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In this issue . . .

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

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Putting Things in Perspective

In the early chapters of *The Mustard Seed Conspiracy*, Thomas Sine summarizes the urgent problems facing humanity in the last two decades of the twentieth century. After illustrating the problems (hunger, injustice, war, etc.), he considers Christian response within the framework of three options. First, is the great escape of extreme, pessimistic eschatology whose proponents are content, even jubilant, to see things go from bad to worse. Second, is the secular agenda of the liberals, who are optimistically confident that human efforts will solve the problems. Third, is the American Dream/Religion of America response of those who buy into the consumerism and the nationalism of our culture. Certainly, as we view the political and economic climate of this election year we see much evidence that biblical Christianity has become equated with the "American Dream" in the minds of many evangelicals. But the challenges of world hunger, poverty, and injustice cannot be dismissed that glibly. We need to listen to the Old Testament prophets and to the teachings of Jesus Christ. We need to humble ourselves before God, our Creator and Redeemer, and ask: "What would you have me do?"—not for *myself* or even for *my country*, but for the sin-sick *world* around us.

The theme of our 1987 ASA Annual Meeting was "Global Resources and the Environment." Our keynote speaker was Vernon Ehlers, Michigan state Senator and former physics professor at Calvin College. He reminded us of the practical, political realities of dealing with environmental problems with justice *and* compassion, with concern for people, their jobs, and the environment. One of the problems that has to be faced is the careful, long-term balance between ecology and economics, between environment and employment. Fred Van Dyke, the author of the lead paper in this issue, discusses "Planetary Economics and Ecologies" in the light of these global problems, and emphasizes the need for a theological evaluation of economics in the light of the obvious reality of over-population, hunger, and environmental deterioration.

Walter Bradley discusses some of the problems of the origin of life in the light of the laws of thermodynamics. He takes issue with both those creationists who claim that "the Second Law of Thermodynamics precludes a naturalistic origin of life," and with those evolutionists who see "no thermodynamic problem with the origin of a living system from simple compounds."

Vladimir Vukanovic discusses some of the "opposite general directions" as seen in life and death, joy and sorrow, good and evil. He emphasizes that opposite directions are associated with slower but more varied development than in a one-direction system.

Phillip Eichman gives us an informative biographical and historical discussion of Michael Faraday, with particular emphasis on Faraday's religious convictions and the people—especially John Glas and Robert Sandeman—who influenced him.

A second installation of our layperson's insert, *SEARCH: Scientists Who Serve God*, centers around the witness of long-time ASA Fellow Vernon Ehlers and his important scientific contributions to the field of audio engineering. (Please remember that extra copies of each issue of *SEARCH* can be ordered from the Ipswich office of ASA for personal distribution, study groups, or educational purposes.)

William Cobern discusses the integration of faith and science learning, and reminds us that science is tentative. Certainly, scientists who write and talk as if they know all the important truths, as well as Christians who worry about the latest scientific threat to Scripture, need to remember this.

Richard Arndt reminds us of some basic misconceptions regarding the supposedly antagonistic roles of science and faith. These misconceptions are still prevalent with those Christians who dogmatically assert that their "literal interpretation" is the exclusively correct one. He concludes with a list of dictionary definitions of key words in the science/faith debate area.

Many of our controversies center around inadequate and sometimes inaccurate definitions. With this issue of *Perspectives*, Richard Bube starts a regular feature in which he will discuss the definition(s) of key words in the science/faith dialogue. Clear definitions will not solve all of our problems, but they certainly could help to direct discussion to the real, in contrast to the imagined, issues.

WLB

Planetary Economies and Ecologies: The Christian World View and Recent Literature

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Understanding and practicing Christian environmental stewardship requires consideration of economic factors affecting environmental problems. This paper evaluates pivotal publications integrating ecologic and economic analysis, including literature which relates this integration in a Christian perspective. Simulation models of world supply and demand systems have identified relationships between environmental degradation and economic policy. Appreciation of such relationships stimulated development of steady-state economic theory. Christian scholars have long recognized theological implications of economics, but have only recently attempted to understand ecologic-economic problems in a scriptural perspective. Their roles in providing integrative literature in this area and in influencing choices of the Christian community are discussed.

In this century, science and scientists have been moving toward increasing specialization. As a result, growing numbers of scientists know more and more about less and less. At the same time that science is fragmenting, practical world problems are requiring a much more integrated approach, especially in ecology. As more and more environmental studies have discovered the causes of ecologic problems, economic factors have often emerged as more major contributors.

In dealing with environmental issues, dissatisfaction with purely pragmatic, technological solutions has occurred as their impotence to solve real ecological problems has been perceived. New, fairer economic policies are proposed, but rejected in favor of national interest. Pollution control technology is developed, but goes unused. Developing countries create national parks on paper, but do not protect them in substance. Individuals conserve, but total stocks of resources still dwindle. Ecologists have discovered that humanity does not lack the means to conserve, but the will. Greed and selfishness have often proven stronger than reason and necessity.

Garrett Hardin was one of the first to prophetically assert that the ecologic crisis had amassed an entire array of problems for which there was "no technical solution."[1] As Aldo Leopold had warned, changes in

ethics could not be "accomplished without an internal change in intellectual emphasis, loyalties, affections, and convictions."[2] Without this conversion, conservation strategies were doomed to fail. Reluctantly at first, then with increasing clamor, environmentalists have demanded a new "stewardship ethic" from theology. Both in response to and independent of this demand, the Christian community has engaged in increased discussion of the biblical basis for environmental stewardship, and has suggested practical applications of biblical principles for current environmental policy. In this journal alone, contributors have begun to explore the biblical basis of environmental ethics, the role of environmental education in the Christian college, the resource manager as an environmental steward, and the application of technology to environmental problems and the plight of the poor in developing nations.[3] Among the most recent and comprehensive responses has been the North American Conference on Christianity and Ecology, convened in North Webster, Indiana in August 1987. Earlier in the same month, the theme of the American Scientific Affiliation's annual meeting in Colorado Springs, Colorado was devoted to Christian environmental stewardship.

The purpose of this paper is: 1) to identify and evaluate pivotal publications which have integrated economics and ecology; 2) to examine specifically Christian literature which has addressed both ecology and economics; and, 3) to suggest what future roles Christian scholars should take in continuing to address this issue.

Ecology and Economics

The growth of the environmental movement in the early 1960's led to a reevaluation of traditional economic models and a search for new ones. British economist Barbara Ward formalized the philosophical concept of "Spaceship Earth" in a call for building a worldwide system of common institutions, policies, and beliefs in 1965.[4] A year later, economist Kenneth Boulding borrowed the same concept, but applied it in much stricter economic terms, in his essay, "The Economics of the Coming Spaceship Earth." Boulding urged a shift from the "cowboy" economy of exploitation to the "spaceman" economy of sustainability.[5] In 1968, Garrett Hardin's classic essay, "The Tragedy of the Commons," eloquently described the collective ecological results of individualistic economic practice.[6] Hardin went even further in an essay in 1970, "To Trouble a Star," when he predicted that "ecology will engulf economics," forcing traditional cost-benefit analyses to assess ecologic consequences.[7] A more comprehensive, technical integration of scientific philosophy, physics, and ecology in relation to economic analysis appeared in 1971, in Nicolas Georgescue-Roegen's classic, *The Entropy Law and the Economic Process*.[8] Georgescue-Roegen argued that the sin of all traditional economic theory was its failure to consider the problem of natural resource extraction. The economic process consists of a transformation of low entropy to high entropy (i.e., waste). Because that transformation is irrevocable, natural resources must form an aspect of economic value. Humanity's natural dowry consists of its stock of natural resources and the planetary flow of solar energy. Humanity, said Georgescue-Roegen, must therefore learn to ration meagre resources to survive in the long run.[9]

In 1972, D.H. Meadows et al. produced *The Limits to Growth*.[10] This book represented a summary of conclusions drawn from a computer model of world supply and demand covering a 200-year period, 1900–2100 A.D. Its conclusions were that

> If the existing trend of exponential growth in all of these critical variables is allowed to continue, the result will be severe, perhaps even catastrophic decline in both world population and industrial capacity, probably within the next century.[11]

These "critical variables" were population, food production, degree of industrialization, pollution, and consumption of nonrenewable resources. The book suggested seven basic policies:

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1. World population should be stabilized by reduction in birth rate, and industrial capital should be stabilized by lowering investment rate to equal depreciation rate.
2. Resource consumption per unit of industrial output should be reduced to a fraction of its current value.
3. Economic preferences should be shifted away from material products and towards services.
4. Pollution production per unit of agricultural output should be reduced to a fraction of current levels.
5. Capital should be diverted to food production, and/or existing inequalities in food distribution should be reduced.
6. Agricultural capital and technology should be altered to place higher priority on soil enrichment and preservation.
7. Average lifetime of capital should be increased, implying greater durability and ease of repair and reduced obsolescence.[12]

Much controversy followed the publication of *Limits to Growth*, not the least of which were elaborate refutations of its pessimistic predictions.[13] The controversy was so great that the Club of Rome itself published a second report, *Mankind at the Turning Point*, to attempt to respond to the criticisms and construct a more realistic simulation model of world supply and demand.[14] But accuracies and inaccuracies aside, *The Limits to Growth* abolished forever the separation of ecology and economics.

Ecologists have discovered that humanity does not lack the means to conserve, but the will.

Steady-State Economics

These concepts spurred development of the paradigm of steady-state economics, of which Herman Daly was the principal architect. In his book, *Steady State Economics* published in 1977, Daly developed ideas about the concepts, institutions, and efficiencies inherent in a steady state economy.[15] Unlike the traditional paradigm of the growth economy, Daly's paradigm assumed a no-growth economy. Three critical variables remained constant: 1) human population, 2) stocks of natural resources, and 3) human artifacts (i.e., manufactured goods). The first is assumed to stabilize through low birth and death rates (i.e., long life span), the second through equality of depletion and renewal rates (i.e., sustained yield management), and the third through equality of investment and depreciation rates (i.e., high durability of capital). Though not specifically discussed, Daly undergirded much of his discussion by taking for granted the validity of biblical concepts about the nature of persons, economy, and justice. His biblical perspectives become most clear when he compares the underlying philosophies of growth vs. no-growth economies. Daly asks:

> Is man basically a fallen creature whose salvation lies with his Creator, rather than with his own creations? Or is man potentially the infallible creator himself, whose salvation lies with his own creations? [The first view] is the traditional wisdom of the ages, taught by the great religions. The second view, man as potentially infallible creator seeking salvation in the perfection of his creations, leads to cosmic vandalism. It is not the view of great scientists, but of the third-rate devotees of modern scientism, whose numbers are legion.[16]

But accuracies and inaccuracies aside, The Limits to Growth *abolished forever the separation of ecology and economics.*

Economics and Theology

The relationship of Christianity and economics has had a long and rich history. Wealth is a major theme of both the Old and New Testaments and particularly the gospels, where Jesus had absolutely nothing good to say about it. The rich and wealthy are condemned in the Old Testament as well, although the Old Testament shows examples of wealthy individuals who were righteous. In every Old Testament case, however, wealth was a sign, or sacrament, of the reality of relationship with God. Abraham's wealth came from his renunciation of all earthly security in order to obey God (Genesis 12:1ff), and from his refusal to appeal to earthly sources which would make him rich (Genesis 14:23). Job learns, in the absence of wealth, that God alone is the Supreme Sufficiency (Job 42:1–6). Solomon's wealth is given as a prefigurement, or sacrament, to show but a shadow of the kingdom of another "Son of David" who will one day rule the universe.[17]

The western work ethic is generally traced to Calvin, by some authors to his credit and by others to his condemnation. Regardless of persuasion, historians are unanimous in crediting both medieval and reformation theology with enormous economic impact.[18] Christian influence affected not only western Europe, but also the economic systems of their New World colonies.

Likewise, modern Christian scholars writing about economics and ecology have generally understood the impact of each on the other. In 1975, Oxford economist Donald Hay, writing specifically for Christians in a pamphlet entitled, *A Christian Critique of Capitalism*,

noted that one of the Bible's most important ideas affecting economic life is that of creation and humanity's dominion of it. Dominion, wrote Hay, is given to all humankind. We exercise a role in creation which includes both its use and its care as trustees. Trusteeship is different from private ownership, for the former implies responsibility to use resources in a manner harmonious with God's intention to provide for all, while the latter does not.[19] Therefore, implied limitations exist on the individual's use of resources. The classic and comprehensive *Earthkeeping*, another book written by Christians and for Christians, also devoted much space to economic analysis, though the book itself was written in response to the ecologic problem.[20]

Christian reaction to the present economic situation has moved primarily in two directions.[21] On one hand, domestic and world need raised hunger to a level of major concern in the Church. Traditional relief efforts have continued and amplified, but demands also have begun for economic reform. Hunger organizations have emerged with purely political strategies, rather than food relief, such as Bread for the World. Hunger awareness even began to affect everyday American life, as books like *The More With Less Cookbook*, by the late Doris Longacre, brought the possibility of simple living into the kitchens of the North American Christian family.[22]

Though not specifically discussed, Daly undergirded much of his discussion by taking for granted the validity of biblical concepts about the nature of persons, economy, and justice.

Perhaps the single most important publication capturing North American Christian attention was the book *Rich Christians in an Age of Hunger* by Ron Sider.[23] Though Sider was primarily concerned with the hunger issue, his thorough documentation and powerful, expressive style led to three major emphases: 1) a confluence with ecologic concern over resource depletion, 2) a call for more biblical public policy by the West in food and aid distribution, and 3) a call for western individuals to live a more simple, less consumptive life. Within two years of its publication, *Rich Christians* had led directly to the Conference on Simple Lifestyles.[24]

A second, equally pervasive but theologically opposing trend has emerged in the convergence of theology and economics. Conservatism and evangelicalism have grown simultaneously, and often together, producing what Van Dahm and others have called the "Christian Far Right" (CFR).[25] The CFR's political agenda has included, among other things, economic revision, but not in the direction of new economic policy and redistribution of wealth. Rather, it has been oriented to increased individualism, unregulated free enterprise, abolishment of long-term debt and credit, a gold standard, abolition of fractional reserve banking, and elimination of most government social services.[26] Articulated by economists like Gary North and organizations like Chalcedon and The Institute for Christian Economics, the overall thrust of such an agenda has been toward a continued growth economy and a western consumptive standard worldwide. North, in fact, has called the "spaceship earth" analogy "a neo-Fabian propaganda device," a "triumph of intellectual chaos," "a call to religious commitment," and an attempt to divinize the state.[27] Related, though not identical, to such an agenda has been the growing interest among Christians in survivalism, and in the prosperity gospel—the proclamation that it is God's will to bless His people with material wealth and physical health.[28] Both strains have formed significant components of recent popular Christian literature.

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Trends related to the latter emphasis can be detected in Christian reaction to environmental pronouncements and publications. *The Global 2000 Report*, a document produced in 1980 by a team of government scientists commissioned by former president Jimmy Carter, made predictions similar to those of *Limits to Growth* regarding world population, resource depletion, and environmental degradation.[29] Economist Julian Simon responded a year later in his book *The Ultimate Resource* to argue that, in the long run, the

resources and waste absorbing capacity of the earth are not finite, and that the potential for increasing the service yielded per unit of resource is unlimited.[30] In a more expanded response published in 1984, *The Resourceful Earth: A Response to Global 2000*, Simon and the late Herman Kahn served as editors for a collection of papers by scientists who refuted *Global 2000* conclusions, namely that: 1) population control is unjustified; 2) though African food production is down, this has nothing to do with environmental conditions; 3) there is not *prima facie* evidence to require any expensive species' safeguarding policy; 4) environment, resource, and population stresses are diminishing; and, 5) there will be a progressive improvement and enrichment of the planet's natural resource base and of mankind's lot on earth.[31]

Many Christians and Christian organizations have aligned themselves with these views and given them uncritical acceptance from both scientific and theological perspectives.[32] However, the fact is that the conclusions of Simon and Kahn are nothing short of incredible. Most disturbing is the book's underlying philosophy. It was tragic to hear from Simon and Kahn that:

> We do not neglect the die off of the passenger pigeon and other species *that may be valuable to us*. But we note that extinction of species—billions of them— . . . has been a biological fact of life throughout the ages, just as has been the development of new species, some of which may be *more valuable to humans than extinguished species whose niches they fill.*[33] [emphasis mine]

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Simon and Kahn asserted that:

> . . . our present world population size . . . is a clear sign of economic success in that we have the know-how and wherewithal to keep many more people alive as well as provide more goods and leisure. . . . Because of increases in knowledge, the earth's "carrying capacity" has been increasing throughout the decades . . . to such an extent that the term . . . "carrying capacity" has . . . no useful meaning . . .[34]

Dismissing concerns about world population growth, Mark Perlman, a contributor to Simon and Kahn's work, stated that:

> To know the exact world population size would be like knowing whether 9 or 10 guests will come to dinner tomorrow. A host or hostess knows that the level of consumption will not be much affected by the difference between 9 and 10 guests. In the case of human populations, the "guests" have, in the recorded past, provided most of their own sustenance. In either case, the "host" has time to adjust to the additional numbers.[35]

Who will be the "host" of this planetary party? Who provides the dinner for all Earth's unexpected guests?

Accusations by popular Christian writers, like Constance Cumbey, that environmental concerns have no biblical basis and are the fruit of heresy, constitute serious obstacles to increased environmental awareness in the Christian community.

Our Response

The Christian community stands today in the midst of choice. One way is turning toward a lower consumptive standard and a greater sensitivity to the needs of creation, the other to survivalism and material prosperity. The final outcome is still very much in doubt. As Christian scholars, we share the burden of that doubt. As yet, there is neither a well-defined theology of ecology, nor a clear path by which environmental and economic concerns are expressed in Christian perspective, especially to the general public. We still have not demonstrated to the Christian laity that there is a biblical basis for environmental concern. Accusations by popular Christian writers, like Constance Cumbey, that environmental concerns have no biblical basis and are the fruit of heresy, constitute serious obstacles to increased environmental awareness in the Christian community.[36]

Long-standing and mature Christian interest in economics, particularly when united with professional ecologic insight, holds great hope in achieving the kind of integrated outlook on world problems so necessary to produce their solutions, but we have not yet arrived at that point. There is little to be found in contemporary Christian literature which carefully integrates economics and ecology. The time is right for those concepts to emerge. Current world ecologic and economic problems have prepared both a need and a receptiveness in the secular community for a comprehensive Christian presentation, but such opportunities do not last forever.

We cannot separate environmental and economic problems. Perhaps we are learning not to try. Our answers to both must be found together in the One in

Whom is hidden all the treasure of wisdom and knowledge. What we write on these issues in the future must grow up, or the world will never find in it or us the answers to their questions, or a reflection of the One we serve.

NOTES

[1]Hardin, Garrett. "The Tragedy of the Commons," *Science* 162 (1968), pp. 1243–1248; see p. 1243.

[2]Leopold, Aldo. *A Sand County Almanac, With Essays on Conservation from Round River* (New York: Oxford University Press, 1966), p. 246.

[3]Van Dyke, Fred G. "Beyond Sand County: A Biblical Perspective on Environmental Ethics," *Journal of the American Scientific Affiliation* 37 (1985), pp. 40–48. Cable, Ted T. "Environmental Education at Christian Colleges," *Perspectives on Science and Christian Faith* 39 (1987), pp. 165–168. Walker, Laurence C. "Resource Managers and the Environmental Ethic," *Journal of the American Scientific Affiliation* 38 (1986), pp. 96–102. Van Dyke, *op. cit.* Ramon, Johan, and Richard H. Bube. "Appropriate Technology for the Third World," *Journal of the American Scientific Affiliation* 37 (1985), pp. 66–71. Brand, Raymond H. "At the Point of Need," *Perspectives on Science and Christian Faith* 39 (1987), pp. 2–8.

[4]Ward, Barbara. *Spaceship Earth* (New York: Columbia University Press, 1966).

[5]Boulding, Kenneth E. "The Economics of the Coming Spaceship Earth," in Henry Jarrett, ed., *Environmental Quality in a Growing Economy* (Baltimore: John Hopkins Press, 1966), p. 9.

[6]Hardin, *op. cit.*

[7]Hardin, Garrett. "To Trouble a Star," *Bulletin of the Atomic Scientists* 26 (January 1970), pp. 17–20; p. 18.

[8]Georgescue-Roegen, Nicolas. *The Entropy Law and the Economic Process* (Cambridge, MA: Harvard University Press, 1971).

[9]*Ibid.*

[10]Meadows, D.H., et al. *The Limits to Growth* (New York: Universe Books, 1972).

[11]Meadows, *op. cit.*, pp. 45–46.

[12]Summarized in Lewis J. Perelman, *The Global Mind: Beyond the Limits to Growth* (New York: Mason/Charter, 1976), pp. 45–46.

[13]For example, on mineral reserves, see David B. Brooks and P.W. Andrews, "Mineral Resources, Economic Growth, and World Population," *Science* 185 (5 July 1964), pp. 13–19.

[14]Mesarovic, Mihajlo, and Edvard Pestel. *Mankind at the Turning Point: The Second Report to the Club of Rome* (New York: E.P. Dutton/Reader's Digest Press, 1974).

[15]Daly, Herman. *Steady State Economics: The Economics of Biophysical Equilibrium and Moral Growth* (San Francisco: W.H. Freeman and Co., 1977).

[16]*Ibid.*, p. 26.

[17]Ellul, Jacques. *Money and Power* (Downers Grove: InterVarsity Press, 1984), p. 41.

[18]For an excellent discussion of Calvin's direct impacts, see John T. McNeill, *The History and Character of Calvinism* (Oxford: Oxford University Press, 1954).

[19]Hay, Donald. *A Christian Critique of Capitalism*, Grove Booklet on Ethics No. 5 (Nottingham: Grove Books, 1975).

[20]Wilkinson, Loren, ed. *Earthkeeping: Christian Stewardship of Natural Resources* (Grand Rapids: Eerdmans, 1980).

[21]Paradise, Scott. "Visions of the Good Society and the Energy Debate," *Anglican Theological Review* 61 (January 1970), pp. 106–117.

[22]Longacre, Doris Jansen. *The More with Less Cookbook* (Scottsdale: Herald Press, 1976).

[23]Sider, Ronald J. *Rich Christians in an Age of Hunger* (Downers Grove: Intervarsity Press, 1977).

[24]Sider, Ronald J. *Living More Simply: Biblical Principles and Practical Models* (Downers Grove: InterVarsity Press, 1980).

[25]Van Dahm, Thomas E. "The Christian Far Right and the Economic Role of the State," *Christian Scholar's Review* 12 (January 1983), pp. 17–36.

[26]North, Gary. *An Introduction to Christian Economics* (Craig Press, 1973).

[27]*Ibid.*, pp. 274–276.

[28]Kantzer, Kenneth S. "The Cut-rate Grace of a Health and Wealth Gospel," *Christianity Today* 29 (14 June 1985), pp. 14–15.

[29]Barney, Gerald O. *The Global 2000 Report to the President of the United States, Entering the Twenty-First Century: A Report* (New York: Pergamon Press, 1980).

[30]Simon, Julian, L. *The Ultimate Resource* (Princeton: Princeton University Press, 1981).

[31]Simon, Julian L., and Herman Kahn, eds. *The Resourceful Earth: A Response to Global 2000* (New York: Blackwell, 1984).

[32]For example, Herbert Schlossberg, author of *Idols for Destruction* and keynote speaker at the ASA's 1984 annual meeting, upbraided Raymond Brand for "ignorance in scientific literature," "false thinking of the neomalthusian movement," and "materialistic fallacies" in a recent letter to *Perspectives on Science and Christian Faith* (39:187) regarding Brand's article, "At the Point of Need." Schlossberg cited Simon and Kahn as an authoritative refutation of these "erroneous conclusions."

[33]Simon and Kahn, p. 23.

[34]*Ibid.*, p. 45.

[35]Perlman, Mark. "The Role of Population Projection for the Year 2000," pp. 50–63 in Simon and Kahn *op. cit.*

[36]Cumbey, Constance. *The Hidden Dangers of the Rainbow* (Shreveport: Huntington House, 1983), pp. 162–163.

Yours is the day and yours is the night.
It was you who appointed the light and the sun.
It was you who fixed the bounds of the earth:
You who made both the summer and winter.

Psalm 73:16–17

Thermodynamics and the Origin of Life

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The significance of thermodynamics to the question of the origin of life has been widely debated for the past twenty-five years. In this paper, the thermodynamic requirements of the origin of life are evaluated and the potential for such work to be accomplished with the available energy sources is determined. Relevant experimental work is interpreted in light of the thermodynamic analysis. Illustrations are included to assist persons not familiar with thermodynamics with its concepts.

Some creationists have claimed that the Second Law of Thermodynamics precludes a naturalistic origin of life. Evolutionists retort that because the earth is an open system, there is no thermodynamic problem with the origin of a living system from simple compounds assumed to have been abundant in the early earth's atmosphere. The purpose of this paper is to evaluate the validity of these conflicting claims, and to determine what one may say thermodynamically about the current origin-of-life scenario.

The minimum requirements for a simple living system must include the capacity to: 1) process energy (to make use of energy from the surroundings), 2) store information, and 3) replicate. The simplest organic system proposed to date that is capable of these functions is the hypercycle of Eigen.[1] This system, consisting of a deoxyribonucleic acid molecule (DNA) and a minimum of forty proteins, is much simpler than the simplest known living systems; namely, the bacteria. Cairns-Smith has proposed an even simpler first living system based on silicates.[2] However, his model is too general to allow a thermodynamic analysis at this time. Furthermore, there has been essentially no experimental work to verify the basic hypothesis of Cairn-Smith's inorganic model. Therefore, we will limit our analysis in this paper to the organic models of early life, in particular those requiring protein and/or DNA or RNA (ribonucleic acid).

Plants function like metabolic motors, capable of converting solar energy into chemical energy in the form of energy-rich compounds. These compounds are then utilized to supply the energy for the various processes required by the plant. Animals in turn eat the plants and utilize their energy-rich compounds to meet the animal's energy requirements. Thus, living systems may be thought of as functioning energetically in a manner similar to that of an automobile. The automobile converts the chemical energy in gasoline into mechanical torque on the wheels. The engine and drive train make that conversion possible. Within living systems, DNA, RNA, and protein molecules, the components of chemical (metabolic) motors, are analogous to the pistons, valves, spark plugs, transmission, *etc.* in an automobile.

As with an automobile, energy flow through living systems can be easily understood and found to be quite compatible with the First and Second Laws of Thermodynamics. However, the origin of living systems presents a much more challenging problem. The British mathematician and philosopher Michael Polanyi has succinctly described the problem in the following way.[3] He notes that the laws of chemistry and physics can be described using differential equations. However, it is in the prescription of the boundary conditions that specific form and function are obtained. To put it another way, there is nothing about an automobile that defies the laws of chemistry and physics. Rather, each component can be shown to function in a way that is completely in harmony with the laws of chemistry and physics. Yet you would never expect to have an automobile come into existence spontaneously. Someone had to prescribe (through design and manufacturing) the conditions under which the chemistry and physics occur to achieve the purposeful end result of the conversion of chemical energy in gasoline into transportation. In a similar fashion, the major problem to be resolved in our current origin-of-life scenario is how a most unlikely arrangement of complex organic molecules capable of processing energy, storing information, and replicating came into being.

The Second Law of Thermodynamics states that processes occurring in nature give a net increase in the total entropy in the universe (i.e., the total entropy in the universe is always increasing). Entropy is a statistical concept that measures the number of ways a system can be arranged. Entropy is also related to information. A system requiring a large number of bytes of specific information would be one with a very low entropy. Thus, the very complex and specific arrangement of molecules associated with even a simple living system constitutes a very low-entropy arrangement of the system. If normal processes in nature increase the entropy (decrease the information) in the universe, how then does one rationalize the origin of life, which requires a local decrease in entropy (or increase in information)?

