After a brief introductory chapter, the authors devote two chapters to describing "Brain Machinery," or neuro-anatomy, and "Brain Architecture," or functional neuro-biology. These chapters are admirably written, without the flood of technical language that could have led to many readers giving up. However, they observe that it is always difficult to pare down the information needed. The authors could have condensed these two chapters into one without confusion.

In the next four chapters, the authors discuss myth-making, ritual, mysticism, and concepts of reality as they may relate to brain activity in the association areas and human evolution. A consistent premise is that this brain activity confers a human advantage. For example, in the chapter on myth-making, the authors describe myth-making as an outgrowth of the ability to anticipate danger. The authors include a nice description of the brain processes involved in the fear response and how humans differ from animals in danger anticipation. The ultimate danger, of course, is death. The chapter is fleshed out with some speculative treatments of how myths got their start and the process by which an individual's idea is transformed into a cultural myth. A similar structure is used in the chapters on ritual, mysticism, and reality.

The book falters in communicating the boundaries between science and speculation. The authors are respected neurologists who are experts in brain imaging, so the science they describe is accurate and current, as one would expect. However, the book is so well written that the differences between the neural activity that the authors observed during religious activity and the acquisition of these abilities during evolutionary development are often subtle. I would highly recommend this book for college students enrolled in a course that examines these types of science/nonscientific boundaries. First-year college science students should be able to read this book without much difficulty and benefit from the discipline of identifying each type of writing in the text. The book is also a good exercise for all Christians in science who need to recognize these differences. Since the science is written at a very accessible level, this book could be enjoyed by anyone interested in the topic.

Reviewed by Robin Pals-Rylaarsdam, Assistant Professor of Biology, Trinity Christian College, Palos Heights, IL 60463.

AGING AND SPIRITUALITY: Spiritual Dimensions of Aging Theory, Research, Practice, and Policy by David O. Moberg, ed. Binghamton, NY: The Haworth Pastoral Press, 2001. 250 pages. Paperback. ISBN: 0789009382.

Venerable ASA member, David Moberg is considered by some people to be "America's premiere gerontologist." His edited book comes with such high recommendations as "an important tool," "the best there is in theory and practice," "a rewarding source," and "rich in practical applications."

The book's sixteen chapters are grouped under four main headings: conceptual and theoretical foundations; research and spirituality; professional and practical implications; and policy implications and priorities for the future. The book includes a brief biography for each of the eleven writers (Moberg wrote six chapters), person and subject indices, and a recommended reading list. The writers come from a variety of backgrounds including a coordinator of food drives, a director of pastoral care, a health care administrator, a case manager, a family therapist, a dental hygiene instructor, and a geriatric nurse.

Some of the more intriguing topics include the spiritual role of the elder, attitudes toward death and dying, the relationship between age and spirituality, hospice care, and the role of the chaplain. As to the spiritual role of the elder, the world would be a better place if elders were "encouraged to exercise an active role in the community." As to death and dying, "most of the elderly ... are not afraid of death itself but of all that could precede death." The 2,500 hospices serving people in every state hold the belief that every person matters to the last moment of life, and therefore they should be cared for in mind, body, and spirit. The role of the chaplain will become increasingly important with the aging of the American population. This may require reallocation of theological and denominational resources.

This helpful collection of articles is relevant to a large segment of the population. Laypersons and professionals will discover here valuable insights and considerations. The writing is not technical, and it can be accessed easily. I particularly appreciate the editor's comments and writing style which are appropriate and thoughtful.

Book Reviews

Three weeks before death from cancer, Cardinal Joseph Bernadin wrote: "I am at peace and I can only account for that by looking upon it as a gift from God ... (but) you have to let go. That letting go is not the easiest thing in the world." The compassion contained in the writings of these articles may aid those struggling with letting go, which eventually may include everyone.