The two most common answers given to this question are equally incorrect, in my opinion. Some creationists say that the Second Law of Thermodynamics renders *impossible* the chemical origin of life because of the infusion of information (decrease in entropy) required.[4] Some evolutionists respond that the required decrease in entropy is precluded by the Second Law of Thermodynamics only in a closed system. They would argue that energy flow from the sun makes the earth an open system, and that this energy flow is somehow capable of producing the required decrease in entropy (increase in information).[5]

Strictly speaking, the earth is an open system, and thus the Second Law of Thermodynamics cannot be used to preclude a naturalistic origin of life. However, energy flow through the system has only been shown to produce negative thermal entropy (affecting the distribution of energy in the system), whereas the origin of life requires a significant decrease in the configurational entropy (affecting the distribution of mass in the system). G. Nicolis and Nobel laureate I. Prigogine have alluded to this problem:

> Needless to say, these simple remarks cannot suffice to solve the problem of biological order. One would like not only to establish that the Second Law ($dS_i > 0$) is compatible with a decrease in overall (system) entropy ($dS < 0$), but also to indicate the mechanisms responsible for the emergence and maintenance of coherent states.[6]

If one wishes to restore a messy room to its original neat (low-entropy) condition, one must do work on the system. Although throwing a stick of dynamite into the room will provide a significant flow of energy through the system, it is doubtful that the configurational entropy of the room will be lowered or that the room will be restored to its original low-entropy state. The energy flow through the room needs to be *directed* if the configurational entropy of the room is to be

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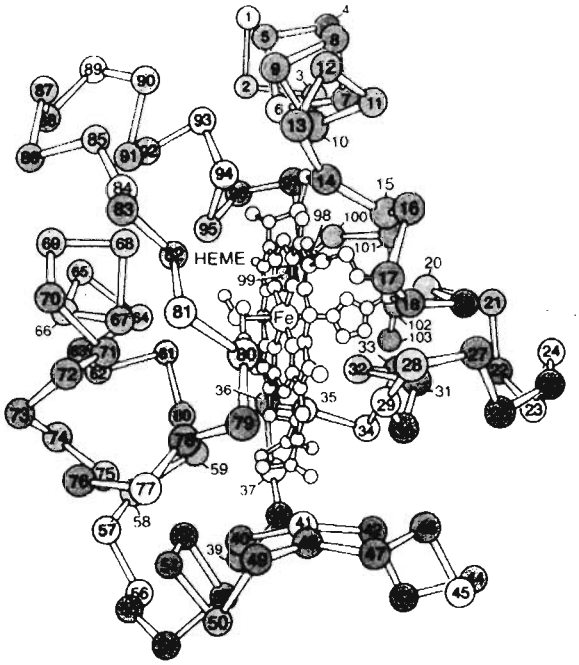

Figure 1A

reduced; i.e., someone needs to do very specific kinds of work to restore it to a neat condition. For precisely the same reason, it is insufficient simply to assume that solar energy is capable of generating the necessary information (or configurational entropy) to account for the first living organism.

In this paper I will quantify the various kinds of work required to produce a protein molecule, and then evaluate what, if any, kinds of available energy might be capable of accomplishing these various components of work. The results of prebiotic simulation experiments will be reviewed in light of these calculations. It should be emphasized that the production of a simple protein is a relatively small step in the formation of a simple living system. Yet even this small step has proven to be very difficult to explain theoretically or demonstrate in the laboratory under prebiotic conditions.

Synthesizing a Protein from Biomonomers

Protein molecules consist of long molecular chains of smaller building blocks, as shown in Figure 1A. To construct a functional protein from these simpler building blocks, one must assemble the building blocks in a very particular way. First, work must be done to get the amino acids to join together to form a polymer chain. Second, one must include only left-handed amino acids in the chain, even though a "prebiotic soup" would be expected to have equal concentrations of L and D-amino acids (see Figure 2). Third, one must also connect all of the amino acids with so-called peptide bonds, as shown in Figure 3. Fourth, the sequence of the various types of amino acids (see Figures 4 and 5) is important since it determines the three-dimensional topography (see Figure 1A) which in turn determines function, as shown in Figure 1B. Finally, it is crucial that only amino acids be incorporated in the polymer chain, even though many other organic molecules capable of reacting with amino acids would be present in any "prebiotic soup." Let us examine the amount of work required to meet these rather stringent requirements to form a functional protein.

The work required to create a protein, or functional polypeptide, from the twenty different amino acids found in biological proteins can be described using the change in Gibbs Free Energy (ΔG):

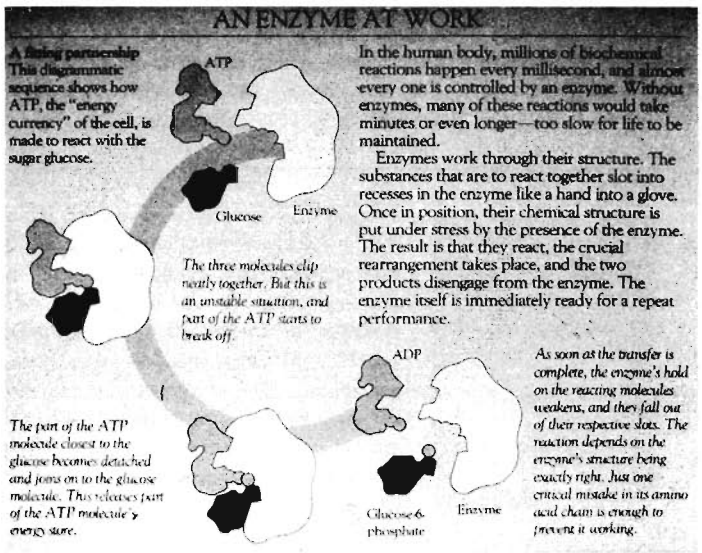

Figure 1B

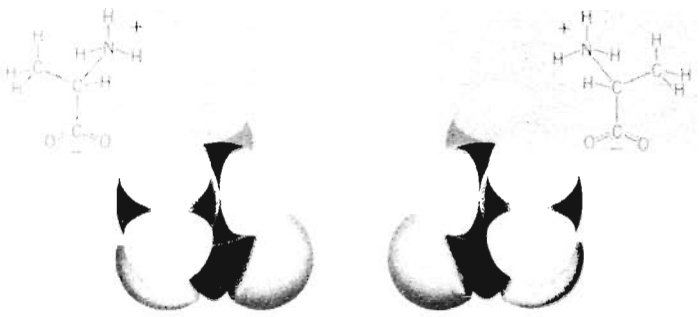

Figure 2

OPTICAL ISOMERS of the amino acid alanine are presented by these two molecular models. Structural formulas are given beside each model. Alanine can exist as one of two mirror images: L-alanine (left) or D-alanine (right). Naturally occurring proteins contain only L-amino acids.

$$\Delta G = \Delta H - T\Delta S = \Delta E + P\Delta V - T\Delta S \quad (1)$$

where ΔH is the change in heat energy or enthalpy, ΔE is the change in bonding energy, $P\Delta V$ is the pressure times the change in volume (this term is negligibly small), and $T\Delta S$ is the temperature in degrees absolute times the change in entropy. The change in Gibbs Free Energy during a chemical reaction, also called the chemical affinity, is a measure of the energy that would be liberated or absorbed during a reversible chemical reaction. A positive value for ΔG indicates movement away from chemical equilibrium, which would require work to be done on the system. A negative value for ΔG implies a movement toward equilibrium, which should occur spontaneously (unless some activation barrier must be overcome).

The change in entropy can be divided into the change in thermal entropy and the change in configurational entropy; terms having to do with the distribution of energy and matter in the system respectively:

$$\Delta S = \Delta S_{th} + \Delta S_{conf} \quad (2)$$

Finally, the configurational entropy can be further subdivided into four components having to do with the above-mentioned specific arrangements of the amino acids into polypeptides to obtain biological function:

$$\Delta S_{conf} = \Delta S_{1c} + \Delta S_{2c} + \Delta S_{3c} + \Delta S_{4c} \quad (3)$$

The configurational entropy work associated with obtaining only L-amino acids in the polymer chain will be called $-T\Delta S_{1c}$. The configurational entropy work to obtain only peptide bonds will be called $T\Delta S_{2c}$. The $T\Delta S_{3c}$ term refers to the additional configurational entropy work to get the proper sequencing of the

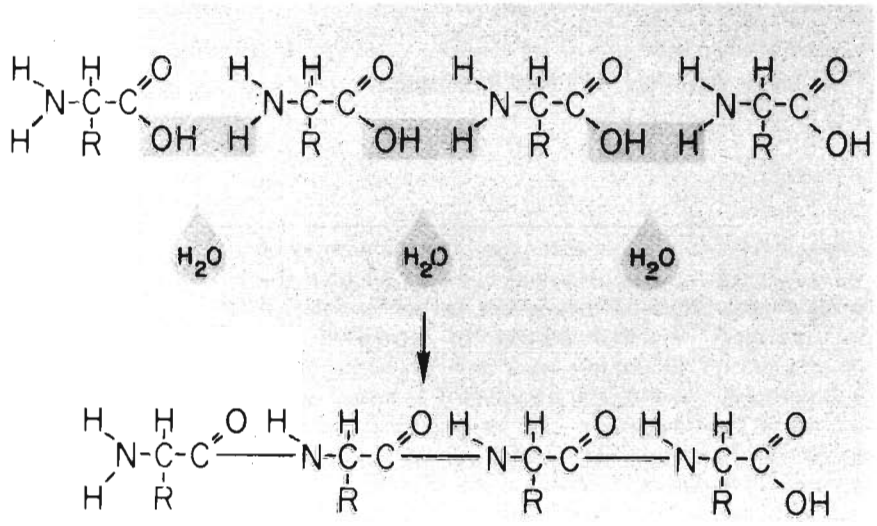

Figure 3

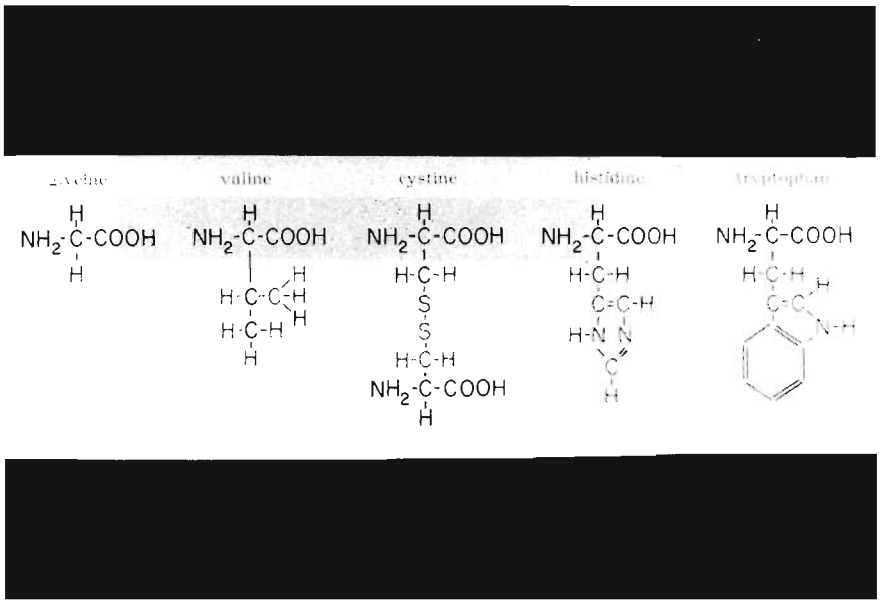

Figure 4

twenty amino acids in the polymer chain. Finally, $-T\Delta S_{4c}$ refers to the sorting and selecting configurational entropy work, or the work to select only the required set of amino acids to be included in the polymer chain from a "prebiotic soup" which contains many different organic molecules. Since each of these terms requires an ordering (or infusion of information) in the system, the respective entropy changes, ΔS_{ic}, are all negative. Noting in Equation 1 that the entropy term is $-T\Delta S$, we can see that a decrease in entropy ($\Delta S < 0$) results in a positive contribution to ΔG. Increases in ΔG represent work to be done on the system, either by available energy within the system (e.g., $\Delta H < 0$ could compensate for $-T\Delta S > 0$) or by external work done on the system.

Using the statistical definition of entropy:

$$S = k \ln\Omega \tag{4}$$

where k is Boltzmann's constant and Ω is the number of ways the system can be arranged, one may calculate the value of the various components of the configurational entropy work. We shall assume the formation of a polypeptide of 101 amino acids in a "prebiotic soup" will normally contain 50% L- and 50% D-amino acids, with 50% peptide bonds, and an essentially random sequence of amino acids.[7] Biological function will be assumed to require all L-amino acids, all peptide bonds, and only specified amino acids at each of the 101 positions. Biological function might be possible with a somewhat less stringent assembly requirement than I have assumed. For example, the type of amino acid at the 101 positions in the amino acid chain may be critical at only 40–50% of the positions. Thus, we will overestimate somewhat the work requirements for the configurational entropy term ΔS_{3c}. However, the requirement for ΔS_{4c} would probably be much greater than all three of the other terms combined, but cannot be calculated without a detailed knowledge of the composition of the "prebiotic soup." The magnitude of the three configurational entropy terms that can be calculated with the stated assumptions should not exceed the actual configurational entropy for all four terms.

The configurational entropy work at T equals 300K to obtain only L-amino acids is given by:

$$\begin{aligned} -T\Delta S_{1c} &= -T\,k\,(\ln 1 - \ln 2^{101}) \\ &= -300\ k \times 1.38 \times 10^{-23}\ \text{J/K-atom} \times (0\text{–}70) \\ &= 2.9\ \text{J/atom} \times 6 \times 10^{23}\ \text{atom/mole} \\ &\quad \times .24\ \text{cal/J} \times 10{,}000\ \text{moles/gm} \\ &= 4.2\ \text{cal/gm} \end{aligned} \tag{5}$$

Note k in the above equation is Boltzmann's constant and has a value of 1.38×10^{-23} J/(atom.K). The molar weight of a polypeptide of 101 amino acids has been assumed to be 10,000 gms, since the molar weight of

amino acids on average would be about 100 gms. The configurational entropy work to obtain all peptide bonds in a system where typically only 50% peptide bonds are obtained (in prebiotic simulation experiments[7]) is calculated as follows:

$$-T\Delta S_{2c} = -T\,k\,(\ln 1 - \ln 2^{101}) = 4.2 \text{ cal/gm} \quad (6)$$

The configurational entropy work required to give sequencing that results in catalytic activity may be calculated as follows:

$$-T\Delta S_{3c} = -T\,k\,(\ln 1 - \ln 20^{101}) = 18.2 \text{ cal/gm} \quad (7)$$

As has been noted, the sorting and selecting configurational entropy work, or work required to select the right set of amino acids from a much larger set of organic chemicals one would expect to find in a "prebiotic soup," cannot be calculated since we do not have a detailed knowledge of the chemical composition of the "prebiotic soup." The change in the $\Delta E + P\Delta V - T\Delta S$ term (see Equation 1) may be estimated from the widely quoted work of Borsook and Huffman that polymerization of two amino acids into a dipeptide increases the Gibbs Free Energy (not counting the configurational entropy work) by 3000 cal/mole.[8] For a polypeptide of 101 amino acids (100 peptide bonds), the increase in energy (or the required work) is 300,000 cal/mole, or 30 cal/gm, assuming a polypeptide molecular weight of approximately 10,000 gm/mole, as previously noted.

The total work required to form a polypeptide from amino acids can now be calculated to be:

$$\begin{aligned}\Delta G &= \Delta E + P\Delta V - T\Delta S_{th} - T\Delta S_{1c} - T\Delta S_{2c} - T\Delta S_{3c} - T\Delta S_{4c} \\ &= 30.0 + 4.2 + 4.2 + 18.2 + ? \\ &= (56.6 + ?) \text{ cal/gm}\end{aligned} \quad (8)$$

Again, let me reiterate that the complex arrangement of molecules necessary to give a functional protein represents a decrease in entropy ($\Delta S < 0$). Thus, the various entropy terms in Equation 8 ($-T\Delta S$) all contribute to the work required to make a functional protein, as described by the magnitude of ΔG.

To illustrate the importance to biological function of getting all the configurational entropy work done properly, consider the problem of trying to write the sentence "HOW DID LIFE BEGIN?" First we illustrate the problem of having a mixture of L- and D-amino acids rather than all L-amino acids. Our original statement becomes harder to understand; the function of communicating information is partially lost.

H O ʍ D I D Γ I Ⱡ E B E C I ᴎ ɓ

The problem that occurs when nonpeptide bonds are found in our polymer is illustrated by using our original statement but joining the letters together in unconventional ways to represent nonpeptide bonds. Again a loss of function is evident; the original message is obscured.

HO≷ ΩIΩ ⅃IƎ⊞ ϖƎƆIZˀ

Finally, the problem of improper sequence is illustrated by taking our original statement and rearranging some of the letters, totally obscuring the original message.

DIF HEG INBW ODIEL?

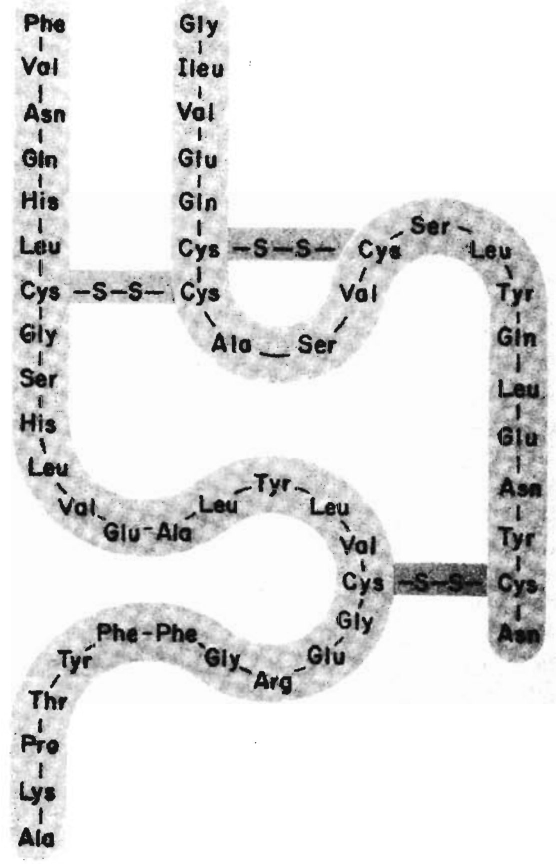

Figure 5

If all three of these problems were superimposed, the original message would be impossible to decipher, illustrating total loss of function. The same degradation of biological function results when the polymer does not have all L-amino acids, all peptide bonds, or proper sequencing of amino acids.

The greatest problem, however, is how to draw from an "alphabet soup" of many English letters (representing amino acids) and Chinese, Greek, and Hebrew symbols (representing other organic molecules) *only* the following set of letters: one each of H, O, W, L, F, B, G, N; two D's and E's; and three I's. The crucial question is whether energy flow through the system is capable of doing the various components of work indicated in Equation 8. We will address that question in the next section, relying heavily on experimental results from the literature.

Can Energy Flow Do the Required Work?

Experimental work to date has utilized mainly two approaches: 1) a two-step approach of first making amino acids from gaseous constituents, and then polymerizing them into polypeptides; and 2) a single-step approach of going directly from gases to polypeptides. The first approach was developed by Fox[9]; the second was pioneered by Matthews.[10]

Both approaches are able to successfully do the $\Delta E + P\Delta V - T\Delta S_{th}$ work, or chemical energy and thermal entropy work. Matthews' approach is successful in doing these components of work because he begins with energy-rich compounds such as cyanide. The polymers he forms have a larger bonding energy (more stable chemical bonds) than the gaseous precursors from which they form, so his chemical reaction goes "downhill" energetically. In Fox's approach, one begins with energy-rich gases such as ammonia, methane, and hydrogen and reacts them to form amino acids and other organic compounds. That reaction is also energetically "downhill." However, the chemist then separates the small percentage of amino acids from the many organic compounds formed from the gaseous reactions and polymerizes them, this step being energetically "uphill." Fox accomplishes this step by thermal polymerization, heating his amino acid mixtures at a temperature that drives off the water formed as a byproduct of the condensation reaction.

Removal of the water effectively prevents reversal of the reaction (see Figure 3). Unfortunately, energy flow through the system has been found to be quite ineffective in doing the configurational entropy work. Does either Fox's or Matthews' approach produce all L-amino acids? The answer is no, unless the chemist in Fox's approach selects out of the initial potpourri of organic chemicals only L-amino acids for use in the second step. In that case, one might say that the chemist does the $-T\Delta S_{1c}$ configurational entropy work (see Equation 8). Does either approach produce all peptide bonds? The answer is again no. Temussi et al. have found, using nuclear magnetic resonance (NMR), that Fox's thermal "proteinoids" have only 50% peptide bonds.[7] The situation with Matthews' polymers is much worse because his reaction product does not consist solely of amino acids, much less of all peptide bonds between the amino acids. That is not surprising; Matthews' approach does not allow the luxury of having a chemist remove only the amino acids for use in the second step of the experiment. To put it another way, Fox's approach has the chemist also doing the $-T\Delta S_{4c}$ work; Matthews' approach leaves it to chance, and chance is not very effective in doing this sort of work.

For such an incredibly improbable event as the current scenario of the origin of life, chance is not an adequate cause.

Does either approach produce an amino acid sequence that gives significant catalytic activity? Dose and Fox have reported a 70% increase in a chemical reaction catalyzed by their proteinoids, compared to the same reaction when the rate is measured in the absence of proteinoids.[9] Catalyses in living systems give a 10^7 increase in the reaction rate. While one might expect primitive proteins to be less efficient than modern ones, Dose and Fox's proteinoids give catalytic activity in orders of magnitude less than that found in biological enzymes (proteins) today, and much too low to overcome the "thermal noise" level in any system (i.e., the degenerative forces resulting from thermal agitation).

Thus, energy flow through a model prebiotic system has been shown to be capable of doing the $\Delta E + P\Delta V - T\Delta S_{th}$ components of required work for polymerization of protein, but not the configurational entropy components of work. Furthermore, there is no theoretical basis for postulating that energy flow through a system is capable of supplying the required configurational entropy work, or information. The work of Prigogine has indicated that a highly constrained system can produce an order analogous to that found in crystals, but that is a far cry from the information-intensive macromolecules characteristic of living systems.[6] Furthermore, the order produced in Prigogine's

systems is of the same magnitude as the information implicit in the boundary constraints.

Our answer to the question "Can the various work terms summarized in Equation 8 be accomplished by energy flow through the system?" is clearly "NO," based on experimental work to date. To be more specific, energy flow through the system is capable of doing the bonding energy and thermal entropy components of the total work term, but thus far has been completely inept at doing the configurational entropy (information) work required. Although the magnitudes of these two types of work are similar (see Equation 8), the coupling of the energy flow to the required configurational entropy (or information work) is extremely difficult, if not impossible. Apart from such coupling, the formation of biologically functional macromolecules is not possible.

One final area of misunderstanding needs to be addressed with regard to thermodynamic problems and possibilities associated with the origin of life. The freezing of water is often used to argue that ordering may occur both easily and spontaneously.[15] To evaluate this contention, one may write an equation similar to Equation 8 for freezing water with appropriate energy terms, as follows, at one atmosphere of pressure:

$$\Delta G = \Delta H - T(\Delta S_{th} + \Delta S_{cf})$$
$$DG = -80\text{cal/gm} - T(-.293\,[\text{cal/gm}]/K) \quad (9)$$

Water freezes spontaneously when ΔG is less than zero. From Equation 9, freezing can be seen to occur when the temperature T is less than 273K. Thus, the freezing of water requires only that the thermal agitation be reduced sufficiently to allow bonding forces to draw the water molecules into a crystal structure. A comparison of Equation 9 to Equation 8 indicates a fundamental difference between the freezing of water and condensation-polymerization chemical reactions: namely, the change in bonding energy is negative in one case and positive in the other. One cannot make the change in Gibbs Free Energy (ΔG) in Equation 8 negative, and thus make the reaction spontaneous, by adjusting the temperature.

An analogy may be useful to illustrate the significance of this sign difference. If you have a pool table with a recessed area in the center of the table, you would not be surprised to find all of the pool balls in this recessed area rather than randomly arranged around the table, unless you agitated the table quite strongly (analogous to heating ice above 273K). On the other hand, if the center of the pool table had a large hump with a small dip in the center of the hump (analogous to polymerizing amino acids), you would find it quite difficult with any degree of agitation to accumulate all of the pool balls on top of the hump in the small dip. It would require strong agitation to get the balls up the hump and such strong agitation would simultaneously jar free from the small dip whatever balls you might already have accumulated there. Thus, while the freezing of water is seen to be quite easy to accomplish by simply adjusting the temperature, no such possibility exists for the condensation-polymerization reactions needed to make DNA and protein. Thus, freezing of water and other phase transformations are seen to be irrelevant to the type of ordering and information production required for the origin of life.

Is Chance a Reasonable Alternative?

It has previously been noted that there does not seem to be an obvious way that the available energy flow in the "prebiotic soup" can be harnessed to do the required configuration entropy (or information) work to make even a simple protein, much less a collection of such macromolecules to provide minimal life functions.

If the information in a living system is illustrated by a book, the accidental formation of a new protein is equivalent to incrementing the letters on one page and producing an alternative but meaningful paragraph.

There is a tendency on the part of some scientists, when confronted with this dilemma, to respond: "It still could have happened by chance." For example, one might argue that the magnitude of the work required to reduce the volume occupied by one mole of an ideal gas by 50%, if done isothermally and in a reversible manner using a piston, can be calculated as follows:

$$-T\Delta S = -Tk[\ln 1^N - \ln 2^N] = TkN \ln 2 = RT \ln 2$$
$$= 416 \text{ cal/mole} \quad (10)$$

where N is Avogadro's number and T is assumed to be 300K. This much work will place all of the molecules into a volume only half the original volume without any reliance on chance. On the other hand, it is conceivable

that all of the molecules could accidentally find themselves in half of the original volume, apart from any work being done on the system. However, the probability of such a chance occurrence is only $[1/2]^{6E23}$, or 10^{-1E23}. Thus, while one could argue that the volume of gas could be reduced 50% by chance, it is not very likely. However, it becomes very believable that such an event could occur if the prescribed amount of work is performed on the system using a piston.

Chance is not a very likely substitute for some mechanism to perform the required work to make a functional enzyme (protein), for the reason just stated. For example, the probability of obtaining all L-amino acids, all peptide bonds, and exactly the right sequence of 100 amino acids would be given by:

$$P = [1/2]^{100} \times [1/2]^{100} \times [1/20]^{100} = 3 \times 10^{-191}$$

If one took all of the organic matter in the universe and used it to make amino acids which were then allowed to continuously react for five billion years, it would still be incredibly unlikely that one would make even one such protein. Yet one simple protein is hardly a prototype for an early living system.

It is appropriate to note that such appeals to chance should not be confused with a scientific explanation. A scientific explanation would postulate a model which, given the age of the universe and the amount of organic mass in the universe, would predict with reasonable probability a successful formation not only of a solitary protein but a family of such macromolecules which could provide the minimal functions of an early living system. For such an incredibly improbable event as the current scenario of the origin of life, chance is not an adequate cause. Rather it is the "God of the gaps" of the atheist until a more reasonable (believable) naturalistic first cause can be found.

Doolittle[11] and Thwaites[12] have attached great significance to the "accidental" formation of a new functional protein alleged to have occurred in the pOAD2 plasmid of *Flavobacterium Sp. K*172.[13] In my opinion they greatly overestimate the significance of such a finding, if indeed it is true. If the information in a living system is illustrated by a book, the accidental formation of a new protein is equivalent to incrementing the letters on one page and producing an alternative but meaningful paragraph. It is hardly equivalent to the formation of the book itself with the letters all properly arranged on the page (all L-amino acids with peptide bonds). Even Fox et al. have minimized the role of chance as an adequate explanation for the origin of biological information sufficient to produce the necessary minimal life functions mentioned at the beginning of this paper. Fox et al. say:

> The particular conjunction of atoms that are necessary for life seems to be exceedingly improbable, similar to the chance that a monkey at a typewriter will produce THE ORIGIN OF SPECIES.[14]

In summarizing this section, it is clear that appeals to chance are no substitute for a bona fide scientific explanation.

Review of Relevant Information from ISSOL's 8th International Meeting

Several papers at the 1986 Berkeley, California meeting addressed issues related to those presented in this paper. First, the geochemists and astrophysicists seem to have come to a clear consensus that the earth's early atmosphere never contained any significant ammonia or hydrogen and, at best, only very small amounts of methane. Since all of the prebiotic synthesis of biomonomers (i.e., simple molecular building blocks such as amino acids, bases, *etc.*) in Miller/Urey-type experiments have used generous concentrations of ammonia, hydrogen, and/or methane, such results are of questionable significance. The biochemists argued that they must have an appreciable amount of at least one of these energy-rich gases, and the astrophysicists insisted that such was not present in the early earth's atmosphere. If one begins with energy-rich gases such as ammonia, hydrogen, or methane, the formation of amino acids and other biomonomers is energetically downhill. On the other hand, if one begins with the atmosphere now thought to exist on the early earth (namely, carbon dioxide, nitrogen, and water), the formation of amino acids is energetically uphill. Solar energy or electrical discharge has proven to be effective in facilitating the chemical kinetics to move an energetically favorable reaction (one that goes downhill) forward, but such energy sources have not proven to be very helpful in driving an energetically unfavorable reaction uphill. It should be noted that the availability of such building blocks has been assumed in this paper,

The impression provided by the debate was clearly that at present we simply do not know how life originated. Each side clearly showed the inadequacies of the other's model, and neither side made any significant attempt to defend their own model.