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

Letters

Is Theism a Theory? A Response to Snoke

David Snoke has recently written a bold and stimulating article ("In Favor of God-of-the-Gaps Reasoning," *Perspectives on Science and Christian Faith* 53, no. 3 [Sept. 2001]: 152–8) in favor of GOG (God-of-the-gaps) reasoning, or perhaps more accurately, criticizing the prevalent assumption that GOG reasoning has no merit. While I agree with much of his epistemology, I think there are serious problems with his treatment of theism as if it were a theory; I doubt that Christianity can accept that kind of self-understanding. In what follows, I will attempt to explicate the main problems with Snoke's position, which are fourfold: (1) there is reason to question the religious adequacy, so to speak, of treating theism as if it were a theory; (2) there are some serious internal problems with theism and Christianity *qua* theories; (3) most people do not approach theism or Christianity with the attitude proper toward a theory; and, (4) it is not as clear as Snoke seems to think that theism and Christianity entail any falsifiable predictions.

Before I begin in earnest, I should note a few minor points. I am sympathetic to Snoke's general epistemological position. As he argues, evidential considerations should play an important role in a person's decision between theism and atheism, and generally in the evaluation of world views or theories. I am also in agreement that if a theory cannot explain something, it ought to be able to explain what counts against it, although, as a careful reading of his article makes clear, that does not automatically cripple a theory or favor one of its competitors over others. Snoke notes several explanatory failings or "gaps" in the atheistic position that weaken it, and he suggests that theism gains credence by being able to explain what atheism cannot. Although I do not think these gaps are as serious or as unlikely to be overcome as Snoke claims, space limits me to noting my disagreement and referring the reader to some of the literature that Snoke does not cite.[1]

The most serious problem concerns Snoke's contention that theism is a *theory*. This is not argued for in his essay but is simply assumed. It is a controversial position, to say the least, and does not seem to sit well with the main themes of the Bible or the bulk of Christian tradition. Since when is God to be considered as part of a theory? The God of Abraham, Isaac, and Jacob, as well as of the Old Testament prophets, Jesus, and the apostles, confronts us as a Thou, a person, a most intimate challenge, not as something hypothetical or theoretical. *Prima facie*, theism in general, and Christianity in particular, are not theories and it may be contrary to their very spirit to see them that way. As John Baillie has said:

> Thus for the New Testament, as for the Old, God is One who is directly known in His approach to the human soul. He is not an inference but a Presence ... The knowledge of God of which the New Testament speaks is a knowledge for which the best argument were but a sorry substitute and to which it were but a superfluous addition.[2]

Having made this point, I will go along with Snoke's contention for the sake of argument, and offer some criticisms of theism and Christianity *qua* theories. In the first place, if theism is a theory, then it has at least the following internal problems (excepting for the moment, the problem of evil, which Snoke appears to recognize as a problem). First, its most crucial concept, God, may be incoherent. I refer to the longstanding and ongoing philosophical and theological debates over the meaning of divine attributes such as "omnipotence" and "omniscience" and over whether a God having these and other essential attributes is possible, for some of them appear to conflict.[3] At the very least, there are serious difficulties in providing a satisfactory account of the concept of God. Second, a similar and related debate is over whether there are any satisfactory explanations of central Christian doctrines such as the Incarnation and the Atonement.[4] I submit that a theory that had as many hotly contested central concepts and claims as theism and Christianity have, and for as long as they have had them, would never last long in the world of science.

Certain other problems follow from treating theism as if it were a theory. Belief in God is not generally held as if it were part of a theory. People tend to believe in God more firmly than they would be entitled to if it were a theory, and tend not to be as willing to consider criticisms and new evidence as commitment to a theory requires. So, Snoke's contention is incorrect as a description of how people in fact embrace theism and Christianity. Should we say that Christians ought to try to accept Christianity as if it were a theory? What then becomes of faith?