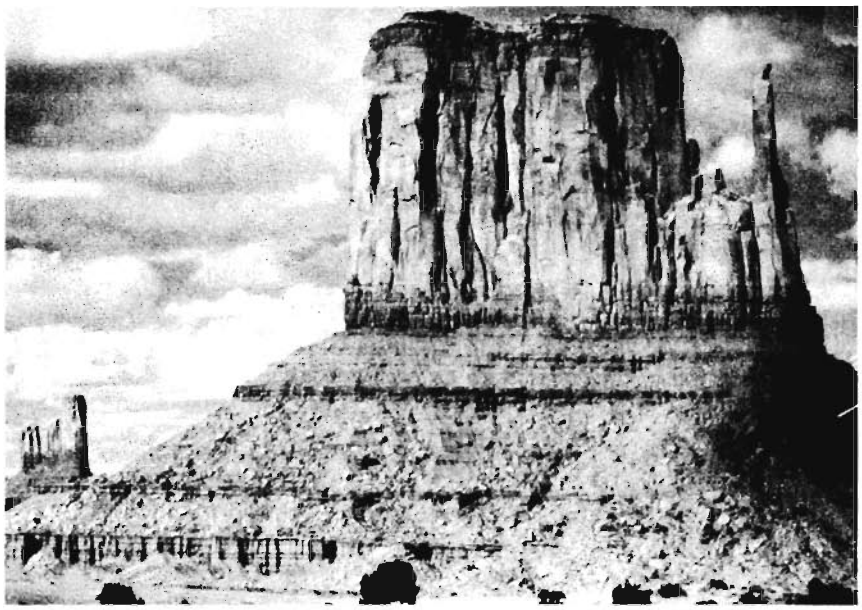

Figure 6

with all of the attention given to the proper assembly of these blocks.

In recent years, some scientists have postulated that maybe the first living system was based on RNA. Certainly RNA is a much better candidate for such a role than protein. However, a presentation by Robert Shapiro entitled "Prebiotic Ribose Synthesis: A Critical Analysis," demonstrated convincingly that we have no basis for believing in a prebiotic origin for RNA. He concluded his presentation with the following summary: "Our present understanding of prebiotic ribose synthesis offers no support for the presumption that significant amounts of oligonucleotides, or even nucleotides, were present on the early earth." There were no technical challenges to his presentation, only a couple of complaints about his being so pessimistic.

An interesting debate was held between the proponents of original life based on RNA and the advocates of original life based on protein. Supporters of the protein-based theory argued convincingly that RNA was much too complicated to have arisen prebiotically, much as Shapiro had argued in his paper earlier in the conference. Proponents of a RNA-based origin of life argued in an equally convincing fashion that protein by itself was too inept to provide the necessary biological functions for even a simple living system. The impression provided by the debate was clearly that at present we simply do not know how life originated. Each side clearly showed the inadequacies of the other's model, and neither side made any significant attempt to defend their own model.

At the heart of the problem is the difficulty in obtaining a first living system that is sufficiently complex to do the minimal things required by life but sufficiently simple to have formed by chance.

Summary

Thermodynamic analysis has quantified the magnitude of the various components of work required to produce one protein. A significant assemblage of protein and RNA or DNA would appear to be necessary to form a system capable of providing the minimal functions of a living system. The results of this analysis used in conjunction with experimental results from the literature clearly demonstrate that energy flow through the system does only the bonding energy work and the thermal entropy work, but not the configurational entropy or information work. The idea that energy flow through the earth system *automatically* solves the problem of supplying the necessary information for a primitive living system is simply not true. At present, there is neither a theoretical basis nor experimental evidence to support such an argument.

Are there any alternatives? One possibility is to postulate a much simpler first living system. Cairns-Smith's silicate precursor to carbon-based life is such a

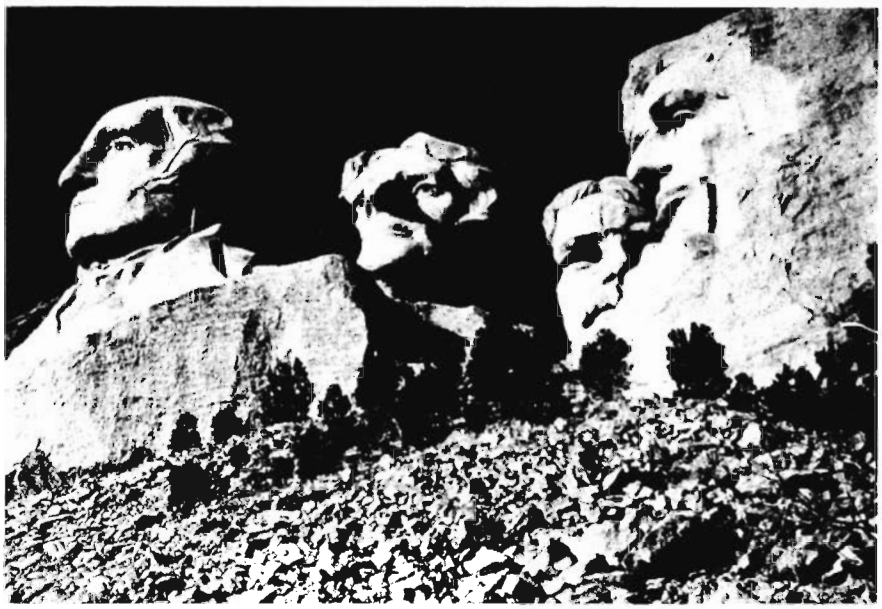

Figure 7

postulate.[2] At present, Cairn-Smith's model suffers from lack of any experimental support or any theoretical model that can explain the fundamental problem inherent in a naturalistic origin of life; namely, information.

A second possibility is that new physical laws might be discovered which could account for the information production necessary in generating the first simple living system. While possible, such a hypothesis at present is little more than a metaphysical statement of faith that all effects must be found to have natural causes.

Third, Hoyle and Wickramasinghe and Sir Francis Crick have suggested life came here from another planet.[17] This interesting suggestion, justifiably based on serious misgivings about current scenarios of a naturalistic origin of life on earth, actually does no more than transfer the problem of information to some remote location in the universe, as these authors note in their respective books.

A fourth alternative is to posit an intelligent creator as the source of the information-intensive first living organisms. When one compares the rock formations in Zion National Monument in Utah to those on Mt. Rushmore in South Dakota (see Figures 6 and 7), the indication of intelligent activity by a sculptor as contrasted to random forces in nature is clearly illustrated. In a similar fashion, the incredible complexity associated with even the simplest living systems clearly suggests an intelligent creator. An unbiased observer could hardly deny the reasonableness of such an inference from the scientific evidence.

Some will react to the suggestion of an intelligent creator by suggesting it is a traditional "God of the gaps" argument. However, I would strongly argue that such a reaction misses what has been the main point of this paper. A "God of the gaps" argument posits God to explain something not yet explainable by physical and chemical processes, apart from any evidence for such a hypothesis. In this paper, I have tried to argue that God is posited not because of what we do not understand, but because of what we do understand. The missing piece to the origin of life puzzle is a dramatic (step function) increase in information. Human experience consistently indicates such increases in information are always the result of intelligent activity, by man in the case of machines, presumably by God in the case of the first living systems.

I recognize that God could have created entirely through miracle, entirely through process, or through some combination of the two. I believe that current scientific understanding clearly suggests God used a combination of miracle plus process to create the first living system. Such a hypothesis is consistent with the Genesis 1 account of origins.

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The mantle of Christ be placed upon thee,
To shade thee from thy crown to thy sole;
The mantle of the God of life be keeping thee,
To be thy champion and thy leader.

From *New Moon of the Seasons: Prayers from the Highlands and Islands*, Alexander Carmichael (Ediburgh: Floris Books, 1986).

Opposite Directions

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Two opposite general directions, towards life and towards death, can be seen in nature. Any particular system of non-alive matter or any living organism is also simultaneously exposed to different opposite forces. The general direction towards life progresses through many stages; at each stage, opposite forces create relative stability and the time necessary to advance to the next stage. The spiritual life of human beings is also exposed to opposites: good and evil. Human beings can achieve spiritual eternal life in love. For them, the end is not the victory of only one direction, death, but both life and death.

Many renowned scientists, particularly physicists, have concluded that a deeper understanding of nature leads to a stronger religious conviction. "To the believer God is in the beginning, and for physicists He is at the end of all considerations," said Max Planck.[1] Nature reveals a harmonious arrangement, a coherence, which cannot come through blind chance. "The wonderful arrangement and harmony in the cosmos could only originate in the plan of an almighty and omniscient being," said I. Newton.[2,3] A. Einstein refers to "His—the profounder sort of scientific mind's—religious amazement at the harmony of natural law which reveals an intelligence of such superiority that, compared with it, all the systematic thinking and acting of human beings is an utterly insignificant reflection."[4] *

The coherence in nature is something which almost every great scientist sees and feels. An inductive way of thinking about natural phenomena is typical among physicists. Understanding that a great variety of phenomena are related to a small number of fundamental principles, understanding the simplicity, harmony and beauty of the ideas which rule nature, already has a religious significance.

Nature is comprehensible. "The incomprehensible thing about the universe is that it is comprehensible," said Einstein. With such an understanding, it is logical for many scientists to ask not only how nature is arranged, but also why; to go from physics to metaphysics. All the scientists mentioned above and many others, in different ways, have answered the question "why?" from a religious viewpoint. Some of them, a minority, like Weinberg, stuck to their probably atheistic guns: "The more the universe seems comprehensible, the more it also seems pointless."[16] But Weinberg did not deny that nature is comprehensible.

Today's direction in theoretical physics leans towards a unique picture of the universe. An attempt is being made to combine the macro- and microcosmos, all forces, the whole universe and its every atom into one unique theory; an attempt that was previously made by Heisenberg and Einstein. In a unique picture of the

*Similar thoughts have been expressed by Kepler, Herschel, Ampère, Pasteur, Oersted, Robert Mayer, Maxwell, Joule, Rutherford, Edison, Marconi, Nernst, James Jeans, Compton, Millikan, Eddington, Dessauer, Pupin, Laue, Jordan, Schrödinger, Weizsäcker, Heitler, Meurers, Margenau, Boyd, Bube and many others.[2-3,5-15]

universe, everything existing in space and time belongs to each other. Human beings are not only inhabitants of an insignificant piece of the universe which can be regarded separately from other pieces. They belong to the Earth and the universe, too.

The harmony and coherence in nature is not static. Everything changes. What is the direction of these changes and where do they lead?

It seems that there are two opposite general directions in nature. The second law of thermodynamics predicts a constant increase of entropy—if it is possible to apply the meaning of entropy to a system such as the universe—a degradation of energy, increase of disorder, and "heat death" of the universe. The probable end of all life in the universe is also predicted by today's cosmology, which forecasts either an ever-expanding universe or a turning point in its existing expansion and contraction. In either case, the conditions for any kind of life would not be possible.

However, scientific research discovers an orderly nature, not a chaotic one. Life is now blooming in many forms on Earth and the human population grows. Harmony in nature could not exist without the simultaneous pull of an opposite general direction leading to order and to life. This has been apparent since to beginning of creation, and many steps led towards conditions favourable to life on Earth. The evolution of life has manifested only one direction, towards increasing complexity.

God's creation of man has opened the door to the development of a spiritual life in love. Teilhard de Chardin (one of the reviews of Teilhard de Chardin is given in reference 17), W. Heitler,[9] and others, have described this general direction. The concept of the changes in nature speaks of its teleological purpose.

Modern cosmology also concentrates on the question "why." Why is there coherence in nature? Why is there coherence between each remote part of physics? Many facts fit the answer: there is a principle in the universe which has combined and directed its properties and development from the very beginning towards life.[18–21] This principle is the so-called anthropic principle, if related to the life of human beings. Holmes Rolston III suggests the expression biogenic or psychogenic principle, relating generally to life of any kind in the universe.[21] The general direction towards life in the universe is caused by an astonishing number of "coincidences." The anthropic principle indicates that these are not really coincidences at all, but that there is a sense deeper than blind chance.

Two opposite general directions, towards life and towards death, seem to have coexisted from the Big Bang until the present in the expanding universe. They advanced slowly, step by step, to their goals. Both processes, opposite in their meanings and goals, could have, at least for a period of time, the same time arrow. Similarly, the prospect for a child is a life full of creativity and love (and the possibility of eternal spiritual life in love) but, at the same time, physical death.

At any stage in the development of the universe, from the Big Bang to life and to human beings, the existence of different forces acting in opposite directions plays an important role.[°°] Any particular part of the universe—atomic nuclei, molecules, crystals, stars or the whole universe—was and is exposed to different processes acting in opposite directions. The existence of opposite processes should not only be understood in the sense of an ideal chemical equilibrium. Thermodynamics describes the equilibrium of an isolated system where only reversible processes occur, with a zero change in entropy. In reality, entropy production and a degree of irreversibility are always present. Still, the existence of processes which go in opposite directions gives some stability to any system. The change in equilibrium does not often occur too quickly.

However, there are cases when reactions practically go to completion. There are processes which develop very fast, for example, explosions. But in these cases

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also, an activation energy is necessary to start the process; it is necessary to have an appropriate temperature, pressure or volume. The absence of these conditions can stop the process. The process does not develop in a complete absence of forces which act in opposite directions.

A stone will disintegrate in a (long) period of time, under the influence of many stresses, into dust. The opposite process, the formation of the stone from dust, hardly ever occurs. Nevertheless, the stone was at one time somehow formed, and the forces which keep its atoms and molecules together resist the gradual increase of entropy for a long time. Entropy's victory is time-consuming; it is slowed down by the existence of forces which act in an opposite direction.

The atomic nuclei consist of positively charged protons and neutrons which are electrically neutral. (Protons and neutrons are also complex particles.) A repulsion electrical force exists between protons. The nuclei would explode without the simultaneous presence of the strong nuclear force which is an attraction force between all particles in the nuclei and which keeps particles together. The examples of forces which act in opposite directions are everywhere we look. The fullness and variety of phenomena in the universe, the temporary stability of different stages in its development and at each level of observation may be attributed to the existence of different processes which act in opposite directions. (Similar ideas are expressed by Hyers.[22])

The root of the idea of opposite processes is in all the world's major religions and cultures; it is in Newton's law of mechanics, and in Heraclitus who wrote: "Opposition unites. From what draws apart results the most beautiful harmony. All things take place by strife."[23]

General Direction towards Life: From Birth of the Universe to Creation of Mankind

Two ideas about the understanding of the development of the universe are interrelated. First, the universe is orderly and created in such a way as to bring life and human beings into existence, although predictions about the future existence of life are negative. Second, development of the universe occurred through many different processes which acted in opposite directions. Here again are a few examples.

The basic features of the universe were determined by conditions existing immediately after the Big Bang. If the physical constants, the strength of the fundamental forces in nature, had been different by only a few percentage points, if the balance between opposite forces had been shifted a little in one direction, no form of life would probably exist. Even if we think about the possibility of life existing in forms different from those we know, our imagination should have a limit. For example, the idea of life arising from groups of chemically inert helium atoms can hardly be imagined.

Even, if we think about the possibility of life existing in forms different from those we know, our imagination should have a limit.

A balance existed between the expansion of the universe and gravitational attraction. Big Bang explosion adjusted this balance in such a way that the universe just escaped its own gravity. If the expansion rate had been faster, the formation of stars and galaxies, caused by gravity, could not have taken place. Matter would have been dispersed, unable to form into galaxies.[19] If the expansion rate had been slower, the universe would have collapsed too quickly to allow for the development of stars such as the sun.

The beginning of the universe is described using the model of a fire-ball. In the early stage of the fire-ball, in about the first millisecond after the Big Bang, neutrons and protons came into existence. Neutrons and protons were transmitted into each other by reactions with other particles. The change of a particle from neutron to proton, and in the opposite direction, and the average ratio of protons to neutrons, could be described by the thermodynamic equilibrium.[19] Because of the expansion and cooling of the universe, the thermodynamic equilibrium was destroyed, and at that moment the abundance ratio of protons to neutrons remained frozen. This ratio was important in the consequent formulation of helium nuclei and the establishment of the ratio between hydrogen and helium. In the fire-ball there existed 22–28% helium; the rest was almost all hydrogen. The material which existed in the fire-ball served as material for star formation. So, hydrogen was the primary fuel for nuclear fusion reactions in the stars, including the sun. If mostly helium had been used as an initial fuel, the stars would have had shorter lives. The life of the sun would probably not have been long

**Note the difference in meaning between the expressions "*opposite general directions*" and "*opposite directions*" in this article. There are two opposite general directions in nature, to life and death. Each particular system is spontaneously exposed to forces which act in opposite directions. The description of the action of forces in opposite directions is specific for every observable system.

enough to enable life on Earth to evolve.

When the stars and galaxies were formed, gravitational force was, as it is now, also balanced by centrifugal effects. Galaxies and clusters of galaxies orbiting around each other and rotating prevent a gravitational collapse.[18,19] Today's assumption is that a central black hole exists in the Milky Way, as in other galaxies. Stars, particularly those close to the black hole, must orbit very fast to escape gravitational collapse. The sun has an orbital velocity of about 900,000 km/hour in the Milky Way.[20]

A balance between opposite forces existed, but a balance so finely adjusted as to serve the general direction to life.

The relatively long, calm and stable period of stars results from the simultaneous action of opposite forces: gravitation and internal pressure, thermally generated, due to the nuclear reactions in the core. [19,20,24,25] The sun and solar system were formed about 4,500 million years ago, with atoms of previous stars existing as part of the collapsing gas. As the sun contracted, its core temperature rose, and this increase caused the ignition of nuclear fusion reactions of hydrogen in helium. This created so much energy that a balance with gravity contraction was achieved. But, after this relatively long, relatively stable period in the history of the sun, some 5,000 million years from now, all the hydrogen will be exhausted. Further contraction of the sun will further increase the core temperature, so that fusion reactions of helium nuclei will be ignited, and the energy thereby released will enlarge the sun's diameter. The sun will become a "red giant," perhaps engulfing the Earth. When all the helium has been used up as nuclear fuel, the sun will probably contract into a relatively small ball; a cold, dark "white dwarf."

The sun's system consists not only of hydrogen and helium, but also of other heavier elements, which didn't exist in the fire-ball. Where did these elements come from? These elements have been primarily formed by fusion processes in the stars. For stars heavier than the sun, a possible end is a supernova explosion. Fusion proceeds from hydrogen to helium, from helium to heavier elements, but in the end instabilities occur and an enormous inner pressure builds up, followed by an explosion.[19,20,24,25] The debris of exploded stars is then incorporated into a new star, formed by the gravitational attraction of cosmic material. Such debris is the source of heavier elements in the new star. Without the previous explosion of stars, our solar system consisting of a variety of elements could not be formed, so life could not exist.

In the actions of different opposite forces the life of the universe has been long enough for the formation of the sun system with its heavier elements. The duration of the sun's relatively stable period has been long enough for life to evolve on Earth. The sun, for millions of years, has radiated just the right amount of energy to Earth. The evolution of life proceeded in only one direction: from the simple to the more complex; and nothing in the universe is known to be as complex as a human being.

There is an enormous difference between living and dead matter. Live beings are capable of reproduction. Life belongs to unity. By separating the parts of this unity, up to a certain limit, matter is still there, but not life. Life is not only a simple cluster of separate parts. In a broader sense, as previously mentioned, the universe itself is not only a cluster of separate parts. A plant has vegetative life. Roots and leaves have their role in the plant's life, but separated, they do not represent the plant. The plant has a direction and cycles of development. The form of the plant, the symmetry, the beauty, are coded in the DNA molecules.

The life of animals is more complex than that of plants. Senses are developed. The circle of interaction between animals and their surroundings is much wider because of their mobility. The ability to communicate with other live beings is much greater. Some species have a fascinating sense of organization. Animals feel joy and sorrow; they have some intelligence. Instinct and learning mostly determine animal behaviour; still, between animals, individuality can be expressed.

Humans can make a moral choice, distinguish between good and evil, are capable of conscience.

Human beings differ totally from anything else known in nature. They are not "developed animals." Evolution affects physical qualities, but it is the spiritual quality which sets the man or woman apart from other live beings. Humans can make a moral choice, distinguish between good and evil, are capable of conscience. They have free will, they can speak, they

have a soul. As the Persian poet wrote: "God sleeps in the mineral, dreams in the vegetable, stirs in the animal, and awakens in the man."[26]

The time arrow described by evolution is directed to the more perfect, more developed. Evidently, this direction is opposite to the extinction of live beings. However, the extinction of species, the death of individuals, caused by natural conditions or the process of aging, occurs all the time. Evolution occurred as a result of opposites: life and death. The general direction towards life, towards the more complex, the more developed, progresses in a constant balance of the life and death of many individuals.

No proclamation about love has a sense, and no virtue has value, if love is absent from the heart.

The general direction towards life started from the Big Bang and progressed through many stages of non-alive and alive matter. The phenomena at each stage are different; what is common seems to be the existence of opposite processes.

The idea of opposite processes can contribute to understanding how the development towards life and to human beings occurred from the creation of the universe, but without accepting the idea of guidance in this development real understanding is missing. From the Big Bang to the evolution of humanity, we can take no credit for this general direction towards life; we can only be aware of it and thank God for it.

* * * * *

There is no doubt that today's scientific knowledge is imperfect. Still, its development has brought, and continues to bring, an awareness of nature as something meaningful.[27] The difference between a scientific and a religious description of the world often seems to be largely semantic.

It would be incorrect to say that a religious description is a supernatural one, while the scientific is a natural one. God's actions can be seen in the laws of nature. Why would God, who created natural laws, violate them except for special reasons such as love or pity? Bube used the words "the normal mode" for God's activity in natural processes and the "unusual mode" for miracles.[15] Science tries to discover scientific laws. F. Dessauer said: "The discovery of natural law is a meeting with God."[6] The relationship between matter and natural law is described by Heitler: "Natural law is something spiritual. The law permeates matter. Human beings understand the law, but did not create it."[9]

The creation of the universe, of human life, is God's creation. A scientific description of phenomena in nature could be interpreted as an attempt towards understanding God's arrangement of the world.

Human Beings

Are human beings so special that their destiny may be discussed in the framework of the whole universe? What a beautiful blue-white planet we have, said the astronauts approaching Earth. But physically, what is planet Earth in the universe? It is a part of the sun's system, and the sun is one of the billions of stars. Earth is not the center of the universe. A center of the universe does not exist.

However, the human capacity to understand the size and position of the Earth in the universe reveals a remarkable quality of the human mind. Thanks to experiments and developed theories, human beings can travel mentally through space and time. They can understand that the wonderful arrangement of the universe, the variety of phenomena and beings born in the superimposition of opposite forces, the existing general direction towards life, clearly speaks of sense in nature.

Perhaps God created, or will create, life somewhere else in the universe, not only upon the Earth. There is now, apparently, no life elsewhere in our solar system. Assuming that the known laws of chemistry and physics are valid everywhere in the universe, there are many stars and planets upon which no life could exist; either the temperature is too high, too low, or other reasons forbid it. Earth has a solid crust; most material in the universe is in the form of gas clouds or plasma balls. Earth orbits around a star which has now been stable for a long time. Still, there could be millions of planets upon which life could develop. At the very least, Earth belongs to a group of bodies upon which life exists in the universe.

Even more important than man's capacity to understand in some way the structure of the universe is his or her ability to feel love and compassion towards others. The importance of anything in the universe cannot be measured only by size and mass. Theoretically, it is possible to imagine a universe without life. This means a mindless universe unable to register its existence, a universe without compassion and love. But would the

existence of such a universe have any sense? The question of purpose can be related to mind, and even more to love. The existence of a purpose of the universe can be seen in its arrangement.

True, human beings commit dreadful and terrible acts. They have many reasons to be very humble. At the same time, they have reason to be aware of their potential values. Christians have a particular reason to believe in their potential values, because of the life of Jesus Christ on Earth. An awareness of the difference between potential value and reality is one important reason for humility.

Success in one direction is not possible without the existence of its opposite.

The path of the general direction towards life, existing from the Big Bang to the creation of human beings, is directed now to greater spirituality, to love. By contributing to goodness in the world, men could be God's collaborators.[27] Love is what gives value to the lives of human beings. "God is love" (I John 4:8,16). The creation of nature and humanity, the coming of Christ to Earth, was all because of love. "Love never ends" (I Corinthians 13:8). Human beings may only approach God with love in their hearts. We should not look upon love as an abstract principle, but as a practical code of life. No proclamation about love has a sense, and no virtue has a value, if love is absent from the heart. The world in which human beings are living is not perfect, but they can make it better. They have to take responsibility for all the evil in the world (Dostoyevski).

However, men and women may follow different directions. They may contribute to the general direction towards death; they may destroy life, or have hate in their hearts. They may be cold, egotistic, or totally indifferent to the needs of their brothers and sisters in whatever society they live.

In the world of different and opposite directions between good and evil, human beings have the opportunity to choose love. If the negative opposite did not exist, there would be no real achievement, no individuality, no free will. Success in one direction is not possible without the existence of its opposite. Achievement requires effort. Whichever direction a human being chooses, he or she will meet some kind of resistance, as it is in all processes in nature.

Predictions

Today's scientific view indicates that life will very probably end at some point in the future; meaning life in its material form, not in its spiritual sense. If the universe were to expand forever, individual stars would complete their cycles and "die." They would explode or become cold, white dwarfs or neutron stars, with a diameter smaller than that of white dwarfs, or collapse into black holes. The orbital velocities of stars in the galaxies would slow down, and entire galaxies would collapse into black holes. The matter escaping black holes would be extremely cold and dark, and the density of matter in the universe would be very small. Eventually, the black holes would evaporate away.[19] If the universe were to contract in the future, the density of matter would increase and perhaps a fire-ball would again be formed. No form of life, no molecules could exist. The universe, perhaps, would not repeat itself.

Even the theory of an oscillating universe, appealing to those who lean towards atheism, does not seem probable according to today's science.[16] Given this theory, the universe is going through an infinite number of cycles of expansion, contraction, Big Bang and new expansion. Theoretical considerations predict that, for such an oscillating universe, the entropy per nuclear particle (ratio of the number of photons to the number of nuclear particles) would rise in every cycle. If our universe were the consequence of infinite pre-existing cycles, the entropy per nuclear particle would be infinite; this does not correspond to the facts.

Life and death are opposites, coupled around the question of human existence. The positive answer to this question is the eternal spiritual life, love, based upon Christ's resurrection.

Every living being, including humankind, has a beginning, a period of development, and death. A similarity exists, it seems, between each individual life, each star, and perhaps the entire universe. With every birth, the possibility of development exists, along with the certainty of death. The future existence of human beings is not necessarily related to the planet Earth, but evidently to the future of the universe.

Is death the answer to all that happens in the universe? This hardly seems logical. Why then the

coherence and the harmony? Why the existing general direction towards life in nature? Nature does not talk only about dying, but also about living. Life does not mean only the variety and perfection of living organisms; it also means development of spirituality. Life and death are opposites, coupled around the question of human existence. The positive answer to this question is the eternal spiritual life, love, based upon Christ's resurrection. This is also, at least partly, the answer to the question of the purpose of the universe. Whether this is the only purpose, we don't know.

Everything in nature is related to a polarity, everything is exposed to different opposite forces in each particular system, and to two opposite general directions, life and death. What will be the end result: the victory of life, or of death, or both? It could be the victory of both: material death and spiritual life in love. In this case, the ultimate end is characterized by an ultimate polarity. Another way of expressing the idea of ultimate polarity lies in the Christian belief in the eternal reward or eternal punishment of all men and women.

End Remarks

To summarize, everything in nature is exposed simultaneously to processes going in opposite directions. Opposite directions could cause a relatively slow development of any system, if compared to a system in which only one direction would strongly prevail. Opposite processes cause a greater variety of phenomena than a one-direction system would dictate. Two general directions, towards life and towards death, have existed from the creation of the universe. The general direction towards life progresses in many stages for both nonalive and alive matter. The action of opposite processes at each stage makes the development of its succeeding one possible. The general direction towards life may lead towards eternal spiritual life in love. Today's science predicts that material life in any form will eventually cease in the universe. Hence, two general directions lead to ultimate polarity, to the fulfillment of opposites: life and death.

I believe in the eternal, spiritual life, in love which never ends. I do not have such complete faith in today's scientific predictions, for they may be contradicted or superceded tomorrow. It is still intriguing how this idea about opposite processes permeates scientific and religious views of the world. Predictions of the end of the material world and the existence of a spiritual world are in the Bible and in the literature of other religions.

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Michael Faraday: Man of God—Man of Science

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Michael Faraday was a man of both tremendous religious faith and great scientific achievement. He was a member of a small religious group who sought to practice simple New Testament Christianity. Some historians have found such a combination of faith and science to be paradoxical, and have sought to show his faith as separate and distinct from his scientific researches. A careful study of his life, however, indicates that such was not the case. The central, guiding principle of his life was his faith in God as the Creator. For Faraday, the universe was the handiwork of God and Faraday was but a humble servant seeking to understand the workings of the creation.

Faraday did not, as some have claimed, "compartmentalize" his scientific and religious beliefs. Rather, his scientific work was an extension of his theology, which included a deeply held view of the biblical account of creation. Thus, Michael Faraday is a key figure in the history of the interaction of science and the Christian faith. The study of his life can lead us to a greater understanding of science and Christianity in our lives today.