The question of whether theism or Christianity entail any falsifiable predictions is more complex than Snoke indicates. A basic distinction made by the philosopher of biology Elliot Sober between *strongly falsifiable* and *weakly falsifiable* theories is instructive.[5] A theory is strongly falsifiable if it entails at least one observation statement O (i.e., a prediction) whose truth or falsehood can be determined by direct observation. Most scientific theories do not by themselves entail observation statements; only in conjunction with auxiliary hypotheses do they do so, which is to say, they are weakly falsifiable. This is acceptable so long as the auxiliary hypotheses are confirmed (and falsifiable) *independently* of the theory in question.

Now, theism by itself does not seem to entail any observation statements, so it is at best weakly falsifiable. As Sober explains, the difficulty for theism concerns auxiliary hypotheses about God, that is, claims concerning what God is like and how he acts. To take one of Snoke's examples, he claims that if theism is true, we would expect there to be "many, daily, direct, miraculous communications from God" (p. 156), a prediction he takes to be falsified and that requires a modification of theism. However, this prediction only follows on the assumption of knowledge about how God would reveal himself to human beings, if he existed. But why suppose that Snoke or anyone else could *know* this? The problem with auxiliary hypotheses about God is that they are not independently confirmed or falsified. Is there any way of confirming or falsifying auxiliary hypotheses about God without presupposing theism? I raise these issues not to take a firm stance on them, but merely to suggest their complexity and cast doubt upon the idea that we can easily find falsifiable predictions for theism and Christianity.

Ever since Hume and Kant, natural theology has been on the defensive, only making a serious comeback in the last twenty-five years or so. Snoke welcomes natural theology as part of his evidentialist epistemology, and wants theism to subscribe to the "normal rules of evidential discourse" (p. 154). In our pluralistic world, this is an understandable and reasonable reaction. However, it is not clear that this is a move theism and Christianity can make, as the problems I have outlined show. Some serious issues concerning faith and reason still need to be addressed.

Notes

[1]On the Intelligent Design—Evolution controversy, see Massimo Pigliucci, "Design, Yes, Intelligent, No," *Skeptical Inquirer* 25, no. 5 (Sept.-Oct. 2001): 34-9; Niall Shanks and Karl Joplin, "Behe, Biochemistry, and the Invisible Hand," *Philo* 4, no. 1 (Spring-Summer 2001) available at the website <www.philoonline.org>; and *Skeptic* 8, no. 4 (2001), which has an excellent section on Intelligent Design. On fine-tuning arguments for the existence of God, see Theodore M. Drange, "The Fine-Tuning Argument Revisited," *Philo* 3, no. 2 (Fall-Winter 2000).

[2]"The Irrelevance of Proofs from the Biblical Point of View" in John Hick, ed., *The Existence of God* (New York: MacMillan, 1964), 209-10.

[3]For an introduction, see Theodore M. Drange, "Incompatible-Properties Arguments: A Survey," *Philo* 1, no. 2 (Fall-Winter 1998). Available at the website <www.philoonline.org>.

[4]For the critical side, see Michael Martin, *The Case Against Christianity* (Philadelphia: Temple University Press, 1991), and Walter Kaufmann, *The Faith of a Heretic* (Garden City, NY: Doubleday, 1961), an older work still worthy of careful study. For a defense of the Incarnation, see Thomas V. Morris, *The Logic of God Incarnate* (Ithaca, NY: Cornell University Press, 1986), and of the Atonement, see Richard Swinburne, *Responsibility and Atonement* (New York: Oxford University Press, 1989).

[5]See Elliot Sober, *Core Questions in Philosophy: A Text With Readings*, 3rd ed., lecture 9, "Is the Existence of God Testable?" (Old Tappan, NJ: Prentice Hall, 2001). For a much fuller and more sophisticated treatment, see Elliott Sober, "Testability." *Proceedings and Addresses of the American Philosophical Association* 73 (1999): 47-76. Available at the website <philosophy.wisc.edu/sober>.

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Choice of Research Topic

Although I am now retired, I was for many years head of a research group and chairman of a university department of electrical engineering. I was therefore particularly interested in the recent issue of *Perspectives on Science and Christian Faith* (53, no. 4 [December 2001]) reporting on a conference dealing with the choice of research projects by young graduates and post-docs. I have to say that I found the advice offered rather disturbing.