The role of Christianity in the development of modern science has been a matter of some disagreement among scholars.[1] There has been a tendency among some historians to view the Christian religion as a hindrance to the development of science.[2] The so-called "conflict" or "warfare" school of thought has evolved out of this viewpoint. The writings of Andrew Dickson White and John William Draper are generally regarded as the origin of much of this type of thinking.[3] There have also, however, been a number of scholars who feel that the development of modern science was influenced and even perhaps nurtured by Christianity.[4]

A number of those in the seventeenth, eighteenth, and nineteenth centuries who made major scientific discoveries were not trained scientists, but rather amateur scientists and often clergymen. The Royal Society, one of the major scientific organizations and certainly a factor in the development of science, was founded by many such individuals.[5] Although not a religious organization, a significant number of its early members personally held strong religious convictions. Robert E.D. Clark has made the following observations regarding the membership of the Royal Society:

> The belief that nature was to be regarded in this light [as "God's other book"] supplied the motive for most, perhaps even all, of the work of the Royal Society in its early days. . . . The prevalent view at the beginning of the scientific movement was that, since God had created nature, only lazy and unthankful people would be uninterested in that upon which God had

> lavished so much thought and care. It was this belief, held with passion, which enabled the early investigators to overcome the discouragements and difficulties with which the beginnings of science were attended.[6]

Hawthorne stated in reference to this organization: "If you look at the lives of some of the early members of the Royal Society, of Bacon and his contemporaries, people who were most interested in the study of Nature, you generally find that they had a very definite Christian faith. They felt that they were studying the handiwork of God, and they expected Nature to be orderly, and to be worth studying: and that was the incentive for their scientific work."[7]

One such Fellow of the Royal Society, and an important figure in the history of modern science, was Michael Faraday. Colin Russell has summarized the importance of Faraday in the history of science: "Faraday . . . was according to almost any criterion a giant amongst scientific men. Possibly the greatest experimentalist in the history of science, and also one of its most successful popularizers. . . . "[8]

Russell's description of Faraday is quite remarkable considering Faraday's personal history. He was born in 1791 to parents of meager means. His father, a blacksmith, was of ill-health and died leaving the family with little financial support. Faraday's education was at best rudimentary, and at 13 he was forced to take a job as a delivery boy for a bookseller. As a young man Faraday was apprenticed to become a bookbinder. This fortunate turn of events allowed him not only room and board, but also an opportunity to read many of the important books of the time. Thus, Faraday was able to further his limited education through his voracious appetite for reading.

He completed his years of apprenticeship and served for a time as a master bookbinder, but the interest in science which his reading had kindled would not allow him to remain in that occupation. After several unsuccessful attempts, he was able to secure a position as a laboratory assistant to Sir Humphrey Davy, Professor of Chemistry at the Royal Institution.

This largely self-educated young man would one day rise from this lowly position to become the Director of the Royal Institution. This self-trained chemist and physicist would contribute tremendously to the growing body of scientific knowledge.

His discoveries were numerous and outstanding. Among them were the following: liquefaction of chlorine, discovery of benzene, development of stainless steel and optical glass, and discovery of the laws of electrolysis and electromagnetic induction. He also made the first electric motor, dynamo, and transformer.

Faraday, the great man of science, was also a devoutly religious man and a member of an obscure, small religious group, known as the Glasites or Sandemanians. Although he lived a very private personal life, his writings, as well as the writings and reflections of those who knew him, can provide us with some insights into the faith and science of this great man. Furthermore, the study of this man of science and his Christian faith can help us to understand the relationship between Christianity and the beginnings of science, and perhaps even aid us in our quest to understand the interaction between science and the Christian religion today.

Faraday and the Sandemanian Religion

The one aspect of Michael Faraday's life about which there is complete agreement among historians is that he was devoutly religious. He was born, reared, lived, and died a member of a small religious group known variously as the Glasites or Sandemanians. To understand Faraday as a person and a scientist, one must first understand his religious beliefs. To do so one must look briefly at the religious group to which Faraday belonged.

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This group took its name from its two most illustrious leaders, John Glas and Robert Sandeman. The members of this group were, for the most part, working class people: weavers, printers, bookbinders, blacksmiths, merchants, and other craftsmen. The leaders of the group, however, were neither ignorant nor unlearned men.

John Glas was born on September 21, 1695 at Auchtermuchty, county Fife, Scotland. He was educated in nearby schools, including a grammar school at Perth. He entered the University of St. Andrews and received a degree of A.M. on May 6, 1713. He went on to complete further studies at the University of Edinburgh. He was ordained in 1719 in the Church of Scotland (or Presbyterian Church) in the Tealing parish, which is located about five miles from the city of Dundee.[9]

Glas was a dedicated minister and sought to serve the needs of his flock. His sermons were noted for their depth of study, and he has been referred to by one historian as a "scholarly man."[10] His devotion to Scripture was intense. As one writer commented, Glas " . . . was determined to make the Scriptures his only rule of conduct. . . . "[11] Such steadfastness to Scripture would lead him to a life of controversy. As one author has commented in this regard: "He did not foresee that holding such a view would bring him into opposition with the precepts of his own denomination."[12]

As a result of his careful study of the Bible, Glas began to seriously question some of the doctrines of the Presbyterian Church, especially in regard to the establishment of a state church. His devotion to God's Word compelled him to speak his views on these matters. He was called into question for these teachings, and following various hearings Glas was deposed from his office as minister on March 12, 1730. This did not, however, deter Glas from ministering to the spiritual needs of his flock. Neither did it dissuade him from his belief "that Scripture is the only standard for doctrine and practice."[13]

Glas and his followers were counted among the other "nonconformists," "seceders," and "separatists" of the time, and were often abused because of their beliefs. There is at least one account of people throwing mud upon Glas and some of his followers, and also an aborted attempt to burn down their meeting house.[14] His following continued to grow, even under persecution, and new churches were added in Scotland and England.

Glas was a prolific writer and authored a number of tracts, books, and other writings. He died on November 2, 1773, and was laid to rest in the family cemetery in Dundee.

The second important leader of this movement was Robert Sandeman. He was born in Perth on April 29, 1718. He entered the University of Edinburgh in preparation for the ministry in the Church of Scotland. He was a capable student and very proficient in mathematics, Greek, and other languages. While at the University, he became acquainted with John Glas and became one of his followers. Sandeman had also become dissatisfied with some Presbyterian teachings and made the decision not to pursue a career in the Church of Scotland. He returned to Perth in 1735 and learned the weaver's trade. In 1737 he married Katherine, the daughter of John Glas. After several years, he left the weaving business to devote more time to ministry in the churches begun by Glas.

Sandeman was a scholar in his own right, and his writings gained a much wider audience than those of Glas. Historians Garrison and DeGroot have commented: "Though the Sandemanians remained few and inconspicuous, Sandeman himself was a theological thinker and writer of great power. His works were widely read and highly regarded by many who had no interest in the peculiarities of his sect, and by some who probably never heard of it."[15]

Glas " . . . was determined to make the Scriptures his only rule of conduct. . . . " Such steadfastness to Scripture would lead him to a life of controversy.

The writings of Sandeman were widely read throughout England and Scotland. Probably his most noted writings were in regard to the nature of faith. Garrison and DeGroot stated that: "Sandeman argued . . . that saving faith is simply an act of man's mind by which he believes the testimony concerning Jesus Christ. . . . "[16] In other words, Sandeman believed and taught a "view of the intellectual nature of faith."[17]

Another writer stated, concerning Sandeman's teaching, that he " . . . contended that faith in Christ is not all that different from any other faith that man has, for all faith is based upon testimony and comes through man's assent to facts."[18] Robert E.D. Clark commenting on

Sandeman's teachings stated that, "Sandeman's main contribution to the sect's theology was the teaching that Christ saves those who believe on him. Belief is a quiet, sensible process. . . . "[19]

Robert Sandeman continued his ministry in Scotland and England, and in 1764 traveled to America to minister to the spiritual needs of the colonists and plant churches in the New World. He succeeded in starting several churches in the New England area. He died on April 2, 1771 at the age of 53 and was buried in Danbury, Connecticut.

To understand the life and work of Faraday, one must seek to understand his faith, for it was this faith which guided his life and his work.

John Glas and Robert Sandeman were men who held the Bible as the highest authority. They were men of vision and were willing to endure hardships to see their dream come true. Their desire was simply to restore the faith and practice of the church of the New Testament. Such a simple faith as this is difficult for many to comprehend.

Michael Faraday lived his life by these same simple principles, and to understand the life and work of Faraday, one must seek to understand his faith, for it was this faith which guided his life and his work. Riley has stated in this regard:

> . . . here [in Faraday's Sandemanian faith] lay the key to so much of Faraday's character—his joyful renunciation of wealth and social distinction, his ability to stride ahead of his contemporaries untrammelled by religious controversies of his day; above all, perhaps, the abounding humility in which he saw himself, not as a man raised by genius above his fellows but as one turning the pages of a book which is already written and finding therein order, pattern and design worthy of the Great Creator. To Faraday the ultimate success of the "scientific adventure" was assured. It remained merely to read the signs aright and hear the music of the spheres.[20]

Faraday and Natural Theology

Michael Faraday lived and worked during the heyday of natural theology. One might therefore ask: what was the role of natural theology in his thinking?

Colin Russell has described natural theology in the following way: "It was at first concerned to demonstrate the existence of God from logic, the universal sense of moral values, the existence of the world, and so forth. In its narrower sense it argues for a Designer from the design and purpose in the world specially disclosed by science."[21] Russell goes on to describe one of the more famous advocates of natural theology, Robert Boyle: " . . . Boyle regarded it as 'a duty' to seek for them [purposes of God], and the opposite of presumption. This became a cornerstone of his strategy as he probed the world of living creatures for signs of 'the great Creator's wisdom' and paraded them in triumph against the hosts of atheism and unbelief."[22]

It would seem that a man so devoutly religious as Michael Faraday would hold a view similar to that of Boyle. Yet, the writings of Faraday do not reflect such a view. This can only be understood in light of the doctrinal beliefs of the Sandemanian church. For the Sandemanians, the Bible was the primary guide to faith and needed no supplemental proofs of its validity. John Glas, though a prolific writer, made few if any references to natural theology. Sandeman did write on the subject, but his views were still a reflection of the basic tenets of faith held by this group.

Cantor has stated in regard to Sandeman's views as follows: "Like natural theologians Sandeman appealed to the argument from design, but his legitimation of this argument lay not within the power of reason but with God's revelation. Thus Romans 1:20 provided the scriptural foundation for his claim that the natural world is a reflection of the divine."[23]

It would seem that there was little doubt in the mind of Faraday that the natural world reflected a divine origin.

Faraday quoted the passage cited above (Romans 1:20) on at least two occasions.[24] In May 1854 he presented a lecture on mental education in which he stated: " . . . even in earthly matters I believe that the invisible things of HIM from the creation of the world are clearly seen, being understood by the things that are made, even His eternal power and Godhead; and I have never seen anything incompatible between those things of man which can be known by the spirit of man which is within him, and those higher things concerning the future, which he cannot know by that spirit."[25]

It is known that Faraday quoted this passage on at least one other occasion as well.[26] Thus, it would seem

that there was little doubt in the mind of Faraday that the natural world reflected a divine origin. The question which we must ask is: how did Faraday look upon this revelation in nature as it relates to the more specific revelation found in Scripture?

Levere has written concerning this question:

> Faraday did occasionally employ natural theology, but his general theology of nature reversed the direction of Paley's argument from design in the physical world to the existence and nature of God. Paley's natural theology was from the standpoint of evangelical (including Sandemanian) theology, valueless as a guide to divine characteristics, unless subjected to rectification by biblical revelation; it would have seemed presumptuous and even arrogant, when applied on its own. . . . Faraday, in contrast, argued *primarily* from God to a limited but unimpeachable knowledge of the natural world. Within such a framework of religious ideas, the thorough-going divorce of science from religion makes absolutely no sense, nor did Faraday attempt it, for he realized that to distinguish science from religion was not to sever them, but only to indicate the latter's absolute and logical primacy, while limiting the former's sphere.[27]

The natural theologians sought to understand God by studying nature (i.e., through the practice of science). Science, however, is ever changing, and thus their endeavor to understand God through science was fraught with problems. As their understanding of science changed, their view of God the Creator was likewise forced to change as well.

The existence of God was, however, for Faraday a basic presupposition. He accepted God's existence by faith, based upon Scripture—not natural theology—and then set out to understand God's creation. His faith was primary and unchanging because it was founded on God's unchanging Word. His science was ever-changing; indeed, he would revolutionize the world around him through his scientific research. But this would not in the least alter his simple faith in God and in His Word.

Science and Religion in the Life of Michael Faraday

Michael Faraday was a person who held deeply seated religious beliefs, and yet was one of the most important figures in the history of modern science. This may seem paradoxical to some, for to many science and religion are thought to be incompatible. There have been those who have sought to depict Faraday as one who completely separated his science from his religion. As Seeger has pointed out, "Faraday has often been held up as the example *par excellence* of compartmentalization of science and religion, owing largely to Tyndall's unsympathetic comment, 'When Faraday opened the door of his oratory, he closed that of his laboratory.' In a letter to Lady Lovelace, Faraday expressed himself in this very vein: 'Religious conversation is generally in vain . . . in my intercourse with my fellow creatures that which is religious and that which is philosophical [or scientific] have ever been distinct things.' "[28]

Science, however, is ever changing, and thus [the natural theologians'] endeavor to understand God through science was fraught with problems.

This notion of "compartmentalization of science and religion" was to some extent popularized by Gillispie who said: " . . . there were a few scientists who, like Michael Faraday, thought that there was no connection at all between physical science and religious truth."[29]

There are those who would desire to demonstrate that Christianity had little to do with the beginnings of science, or even to show that Christianity has inhibited the growth of science. It would seem that some writers have emphasized this aspect of Faraday's life in order to support such a conclusion. Yet, is this a true representation of Faraday's beliefs? Or rather, is this not a misconception based upon these individuals' presuppositions?

Seeger continues his comments on this question as follows: "To be sure, he had little concern about speculative relationships between science and religion. He regarded each field as having its own proper authority and sphere of influence. Examining his science and his religion more closely, however, one finds that his attitudes toward both are quite similar; both rest upon an experimental basis and both look up to one God."[30] Such a statement parallels closely the views of Glas and Sandeman described earlier.

Even the skeptical Tyndall expressed in his book *Faraday as a Discoverer* that, "the contemplation of Nature, and his own relation to her, produced in Faraday a kind of spiritual exaltation which makes itself manifest here. His religious feelings and his philosophy [or science] could not be kept apart; there was an habitual overflow of one into the other."[31] Thus, the faith of Faraday was not so distinct from his scientific work. As the biographer Williams stated: "Faraday always insisted that he kept his science and his religion separate, yet his deepest intuitions about the physical world sprang from his religious faith in the Divine origin of nature."[32] Williams further says: "In a

very real sense, Faraday's science was firmly rooted in his faith."[33]

Clark expressed similar thought concerning Faraday's faith. He stated: "But if there was no science in his religion, there was certainly religion in his science! It is true that he did not outwardly tie them together; he always kept them distinct in his dealings with his fellow men. He was convinced that no effort of man's reason can confirm eternal life. There are in fact two sorts of faith, and with one of them science has nothing to do."[34]

Thus, the view that Faraday held his scientific endeavors totally separated from his faith is not shared by all scholars. There are many who feel, as I do, that Faraday's faith was the basis for his life and his work.[35] It has been noted that he did on more than one occasion make reference in public to God as Creator. In an unpublished manuscript on the nature of matter he made three references to God's creative activities.[36] Thus, an affirmation of his faith was not totally absent from Faraday's writings or public lectures. Such references were infrequent, but not lacking.

It should not be surprising, given his Sandemanian background, that he did not make more frequent reference to Scripture. It should be remembered that these people held the Bible in highest regard, and would never use it frivolously. Neither were they noted for evangelism. Tyndall pointed out in his biography that Faraday never spoke of religion unless he was asked. He would then speak freely of his faith, and yet do so in a manner respectful of the beliefs of others. In general, the Sandemanians tended to keep their religion within the assembly of other believers, and this is evident in the life of Faraday as well.

It would be good at this point to give two further quotes from historians of science in regard to Faraday's faith. J.A. Crowther has said:

> Faraday's religion was indeed, the very core and centre of the man, filling his whole life with power and peace, and embodying itself in all his actions. He would never force it upon others, though he was always ready to speak of it when questioned, not with the air of one improving the occasion, but simply giving the information which was sought. If his deep religious beliefs but rarely found their way into his scientific discourses it was because he held that they were on a plane far above even that of science, a plane to which no man by mere intellectual processes could hope to rise.[37]

Russell described Faraday's faith in this way:

> For Faraday, faith had to come first. It was *then* possible for the eye of faith to perceive in the universe signs of God's greatness and power. Writing to de la Rive in 1859 he confessed that when he spoke of God's 'material works' in a 'common lecture' he did not like 'to deal irreverently with religion by drawing it in at second-hand.' Nevertheless 'it is impossible to forget who hath ordered them.' Thus Faraday unlike Sandeman himself, reversed the direction of logical inference associated with Paley and other natural theologians. He did not believe in a progress 'from nature up to nature's God', but a pilgrimage in the opposite sense. More clearly than most of his contemporaries he could see the limitations of an apologetic derived from nature, either alone or as the dominant source. In his lectures and discourses the usual silence about a Divine Creator springs, therefore, not from disbelief but its opposite: a highly articulated theology based on revelation.[38]

The author of Hebrews said, "By faith we understand that the universe was formed at God's command . . . and without faith it is impossible to please God, because anyone who comes to him must believe that he exists and that he rewards those who earnestly seek him" (Hebrews 11:3,5 NIV). These words provide a presuppositional foundation for all Christians, including those who work in science. A study of the life of Michael Faraday would suggest that this was also the basis for his life and work. He first accepted by faith that God is Creator. This was not for him an irrational belief, but was rather the result of careful study of the evidence. From this basis of faith, he then searched the universe for the handiwork of its Creator.

Faraday's science was ever changing as new discoveries were made. His religious beliefs were in contrast founded upon Him who is the source of all things, both scientific and religious.

This passage from God's eternal Word can still provide a foundation for our work as scientists in the latter half of the twentieth century. Belief in God as the Creator can still provide a presuppositional basis for our scientific work today. From this beginning point we can then practice our science with confidence, knowing that behind the cosmos is the Creator.

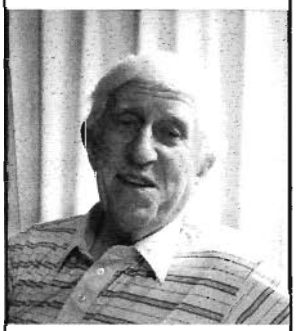
Conclusions

Michael Faraday was a man of both tremendous religious faith and great scientific achievement. It may seem paradoxical to some to find such a combination of characteristics in the life of one man. Perhaps because of this seeming paradox, some historians have sought to find in the life of Faraday something to suggest that his life as a scientist was in no way connected with his Christianity. It has been noted that Faraday made a

SEARCH

Scientists Who Serve God

FOR HALF A CENTURY, HE'S FIGURED OUT HOW



As a boy growing up in Oregon, F. Alton Everest was delighted when his homemade cigarbox microphone made a fly's footsteps sound like a stampeding elephant. He grew up to become a licensed acoustical engineer, his work touching the lives of people around the world.

Alton (the "F" is for Frederick) earned a B.S. in electrical engineering at Oregon State University. At a Baptist church in Corvallis he met his sweetheart, Elva. After she graduated from OSU they married and moved to California so he could obtain an E.E. degree at Stanford. In 1936 the young engineer plunged into a brand new field: television. An experimental broadcasting station in Los Angeles, W6XAO (later L.A.'s channel 9), hired him to design a receiver which amateur radio "hams" could build from his plans—since there were no commercial TV sets to pick up the station's signals.

Listening for submarines—and shrimp

Oregon State brought Everest back to its faculty to begin what would have been a distinguished academic career, but the U.S. government soon needed his experimental skills. In 1941, a few months before Pearl Harbor, he returned to California to do fundamental research in underwater sound at the Navy Radio & Sound Laboratory (now the Naval Ocean Systems Center) at Point Loma, San Diego. As a civilian scientist under a U. of California contract, he supervised the "Listening Section" of the lab.

Everest's section had two ships, one sporting a powerful underwater "loudspeaker," the other for dangling hydrophones into the sea. His group studied sonic propagation in the sea and was one of the first to record the now-familiar sounds made by porpoises and whales. A puzzling chorus of snapping sounds was identified by a biologist of the Scripps Institute of Oceanography as coming from colonies of million of tiny shrimp. Learning to distinguish such sounds from those of submarines and ships made a big difference in World War II. One U.S. submarine sneaked into Tokyo harbor under cover of high-noise areas of snapping shrimp. Eventually Sound Navigation & Ranging (SONAR) was perfected as the underwater counterpart of RADAR.

Busy getting a bee's eye view

In 1945 Alton Everest settled down to a twenty-five year stint at the Moody Institute of Science (first in West L.A., then in Whittier, CA). Once again "in at the beginning" of something important, he assisted Irwin Moon in founding MIS and became its scientific director. Moon was an energetic evangelist who used dramatic scientific demonstrations to illustrate his gospel messages. After carting tons of equipment around to appear on military bases during WWII, he was eager to put his "Sermons from Science" on film. Using mostly scrounged and war-surplus equipment, "the biggest little studio in the world" operated under the oversight of Chicago's Moody Bible Institute.

God of Creation was the first of twenty MIS films, seen by millions around the world. Moody science films have won more than fifty national and international awards. Many problems in putting the wonders of nature on film were solved by MIS workers led by Everest, who published those solutions in technical journals. They built working models of a human ear and a honeybee's compound eye. They designed a new type of camera lens to photograph bees up close without "frying" them under hot studio lights. On location Everest set off flares on a beach to film a grunion run at midnight and recorded the mating call of an elephant seal weighing over a ton.

In 1970 Alton Everest "retired" from MIS with many fascinating tales to tell. Typically, it was another beginning for this ingenious problem-solver.

Ω

Scientific Investigation

GOOD STUDIO DESIGN: A SOUND INVESTMENT

When F. Alton Everest retired from Moody Institute of Science, he briefly resumed the teaching career interrupted almost thirty years before. With their three children grown, the Everests were free to go overseas. They moved to Hong Kong, where Alton taught broadcasting and film-making in the Communications Department and Elva taught in the English Dept. of Hong Kong Baptist College. They hosted a whole new "family" of Asian students.

Teaching in Hong Kong (1972)

Returning to their California home in 1973, the Everests needed a source of income. At sixty-three, Alton carved out a new career for himself as a consulting engineer. He had already helped with the acoustical design of several recording studios and, while setting up foreign distribution of Moody science films, had seen many inadequate missionary recording studios.

Translating good science into good sound

Everest wanted to help Christian ministries improve their facilities for recording sound but he knew that their funds were often limited. How could he help them and at the same time support himself? First, he wrote a series of books, beginning with *Acoustic Techniques for Home and Studio* (TAB Books, 1973). In those books he showed how to use scientific principles of studio design even with inexpensive materials.

Then, turning a room of his home into a sound studio, he produced test tapes to mail overseas with instructions for playing the tape in a studio while recording the room's response under specified conditions. The response tape was sent back to Whittier, where Everest used complicated test equipment to analyze its quality. From those results and a description of the present installation, he could give detailed advice on exactly how to improve the studio's acoustic performance, all by mail.

Many factors affect the fidelity of recorded and reproduced sound. The size and shape of a small room can set up "standing waves" that enhance some frequencies and attenuate others. Construction materials vary greatly in sound-absorbing and sound-reflecting characteristics. (So-called acoustical tile "soaks up the tweet but leaves the boom.") Extraneous sounds hardly noticed otherwise can ruin a recording. (The whirring of a fan coming through ductwork and the hum of fluorescent lighting are notorious background noises.)

To the uttermost parts of the earth

By 1988 Alton Everest had completed something like 150 consulting projects in Asia, Africa, Latin America, Europe, and North America, with substantial discounts to mission groups. His skills have been applied from Seminario Teologico Bautista Mejicana to Radio Sawtu Linjiila in Ngaoundere, Cameroun. He has designed major facilities for Pacific Broadcasting Association in Japan, for Far East Broadcasting Co., and for Back to the Bible Broadcast. He has worked for individual churches and for commercial enterprises with names like Sound Advice and Salty Dog Studios.

And this particular salty dog (now seventy-eight) has been learning new tricks all along. A job in Bolivia taught him the excellent sound-insulating qualities of two-feet-thick adobe walls. In Liberia, where a missionary studio couldn't afford fiberglass, ginned cotton is a major export crop. Sure enough, it makes a good low-cost sound absorber.

Ω

Would you repeat that, please?

EXPERT AUDIO ADVICE

Much of Everest's audio engineering knowledge is available to "unsophisticated audiophiles" in a series of inexpensive handbooks published by TAB Books (Blue Ridge Summit, PA 17214), a major publisher of "how to"books.

TAB titles by Everest include No. 781, Handbook of Multichannel Recording (1975); No. 966, Complete Handbook of Public Address Sound Systems (1978); and No. 2606, Successful Sound Systems Operation (1985). The following are 2nd editions: No. 1696, Acoustic Techniques for Home & Studio (1984); No. 2966, How to Build a Small Budget Recording Studio from Scratch (1988); No. 3096, Master Handbook of Acoustics (1988).

(Speaking of audio, do you know where the German automobile, the Audi, got its name? August Horch, who founded the company in 1909, used the Latin translation of horch, which in English means "Listen!")

Theological Reflection

IS HEARING CRITICAL FOR FAITH?

From a biblical point of view, does something special about *hearing* the gospel make oral communication of greater spiritual significance than, say, written communication?

The Bible comes to us as the written Word of God, yet is full of admonitions to *hear* God's voice, to *listen* to what God has to say through his prophets, apostles, and his Son. Divine communication goes both ways: the Lord *hears* the prayers of his people. Add to this all the references to "psalms and hymns and spiritual songs, singing and making melody to the Lord" (Eph 5:19).

Emphasis on auditory communication stretches throughout the Bible: from God's direct conversation in the Garden of Eden (Gen 2 & 3) to the warning to anyone "who hears the words of the prophecy of this book" not to change them (Rev 22:18-19). The great *Shema* ("Hear, O Israel") is associated with the giving of the Mosaic law (Deut 6:4-9). And Jesus frequently repeated the phrase, "He who has ears to hear, let him hear" (Matt 11:15).

Reading the Bible together

A fluke of technological history?

Quaint phrases for listening, like "give an ear" or "incline your ears," remind us that the Bible was written long ago. Parts of it may have had an even longer oral history. At one time all information was probably transmitted orally. Australian aborigines still chant creation stories kept alive for perhaps 30,000 years in a culture with no written language.

Writing came along as a way of *recording* information. Thousands of years later, the invention of printing made it cheap to "spread the word." We're so used to reading letters, newspapers, and books that we forget how communication has changed. Today's youngsters think of black-&-white television as an antique, but the human voice was first transmitted via radio in 1900 and the first commercial radio broadcast came only in 1920. Think of the progression from dictaphone-like cylinders to "78s" to hi-fi LP recordings to today's CDs. Maybe the best means of communicating depends only on the available technology.

Or something more?

On the other hand, all children (even in modern, hi-tech societies) learn to speak before they learn to read. Editors recognize that "spoken English" differs from "written English." Scientists are now exploring how our brain patterns are shaped in early childhood by spoken language. Speech (and music) may "touch our souls" simply because intelligible sound has played a key role in making us human in the first place.

Barbara McClintock, who won a 1983 Nobel prize for her discoveries in genetics, urges fellow scientists to "listen to the material" and "let the experiment tell you what to do." Perhaps those are more than "figures of speech." Walter Thorson, a physical chemist and philosopher of science, thinks that "seeing" and "grasping" may be more egocentric modes of perceiving: "The scientific tradition really depends on an inward *listening* attitude, the notion that we will hear music, not noise, if we listen, and that it really comes from outside us."

To Thorson, science is based on trust in our ability to comprehend order in nature by allowing it "to speak to us of itself." He concludes: "For the knowledge of creation, as for the knowledge of God, it can be said: 'Faith comes by hearing—and hearing by the Word of God' (Rom 10:17)."

Ω

LEARNING TO LISTEN

F. Alton Everest has produced two training courses on cassette tape, accompanied by fully illustrated manuals. Auditory Perception (eight units) demonstrates basic aspects of the hearing system, for discerning listeners and those who make music or record it. Critical Listening (ten units) exposes the listener both to clean, pure sounds and to distorted ones, to teach how to distinguish them. Like Everest's books, each course presents a mass of technical information in understandable form.

These courses were so innovative that book publishers were not interested. Privately published, they are available from Mix Bookshelf ("The Recording Industry Resource Center," 6400 Hollis St., Emeryville, CA 94608).

Moody Institute of Science is still going strong, by the way, now producing videocassettes as well as films. Their latest film, Journey of Life, winner of the CINE Golden Eagle award, was shown in a Scientific Film Festival held in Beijing, China, in 1987. In addition to explicity Christian materials, MIS has put some of the same dramatic footage into films, videocassettes, and filmstrips suitable for public school use. (Address for either catalog: MIS, P.O. Box 5040, Whittier, CA 90607.)

Thoughtful Worship

A LIFE OF HIGH FIDELITY

Alton Everest has been concerned about fidelity ("faithfulness") in sound reproduction. He has put his technical skills to work all over the world so the message of Jesus Christ can be transmitted clearly and understandably.

More than that, he and Elva have wanted their whole lives to be characterized by faithfulness. They have worked as a team, regarding Alton's profession as their primary focus of Christian service. He has assisted in producing outstanding films, written useful books, upgraded the quality of Christian broadcasting, and taught young Asians how to reach their generation more effectively.

Devotions at meals, a family custom

But Alton Everest leaves another important legacy. In 1941 he helped found the American Scientific Affiliation, an organization of evangelical Christians working in all branches of science and technology. Everest was ASA's first president, editor of its 1948 volume, *Modern Science and Christian Faith*, and first editor of its Newsletter. Thousands of ASA members have dedicated themselves to bringing science and Christian faith together in a way that respects both.

Because Alton Everest has integrated science and biblical faith so well, Wheaton College granted him an honorary D.Sc. degree in 1959. His life shows how the Lord uses individual talents when they are dedicated to Christ. Admiting that he can't understand "lazy Christians," he quotes Ecclesiastes 9:10: "Whatever your hand finds to do, do it with your might." A favorite New Testament chapter is Romans 12, about "laying our lives on the line."

What about our human limitations? Ironically, Everest has suffered a severe loss of hearing in recent years. What's he doing about that? Researching the whole subject, of course—so he can write articles to help others understand our marvelous God-given auditory system.

Lord, help us all to be "high-fidelity" Christians. Amen.

Ω

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statement which implied some separation between the two. However, as Berman pointed out, "Faraday himself denied any relationship between his science and his religion, but an analysis of the two does not bear out this denial."[39] The present work confirms this view that Faraday did not completely "compartmentalize" his science from his religious beliefs.

In his public lectures and writings he seldom called upon his religious beliefs. Religion, to Faraday and the Sandemanians in general, was a private matter. They tended to keep their religious faith among themselves, and thus it is not surprising that Faraday was not known as one who paraded his Christianity before others. Yet, as Berman observed: "The single most important fact about the 'inner' Faraday was a deep religious commitment that pervaded his life and work. . . ."[40]

Faraday held that belief and faith were similar, regardless of whether they were based upon God's revelation or from human activities, such as science. As a Sandemanian, however, he placed the revealed Word on a higher plane than scientific data. Scripture was, for him, the final authority; unchanging as God Himself is unchanging. As one of the foremost scientific researchers of his day, he well knew that science is not static or unchanging, but always progressing. Thus, Faraday's science was ever changing as new discoveries were made. His religious beliefs were in contrast founded upon Him who is the source of all things, both scientific and religious.

In examining his life we see the primacy of his religious faith. This was the very basis for his life and his work. His scientific research was but an extension of his faith in God the Creator. He spent a lifetime searching out the riches of God's creation. Perhaps this was best summarized by Berman, who said: "Faraday was quite literally at play in the fields of the Lord."[41] Or, as Riley concluded, Faraday looked upon himself "as one turning the pages of a book which is already written and finding therein order, pattern and design worthy of the Great Creator."[42]

NOTES

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[19]Clark, p. 145.

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Communications

THE INTEGRATION OF FAITH AND SCIENCE LEARNING

A major concern of Christian teachers is the integration of faith and learning, and the relationship between academic disciplines and Christian faith and behavior. One of our goals as teachers is to define and articulate an integrated relationship in the classroom. Unfortunately, with respect to the natural sciences, a well-balanced, mutually supportive relationship is often obscured by overly zealous Christians who feel that integration of faith and learning means either using aspects of science to support biblical truth, or defending the integrity of Scripture against perceived scientific attacks. In both cases there is a lack of scientific understanding.

One of the primary assumptions in modern science is "tentativeness." Scientists know very much about the natural world, but, nonetheless, in science there is rarely indisputable proof of hypotheses and certainly no absolute truth. All facts, hypotheses and theories are subject to changes in the light of further discovery, evidence and insight. When a Christian then uses a discovery or tenet of science to support a biblical truth, which he undoubtedly holds as absolute, he is using evidence which by nature is tentative. What happens at a later time when scientists alter or overthrow that tenet? The argument for biblical truth is damaged, for one is led to conclude that the biblical truth is just as tentative as the scientific truth that was used to support it.

The assumption of scientific tentativeness should also be remembered when one perceives a scientific threat to Scripture. For over 100 years now, the best example of such a threat has been the General Theory of Organic Evolution. Christians need to remember that despite claims that sound like absolute truth, evolution is a theory, albeit an important one. It is one that has changed significantly since Darwin's first conception of it, and remains a theory subject to revision. There are, of course, people who try to use scientific theories against biblical truth. They do this with some success, but oftentimes Christians play into their hands by allowing themselves to be provoked with phantom issues.

The relationship between Christian faith and science has little to do with arguments between the two, or with the using of one to support the other. In the past, the relationship was one of presuppositions which predisposed a Christian-oriented society to pursue scientific knowledge. These presuppositions included the belief in an orderly physical world, and the reality of cause and effect. Today it is hard for us to see that relationship because science has become known for its highly prized technological applications. Nations that have had little Christian influence pursue science zealously because they associate science with technological advancement. Yet for Christians, faith should still be a motivation to pursue basic scientific knowledge. By this we demonstrate our belief that God has wrought a good creation; and as our knowledge of the natural world increases, so does our awe of the Creator.

Presuppositions of Science and the Biblical World View

In 1961, the late Georgetown historian Carrol Quigley published a fascinating, perspicacious study of civilizations, *The Evolution of Civilizations*. He noted that although regions within any civilization often vary considerably, no region can be adequately described without reference to ideological elements that are common to the civilization as a whole. In Western civilization, for example, whether one is describing Greece or the USA, Poland or Australia, the description will be incomplete without terms such as Judeo-Christian, scientific, industrial, and capitalistic. Quigley gives these and nine other terms as examples, but the first two are the pertinent ones for this essay. Western civilization is both Judeo-Christian and scientific. Quigley, who was not an evangelical Christian, rejected the notion that this concurrence was a mere fortuitous circumstance. He considered all ideological elements of a civilization to be interrelated.

The particulars of the relationship between Judeo-Christianity and science is the scholarly forté of R. Hooykaas, an Utrecht professor of the history of science. He points out that while science has flourished from time to time in other civilizations, the expansive and technologically fruitful discipline of modern science arose only in the West. Even the

Islamic civilization, which shares with the West classical Greek roots and whose science and development during the Middle Ages far exceeded that of the West, failed to develop a modern science. In the history of science one finds that the Hebrews made few lasting material contributions to science, but their Bible has endured and influenced the way in which Westerners perceive the world. That influence is a salient distinctive of the West, and modern science is in part the product of it.

Just how is it that Westerners "see" the world, and in what manner is that vision biblical? After all, not that many Westerners consciously think of their cognitive processes as being biblically influenced. Nevertheless, the Bible has influenced Western thinking in many ways. The influences pertinent to science have to do with the reality and nature of the physical world, the nature and role of mankind, and the value of secular work. Since science is the study of the physical world it is easy to see that only those who are convinced of a "real" physical world will bother to pursue the study of it. Futhermore, one must be convinced that the real physical world is orderly and therefore understandable. Then one must be convinced that humans are capable of such understanding, and that it is proper and profitable to make the attempt. Finally, the efforts (particularly "hands-on" experimenting) made in such attempts must be esteemed in the society.

In the study of civilizations one can find a correlation between the lack of the above presuppositions and the stultification of science. Classical Greece is a case in point. Although known as the birthplace of science, it also could have been the deathplace save for Muslim and early Western scholars. One of the main reasons that Greek science did not continue to flourish was the pervasive notion that the world of ideas, concepts and philosophy was more real and certainly more important than the physical world. Thus, the Greeks denied themselves the essential experimental methods of science that must be coupled with theory and philosophy.

In contrast to Greek philosophy, the Bible clearly teaches that there is a real physical world. "In the beginning God created . . ." the world, and not only that, but God pronounced His creation good. Then He commissioned mankind to subdue and reign over creation (see Genesis 1). Here in these few words one finds the foundation of a world view that holds to a real physical, understandable world and sanctions the investigation of that world. Furthermore, the Bible is eminently historical. Abraham was called out of Ur. Moses led the Hebrews. Jesus the Nazarene was crucified at Golgotha. These historical events are physical events, and demonstrate to those influenced by the Bible the importance of the physical world. Futhermore, work is held in honor; all work, not just religious work. The best indication of this is that Adam was expected to till the soil even in the garden of Eden. If in Eden, that paradise, there was work to be done, then work must be a part of that which is good and worthy of esteem.

There is much more that could be said on this topic, but in a nutshell these are the biblical influences on Western thinking that were and are so conducive to science. As Hooykaas has said metaphorically, "whereas the bodily ingredients of science may have been Greek, its vitamins and hormones were Biblical." These vitamins and hormones are the biblically assured, understandable world, and the sanctification of work and inquiry.

Faith, Learning, and Responsible Action

A second aspect of the integration of faith and science learning ought to be the biblically motivated and directed responsibility to influence the development and deployment of applied scientific knowledge. One could argue that this responsibility is obligatory because of the positive relationship between biblically influenced thinking and the rise of modern science. More important, this responsibility is obligatory by virtue of the stewardship commands of the Gospel.

Although there are many things to which the Bible does not speak directly, Christians nonetheless find biblical principles for guidance in all areas of life. The control of the application of scientific knowledge is no exception. I would like to draw two principles from three verses of Scripture and apply them to two areas which are most perplexing. The verses are:

> And God saw every thing that He had made, and, behold it was very good. (Genesis 1:31a)

> For God so loved the world, that He gave His only begotten Son . . . (John 3:16a)

> Therefore, all things whatsoever ye would that men should do to you, do ye even to them . . . (Matthew 7:12a)

One sees in these verses that the earth is God's own creation, the Fall notwithstanding, and that the creation is good. It is seen that God has immense love for a special part of His creation, people, and that it is the law of God that people do good to each other. The principles are:

1. Because God created the earth and called it good, it is ungodly to commit wanton violence against that creation.
2. People, that special creation of God and loved by God, should not suffer violence, and moreover should be respected as God's loved ones.

Due to the Fall, we see in Scripture violence used to restrain evil, and thus have arisen concepts such as "The Just War." The justifiability of such violence does not however negate the above biblical principles of nonviolence and of doing good, in fact the Just War theory incorporates those principles. Those principles are a restraint that cause Christians to ask: Is this violence to God's creation and His loved ones necessary? And this is a question that must be asked today, unless Christians wish to abdicate their responsibility to help resolve today's foremost problem in the application of scientific knowledge; that is, the development of modern weapons, the use of which would destroy the world.

The development of weapons of mass destruction is the result of a foreign policy which the USA and the USSR have followed for thirty years; Mutually Assured Destruction, otherwise known as MAD. Christians—and remember that Christians make up a significant segment of the voting

public, and thus share responsibility for the actions of elected officials—must ask if this is a biblically defensible position. It appears that the policy has been effective in preventing a major war these past thirty years, but does a desired result justify a willingness to commit an action that is unbiblical? Remember that MAD has only been effective because each side has believed that the other side was willing to commit mass destruction, that each side was willing to literally destroy the earth in order to thwart the other side. Can any Christian seriously believe that God would for any reason condone this utter annihilation of His creation? This not only ignores God's principles of nonviolence and of doing good, but raises other conflicts with Scripture. If a Christian supports the development and use of weapons for the policy of Mutually Assured Destruction, is not his willingness to commit mass destruction in conflict with God's scripturally stated intention that Christ should return to an intact world? If ever there was an area which required the integration of Christian faith and scientific learning it is here in the development and use of modern weapons.

A second area where the application of scientific knowledge must be dealt with carefully is in the development and subsequent use of industrial technology. Especially in the West, people enjoy a comfortable standard of living largely due to industrialization, but there are also the perplexing difficulties of actual and potential pollution. Take, for example, the actual pollution of acid rain and the potential pollution of a chemical spill the magnitude of the recent spill in Bhopal, India.

On the surface, it would seem that this should be no problem, after all it is a silly bird that fouls its own nest. Yet one can find many existing cases of pollution and potential threats of pollution that people accept simply because the alternatives are deemed too expensive. Consider two examples. The technology for significantly reducing pollution caused by automobile emissions has been available for some time now, but attempts to mandate the use of that technology have been stoutly resisted. Unfortunately "dirty cars" are cheaper than "clean cars." Sometimes the use of a dangerous technology is desirable, but paying for the safe use of that technology is not. The chemical industry is a case in point. The public wants the products but they want them at a price that discourages a manufacturer from employing the safety practices that he should. It is hard to imagine a Christian saying to God that he polluted God's good creation and harmed God's loved ones because it was too costly to do otherwise, but in the final call to judgment that is what is going to happen.

The integration of faith and scientific learning requires first that Christians hold to true godliness, which mandates that one love, respect and preserve that which God loves and has called good. Second, all Christians need to be informed of what is happening on God's earth. It has been noted that for all too many Christians, world affairs stopped at 33 A.D., with the exception of the establishment of the modern state of Israel. Finally, the integration of faith and learning requires that Christians give voice to their consciences and act responsibly to influence the use of knowledge for the well-being of humanity. Today, scientific knowledge is highly advanced and has already been used for many marvelous and God-honoring purposes. Yet that same knowledge holds the potential for creation-altering, evil effects which no Christian can ignore with impunity.

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MYTH: Science is in Conflict with the Christian Faith [1]

Prologue

Imagine yourself living 3500 years ago. It is night. Look up at the stars and at the moon. Remember that you don't have a telescope, electric lights or flashlight, nor have you had basic courses in chemistry, physics, mathematics, astronomy, geography or geology. Notice the movement of the stars and moon during the next two hours. You already know that the sun rises in the east and sets in the west.

I now tell you that the earth is a sphere, that it is spinning very rapidly on its axis, that the moon is revolving around the earth which, in turn, is revolving around the sun, and the sun itself is moving rapidly, revolving around a point in space, and is actually a small star. Would you believe me? Pronounce me crazy? Or, burn me at the stake?

Actually, there are two extremes in explaining or coping with the unknown: investigation and natural explanation, or attributing phenomena to God's intervention and specific activity with no further investigation necessary. The middle ground is occupied by many people and groups, including the ASA.

Seven Propositions

1. Genesis 1:1 tells us *who* created (God), *what* He created (the heavens and the earth) but not *when* or *how* (by what mechanism) He created. Note that God's existence, power and intelligence are presupposed.

2. Religion deals with meaning and purpose, and the past, present and future (beyond death). Science deals with explanation of observable phenomena (past and present) and prediction of future events, but *not* meaning and purpose. Note that some phenomena cannot be observed directly; e.g., subatomic particles. Since both religion and science attempt to explain origins, but from different premises (supernaturalism vs. naturalism), one must know and understand the assumptions and limits of both religion and science. Consider this illustration regarding "meaning and purpose": A scientist can describe a book in meticulous detail by age, weight, size, shape, spectrographic analysis, number of pages, frequency and shape of symbols (letters, numerals), *etc.*, and yet miss the whole meaning and purpose of the book if he/she cannot read and understand the author's language.

Is it not possible that the same illustration applies to human beings in relation to God and the universe?

3. Creation and evolution need not be diametrically opposed and mutually exclusive. Many highly qualified scientists who are devoutly Christian believe that evolution is a process that God used to create different life forms.

I believe that creation vs. evolution is a false dichotomy, because one can legitimately hypothesize that God used both creative means and evolutionary mechanisms (in ways that I don't understand) to produce the physical universe and life as we know it. In fact, God seems to me to display much more creative genius by devising a simple, four-letter alphabetic code (DNA—deoxyribonucleic acid) and a few basic life forms to bring about, through evolutionary processes, the amazing, complex and innumerable varieties of life as we know it, than to require Him to create millions of different animal and plant species individually.

4. Many outstanding scientists in the last three centuries were Christians, or at least theists, and all scientists since the 1600's have believed in an orderly, rational universe.

> Science cannot tell us why such a real and rational universe exists; it simply makes these assumptions in order to carry on its investigations. The dependence of such beliefs, both historically and philosophically, on the biblical doctrine of creation leads directly to the role of Christianity in the scientific revolution. . . . Those four leaders of the scientific revolution [Copernicus, Kepler, Galileo, Newton] were Christians, as were many others such as Bacon, Boyle, Pascal, and Ray. It never occurred to them that their scientific research and its results could be at odds with their Christian faith.[2]

5. Knowledge is not necessarily equal to "Truth." ("You shall know the truth, and the truth shall set you free" John 8:32. This quotation, taken out of context—and often carved across a library entrance—erroneously equates knowledge with truth.)

Many Christians believe that all "Truth" is God's truth, wherever it is found and whoever states it.

> One aim of the physical sciences has been to give an exact picture of the material world. One achievement of physics in the twentieth century has been to prove that that aim is unattainable. . . . There is no absolute knowledge. And those who claim it, whether they are scientists or dogmatists, open the door to tragedy. All information is imperfect. We have to treat it with humility. . . . Science is a very human form of knowledge. We are always at the brink of the known, we always feel forward for what is to be hoped. Every judgment in science stands on the edge of error, and is personal. Science is a tribute to what we can know although we are fallible. In the end the words were said by Oliver Cromwell: "I beseech you, in the bowels of Christ, think it possible you may be mistaken."[3]

> The question of the ultimate source of information is not trivial. In fact it is the basic and central philosophical and theoretical problem. The essence of the theory of Divine Creation is that the ultimate source of information has a separate, independent existence beyond and before the material system, this being the main point of the Johannine Prologue.[4] [cf. John 1:1–5]

6. The creation/evolution controversy is actually one manifestation of larger, age-old conflicts.

Thaxton et al. recently wrote: "Very often the debate between theism and naturalism is cast as a conflict between religion (i.e., the supernatural) and science."[5] However, as Ian Barbour has pointed out, this is a mistake: "It is a conflict between two metaphysical interpretations of the nature of reality and the significance of human life."[6]

More recently, Hummel described two "major areas of misunderstanding regarding biblical creation and biological evolution." The first area concerns "the nature of modern science and the status of its laws," and the second is proper interpretation of the Bible. Hummel explained how naturalism and the scientific method have come to be, for many, "the only valid approach to understanding reality." He further stated that no scholar or scientist is ever completely objective, because each brings his/her own set of values and point of view into play when studying anything.[7]

I believe also that the problem/conflict is one of authority: The Church's view of reality vs. that of empirical science. For example, the Ptolemaic view of the universe (as held for centuries by the Church) conflicted with the Copernican as defended by Galileo (in the early 1600's). "Galileo thought that all he had to do was to show that Copernicus was right, and everybody would listen."[8] "We must never forget that Galileo defied the holy establishment in 1616 and in 1633 in defense of a theory not his own, but a dead man's, because he believed it true."[9] Note: Galileo believed Copernicus based on his own direct observations.

> Few episodes in the history of science have generated more intense debate than the ecclesiastical condemnation of Copernicus' astronomy in 1616 and the trial of Galileo in 1633. In one form or another that controversy continues unabated almost four centuries later.[10]

> . . . [However] . . . Galileo's trial of 1633 was not the simple conflict between science and religion so commonly pictured. It was a complex power struggle of personal and professional pride, envy and ambition, affected by pressures of bureaucratic politics.[11]

Two other examples of this conflict are seen in a newly elected abbot (c. 1884) who burned all of Mendel's papers on genetic research,[12] and Christian zealots who destroyed original manuscripts in the great library of Alexandria (Egypt) in A.D. 389.[13]

Dr. Richard Bube, Professor of Materials Science and Engineering, Stanford University, long-time member and Fellow of the ASA, suggested one of the main reasons biblical Christians disagree among themselves (besides fallibility and ethnic/cultural/political/economic differences) is the "*a priori* choice of one of two hermeneutical perspectives to the exclusion of the other: a deductive perspective as contrasted with an inductive perspective."[14] He maintained both approaches need to be integrated and balanced. Bronowski also commented on the importance of understanding perspectives on reality, and having "fresh eyes."[15]

Bube stated that differences among Christians regarding creation vs. evolution are primarily due to a conflict based on inductive vs. deductive reasoning.

> Traditional conservative Christianity has often been based heavily on a deductive approach to Scripture. In this sense such Christianity has followed the pattern of science before Galileo and Newton. It has emphasized specific passages in the Bible, assumed to give a clear and easily understood teaching on the matter; all other descriptions and events, whether biblical or extra-biblical, must then be interpreted to fit the deductions made from the selected passages.[16]

I further believe Christians have erred for centuries—and still do—by drawing battle lines in the wrong places: e.g., marine fossils on mountaintops prove the Genesis Flood; the earth is the center of the universe; evolution is a false theory; *etc.* When such erroneous propositions are proven wrong, non-Christians often "throw the baby out with the bathwater" by incorrectly assuming that Christians are wrong about everything else in which they believe strongly, including essential doctrines of the Faith; e.g., Christ's Virgin Birth, Deity, and Vicarious Atonement.

One of the main reasons I reject "creation-science" as espoused by Dr. Henry Morris is that he and his colleagues/followers impose their view of what God had to do not only on us, but on God! Note that Dr. Morris' conclusions about God's creative activity are deduced from his belief about God's character and nature.

> Surely an omniscient God could devise a better process of creation than the random, wasteful, inefficient trial-and-error charade of the so-called geological ages, and certainly a loving, merciful God would never be guilty of a creative process that would involve the suffering and death of multitudes of innocent animals in the process of arriving at man millions of years later.[17]

I also object to Dr. Morris requiring that belief in a recent, special creation of the universe, earth, and man, be a vital part of being a biblical Christian. In other words, to be a Christian you must subscribe to his interpretation of recent creationism.

7. In summary, I believe that scientific endeavor, properly understood and conducted, and Christian faith are not in conflict. However, controversies and conflicts have occurred and continue to occur because of misunderstandings regarding both the scientific enterprise and Christianity, as described in the body of this paper.

* * * * *

The following scripture and definitions are relevant and important if one is to understand the reasons for conflicts and misunderstandings between science and Christianity.

Relevant Scripture

1. "In the beginning, God created the heavens and the earth." (Genesis 1:1)
2. "In the beginning was the Word, and the Word was with God, and the Word was God." (John 1:1)
3. "By faith we understand that the universe was formed at God's command, so that what is seen was not made out of what was visible." (Hebrews 11:3, NIV)
4. "The fear of the Lord is the beginning of knowledge, and the knowledge of the holy is understanding." (Proverbs 9:10; see also Proverbs 1:7)

Definitions

(from *Webster's New World Dictionary*, Second College Edition, New York: Simon & Schuster, 1980)

1. *A priori*: "based on theory instead of experience or experiment; before examination or analysis."
2. *Christian*: "a person professing belief in Jesus as the Christ" ("the Messiah whose appearance is prophesied in The Old Testament").
3. *Deduction*: "*Logic* the act or process of . . . reasoning from a known principle to an unknown, from the general to the specific, of from a premise to a logical conclusion."
4. *Empirical*: "relying or based solely on experiment and observation rather than theory. . . . "
5. *Epistemology*: "the study or theory of the origin, nature, methods, and limits of knowledge."
6. *Falsify*: "to prove or show to be untrue or unfounded."
7. *Hypothesis*: "an unproved theory, proposition, supposition, etc., tentatively accepted to explain certain facts or . . . to provide a basis for further investigation. . . . "
8. *Induction*: " . . . a bringing forward of separate facts or instances, especially so as to prove a general statement; . . . *Logic* reasoning from particular facts or individual cases to a general conclusion. . . . "
9. *Law* (scientific): "a sequence of events in nature . . . that has been observed to occur with unvarying uniformity under the same conditions" (e.g., the law of gravity).
10. *Naturalism*: "*Philosophy* the belief that the natural world, known and experienced scientifically, is all that

exists and that there is no supernatural or spiritual creation, control, or significance."

11. *Religion*: " . . . belief in a divine or superhuman power or powers to be obeyed and worshipped as the creator(s) and ruler(s) of the universe . . . any specific system of belief, worship. . . . "
12. *Science*: " . . . systematized knowledge derived from observation, study, and experimentation carried on in order to determine the nature or principles of what is being studied."
13. *Scientific* (Method): " . . . designating the method of research in which a hypothesis, formulated after systematic, objective collection of data, is tested empirically."
14. *Scientism*: "the techniques, beliefs, or attitudes characteristic of scientists; the principle that scientific methods can and should be applied in all fields of investigation; often a disparaging usage."
15. *Suppose* (re: assumption/premise/presupposition in scientific investigation): "to assume to be true, as for the sake of argument or to illustrate a proof."
16. *Theory*: "a formulation of apparent relationships or underlying principles of certain observed phenomena which has been verified to some degree." (Too often incorrectly used instead of "assume," "guess," "hypothesize," "speculate," *etc.*)
17. *True*: " . . . reliable; . . . in accordance with fact; . . . accurate . . . right . . . correct . . . real; genuine, authentic. . . . "
18. *Truth*: " . . . the quality of being in accordance with experience, facts, or reality; . . . reality; actual existence. . . . "

NOTES

[1]Carkner, Gordon, Herbert J. Gruning, Richard Middleton and Bruce Toombs, *Ten Myths About Christianity* (Ontario, Canada: InterVarsity Press, 1984).

a. Jesus Christ was only a great moral teacher.
b. Christianity stifles personal freedom.
c. Christianity is just a crutch for the weak and helpless.
d. Conversion and religious experience are the result of social conditioning.
e. Christians are other-worldly and irrelevant to life in the 20th century.
f. Science is in conflict with the Christian faith.
g. The Bible is an unreliable set of documents and cannot be trusted.
h. There is no evidence that Jesus Christ rose from the dead.
i. The presence of evil and suffering in the world proves there is no God.
j. It doesn't matter what you believe, because all religions are basically the same.

[2]Hummel, Charles E., *The Galileo Connection*. (Downers Grove, IL: InterVarsity Press, 1986), pp. 159–160.
[3]Bronowski, Jacob, *The Ascent of Man*. (Boston: Little, Brown and Company, 1973), p. 353.
[4]Fong, P., "Thermodynamic and Statistical Theory of Life: An Outline," in *Biogenesis, Evolution, Homeostasis*, edited by A. Locker. (New York: Springer-Verlag, 1973), p. 105.
[5]Thaxton, Charles B., Walter L. Bradley and Roger L. Olsen, *The Mystery of Life's Origin: Reassessing Current Theories*. (New York: Philosophical Library, Inc., 1984), p. 208.
[6]Barbour, Ian G., "The Methods of Science and Religion," in *Science Ponders Religion*, edited by Harlow Shapley. (New York: Appleton-Century-Crofts, Inc., 1960), p. 200.
[7]Hummel, pp. 14–15.
[8]Bronowski, p. 205.
[9]Bronowski, p. 211.
[10]Hummel, p. 82.
[11]Hummel, p. 116.
[12]Bronowski, p. 387.
[13]Bronowski, p. 164.
[14]Bube, Richard H., "Deduction vs. Induction: Understanding Differences Between Biblical Christians," *The Journal of the American Scientific Affiliation*, Vol. 37, No. 4, December 1985, p. 196.
[15]Bronowski, pp. 176, 180, 196, 200, 255, passim.
[16]Bube, p. 203.
[17]Morris, Henry M., "Number 132—Recent Creation is a Vital Doctrine," *Impact*, June 1984.

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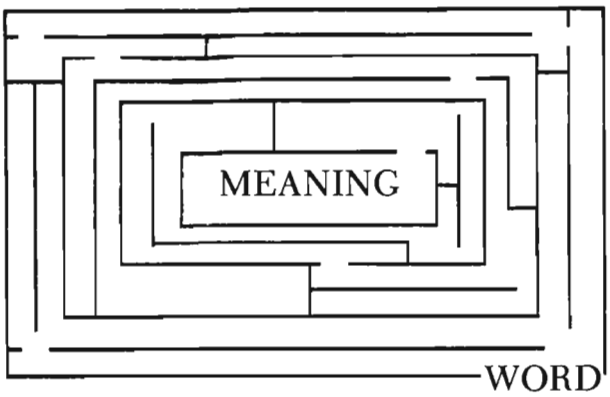
Correction:

Perspectives, Vol. 39, No. 4, December 1987, "Instrumentalism in Psychology: Some Implications," page 202, reference 1 (Byl, J.) should read:

Byl, J. 1985. "Instrumentalism: A Third Option." *Journal of the American Scientific Affiliation*, 37 (1):11–18. [Our apologies to the readership for this error.]

Penetrating the Word Maze



Taking a look at words we often use—and misuse. Please let us know whether these attempts at clarification are helpful to you.

Today's word is "PROVE."

The Dictionary Definition: "*to establish the existence, truth, or validity of (as by evidence or logic)*" [Webster's Ninth New Collegiate Dictionary, Merriam-Webster, Springfield, MA (1987)].