My chief cause for concern was the overriding importance attached to individual choice. My experience suggests that a fulfilling career in research generally requires team work. It may be that a few outstanding scientists work best in isolation, although I doubt it. But the creativity of most ordinary research workers is enormously enhanced by regular discussion with colleagues. The conference did not mention that giving is the other side of receiving. In this connection, I found the advice on choosing a supervisor to further one's career somewhat distasteful.

Nor do I like the idea of encouraging research workers to live from grant to grant. In my experience, the financing of research is best left to the head of a research group. Younger members need to be protected from commercial pressures so that they can give themselves unreservedly to the quality of their work and the enjoyment of it.

I fear that much of the advice given at the conference may increase the perception of science as a self-regarding pursuit and may strengthen the postmodern backlash against it.

I have been an appreciative reader of *PSCF* for many years and hope you will forgive the criticism.

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A Reply to the Dialogues

The March 2002 issue of *PSCF* contains a dialogue concerning science, naturalism, biology, and design.[1] Walter Thorson argues for a new definition of naturalism in science, with the unstated assumption that evolutionary biology would be included in such a science.[2] Although biology is usually classified as a science and biologists use the scientific method for investigation, the biochemical evolution of the first cell and macroevolution are supernatural. Uniting evolutionary biology with naturalistic science joins two mutually exclusive categories.

If science is defined as the study of natural things and natural processes in which supernatural causation is absent, evolutionary biology is not scientific. If science is defined as the study of the physical universe in which causation could be supernatural, evolutionary biology would be scientific. The two sets of definitions are functionally equivalent if God does not exist. Since the large majority of scientists accept a definition of science that excludes supernatural causation, such a definition of science should be accepted as the best working definition.

Letters

Thorson wrote: "Theological reflection on creation is entirely legitimate, but must be clearly distinguished from the mundane study of creation with which science is concerned." To be precise, science is the study of the product of creation. The act of creation is supernatural. The product of creation is natural. In parallel fashion, the act of macroevolution is supernatural. The product of macroevolution is natural. Biology is the study of the product of macroevolution.

The biochemical evolution of the first cell and macroevolution are supernatural. The probability of naturalistically or randomly assembling a small protein composed of 100 amino acid residues is about I chance in 10^{65} per try.[3] Less than 10^{50} tries have existed over the last 3.5 billion years, because less than 10^{50} proteins have existed on Earth during that entire period. The probability of naturalistically assembling just one necessary, functional small protein by using every try available is about one chance in 10^{15} or one chance in a million billion [$10^{-65} \times 10^{50} = 10^{-15}$].

Thorson wrote: "[W]e need a new 'naturalistic' biological science which is more than the application of physical science to biosystems." A naturalistic science is proper for the study of microevolution, since the DNA in microevolution already exists and already functions. A naturalistic science is not proper for the study of the biochemical evolution of the first cell and macroevolution since they involve the supernatural creation or supernatural assembly of functionally new DNA.

Thorson desires science to be naturalistic because he sees God as transcendent. God is not transcendent just because his methods are obscure. In evolutionary biology, God is also immanent. An example might suffice.

> A defined high-energy photon is generated and streaks through space for 100 years. At the right moment in time, a man, of his own volition, runs for a fly ball, stumbles, and wipes out on the grass. As he lies sprawled on the ground, the high-energy photon penetrates one of his sperm cells and energizes and alters DNA at a precise location while in a specific spatial orientation. The sperm cell, which contains the DNA altered in a manner preordained by God, fertilizes an egg. The two form the DNA component of a child woven together by God in the womb of the mother.[4]

God is immanent in the details of evolutionary biology, for he said, "Who gave man his mouth? Who makes him deaf or dumb? Who gives him sight or makes him blind? Is it not I, the Lord?"[5] Our inherited make-up is a personal gift from God.