* * * * *

How do we respond when someone asks the traditional agnostic question, "Can you prove the existence of God?" Do we stammer and begin to talk about ontological, cosmological and teleological "proofs" for the existence of God? Or do we simply say, "No, and we shouldn't be surprised, because the kinds of things that can be 'proved' are very small indeed."

Few words are more often misused in discussions relating science and religion than the word "prove." This misuse reflects the equally common misuse of the word in everyday language.

Following the dictionary definition, "to prove" means to *establish* the truth or validity of something by presenting evidence or by logic. Here the word "establish" is usually taken to imply absolute conviction, so that only a mentally incompetent or a wilfully obstinate person could deny it.

The means of "establishing" in "proving" are the presentation of evidence or the application of logic; i.e., utilization of the scientific method. But a person who assumes that all significant dimensions of life or all insights into the truth, are ascertainable by the scientific method, has already made a fundamental faith assumption. The validity of this assumption itself certainly cannot be "proven." We need to recognize,

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This column is a regular feature of *Perspectives on Science and Christian Faith*, written by **Richard H. Bube**, Professor of Materials Science and Electrical Engineering at Stanford University, Stanford, California.

therefore, that major areas of life's most precious characteristics—the existence of God, the uniqueness of human nature, love, beauty, justice, courage, hope, or any other topic with profound philosophical or theological significance—are simply not areas to which one can meaningfully apply the categories needed for "proof" to be considered.

But the appropriate understanding of "prove" is even more limited than this. Even within those areas in which it is appropriate to apply scientific methods, we are still severely limited in what we can adequately describe as "proof." The basic meaning of "to prove" —if interpreted rigorously—means (1) that it is not possible to prove *anything* without reference to some underlying assumptions that are chosen without prior "proof" (i.e., "on faith"), and (2) that even within the constraints of point (1), it is still not possible strictly to prove anything except in the fields of mathematics and formal logic.

Here the dictionary definition may do us a disservice, for it implies that proof may occur equally well *either* by the presentation of evidence or the application of logic. If we take the definition of "to prove" as "to establish" in an unquestionable sense, then it follows that the presentation of evidence can never "prove" anything. The presentation of evidence may convince us that it is permissible and possibly even wise for us to believe something, but it cannot decisively establish "truth and validity."

Therefore, *even within science itself*, it is not strictly possible "to prove" most things. There are, of course, a category of questions to which one might still insist that the name of "proof" is appropriate; questions of a relatively simple and factual nature for which the evidence is so overwhelming that indeed no one would disagree except the mentally deficient or the wilfully obstinate. Can one not "prove" that a particular flower is red by showing it to the questioner and letting the evidence of his eyes be sufficient (unless, of course, he is color blind)? Can one not legitimately claim that it has been "proved" that the earth is round rather than flat, or that the earth moves around the sun rather than the sun around the earth, or that the universe is nearer to 15 billion years old than 10,000 years old? These are indeed examples of situations where the accumulation of evidence is so great that no alternative can be envisioned. But I would suggest that this is a "soft" use of "prove;" if we do use the word in this way, we need to stay alert so that its implications do not stray into other areas where it is not possible to speak of authentic proof.

It might also be claimed that whereas it is not usually appropriate to speak about "proving" the truth of a particular argument in science, it is appropriate to speak of "disproving" the truth of that argument. It is frequently said that all the evidence in the world cannot "prove" a theory true, but only one experiment can "prove" a theory false. In fact, the ability to be falsifiable is one of the criteria that has been used to ascertain whether a theory is truly scientific or not. Although the case for this perspective may be overstated, and may not take sufficient account of the resilience of orthodoxy and politics in the scientific community, it does come close to a valid case for the use of "prove" in a negative sense.

It is possible to prove some things within mathematics and formal logic, *provided* that we agree on the postulates which are assumed to permit the logical process to be carried out. In this procedure we do establish the truth of our mathematical and logical conclusions, *provided* that the postulates are true. But the truth of the postulates cannot be subjected to logic, and cannot be proved from anything more fundamental.

There is only one good piece of advice: be very careful of the use of "prove" yourself, and don't thoughtlessly accept anyone else's use of "prove" in popular or even technical discussions.

Remember to write to the Editor or Author if you would like to prove this column wrong.

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Book Reviews

SCIENCE AND THE BIBLE by Seán P. Kealy. Dublin: Columba Press, 1987. 91 pages. Paperback; $7.95.

Seán (John) P. Kealy has written a few other books in theology and in the history of Bible interpretation. Those books deal with technical theology, and they provide many footnotes and ample references from which Fr. Kealy has drawn material and ideas.

This little book, however, is not written at the level of a scholarly treatise. It touches on several important and controversial topics which the reader would expect from a book with this title, as is indicated by the chapter headings: The Age of Science, A Changed Understanding, People and Their Universe, Mystery and Transcendence, Creation, Evolution, Miracles. But the topics are not explicated in detail, nor is there detailed defense of one or another view. The book is more like a collection of homilies, or like a series of brief lectures given to a general audience.

Seán Kealy takes the Bible to be God's inspired word. He also accepts the validity of the scientific study of God's world, and he accepts the results published by the mainline scientific community as being the best understanding of our world which is available at the present time. He has no problem with the Earth being billions of years old, nor does evolutionary development of living organisms threaten his faith in God as Creator and Governor of the universe. He provides some review of alternative views within the modern scientific picture of the universe, but he does not provide a careful evaluation of those scientific results and methodology. There is no help here for readers who are looking for a defense against the claims of young-Earth "scientific creationists."

Kealy thinks that there has been a return to a sense of mystery and transcendence in the study of modern science, and that scientists and theologians have more respect for each other's work today than has been the case for the past couple of centuries. Although there will continue to be some disagreements which will get, and deserve, serious attention, he thinks that the discussion will become more like a consideration of ideas among colleagues than like a battle between opposing camps. (But it never was so much a battle between theologians and scientists as some historians depicted it to be.) We pray that Kealy may prove to be a true prophet, but the experience of this reviewer indicates that the phenomenon of young-Earth "scientific creationism" is unlikely to go away by simply not taking it into account.

If one of your acquaintances asks, "Are there really serious Christians who accept both biblical Christian faith and the results of modern scientific study?", suggest that they read this book. Or, you may want to give the book to a young person who is just embarking on the study of science or of theology. For the serious student, however, be sure to suggest that the reading of this book be followed by study of some materials which will provide a stronger basis for evaluation of competing ideas in Christian theology, in modern science, and in the relationships between them.

Reviewed by Clarence Menninga, Professor of Geology, Calvin College, Grand Rapids, MI 49500.

THE PHILOSOPHY OF SCIENCE AND BELIEF IN GOD (2nd ed.) by Gordon H. Clark. Jefferson, MD: The Trinity Foundation, 1987. 140 pages. Paperback.

The good news about this little book is that it is pro-science. The bad news, at least for some readers of this review, is that it sees science as outside the fold of truth. The late Gordon Haddon Clark, professor of philosophy at Wheaton College, Butler University, Covenant College, and author of some forty books, was known as a stickler for definitions. The major concern of both the present reader and of Clark in this book is, if not a source of truth, what then *is* science?

Apparently many scientists practice science, and do it well, without knowing what they are doing. It is one thing to skillfully use a recipe, the scientific method, and obtain useful results. It is quite another to back off and do philosophy of science, asking the epistemological question: *What does it mean*? Clark's book is an invitation to journey with him through epochs of scientific endeavor and build a personal philosophy of science as he surveys the history of the problem of understanding one scientific topic—motion. Helmut Thielicke wrote *A Little Exercise for Young Theologians*. Clark's book could be subtitled, *A Little Exercise for Young (and Older) Scientists*, especially those who do science, but have never thought through the philosophy of their discipline.

The more obvious purpose of Clark's book is apologetic. Since science is a frequent source of attack on the Christian faith, then an analysis of the capability of the method of

science to serve as a foundation for such attacks is appropriate. If science is not a source of truth, then there is no epistemological basis for denying God or miracles in its name.

Clark's book is a new edition of his 1964 work by the same title, with the addition of a foreword and appendix by John W. Robbins of the Trinity Foundation. Also included is a 1978 essay by Clark entitled, "The Limits and Uses of Science." The reader would do well to compare this work with the chapter on science in his *A Christian View of Men and Things* (Grand Rapids: Eerdmans, 1951).

The argument centers on motion, because it is basic to all science. Without motion there would be no science. Motion or change is familiar, but usually only superficially understood. How does science explain motion? *Can* science explain motion? Newton, for example, did not even attempt to define it. In Clark's first chapter, he deals with motion as it was understood by the ancient Greeks. The second delves into motion as seen in the Newtonian era. The final chapter brings the issue into the twentieth century of Einstein and Percy Bridgeman, and to Clark's own view.

A more in-depth survey of each chapter reveals the flow of the argument. Among the ancient Greeks, Zeno, Heraclitus and Aristotle are presented. Zeno, with his clever paradoxes, showed the mathematical impossibility of motion. Heraclitus assumed motion and declared it universal—everything flows, changes, moves. But this leaves the changing unreal and illusory, with speech impossible. Aristotle tried to define motion as potentiality, due to immanent principles, but as Clark shows, the term is left ambiguous and ultimately nonsense.

The early modern period found Newton refusing to define motion. Pre-Newtonian attempts in terms of impetus and inertia were ineffective. Newton was against Aristotelian "occult qualities," but found himself leaving gravitation in that category. This raises the philosophical question: Can "explanation" then ever be more than mere description?

Newton's successors developed his science into mechanistic philosophy, or *scientism*. That world view dominated the nineteenth century: Clark traces this development through Descartes, de la Mettrie, Cabanis, Buchner and Haeckel, into materialism and mechanism—a scientism with religious, ethical and human import. The border into philosophy, however dim, had been crossed (p. 52). Now, in the early twentieth century, science seemed the only door to truth; as per Karl Pearson, W.K. Clifford, A.J. Carlson and Hans Reichenbach. By the middle of the twentieth century, Ernest Nagel claimed scientific support for naturalism; an updated materialism which allows for the emergence of mind and values. Clark proceeds to show that "Newtonian science, quite apart from any twentieth century reversal, cannot validly support these conclusions. The picture of science is itself mistaken, and its extension to religious affairs is unwarranted (p. 57)." Again, after analysis of the scientific procedure, Clark claims, "All the laws of physics are false."

Clark carefully traces the collapse of Newtonian mechanics in the twentieth century. Logically, Newton's laws do not even qualify as special cases of the new, Einsteinian outlook. Using light as an example, both the corpuscular and wave theories have been proven false by crucial experiments, yet both theories are necessary and still used. But it is logically impossible that light both travels and does not travel! One of these is false by the law of contradiction.

The author's own view of science is at last presented. He follows partway with Percy Bridgeman (*The Logic of Modern Physics*, 1927, and *The Way Things Are*, 1959), whose view is called *Operationalism*:

> Length, mass, electric charge and all the concepts of physics are descriptions of operations performed in laboratories. They are not descriptions of natural objects or physical realities. The laws of physics, the equations embodying the concepts, do not describe how nature goes on. They describe how the physicist goes on. It would be most astounding if the processes of nature and the processes of the physicist were the same. On the contrary, the most certain truth of physics is that physics is not true—not true as an account of what nature is and how nature works. The concepts of physics are the operations of the physicist. (pp. 78, 79)

One result of this is that there are "at least two different kinds of 'space' "; that near at hand which we can measure with a stick, and astronomical distances where time and space are intermeshed and Einsteinian relativity is a factor. Similarly, there are two kinds of time.

Clark differs with Bridgeman, however, in at least one significant way. He does not go on to conclude that therefore *all* knowledge is relative. This self-defeating notion neglects absolute aspects of knowledge. So laboratory procedure is not "the sole gateway to all knowledge." Operationalism can be combined with an epistemology that allows for truth in other areas, including revelation.

Finally, Clark cites other twentieth-century philosophers of science who have become skeptical of science as even *a* door to truth. Sullivan realizes that the match of science and reality must be taken on faith (p. 82). Frank, who criticized Sullivan, himself does not know if present notions of physics will survive into the future (p. 82). Even Churchman bases laws in part on nonscientific ethical judgements (p. 85). After answering direct challenges to operationalism, Clark concludes as follows: "Operationalism is here offered absolutely as a philosophy of science. Instead of being the sole gateway to all knowledge, science is not a way to any knowledge—unless . . . it is a knowledge of what to do in a laboratory. But a knowledge of nature, No" (p. 93). Science is a way of doing things. Its value is as great as the value of life. But that value we learn from theology and philosophy, not from science.

This book is highly recommended to all scientists.

Reviewed by Gilbert Brewster Weaver, John Brown University, Siloam Springs, AR 72761.

TECHNOLOGY AND JUSTICE by George Parkin Grant. Notre Dame, IN: Notre Dame Univ. Press, 1987. 135 pages. Paperback; $8.95.

This short book is a collection of six essays by the author, who is described as "Canada's leading political philosopher." They are dedicated to expounding various aspects of the thesis that modern technology has shaped and affected our thinking in many fundamental ways of which we are not even aware.

The book overall is indeed thought-provoking, and presents a challenge to come to grips with how much our perspective on life is subtly determined by the society in which we live. Grant contents that " 'technology' is the pervasive mode of being in our political and social lives" (p. 17). We need to recognize that

> The coming to be of technology has required changes in what we think is good, what we think good is, how we conceive sanity and madness, justice and injustice, rationality and irrationality, beauty and ugliness. . . . the account of existence which arises from the modern co-penetration of knowing and making exalts the possible above what is. (pp. 32, 34)

Continuing with this theme in "Faith and Multiversity," Grant enters into a consideration of the relationship between faith and science. He contrasts the project of reason to gain objective knowledge by "the summonsing of something before us and the putting of questions to it, so that it is forced to give its reasons for being the way it is as an object," with the nature of faith, for which he uses Simone Weil's definition: "Faith is the experience that the intelligence is enlightened by love." He dwells on the impersonal nature of science, by which concentration on things as objects prevents us from loving them for their beauty. The loss of a human awareness of nature untouched by technology is rapidly changing society: "Anything apprehended as resource cannot be apprehended as beautiful" (p. 51).

> It is not surprising that those studies in our multiversities which depended on our intelligence being enlightened by love, and which were publicly sustained because they taught people to participate in justice, should now have faded into antiquarian research. After all it is not very difficult to know these days what justice is, what beauty is. The first is the result of interested calculation; the second is the means of entertainment. (p. 61)

He deplores the trend in which the humanities have acquired wealth and prestige by adopting the methodology of the sciences, with the result that they have lost their significance for society.

These comments illustrate the general thrust of Grant's approach. He is not easy reading, but what he has to say usually has the ring of truth about it far beyond our usual perceptions. He writes from a Christian perspective and motivation, and describes himself as "a lover of Plato within Christianity" (p. 90). His language is creative and provocative, with many quotable statements. I particularly liked this one:

> Why is it that humanities research produces only this irrelevant museum culture? The overriding reason is of course that any high culture other than technology is now simply epigonal in Europe, and high culture in the U.S. is an epigone of these epigones, and we in Canada are in turn an epigone of the U.S. (p. 98)

If that doesn't send you scurrying for a dictionary, you're one up on this reviewer! I also liked: "The mating of the German model of the university with American capitalism produced in the fifties its Chicagos and Berkeleys and Yales" (p. 100).

It is one thing, however, to begin to recognize the extensive restraint associated with the technological orientation of our scientific society, and quite another to fail to take cognizance of the authentic insights into reality that the best of science is capable of giving us. Given his stimulating treatment of the former part of this difficult subject, it is a little disconcerting to find the chapters on euthanasia and abortion handicapped by a failure to perceive the latter. He confuses the discussion of "euthanasia" by insisting that the only relevant meaning of this term is the putting to death of another human being, presumably because that human being is regarded as valueless.

One sees in these two chapters unfortunate characteristics common to the writings of many Christians. Firstly, out of genuine, undebatable and totally justifiable concern for the real excesses that may result (such as legally sanctioned murder in the case of euthanasia, or total disregard for fetal life in the case of abortion), they take a very strict position, which by its very nature excludes the possibility of treating less excessive situations fairly. Secondly, they invoke the "domino theory" or "slippery slope" argument as the ultimate paradigm to argue that any less strict consideration of less excessive situations is the first step to major excesses. And thirdly, they do not meaningfully appreciate or incorporate such concepts as "process" and "emergence" in dealing with the beginning and ending of life.

Many Christian discussants are apparently unwilling to allow any insights from the evident biological information about fetal development to inform the significance of the process of becoming a person, or of the emergence of personal properties with biological development. While one can sympathize with the strategic caution underlying such approaches, it does not seem that positions can be developed in this limited way that will be adequate for the issues not only of today but of tomorrow as well.

All in all, these essays are highly stimulating and provide valuable input for Christians striving to come to terms with these issues. They are especially valuable for those who suspect that our technological world view has far more effects on our lives than we ordinarily suspect.

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

CIRCLES OF GOD: Theology and Science From the Greeks to Copernicus by Harold P. Nebelsick. Edinburgh: Scottish Academic Press, 1985. 284 pages, index. Hardcover; $24.00.

Circles of God is one of six volumes in a series entitled "Theology and Science at the Frontiers of Knowledge," edited by T.F. Torrance. It was written by Harold P. Nebelsick, Professor of Doctrinal Theology at Louisville Presbyterian Theological Seminary. Nebelsick has also authored another book in this area of study, *Theology and Science in Mutual Modification*.

In *Circles of God*, the author discusses the history of astronomy from its beginnings in Babylonian astrology to Copernicus and the heliocentric theory. Special emphasis is given by the author to the contributions of the Greek philosopher-scientists and the church fathers in developing the scientific concepts of cosmology. As the subtitle implies, the author's thesis is that theology (which is defined in the book as "thought about God or gods") had a very definite influence upon the development of science (which is defined as "thought about the world").

This book would serve as an excellent reference work for the person interested in the relationship between theology and scientific thought, particularly in regard to astronomy and cosmology. It was not written for the casual reader but rather for one interested in a detailed and scholarly study. The footnotes are extensive (averaging about 10-12 pages per chapter) and generally refer to primary sources. There is a complete index of persons and another index of subjects.

Following a general forward by T.F. Torrance, a preface, and an introduction, the book is divided into chapters corresponding to periods of history: (1) Greek Theology and Greek Science, (2) Measuring the Universe, (3) Science Encounters the Christian Faith, (4) Late Medieval Cosmology, and (5) Copernican Cosmology.

In each chapter, the author traces the development of ideas related to theology and astronomy. He contends that theology definitely shaped the developing scientific theories about the universe. His conclusions regarding Copernicus are especially interesting. The author does not agree with the idea that there was any revolution associated with Copernicus and his theory. He points out that the theory was distributed and openly discussed years before it was formally published. Further, he proposes that Copernicus' description of the circular motion of the planets was influenced by his theological presuppositions. He states that the view of perfect circular motions of the planets in Copernicus' theory resulted from the view that the universe reflects the perfection of God Himself. Thus, with this as a theological presupposition, the motions of the planets had to be circular, since the circle represents perfection.

The author further proposes that it was Kepler, with his theory of elliptical orbits, who "saved the 'heliocentric' theory by destroying the Copernican demand for circles and harmony of pattern and motion on which it was based."

Books Received and Available for Review

(Please contact the book review editor if you would like to review one of these books.)

B. Anderson, *Creation Versus Chaos*, Fortress Press

R. Augros and G. Stanciu, *The New Biology: Discovering the Wisdom in Nature*, Shambhala

J. Beker, *Suffering and Hope*, Fortress Press

A. Blinder, *Hard Heads, Soft Hearts: Tough-Minded Economics for a Just Society*, Addison-Wesley

E. Chaisson, *The Life Era: Cosmic Selection and Conscious Evolution*, Atlantic Monthly Press

C. Colson, *Kingdoms in Conflict*, William Morrow

C. Dickason, *Demon Possession and the Christian: A New Perspective*, Moody

J. Dwyer, *Foundations of Christian Ethics*, Paulist Press

N. Eldredge (ed.), *The Natural History Reader in Evolution*, Columbia Univ. Press

R. Frankl, *Televangelism: The Marketing of Popular Religion*, Southern Illinois Univ. Press

D. Garan, *Our Sciences Ruled by Human Prejudices: Humanly Necessary Blindness Persisting Even in Sciences*, Philosophical Library

O. Gingerich (ed.), *Scientific Genius and Creativity*, Freeman

V. Grounds (ed.), *Nuclear Arms: Two Views on World Peace*, Word

C. Gulston, *Jerusalem: The Tragedy and the Triumph*, Zondervan

A. Herscovici, *Second Nature: The Animal-Rights Controversy*, CBC Enterprises

L. Levine, *Defender of the Faith: William Jennings Bryan*, Harvard Univ. Press

S. McFague, *Models of God: Theology for an Ecological, Nuclear Age*, Fortress Press

D. Myers and M. Jeeves, *Psychology Through the Eyes of Faith*, Harper and Row

D. Reardon, *Aborted Women: Silent No More*, Loyola Univ. Press

P. Rieff, *The Triumph of the Therapeutic: Uses of Faith After Freud*, Chicago

J. Schwartz, *The Red Ape: Orangutans and Human Origins*, Houghton Mifflin

T. Shumate, *The First Amendment*, George Mason Univ. Press

W. Strehlow and G. Hertzka, *Hildegard of Bingen's Medicine: Holistic Health*, Bear & Company

C. Sutherland, *Disciples of Destruction: The Religious Origins of War and Terrorism*, Prometheus Books

P. Tournier, *A Listening Ear: Reflections on Christian Caring*, Augsburg

A. Thomson, *Tradition and Authority in Science and Theology*, Scottish Academic Press

R. Viladesau, *Answering for Faith: Christ and the Human Search for Salvation*, Paulist Press

R. Wells and T. Askew, *Liberty and Law: Reflections on the Constitution in American Life and Thought*, Eerdmans

E. Worthington, *Counseling for Unplanned Pregnancy and Infertility*, Word

R. Youngblood (ed.), *The Genesis Debate*, Nelson

Circles of God is a worthwhile contribution to this area of historical research, and would be useful to anyone interested in further study of the subject.

Reviewed by Phillip Eichman, Biology Department, Harding University, Searcy, AR 72143.

THE ANTHROPIC COSMOLOGICAL PRINCIPLE

by John D. Barrow and Frank J. Tipler. New York: Oxford University Press, 1986. 706 pages. Hardcover; $29.95.

This book is a massive, overwhelming, tour de force treatment of teleological arguments and the teleological basis for scientific thinking from the 6th century B.C. to the present time, with postulated implications extending to "the end" of the universe. The authors' own "dedication page" is a choice example of humor:

> Ah Mr. Gibbon, another damned, fat, square book.
> Always scribble, scribble, scribble, eh?
> (THE DUKE OF GLOUCESTER, on being presented with volume 2 of *The Decline and Fall of the Roman Empire*)

In a book review in *Physics Today*, reviewer James L. Anderson of Stevens Institute of Technology writes, "I found the presentation relentless. There was no space, no doubts. The reader is simply overwhelmed in the end, but not necessarily convinced." Let these words be a warning to the reader: you are in for a job—but perhaps quite an interesting one. This is an important and valuable book even if one agrees with reviewer Anderson's opinion that no matter how fascinating the discussion may be, it is "not part of the discourse of contemporary science."

The authors of this book are by profession, scientists and by philosophy, advocates of scientism. Barrow is University Lecturer in Astronomy at the University of Sussex, and Tipler is Associate Professor of Mathematical Physics at Tulane University. They start with the assumptions that the universe is all that exists [and that, therefore, if there were such an entity as "God," it (or he) must be part of the universe], and that if something cannot be measured, it does not exist. It is therefore particularly interesting to note that the citation of the Anthropic Principle is an attempt to return to a teleological form of description, even with the claim that it has had some striking successes when applied to global questions.

One of the dominant historical "proofs" for the existence of God from a growing scientific description of the natural world was the "Argument from Design." At first limited merely to observations of the form of the world around us, then extended to more detailed information on the characteristics and interrelationships of living creatures and human beings, and finally added to extensively by growing knowledge of the properties and history of the world, the Argument from Design has maintained a primary place in the theological apologetic arsenal. In recent years, the continued development in understanding the structure and properties of the natural world has revealed an enormous amount of evidence indicating that the properties of the universe are incredibly fine-tuned in such a way as to make the existence of conscious life possible. In the face of this evidence, many scientists with no religious foundation whatsoever have been led to propose what they have called "The Anthropic Principle." Based on the Greek word for man, *anthropos*, this Principle (or set of Principles) may in many ways be regarded as a secular "argument from design," although its scientific proposers are quick to deny any theological content in the Principle(s). In ten close-packed chapters, Barrow and Tipler treat topics related to these issues historically, and then topically with references to physics, astrophysics, cosmology, quantum mechanics, and biochemistry, including over 1500 references to the literature. They then proceed to draw speculative predictions about diverse topics, such as the existence of extraterrestrial intelligent life and the future of the universe. Thus, the book proposes not only a "secular argument from design," but also a "secular eschatology."

Three major forms of the Anthropic Principle are suggested. The *Weak Anthropic Principle* states: "The observed values of all physical and cosmological quantities are not equally probable, but they take on values restricted by the requirement that there exist sites where carbon-based life can evolve and by the requirement that the Universe be old enough for it to have already done so." A popular restatement might be: "If the universe didn't have the properties it does, we wouldn't be here to observe it." Or in design language: "The detailed properties and parameters of the universe appear to be designed for the origin of human life."

There is, then, a fundamental choice that is not dictated by the evidence. 1) We may choose to believe that there can be and have been an infinite number of possible universes existing in the past, the present and the future, and that it just so happens that we exist and are aware of our universe because, of all the possible universes, it (perhaps alone) had the unique combination of parameters and properties that would allow the emergence and sustenance of human beings. Such a view is based on chance, not only the common scientific definition of chance, but an absolute, ultimately uncaused, non-theistic perspective, deliberately involving the faith choices characteristic of scient*ism*. Or, 2) We may with equal justification from the scientific evidence choose to believe that this one universe, which is so carefully arranged so as to allow the development of human life, is the result of a creative design; the creating, shaping and sustaining activity and power of God on our behalf.

There is no compelling reason from the scientific data alone to guide us in which one of these two choices we should make. If, together with the authors of this book, we choose to believe that there is no transcendent God, then of course we have at the same time chosen to accept the first position. If, for a variety of reasons not directly related to scientific evidence alone, we already have a faith in God, then the second position appears the more reasonable.

A second form of the Principle is the *Strong Anthropic Principle*: "The Universe must have those properties which allow life to develop within it at some stage in its history." This form of the Principle not only states the observation that the properties of the universe are restricted to narrow ranges compatible with the development of human life, but asserts in addition that this is a necessary state of affairs. If one interprets the data as evidence for the designing purpose and activity of God as indicated by biblical revelation, then the form of the Strong Anthropic Principle follows directly from God's intention. If, indeed, it is God's revealed intention to bring forth a people for fellowship with Himself, then the created universe clearly *must* have the properties that allow the development of human life, since that is the reason for which God created it.

This is, however, not the position of the authors of this book, who would dismiss such a position as "religious." Instead, they seek for justification from certain speculative positions that they claim are derived from interpretations of modern quantum mechanics.

If one accepts the Strong Anthropic Principle for some of these nonreligious reasons, it is proposed that a reasonable conclusion is the *Final Anthropic Principle*: "Intelligent information-processing must come into existence in the Universe, and once it comes into existence, it will never die out." It is evident that this Final Anthropic Principle is purely philosophical or quasi-religious speculation, without any direct scientific support or necessity.

Among the striking examples for fine-tuning the universe are discussions of atomic level coincidences, the dimensionality of the universe, the relationship between size and life, special properties of two-nucleon bound states (proton + neutron = deuteron), the origin of light elements, initial conditions for a Big Bang expansion, and the unique properties of water.

In the section that I have termed "secular eschatology," the authors argue against extraterrestrial intelligent life on the basis of the Anthropic Principle(s), and explore ways in which intelligent life can survive the dissolution of the present universe (following the final Anthropic Principle), even to digital coding in the spin states of residual electrons and positrons when all other matter is gone.

The extent of the quasi-religious flavor of the book can be seen by considering the final words of the text:

> If life evolves in all of the many universes in a quantum cosmology, and if life continues to exist in all of these universes, then *all* of these universes, which include *all* possible histories among them, will approach the Omega Point. At the instant the Omega Point is reached, life will have gained control of *all* matter and forces not only in a single universe, but in all universes whose existence is logically possible; life will have spread into *all* spatial regions in all universes which could logically exist, and will have stored an infinite amount of information, including *all* bits of knowledge which it is logically possible to know. And this is the end. (pp. 676, 677)

Christians concerned with apologetic issues in particular will profit from acquaintance with the facts and arguments of this book. The discussion of the various forms of the secular Anthropic Principles illustrate the lengths to which human beings are driven in order to rescue some sense of meaning and ongoing purpose without God and without His presence. Everything can be reduced to an infinite number of possible universes, each of which exists or at least has the logical possibility of existing, and one of which just happens to have all of the required properties to allow the development of human life. To suppose that this lays the foundation for a prophetic view in which one may suppose that there is some necessity for intelligent life to come into being, and hence some necessity for intelligent life never to cease being—even if the form of its being is limited to the spin orientations of electrons and positrons—is to give expression to a genuine religious longing within an avowedly anti-religious context. How different is the Christian hope expressed in Revelation 21:1–22:5!

Reviewed by Richard H. Bube, Department of Materials Science and Engineering, Stanford University, Stanford, CA 94305. (This review is based on a chapter, "The Anthropic Principle," in a book authored by the reviewer, Shaping the Future: Modern Science and Christian Choices, *to be published in 1988 by Fleming H. Revell.)*

GALILEO: HERETIC by Pietro Redondi, trans. by Raymond Rosenthal. Princeton, NJ: Princeton University Press, 1987. 356 pages. Hardcover; $29.95.

Historians live for the day when they will find a document in some dusty archive which allows them to challenge the account of an important cultural episode. In spring 1982, Pietro Redondi, Associate Director of the Alexander Koyre Center for the History of Science in Paris, was handed a leather-bound book from the restricted shelves of the Vatican Library. It was thought to record contemporary church reaction to Galileo's idea that the physical world is composed of invisible atoms. In the volume, Redondi came upon a previously unrecorded, anonymous, hand-written, three-page letter sent to the office responsible for the Inquisition denouncing Galileo as a heretic for his atomistic views in his 1624 work, "The Assayer." This accident led to the writing of *Galileo: Heretic*; a work which has resulted in considerable attention, if not agreement, on both sides of the Atlantic.

Redondi weaves an intricate tale of plot and counter-plot in the context of 17th-century international politics, Counter-Reformation theology and conflicting personalities as he reinterprets Galileo's trial—traditionally held to dwell on his Copernican views and relationship with Pope Urban. Instead, Redondi argues that the true issue was the effect of atomism on the church's view of the "literal presence" of Christ in the Sacrament. The Church had couched its view of the Eucharist in terms of Aristotle's theory that matter is composed of "real" and "accidental" qualities, the latter being the characteristics apparent to the senses. Galileo's accuser saw the "permanence of atoms" and the "philosophy of accidents" as challenging the accredited theological philosophy, and contradicting the dogma of transubstantiation by affirming the real permanence of quantity as a "shaped substance."

The dogma of the Eucharist was a key to Counter-Reformation faith. Any deviation from the party line would play into the hands of the Protestant protagonists. Galileo had been warned by the previous Pope against teaching the views of Copernicus and had managed to live with the injunction while cultivating many friends in the Church establishment. The new Pope Urban VIII, a reform-minded cleric, became a friend and patron. The earlier Jesuit opposition to Galileo, however, continued to fester. Redondi argues that Galileo was shielded from this opposition by friendship with the Pope and others high in the Church until the late 1620's. At that point, national and international politics spelled the end of the liberal scientific climate encouraged by Urban. In order to

placate the Jesuits, he had to allow Galileo to be brought to trial. Caught in events that he could not avoid, the Pope was able to orchestrate the "trial" on his own terms. He appointed an independent inquiry headed by his nephew which was to deal only with the lesser charge of Copernicianism.

This plea bargain solution offered something for everyone. The Jesuits saw their enemy tried and condemned as a symbol of the return to orthodoxy. The Pope was able to avoid the scandal of having protected a heretic, and Galileo's life was preserved. Redondi's revised scenario has seen little acceptance among science historians; yet, all have praised his examination of the larger events and issues which shaped this trial. The book is profitable yet demanding reading. To understand these events we must learn to view science and culture with seventeenth-century eyes, which Redondi evokes with unusual power.

The Catholic Church has been traditionally faulted for buttressing its theology with Aristotelian natural philosophy and impeding the development of science during this period. Yet, one is drawn to suggest a late twentieth-century parallel with the fusion of "creation science" and conservative Protestant theology.

Reviewed by J.W. Haas, Jr., Department of Chemistry, Gordon College, Wenham, MA 01984.

THE BLIND WATCHMAKER by Richard Dawkins. New York: Norton and Co., Ltd., 1986. 318 pages, index, biblio. Hardcover; $18.95.

I bought this book because I wanted to assess the current state of evolutionary theory as an explanation for the origin and variety of life. I was surprised at the weakness of the evidence presented: either Richard Dawkins is preoccupied with defending his own brand of evolution, or the evidence is much weaker than I thought. Considering the subtitle, "Why the evidence of evolution reveals a universe without design," the book is surprisingly light on factual evidence. Dawkins forsakes the traditional lines of evidence such as homology, the fossil record, and biochemical affinities for computer-game models of natural selection, flights of fancy into the realm of the highly improbable, and explanations of information storage and replication in genetic systems. This is an exposition of Darwinian gradualism, the assumption being that to understand it is to believe it.

Dawkins states that a strong argument for theism once rested upon the evidence for design in the biological world, but this argument has been demolished by Darwinism. He calls this an "Argument from Personal Incredulity" (p. 38). That is, because the individual *cannot imagine* how the peacock got his fancy tail, he assumes the tail must have been designed; hence, there must have been a Designer. Dawkins isolates a weak example from a creationist book and shows that it doesn't take much knowledge or imagination to explain certain adaptions. Agreed. But Dawkins' entire argument is merely an Argument from Personal Credulity. That is, because he *can imagine* how the biological world might have originated through purely "natural" forces, therefore it must have occurred that way.

The author is an Oxford-educated zoologist who taught at the University of California at Berkeley before returning to Oxford. This is his third book for the lay public. Taking off from the famous "watchmaker" passage in Paley's *Natural Theology*, Dawkins responds, "The analogy between telescope and eye, between watch and living organism, is false. All appearances to the contrary, the only watchmaker in nature is the blind forces of physics, albeit deployed in a very special way" (p. 5). Such a strong statement can arise only out of a preconception of atheism. So we do not have here a balanced examination of the evidence for and against design in the natural world; we have an "impassioned" (his word) attempt to persuade the reader that Darwinism is true, and that arguments from design are false.

Dawkins labors much to show that gradualism can explain everything. He takes the example of the eye, a long-time favorite of creationists, and attempts to show that the eye could have developed from the non-eye through natural selection through a multitude of small improvements. Responding to a statement by Steven Jay Gould that "We [evolutionists] avoid the excellent question, 'What good is 5 percent of an eye?' by arguing that the possessor of such an incipient structure did not use it for sight." Gould's point is that a proto-eye would have to go through many stages of evolution while completely useless before having any survival benefit. But Dawkins sidesteps the problem by saying "[But] 1 percent vision is better than total blindness." Granted, but there must be millions of changes required from having no eye at all to an eye that has 5 or 1 percent vision, compared to a fully functional eye. What is the mechanism which drives evolution during this period when the proto-sense or proto-limb or proto-feather, etc., is totally functionless, and indeed would be a hindrance? For surely there is an energy cost involved with the development of organs, and a useless limb is worse than no limb at all. And if this is true for the development of the eye or limb, it is a thousand times more crucial for the origin of life, where an extremely complicated mechanism for reproduction must arise *before* natural selection has any material upon which to operate.

Dawkins is so committed to his position of gradualism that he either baptizes or excommunicates anyone who disagrees with him. Sweeping aside their own statements to the contrary, he baptizes punctuationists into his own position, saying that they are really gradualists who got carried away with the publicity they could gain by claiming to find fault with Darwinism. The poor fellows came to believe their own press hype, but Dawkins knows that at heart they are really gradualist Darwinians.

For a book that claims to refute theism, there is a strange silence on the massive literature written from a creationist perspective, nor does he review and refute creationist arguments. Perhaps he thinks that has been done already, but that raises the question, "What is the intended audience for this book?" I honestly don't know. At the beginning of the book, he pokes fun at a weak argument in a recent creationist book, and now and again he takes potshots at "creationists" without

being specific about who or what sort of creationist he means. In his last chapter he deals with "Doomed rivals," meaning competing scientific theories. Here, after reviewing and rejecting various competing theories, he deals with creationism in one page, saying it is obviously false because it assumes that which it tries to prove: that ultimate order (God) led to temporal order (life). This sounds more reasonable to me that his thesis that ultimate disorder led to temporal order.

The wildest chapter, entitled "Origins and miracles," deals with the origin of life. We may sum up this chapter in one sentence: "Nothing is impossible except that there is God." Dawkins throws around a lot of numbers, but it's a snow job that avoids serious calculations. In fact, he argues that the origin of life *ought* to seem improbable to us because our subjective sense of the probable has evolved to reckon only on events involving modest amounts of time and space. This might carry some weight if supported by calculated probabilities. His is at best a feasibility study, not a demonstration. He shows that the sign is correct, never mind about the magnitude.

Dawkins is working out his metaphysical presuppositions, disguised as science. We can't blame him for that, but the reader should be aware that the author of this work is a philosophical wolf wearing the clothing of a scientific sheep.

Reviewed by J.R. Cogdell, Department of Electrical and Computer Engineering, University of Texas at Austin, TX 78712.

TAKING DARWIN SERIOUSLY by Michael Ruse. New York: Basil Blackwell, 1986. 296 pages, index. Paperback.

Michael Ruse, a philosopher at the University of Guelph, writes extensively in evolutionary philosophy. This work attempts to derive knowledge and ethics from Neo-Darwinism. Ruse begins with an overview of the nature of "evolution," continues with a sharp critique of previous Darwinian concepts of epistemology and ethics, gives a quick sketch of human origins, and finishes with his own careful synthesis. Ruse writes within the modern synthesis school, especially using E.O. Wilson's concept of epigenetic rules. Ruse is clearly anti-theistic, creating odd twists of logic when he must consider a "God hypothesis," (e.g., his history is straight out of the outmoded "warfare" model).

Despite a valiant effort, Ruse runs aground on Hume's shoals. He too cannot *know* if causality is objectively real, but must simply trust the common sense selection gave him. Ruse calls theism the only solution, but "if metaphysical skepticism is something which can be avoided only by invoking such problematic notions as the thing-in-itself or the Christian God, can it really be quite the devastating critique it appears to be?" Most certainly! Particularly when doing "logic" at the metaphysical limits, such logic as rejecting God. For Ruse, no causality is secure, no proof seems completely solid but God's absence. His "proof" is one statement: a good God would not permit evil. No discussion is made of the Christian position of human responsibility, universal evil and certainty of judgment. Ruse, not the Christian, has a weak view of evil—Hellfire is the analytical response of God's justice.

Ruse also cannot justify real morality. He says Wilson destroys moral reality by making moral strictures just evolutionary adaptations, disguised selfishness, but Ruse considers Hume's law valid. One cannot derive "ought" from "is." However, Ruse calls our common human morality a *racial* co-adaptation favoring *individual* genetic survival. The sense of "objective" morality is just "a collective illusion foisted upon us by our genes," and God is nothing but part of that illusion of objectivity. Ruse, a moral man, wants us to stay with the morality game. However, by implying that we "ought" to accept our Darwinian moral urges, he calls that last moral brick *truly* objective. Why? Does Ruse urge *us* to keep on playing because his *own* genes want to make sure they survive?

Ruse thus breaks Hume's law by turning *ought* into just a unique sort of *is*. He slips in group selection, for we should be programmed to feel it moral to rape and kill the children of our people's enemies. He follows the "adaptionist" program by *first* showing what we all think is right, and *then* explaining it by selection. Ruse has no answer for Nietzsche's superman. In the end, he fails because of his personal faith commitments to God's nonexistence and to autonomous and undirectable natural causation. The Darwinian foundation could only be valid if there were a directive and objective reality *behind* the processes of nature.

Reviewed by David L. Wilcox, Professor of Biology, Eastern College, St. Davids, PA 19087.

THE CASE FOR TEACHING CREATION by A.J. Hoover. Joplin, MO: College Press Publishing Co., 1981. 84 pages. Paperback; $2.95.

This brief book contains materials that Hoover developed and used in two public debates on whether or not evolution should be the only theory of origins taught in public schools. Some of the material came from his earlier books. *Fallacies of Unbelief* and *Fallacies of Evolution*. As a professor of history, he gives scientific creationism an added perspective in dealing with historical events such as origins.

Hoover begins by defining the term "strict science" to mean direct observation, experimentation, and repeated verification of an event or process. He defines "loose science" as the more theoretical, less conclusive inferences based on circumstantial evidence. He repeatedly states that origins has no definitive evidence and is still an open question that can be approached only indirectly as loose science.

Chapter two focuses on "the five possibilities of teaching," i.e., only creation, only evolution, neither creation or evolution, evolution without dogmatism, and both creation and evolution. Hoover concludes that even the teaching of evolution without dogmatism is too biased, and recommends

teaching both creation and evolution in public school classrooms. By creation, he means only "scientific creation."

The third (and largest) chapter is devoted to "the creation model of origins," which is standard young-earth, 24-hour day scientific creationism in slightly less dogmatic terms than usual. Chapter four discusses seven of the main objections to teaching creation in public schools. In a section titled "There are Many Theories of Creation," Hoover states that most of the Babylonian, Hindu, Buddhist, Nordic, Eskimo, and Polynesian stories of creation are "faithfully represented in the schools by the evolution model." He presents only two choices: evolution and scientific creation. Hoover says nothing about progressive creation, the gap theory, or any of the other biblical versions of creation, even though he states that we should teach "all plausible explanations of the problem."

The fifth chapter addresses the distinctions between religious and nonreligious theories. Hoover concludes with a short, powerful chapter recommending that "both creation and evolution should be investigated in classes like 'Theories of Origins,' just as we have classes called 'Theories of Personality' and 'Theories of History.' " He again quotes the words of Clarence Darrow, who said "It is bigotry for public schools to teach only one theory of origins." Two pages of references on scientific creation and evolutionary views are suggested for further reading.

This book is concise, readable, and one of the more interesting presentations of scientific creation. Although biologists may find the oversimplifications, inappropriate use of the word "proof," and other absolute terms distracting, this book is still useful as one of several books that persons interested in gaining a broad perspective of the controversy over teaching origins and evolution in the public schools should read.

Reviewed by Duane Thurman, Professor of Biology, Oral Roberts University, Tulsa, OK 74171.

AMERICAN SCIENCE IN THE AGE OF JEFFERSON by John C. Greene. Ames, IA: Iowa State University Press, 1984. xiv + 484 pages, illus., index. Hardcover, $39.95; Paperback, $24.95.

John C. Greene has resisted successfully one of the historian's greatest temptations. He does not impose himself upon his material but lets it speak for itself. Consequently, instead of his narrative strongly advancing one central thesis, it allows the various characteristics of science in Jeffersonian America to emerge by themselves.

A glance at the table of contents indicates that this piece of history may be a mere discipline-by-discipline catalogue. Greene's book is more, however, than an encyclopedic account of the scientific enterprise in America from 1780 to 1830. The broad theme that emerges is that American science in the early nineteenth century "found an appropriate spokesman and symbol in Thomas Jefferson." By this Greene means that the leading characteristics of American science—"patriotism; utilitarianism; antitheoretical bent; fascination with the geography, flora, and fauna of the North American continent; and interest in the relations of science, politics, and religion"—were also the factors that marked Jefferson's highly influential intellectual leadership (p. 27). Thus, the book's title indicates the historical period while hinting at the theme that American science in the post-Revolutionary era was shaped by Jeffersonian concerns.

The opening and closing chapters are the most valuable for a reader whose time prohibits careful attention to the almost 500 pages. The first chapter gives the "American Context." Here Greene sets the stage, providing introductory summaries of American life around 1800. He treats the political climate, the religious outlook, popular conceptions of science, and introduces the reader to Thomas Jefferson. In addition to highlighting key subjects from the book, the last chapter provides a brief but helpful discussion of alternate interpretations of early American science.

Between these two general chapters lies a wealth of detail that evidences Greene's mastery of both primary and secondary literature. He begins with a survey of the institutional setting of American science. Although he underscores the leadership of Philadelphia, Boston, New Haven, and New York, his chapter on "Outposts of Science in the South and West" acknowledges the roles of Charleston, Cincinnati, and Lexington. The balance of the book is a chapter-by-chapter survey of individual scientific disciplines: astronomy, chemistry, geography, geology, botany, zoology and paleontology, physical anthropology, archaeology, and comparative linguistics.

That he does not devote a chapter to medicine is perhaps ironic in light of his early acknowledgement that "[t]he leading figures in the American medical profession . . . formed the backbone of the American scientific community in everything except natural philosophy" (p. 9). On the other hand, such an omission is justifiable on the grounds that medical *science* did not yet exist as such.

The merit of Greene's topical treatment may be questioned. The fact that certain names reappear in numerous chapters is indicative of the fact that American science in the early nineteenth century had not quite reached the age of specialization. Such a discipline-by-discipline structure does not significantly weaken the book, however.

This book does not concern itself as much with religion as do two of Greene's earlier books, *The Death of Adam—Evolution and Its Impact on Western Thought* (1959) and *Darwin and the Modern World View* (1961). Nevertheless, this reviewer cannot overlook Greene's failure to avoid the use of military metaphors in his discussion of science and religion: "Thus the battle lines were drawn . . . between those who conceived the progress of knowledge and society in Christian terms and those who conceived it as a consequence of the inevitable triumph of reason and nature over arbitrary and oppressive institutions of church and state that found their ultimate sanction in supernatural revelation" (p. 19). Although Greene does not sound the trumpet of Andrew Dickson White, comments like these are a bit too similar to the passé warfare rhetoric. Once again, this is a minor

criticism. Such is necessarily the case; for Greene's work is a masterful presentation without glaring flaws.

This book is a welcome addition to the history of American science, for it does not simply rehash Brooke Hindle's *The Pursuit of Science in Revolutionary America* (1956) or Raymond Stearns' *Science in the British Colonies of North America* (1970). A must for the professional historian of science, Greene's contribution will certainly remain a standard work for some time. This book is also a very readable presentation for the layman interested in the state of American science in the years following the fight for independence.

Reviewed by Mark A. Kalthoff, Graduate Student, Dept. of History and Philosophy of Science, Indiana University, Bloomington, IN 47405.

PSYCHOLOGY AND THE CHRISTIAN FAITH: An Introductory Reader by Stanton L. Jones (ed.). Grand Rapids, MI: Baker Book House, 1986. 267 pages, index. Paperback; $11.95.

Editor Stanton L. Jones, a clinical psychologist and professor in the Department of Psychology at Wheaton College, describes in the preface the tensions he experienced as an undergraduate student of psychology between the biblical view of man he held and psychology's generally reductionist and determinist view of man. His goal in the present volume is to supplement the standard introductory psychology text by presenting to the beginning student examples of how Christian scholars in various disciplines within psychology are integrating their profession with their faith. This book's format is similar to standard texts, beginning with a discussion of the nature of psychology as a science, physiological psychology, perception, emotion, and developmental psychology, followed by chapters on personality theory, counseling, social psychology, and community psychology.

Jones begins by discussing two approaches to integration, that of the "limiters of science" and that of the "Christianizers of science." The "limiters" typically claim that science and religion observe and try to explain the same aspects of reality from non-overlapping, independent perspectives. The "Christianizers" argue that a psychologist's Christian world view should determine what questions are relevant and important to study, how theories are devised and evaluated, and what methodology is used. Jones also presents the views of scientists and Christians who are opposed to integrating psychology and Christianity.

In the next chapter, D.M. MacKay argues that advances in brain research will not undermine the biblical view of man, as many Christians fear. Knowledge gained through perception is impoverished and faulty, according to traditional theories of human perception. These theories pose problems for Christians because we believe that we can know the truth. B.H. Hodges, in Chapter 3, offers an alternative to traditional theories by presenting Gibson's theory of direct perception as a valid model for Christian perception of truth.

In other chapters, L. Steele relates Piaget's, Erikson's, and Kohlberg's stage theories of developmental psychology to stages of spiritual growth in an attempt to answer questions of how new Christians and mature Christians experience their faith. H.D. McDonald presents the inadequacies of personality theory, in contrast to the Bible, for explaining and understanding the self. He argues that personality theory describes the persona or mask that we wear, but not the self. C.S. Evans discusses the person as a responsible agent, decrying traditional psychology's mechanistic approach to understanding human behavior.

Two chapters address the relationship between psychotherapy and Christian faith. D.G. Benner and S.L. Palmer, after arguing that each of the major theories of psychotherapy are inconsistent with the biblical view of man, discuss some of the virtues and inadequacies of current Christian psychotherapy. C.W. McLemore and D.W. Brokaw discuss the unique responsibilities of the Christian psychotherapist, including some of the problems of the psychotherapist as evangelist.

D.G. Myers discusses how the major findings in social psychology on the reciprocal relationships between behavior and belief, and action and attitude, are consistent with the biblical view of the relationship between faith and action. He also discusses how the biblical view of humans as being self-deceptive and prideful is supported by recent social psychological studies on the illusions of human thought.

There are also chapters by R.C. Roberts on emotions as construals, by G.D. Weaver on the psychology of religion, and by Jones on community psychology.

I think the editor has amply met his goal of presenting articles that are understandable to introductory students and representative of a wide range of psychology's disciplines. The chapters were not only well written and thought provoking, but several of them were "convicting." I found that my own "limiter" perspective needs reexamination. This book is highly recommended, not only for introductory psychology students, but also for all individuals interested in psychology and Christianity.

Reviewed by Mary Masters, Psychology Department, University of Connecticut, Storrs, CT 06268.

COUNSELING AND THE SEARCH FOR MEANING by Paul R. Welter. (Vol. 9 in the "Resources for Christian Counseling" series, Gary R. Collins, general ed.) Waco, TX: Word Books, 1987. 269 pages, index. Hardcover.

Dr. Welter is a counseling psychologist who has been a professor in the department of counseling and school psychology at Kearney State College in Kearney, Nebraska since 1968. His educational background includes a B.D. from Fuller Theological Seminary.

The book is divided into four parts. The first is "Recognizing and Understanding the Problem" of meaninglessness. The

second part of the book contains about thirty short (3-4 page) chapters that briefly address "Specific Counseling Approaches and Methods." The final two parts of the book are concerned with "The Counselor's Use of Self" and "Preventing Meaninglessness."

Welter draws heavily upon the insights of Viktor Frankl, especially *Man's Search for Meaning*, and emphasizes logotherapy, which states that man's primary motivation is his striving to find meaning for his life. The logotherapy approach has four basic steps: (1) Helping the client distance himself from his symptoms; (2) Attitudinal Change; (3) Actual Reduction of Symptoms; and (4) Orientation to Meaning before Terminating Counseling.

There are a lot of valuable insights in this book, but it tries to cover so many discrete topics that it fails to provide any depth of treatment that is needed for the book to have the desired substance. Consequently, I had my interest piqued in several areas but was left frustrated by the limited extent of the discussion.

The main value in the book for me was its repetition of dealing with man's need for meaning as part of treating any personal and social disorder, and pertinent case histories to illustrate the way that this issue was used in counseling. This caused me to think about ways that I can help others who have problems in finding meaning in life. Other ASA members might find the book equally helpful.

Reviewed by D.K. Pace, Johns Hopkins University Applied Physics Laboratory, Laurel, MD 20707.

LOOKING BOTH WAYS by Richard Perkins. Grand Rapids, MI: Baker Book House, 1987. 198 pages. Paperback.

Richard Perkins is a most capable and fair scholar in his treatment of the driving social forces of sociology and the fundamentals of our earthly walk with Christ. *Looking Both Ways* is a successful attempt to warn the reader that sociology and Christianity do not always naturally coexist. Richard Perkins is a professor of sociology at Houghton College and has written several published articles.

Perkins persuades us to mentally and spiritually understand our society from several perspectives. Sociology aids students in integrating the self into the social milieu of which they are a part. Christian sociology, according to Mr. Perkins, is the most valid and intellectual method of viewing society. He writes that "the combination of Christianity and sociology provides a special method of encountering the social world."

Christian sociology offers the societal sojourner a unique perception of social reality while understanding the forces that shaped it. Incumbent upon the socially conscious Christian is the requirement that he or she attempt, as much as possible, to understand those forces which produce the human social condition and alter our lives for better or worse.

Within the pages of this book, Perkins adequately deals with two haunting, yet challenging, ideas: social reality is a human product, and humans are conditioned by the societal structure to which they relate. Perhaps many students in Christian colleges have trouble with these ideas. However, these two basic ideas are most prevalent in sociology, and there are those moments when the perplexities of social forces upon us create some form of human dissonance. The author competently presents the ongoing dilemmas of willingly exploring the sociological imagination relative to Christian thought. He analyzes the dilemmas and attempts to teach us that it is imperative that we understand our social world from several different perspectives.

Perkins succinctly reminds us that within Christian academics we can benefit by learning what sociology has to offer. If you want to know more about how Christian and sociological thought meet, this is the book for you. It is scholarly, Christian, sociological, and well written.

Reviewed by L.D. O'Kelley, John Brown University, Siloam Springs, AR 72761.

A SKELETON IN THE DARKROOM by Gilbert Shapiro. New York: Harper and Row, 1986. 160 pages. Hardcover; $13.95.

Gilbert Shapiro in this simply written, fascinating text exposes us to six major discoveries which were made unexpectedly. These stories illustrate the fact that luck and accidents can combine with hard work, alertness, and perseverance to yield unexpected major discoveries. The six situations include: Roentgen and the discovery of x-rays; Oersted and the connection between electricity and magnetism; Fleming and the discovery of penicillin; Wilson, Penzias, and microwave background radiation and the Big Bang Theory; Ting and Richter and the discovery of the Ji Psi Meson; and Luis Alvarez and the comet impact hypothesis leading to the death of the dinosaurs.

The text is well written on a popular scientific level, and provides some insight into the role of serendipity in scientific discovery. No comments are made on the Christian faith of these scientists. This would be a useful book to browse through to enjoy the historical perspective of discoveries which have changed the twentieth century.

Reviewed by Fred H. Walters, Southwestern Louisiana University, Lafayette, LA 70504-4370.

MIRACLES AND THE CRITICAL MIND by Colin Brown. Grand Rapids, MI: Eerdmans, 1984. 383 pages, index. Hardcover; $19.95.

Colin Brown is a professor of Systematic Theology at Fuller Theological Seminary and has written an important book on the subject of miracles. Brown offers an extensive account of the debate on the subject of miracles from the early church to the present time. He divides this history into four sections. The first covers a "prescientific age" from the early church through the Reformation. The second deals with the rise of skepticism in the seventeenth and eighteenth centuries. The third addresses the nineteenth century, and the fourth is concerned with what Brown calls the "ongoing debate."

Brown says that this book grew out of an earlier inclination to write a book on why he believed in miracles, which he has not yet written; but the consideration of which led him to realize that a fresh examination of the arguments for and against miracles was needed. And that is what this book is: a review of the debate about miracles from the early church to the present. Brown is a careful and thorough scholar who writes clearly. He has presented the views of the various protagonists fairly and has focused his attention on the critical issues. Many will find his descriptions of these debates a helpful guide to areas of personal interest.

I'm sorry that he has not yet written the book for which this one provides a foundation. It is the one of more interest to most of us. Likewise, I wish that Brown had addressed a broader spectrum of current thought on miracles. He focuses only upon three groups of scholars: philosophers, apologists, and students of the New Testament. It would have been helpful, especially for ASA members, to have more extensive indications of current scientific thought about miracles.

Reviewed by D.K. Pace, Johns Hopkins University Applied Physics Laboratory, Laurel, MD 20707.

COMLETELY PRO-LIFE by Ronald J.Sider. Downers Grove, IL: InterVarsity Press, 1987. 239 pages, index. Paperback; $7.95.

In this book, Ronald J. Sider, Professor of Theology at Eastern Baptist Theological Seminary, undertakes the highly commendable task of developing a consistent "pro-life" perspective on a whole spectrum of issues, not just on one issue as is so often the case. As the Executive Director of both JustLife and Evangelicals for Social Action, he is in a particularly suitable position for this development.

This goal is so ambitious, and the number of possible areas of concern so large, that limitations of space clearly hamper the full exposition needed to make the goal a reality. Are there any facets of social life that do not bear in some way on the "sanctity of human life?" Sider has chosen to devote about 40 pages to each of the following four important areas: abortion; economics and the poor; sexuality, feminism, and the family; and nuclear weapons. In a fifth section, he devotes about one page to each of the following four areas: smoking, alcoholism, racism, and environmental destruction. Finally, at the very end, he mentions another three critical issues about which he says nothing: biotechnology, euthanasia, and capital punishment. The book concludes with appendices containing the Chicago Declaration of Evangelical Social Concern of 1973 and a reaffirmation of ESA's Commitments issued in 1984, 29 pages of notes, and an index.

In each of his four main discussions, Sider devotes a chapter to an exposition of the nature of the problems faced, and then, in keeping with his concern that evangelical Christians be involved in social action related to their convictions, he adds a second chapter in each case devoted to the development and implementation of suitable public policy. These latter considerations are guided by three important principles: (1) "The church should first model in its own life what it calls on the government to legislate"; (2) "Christians should not use the state to impose religious beliefs on others"; (3) "Christians should not use the state to make it illegal to violate biblical ethical norms except where such violations harm the rights of others." Sider wisely points out that a Christian political activity can be judged as to whether it maintains a proper balance between concern for freedom and concern for justice.