Thorson seeks a bio-logic "a logic controlling achievement of certain tasks or *functions*." For both natural and metaphysical reasons, the bio-logic is not discoverable through scientific investigation.

The bio-logic is not discoverable for the following natural reasons:

1. A bio-logic is unique for each protein and each enzyme. Physicists can experimentally approximate the physical-logic of simple entities because they are uniform and contain mundane information. A billion oxygen molecules exhibit similar behavior and interact uniformly. A billion proteins and enzymes exhibit diverse behavior and each interacts uniquely.
2. The comparative study of fossils, homologous structures, proteins, and DNA provide no information for determining the origin of the bio-logics.
3. Since science cannot sufficiently explain the bio-logic of even one small enzyme, it is totally incapable of determining the entire bio-logics.[6]

The bio-logic is not discoverable for the following metaphysical reasons:

1. The bio-logic of the protein or enzyme resides in the purpose and design of God that precedes the initial appearance of the protein or enzyme.
2. Since the bio-logic arises from a supernatural purpose, the total bio-logic must be appropriated by supernatural revelation.
3. The bio-logic arises from a supernatural concept of function, which culminates in glorifying God.

Therefore, Thorson's bio-logic is not achievable. On the other hand, the intelligent design proposed by William Dembski is also problematic. Intelligent design cannot differentiate between macroevolution by intelligent design and progressive creation by intelligent design. Comparative studies of fossils, homologous structures, proteins, and DNA do not differentiate between them. Scientific experimentation cannot differentiate between them because they both involve supernatural causation.

Proponents of intelligent design make a fundamental error in strategy when they attempt to include intelligent design in a science curriculum. No study of biological origins, including intelligent design, is scientific. A more fruitful approach for the intelligent design movement would be to show that the naturalistic biochemical evolution of the first cell and naturalistic macroevolution are highly irrational scientific hypotheses, which also need to be excluded from a science curriculum. Intelligent design, the naturalistic biochemical evolution of the first cell, and naturalistic macroevolution should be transferred to some other curriculum such as philosophy, religion, or to an entirely new course.

Notes

[1] *Perspectives on Science and Christian Faith* 54, no. 1 (March 2002).

[2] Walter Thorson, "Legitimacy and Scope of 'Naturalism' in Science," *Perspectives on Science and Christian Faith* 54, no. 1 (March 2002): 2–11.

[3] H. P. Yockey, "A Calculation of the Probability of Spontaneous Biogenesis by Information Theory," *Journal of Theoretical Biology* 67 (1977): 377–98; and J. F. Reidhaar-Olson and R. T. Sauer, "Functionally Acceptable Substitutions in Two a-Helical Regions of Repressor," *Proteins: Structure, Function, and Genetics* 7, no. 4 (1990): 315.

[4] See: Psalm 139:13

[5] Exodus 4:11

[6] Yockey; and Reidhaar-Olson, 315.

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- History and Philosophy of Science
- Physical Sciences
- Science Education
- Social Sciences

Local Sections of the ASA are organized to hold meetings and provide an interchange of ideas at the regional level. Additional information can be obtained from the national office. Listed below are some of the more active local sections.

Local Sections

- Chicago–Wheaton
- DC–Baltimore
- Eastern PA
- Rocky Mountain
- San Francisco Bay
- Southwest (AZ)

What Is the American Scientific Affiliation?

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

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

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

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American Scientific Affiliation

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

Canadian Scientific & Christian Affiliation

A closely affiliated organization, the Canadian Scientific and Christian Affiliation, was formed in 1973 with a distinctively Canadian orientation. The CSCA and the ASA share publications (*Perspectives on Science and Christian Faith* and the *ASA/CSCA Newsletter*). The CSCA subscribes to the same statement of faith as the ASA, and has the same general structure; however, it has its own governing body with a separate annual meeting in Canada. Contact CSCA by writing to: Canadian Scientific and Christian Affiliation, P.O. Box 40086, 75 King St. S., Waterloo, ON N2J 4V1 or visit their web site at: www.csca.ca.

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