As usual, Sider's commentary and suggestions are insightful and provocative. His arguments in two areas, however, are somewhat weakened by the approach used. In the discussion of "Building Peace in the Nuclear Age," he deliberately chooses to express his remarks in the framework of Just War Theory, although he admits that he does not hold to that view—presumably on the belief that a majority of Christians do hold a Just War Theory, and would be alienated if he expressed his own views based on nonviolence. Since it is highly questionable whether any war fought in the last few centuries (if ever) satisfied the requirements of the Just War Theory, its acceptance as a way to define what military attitudes and practices are appropriate for Christians today dilutes the effort.

Few, if any, Christians would disagree completely with the general conclusions that Sider reaches concerning abortion, but his approach to the discussion is unfortunately based on very little care for the meaning of key words and no consideration of the elements of process, development and emergence that occur during fetal development. To speak about "abortion" as a concept that involves no serious differences depending on *when* the abortion is anticipated during the process of fetal development, misses the point of what is actually happening during that development. Poorly stated issues such as whether "the fetus is a fully human being," or "whether the fetus is truly human" detract from the ability to see through the critical issues clearly. Being "human" and being "a person" are terms used indiscriminately as if they were synonymous, sometimes being traded off back and forth in the process of making a point. After considerable confusion generated by this kind of lack of discrimination as to what words mean, Sider concludes the section on abortion with a beautiful statement:

> It is to work as hard for pro-life programs designed to guarantee quality of life to the already living as we work for policies that

> will ensure life itself to the not yet born. That ought to be the acid test of the moral integrity and biblical validity of the pro-life movement. (p. 70)

In spite of its shortcomings in a few places, Sider's book is an important one for Christians to read, share, and discuss with one another. Evangelization and social action are not two exclusive programs that Christians can and should be involved in, but an integrated approach to life in this world. We should be grateful to Sider for reminding us so challengingly.

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

THE DISPOSSESSED: Homelessness in America by George Grant. Westchester, IL: Crossway Books, 1986. 283 pages, index. Paperback; $8.95.

I wanted to like this book. It treats such an important subject, one with which few Christians even try to grapple. Its author is serious about the subject. Not only is he actively involved in ministry to the homeless through HELP Services, a relief organization that he heads, but he also lived on the streets with the homeless of New York briefly as part of his research for this book. The book contains a short (four-page) appendix of "Do's and Don'ts" that will be invaluable for any church or individual Christian that wants to help the homeless. Its advice is specific and practical. The book is worth purchasing simply for this appendix.

The truth of the matter is, however, that I did not like the rest of the book. My response to it overall was very negative. It struck me as propaganda—not just to promote interest in helping the homeless but for a simplistic world view. Throughout the book there are swipes at socialism and the United Nations. The sources cited for much of the book's information are newspapers and weekly news magazines, neither of which should be revered as particularly authoritative. Sometimes the author's logic is not convincing, as when he presents a few anecdotes about the effectiveness of nouthetic counseling and church/home care for treating the mentally ill, and concludes that this is the best (only effective?) way to treat this problem.

The problem for me personally is that I agree with many of the basic ideas promoted by Grant—the Lordship of Christ, the authority of the Scriptures, the central role of the Church in God's plan for society, etc.—but I was repelled by the caricature which his oversimplification of the issues involved communicated to me. Grant is very selective in what he presents. For example, he quotes several sources about the failure of secular psychotherapy and presents only anecdotes of success for nouthetic counseling, apparently blind to the fact that it too fails at times. He provides no comprehensive statistics about their relative success rates, no fair and equitable comparison of the two.

Grant draws a number of conclusions about government's proper role in dealing with the homeless (and other problems) based upon the silence of Scripture on the subject. His tacit assumption appears to be: if the Bible does not explicitly say that government should have a particular role, then it is improper for government to pursue that activity. This is not a claim made by the Bible, nor does it seem to me to be a viable presupposition except when applied very selectively to support one's preconceptions.

Grant addresses many aspects of homelessness: mental illness, alcoholism, housing regulation, unemployment, etc. In this, he does a great service by forcing the reader to think about many of the dimensions of the homelessness problem. His underlying premise is that homelessness results from human sinfulness. Therefore, its removal is contingent upon the Church's application of biblical principles. Amelioration of the problem is beyond the capacities of any secular organization (government, U.N., etc.). Unfortunately, while Grant properly sets forth Christian responsibility to care for the needy, he fails to address the issues of a society containing a majority of unregenerated people. Likewise, an appendix by James Jordan discusses schizophrenia and acknowledges that it can have organic causes, but only proposes ways to cope with schizophrenia caused by sinful behavior. This dealing with part of the problem as if it were the whole problem is what bothers me about Grant's book—and what makes me call it propaganda.

I believe that we as Christians are charged by God to address the problems of our society, and that includes caring for the needy. Grant's book directs our attention to the homeless, and for that I recommend others read it. However, we also need a more complete and balanced treatment of the subject than provided by Grant.

Reviewed by D.K. Pace, Johns Hopkins University Applied Physics Laboratory, Laurel, MD 20810.

UNREACHED PEOPLES: Clarifying the Task by Harley Schreck and David Barrett (eds.). Monrovia, CA: MARC, 1987. 302 pages. Paperback.

This book is one of the results of the International Congress on World Evangelization held in Lausanne, Switzerland in 1974. (A second International Congress is planned for 1989.) It is divided into three main parts: "Clarifying the Task," "Reaching People in Africa," and "Registry of the Unreached."

In "Clarifying the Task," a selective chronology provides an outline of the spread of biblical faith over the past two millennia. The bulk of this section, and the book, contains 13 case descriptions written by people familiar with the situation in Africa.

"The Registry of the Unreached" contains the name, size, chief religion and language of the variety of peoples found in

the world. In addition, the amount of the Bible available in their native languages is given.

Harley C. Schreck is an urban anthropologist currently serving with World Vision International. David B. Barrett serves as missions researcher with the Foreign Mission Board of the Southern Baptist Convention. This book is the seventh in a series dealing with topics important to world missions. It will be helpful in enlightening Christians about the history, current status and future outlook for world evangelization.

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

THE CHRISTIAN VISION: Man in Society by Lynne Morris (ed.). Hillsdale, MI: Hillsdale College Press, 1984. 150 pages, index. Paperback.

This timely book is about values and faith and their place in a college liberal arts curriculum. George Roche, President of Hillsdale College, wrote the foreword, while Thomas J. Burke, who teaches religion at the same institution, provides an introduction and conclusion. Both advance a rationale for the establishment of a formal Christian Studies program at Hillsdale. Their basic thesis is that Christian studies and the liberal arts are inherently compatible, complementary, and essential for understanding the Western cultural heritage. The volume features such well-known Christian theologians and scholars as Carl F.H. Henry, Thomas Howard, Stanley L. Jaki, Gerhart Niemeyer, Paul C. Vitz, and James Packer. Their papers were presented as key addresses during a week-long seminar on the topic, "*Imago Dei*: A Christian Vision of Man" at Hillsdale's Center for Constructive Alternatives, in September 1983.

In a cogently argued essay on "The Crisis of Modern Learning," Carl F.H. Henry, author of the six-volume *God, Revelation and Authority*, posits the necessity of returning God and shared moral values once more as cohesive forces to liberal arts studies in order to overcome the intellectual and moral crisis of contemporary Western civilization. In a more rambling, "Mere Christianity: A Focus on Man in Society," Thomas Howard, author of *The Achievement of C.S. Lewis*, bewails the fact that Christianity has "very little, if anything, to say about culture," and that the world of culture or the arts has never been "the matrix for virtue." He thus, unwittingly, devalues culture, if not the larger enterprise of learning, since neither leads to the City of God or assures even the exercise of virtues. Howard's thesis stands in sharp contrast to James Packer's "A Christian View of Man." The author of *Fundamentalism and the Word of God*, Packer sees the intellectual engagement and the interdisciplinary discussion of life's great issues as an integral part of our earthly pilgrimage and spiritual quest for fulfillment in fellowship with God. His conceptions of Christian humanism and human dignity rooted in the fact that we are made in the image of God (Genesis 1:26, 5:1–2) are equally compelling. This concept of human dignity and rationality is anchored in its historical context by Gerhart Niemeyer in his essay on "Augustine's Political Philosophy."

Of greatest interest to members of the ASA may be the two remaining essays in the volume. "God and Man's Science: A View of Creation," by Stanley L. Jaki, author of *The Road of Science and Ways of God* and recipient of the 1987 Templeton Prize for Progress in Religion, explores an ingenuous cosmological argument for God's existence. He also provides numerous instances of the fallibility or "humanness" of science, without, however, drawing the inescapable espistemological conclusions concerning the basic limitation, tentativeness, and imperfection of science and all of human endeavor. Jaki argues convincingly that: "Both history and logic show that God, the Christian God, is needed in order to let man have science, and if that science is truly a science or cosmology, man's view of the universe becomes a view of creation." Jaki concludes that modern science reveals that everything is consistently interconnected in the universe, which lends support and encouragement to interdisciplinary research in all the sciences.

The impassioned paper, "A Covenant Theory of Personality: A Theoretical Introduction," by Paul C. Vitz, author of *Psychology as Religion: The Cult of Self-Worship*, is perhaps central to the volume for both social and natural scientists. Vitz proves beyond doubt that ideas and values have consequences in real life in that they may radically change our understanding as well as the very configuration of facts concerning human nature and behavior. He methodically expounds a Christian concept of personality, with its basic Christian value assumptions and characteristics, and shows how in each instance—from the individual's self-concept to his relationships with others—the Christian concept of personality rooted in faith and agapé love is superior to secular concepts in both clinical and common sense terms. Vitz is careful to note early on in his essay that a *Christian* psychology must be truly a *psychology*, but a "broader, deeper and truer psychology."

This small symposium volume thus conveys to the scholar-believer a credible exposition of the relevance of, and the need for, incorporating Christian values and faith into the arts and sciences. It may still not convince the agnostic or the non-believer for three reasons: 1.) the suspicion that institutionalized Christian values and beliefs could erect new barriers to freedom of thought and inquiry, and thus persecute latter-day Galileos; 2.) the fear of God; and 3.) the blindness of the sinner.

More basic, the volume leaves unanswered the question of the ecumenical quest for dialogue and reconciliation among those who would call themselves Christian. This quest is reflected by the imperative for a Second Reformation in the religious sphere, coupled with the prospects for a post-Kantian Second Copernican Revolution in the scientific sphere. In sum, the book does not address the great need in the latter part of the twentieth century to extend Christian charity to both faith and knowledge by reminding their practitioners that faith is a gift of God (Ephesians 2:8), and that all human expression of either faith or knowledge is contained in earthen vessels this side of paradise (II Corinthians 4:7). The conclusion follows that the human odyssey in

both faith and knowledge is inherently fallible, imperfect, and incomplete (I Corinthians 13:12). If that is true, then freedom, pluralism, and tolerance among believers and non-believers alike constitute essential human and Christian values for peace among men and optimum progress—moral, material, and spiritual—toward the City of God.

Reviewed by Oskar Gruenwald, President, Institute for Interdisciplinary Research, 2828 Third Street #11, Santa Monica, CA 90405.

OPERATION WORLD by Patrick Johnstone. Waynesboro, GA: STL Books, 1987. 501 pages. Paperback.

This book is intended to serve as a resource for Christians in becoming better acquainted with world needs. It provides background facts and figures on every country in the world including its area, location, population, ethnic composition, literacy rate, official languages, politics, religions, and churches.

A helpful appendix gives the name of every state or territory in the world, the title of its leader, and the names of its most important decision-makers. Another appendix provides the names and addresses of magazines from all over the world which cover the condition of the Church. A list of 92 missionary agencies, a bibliography of statistical sources, and a short glossary are also included.

Patrick Johnstone has served as a missionary to southern Africa but is presently serving as director of research for WEC International in England. His book was first published in 1974 and is now in its fourth revised edition.

While this book could serve as a guide for prayer and missionary support, it is much more than that. It is a valuable resource to keep concerned Christians informed about the geographical, political, economic and spiritual condition of the world God loves.

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

MANAGEMENT: A Biblical Approach by Myron Rush. Wheaton, IL: Victor Books, 1983 (fifth printing, 1986). 236 pages. Paperback.

What is the biblical approach to management? "Management," says Myron Rush, "is meeting the needs of people as they work at accomplishing their jobs."

With that very practical definition, Mr. Rush introduces us to his basic primer in the science of management. The book fully integrates scriptural principles and examples with accepted business management techniques. It is a most readable text, one which Christian managers may find themselves consulting again and again for its helpful insights on basic organizational and human relations topics.

Rush is himself a management consultant, working with for-profit and non-profit organizations. He holds a master's degree in social science and education from Central Missouri State University and has taught various management courses at higher education institutions. Rush also has first-hand management experience. He is co-owner of Sunlight Industries, Inc., a solar energy manufacturing firm. He is the author of *Lord of the Marketplace* (Victor Books, 1986) and *Tapping Employee Creativity*, a book which "deals with the participative management process in private industry."

The existence of that companion book may explain the somewhat cursory treatment of the "participative" team style in a later chapter of this book. Given the great body of writing on "servant leadership" and the bulk of modern business studies in effective management styles, Rush could have clarified the distinctives of his biblical approach more persuasively. Of the four management styles he describes (dictatorial, authoritative, consultative and participative), Rush says, "I feel there is no single right style of leadership."

Rush thinks that the Christian manager should choose from the various leadership styles in the proper circumstance. Jesus driving the money changers out of the temple, for example, does not justify the use of a dictatorial management style in every situation.

Rush goes on to explain the different conditions under which various leadership styles might be adopted. This nonjudgmental approach, however, may be misleading to apprentice Christian managers searching for a biblical model. Certainly, the earlier chapters on "A Productive Work Environment," "The Team Spirit," and "Good Working Relationships," emphasize the more traditional understanding of servant leadership. Rush also introduces a chapter on leadership styles with the admonition to leaders in the church from I Peter 5:3—"Not lording it over those entrusted to you, but being examples to the flock." "The Christian leader is to serve those under him by helping them to reach maximum effectiveness," says Rush in one of his earlier chapters. "And the higher up in an organization a person goes, the more he is to serve." Hopefully, that model remains clear to the reader throughout this book.

Management: A Biblical Approach offers fifteen chapters, with good outlines of such rudimentary management topics as planning, decision-making, communication, delegation, time management, performance evaluations, and advice for handling the inevitable conflict that occurs in every organization. While the chapters are fairly simple and the text includes some subtitles, the lack of an index does make the book less useful as a reference volume.

Some illustrations and management tools are included in the book. The charts on team dynamics are particularly cogent. (I have used them for my own executive team retreats.) More treatment of individual differences (or having "gifts that differ") would have been helpful to management

novices. Also, some of the suggested management techniques, such as a sequential comparison and ranking system for daily task planning, seemed to be cumbersome. (Many people prefer a simple card-stacking system or a quick letter/number assignment for prioritizing daily tasks.)

A leader's guide and visual aid packet are available for group study of this book (neither of which were included in this review). Some discussion questions are printed at the end of each chapter, but the book's style may lend itself more to personal reflection and managerial growth. Business anecdotes and many biblical illustrations are effectively woven into the body of each chapter.

As an introductory reading on management from a Christian perspective, this book is very helpful. It could be especially useful as a supplement to an undergraduate course in business. In an area dominated by names like Drucker, Peters and Iacocca, it is refreshing to have a book on successful management techniques which uses Scripture as a guide. While we would not expect this work to be a bestseller in the field of management, we can look with confidence for Rush's disciples to be "successful" Christian managers.

Reviewed by John E. Brown, III, President, John Brown University, Siloam Springs, AR 72761.

WHY WORK? Careers and Employment in Biblical Perspective by John A. Bernbaum and Simon M. Steer. Grand Rapids, MI: Baker Book House, 1986. 101 pages, appendices, indices. Paperback.

Michael Harrington has offered the opinion that "more and more university students are convinced that work in American society is morally empty, aesthetically ugly, and, under conditions of automation, economically unnecessary." *Why Work? Careers and Employment in Biblical Perspective* reconstructs the moral basis for a Christian philosophy of work. People in the process of choosing a career, changing a career, or even confirming a career will find *Why Work?* to be a helpful guide for their decision paths.

The book was developed as a study guide in conjunction with the American Studies Program in Washington, D.C., of which Bernbaum is the director. Students from the more than seventy member colleges in the Christian College Coalition live and study in the nation's capital while engaged in any one of a wide range of internship opportunities.

John Bernbaum holds a Ph.D. degree from the University of Maryland. He served for a time as a policy analyst in the State Department before assuming his duties as director and lecturer for the American Studies Program. He had edited two other books, *Perspectives on Peacemaking* and *Economic Justice and the State.* Simon Steer was a student at Princeton Theological Seminary and served as a research assistant to the Coalition during the writing of this text with Bernbaum.

Why Work? is designed more as a survey course syllabus than as an exhaustive text. The authors use excellent study questions and reference guides at the end of each chapter to lead the serious student into a deeper inquiry. An annotated list of twenty recent publications on career guidance from a Christian perspective is also provided.

Bernbaum and Steer first present a sound biblical and philosophical basis for the purposes of work. The authors emphasize not only the introspective nature of Christian vocation, but also the helpful notion of the relative "cultural worth" of one's chosen labor—a factor often neglected in evaluating careers outside of church ministry.

The book's introduction and second chapter contain concise, thoughtful critiques of the Marxist-capitalist debate. The authors maintain a clear biblical focus, granting no special place in the kingdom of God to any particular economic system.

The authors draw an important distinction between the "calling" of all Christians to wholeness in Christ, a special call from God to church ministry, and the separate matter of choosing a specific, secular career. This guidance will be particularly helpful to younger Christians, who sometimes become entangled in vocational indecision while awaiting an emphatic, revelational "call" to a given occupation. After reviewing the biblical and historical antecedents for the purpose of work and the "call" to Christian vocation, the authors contend for a broader social application of this Christian viewpoint. Bernbaum and Steer offer this syllogism:

> If all economic activity, according to Scripture, involves exercising our responsibility as God's stewards and is a fulfillment of our role as co-creators, and if our labor is the way we meet the material needs of ourselves, our families, and others in need, making a priority of finding jobs for people becomes critical in a nation's life.

Some people might find this tone of advocacy in the book distracting from its otherwise academic nature. On the other hand, the self-centered materialism of modern American culture may require just this kind of strong reproach to the status quo.

In a very effective fifth chapter, Bernbaum and Steer use an "interview" format with Christian professionals from the Washington, D.C. area. These dialogues help the reader to better grasp the sometimes abstract principles of belief-centered career choice by demonstrating how Christian values have been integrated with pragmatic personal decisions. Says one married female professional: "I have watched my colleagues moving up the scale past me while I worked on a part-time basis [in order to spend more time with her children]. But the process of prayerfully dealing with that has been extremely beneficial in that it has led me to re-evaluate the meaning of success."

As Bernbaum and Steer point out in an earlier paragraph: "Modern American culture and particularly the so-called Yuppie generation reveals . . . a fallen attitude toward work. This takes the form of idolizing upward mobility in one's

career for the purpose of personal material gain and prestige. Rather than being a service to God and humanity, work is a source of purely personal fulfillment and a means to material prosperity."

So, why work? "We work to serve God and bring glory to His name; we work to fulfill our distinctiveness as humans by being stewards and co-creators with God in the world; we work to provide for our needs and those of our families because that is what God intended; and we work to help others who are in need in our world."

If Bernbaum and Steer's *Why Work?* can stem the secularizing flood for even a handful of Christian exemplars, they may well help to call the church back to its biblical roots in understanding both wealth and work.

Reviewed by John E. Brown, III, President, John Brown University, Siloam Springs, AR 72761.

CHRISTIANS IN THE WAKE OF THE SEXUAL REVOLUTION by Randy Alcorn. Portland, OR: Multnomah Press, 1985. 318 pages, index. Hardcover.

The author is on the pastoral staff of a community church in Gresham, Oregon. He has written several articles for *Moody Monthly, Christian Life,* and the *Christian Writer,* but lists no other books. His educational background is not listed, nor his other qualifications as an authority for writing such a book. Evidently his capability has been demonstrated as a speaker and pastoral counselor.

The book is divided into four parts: Where does the world end and the church begin?; Life in a technological Corinth; God has something to say; and, What can we do to promote spiritual maturity? There are 20 chapters within these divisions, and the book has a rather complete annotated bibliography with two indices—one for scriptural citations and the other for subjects.

In part one, the author graphically describes an erosion of morality in the country and the various influences that have contributed to this decay. But, in a way, the most disturbing information is about the church and church leaders, where one would expect purity. In one instance, after a particularly detailed listing of sexual sins, he states that he was told about these incidents in his counseling sessions. As there is no evidence of permission to share that confidential information from the participants, the issue of confidentiality is raised.

Rev. Alcorn quotes from many sources and polls to demonstrate the sweeping effect of the sexual revolution. He counted titles in a supermarket book section and discovered hundreds of books with sexual content. There is no question about his extensive research on the topic, and his many and lengthy quotations abet his statements.

In part two, he reports about the media, child abuse, pornography and homosexuality. Reviews about the effects of pornography on behavior are listed. The tensions about the sweeping homosexual movement and the church are also depicted. Finally, comments about the backlash to "the great sex swindle" are noted, including the effects that AIDS and other sexually transmitted diseases have had on the sexual revolution.

Part three presents a biblical answer to some of the problems noted in the first part of the book. He covers the topics of lust, and masturbation, which he states is in itself not sinful, but can become sinful when accompanied by lust. As this is a problem for many Christians, his handling of it appears balanced. If unaccompanied by lust or others involved in the practice, he states that it is more a measure of immaturity than sin. Alcorn also reviews the literature on premarital sex and adultery. The final chapters on this subject involve the consequences of sexual sin and forgiveness, with many scriptural quotations.

The last part offers some constructive ideas about what "we" can do about the problems noted. This is divided into sections about the family, the church, and the world, and indicates some practical things that can be done.

My first impression about the book's frank revelation of a series of sexual sins was that it too was pornographic! However, the handling of these sensitive issues was quite well done, and this book could be a source book for help in understanding the nature of this revolution that affects all of us in intimate ways.

Reviewed by Stanley Lindquist, Professor of Psychology, California State University, and President of Link Care Foundation, Fresno, CA 93711.

GOD WHO STANDS AND STAYS by Carl Henry (Vol. VI of "God, Revelation and Authority"). Waco, TX: Word Books. 1983. 513 pages, index. Hardcover; $24.95.

The author, who was the founding editor of *Christianity Today* magazine, has lectured at campuses in the U.S. and abroad, and served as lecturer-at-large with World Vision International. He has written twenty volumes and edited significant symposia. Anyone who has read his works knows how thorough they are in reporting the varied views of theologians, and in giving an evangelical view of the Scriptures.

The nature of God and His relation to numerous problems is the central theme of this volume. Some topics discussed include: His transcendence and immanence; His freedom to elect; His creative activity; how long He took to create; the nature of man, angels, Satan and demons; His fatherhood, holiness and love. Such problems as evil as a religious dilemma, the crisis of evolutionary history, justice and the kingdom of God, the Christian and political duty, divine providence and Auschwitz as a suspension of providence are summarized from both evangelical and non-evangelical perspectives.

Henry writes: "The fact is, and it is often forgotten, that scarcely a century ago almost everyone—scientists and other scholars as fully as the rank and file of people, nonchristians no less than Christians—held such 'traditional' views" (referring to recent earth creation and fixity of species). The author then mentions that the Genesis account differs remarkably from other ancient views of origins: God "creates first and foremost for his own glory," . . . "the creation account was not written with a scientific intention; it is nonempirical in the sense that it does not offer laboratory observation and verification as the ground of its affirmations." He evaluates the differing correlations of science and Scripture and concludes that "the doctrine of creation is the bedrock foundation of every major doctrine of the church." The Big Bang and steady-state theories are evaluated, and the term *day* from Genesis is considered to have "no consistent chronological value."

Quotations are given to show that "more and more scholars with little express religious interest are disputing the so-called closed case for evolution," and that "the big evolutionary issue today is over gradual or spasmodic change, with the spasmodic clearly winning the field." Transitional forms are not seen in the fossil record, so there is a conclusive refutation of Darwinism. Henry has a great deal more information on "The Crisis of Evolutionary Theory" and concludes that "the comprehensive premise of universal evolution is not derived from empirical science but is postulated by faith."

Noting that "what most divides Theology and evolution and philosophy is the comprehension of man's essential nature," Carl Henry has written 32 pages on the origin and nature of man. Did religion, tools, or use of fire identify the first man? He concludes that the essential identifier is the presence "at least in some respects of the divine likeness." "No incontrovertible evidence confirms the claim that man, as we define man and as the Bible defines man, lived upon the earth for hundreds of thousands of years."

Much more than has been hinted is in this book. A thorough compendium of beliefs has been gained from the wealth of Dr. Henry's reading, as suggested by his 23-page bibliography. One can also find the phrase of a topic he is discussing by noting the phrase at the top of each odd-numbered page. For example, "Four Major Views of Human Origin" followed by "The Hypothetical Ladder of Human Evolution." The reader is also helped by three indices: Person, Scripture, and Subject.

A masterly work; you will want to use this book in enlarging your comprehension of significant subjects.

Reviewed by Russell L. Mixter, Professor Emeritus of Zoology, Wheaton College, Wheaton, IL 60187.

THE MYTH OF CERTAINTY: The Reflective Christian and the Risk of Commitment by Daniel Taylor. Waco, TX: Word Books, 1986. 154 pages. Hardcover; $10.95.

Daniel Taylor, Associate Professor of English Literature at Bethel College, St. Paul, has written a short, lively, and practical book for any Christian who has unresolved doubts about Christianity, but specifically for the reflective Christian who is plagued, and frequently paralyzed, by them. Christians in the sciences, especially young people without a fully integrated world view, are particularly susceptible to such doubts. It is for them that I most strongly recommend this book.

The book can be divided into three main parts. The first three chapters explore the reflective Christian's relationship with Christian and secular subcultures. The fourth, and longest, chapter examines the roles of faith and reason in the search for truth and certainty. The last two chapters suggest how to survive as a reflective Christian by risking commitment.

A reflective Christian, according to Taylor, is primarily a question-asker, but is rarely satisfied with the standard answers. Like the secular intellectual of the late twentieth century, the reflective Christian tends to be skeptical, if not cynical. He often finds himself in conflict, or in tension, with both the church and the secular world. To survive in the church, he may stifle his incessant thinking or compartmentalize different aspects of his life, creating a kind of "subdued schizophrenia" of faith and doubt. Worse yet, disillusioned, he may leave the church. Taylor, who knows how the obsession with truth can drive a person to despair when the answers elude him, counsels him to stay. And not only to occupy a pew but to commit himself to a life of faith and action.

Taylor writes from his experience at the conservative end of the Christian spectrum, where authoritarianism and anti-intellectualism are often at home. Quoting such writers as Barth, Pascal, and Kierkegaard, Taylor might be considered a tad "liberal" by some in this subculture. But he does not advocate lessening intellectual tensions by shifting toward the liberal end of the spectrum.

Where hypocrisy, narrowmindedness, and intolerance in the Christian subculture may drive the thinker away; pluralism, relativism, and intolerance of faith in the secular subculture do the same to the believer. The reflective Christian, with a foot in both worlds and his whole heart in neither, may be torn apart. To illustrate this dilemma, Taylor uses an innovative device. Eight fictional interludes featuring a (clearly autobiographical) character in conflict with these two subcultures punctuate the book. With wit and vivid characterization, Taylor sketches the world of the reflective Christian, through which the reader experiences the dilemma vicariously. More importantly, the reader grows with the

fictional character in understanding the complexities of faith and doubt. The effect of a combined fictional and nonfictional approach to the subject is that Taylor appeals not only to the reader's (possibly overdeveloped) intellect, but also to his heart—yet without sentimentality. Taylor brings him to the realization that it is a Person to whom we are committed, not a belief system.

Not until the fourth chapter does Taylor finally state the book's premise, that "for human beings certainty does not exist, has never existed, will not—in our finite states—ever exist, and, moreover, should not. It is not a gift God has chosen to give His creatures, doubtlessly wisely" (p. 94). However, he says, the secular orthodox maxim of the Western world—doubt everything—should not be uncritically accepted as the only method for arriving at truth. Reason, logic, and the scientific method are not appropriate in many areas of life. This doesn't mean Christians should be obscurantists. Rather, recognizing the limitations of reason, the reflective Christian will be better able to integrate his doubts into a living faith. And as Taylor points out, "while certainty is beyond our reach, *meaning*—something far more valuable—is not. Meaning derives from a right relationship with God, based not on certainty and conformity, but on risk and commitment" (p. 94).

If every choice or decision in life involves an element of risk, why should our relationship with God be any different? Everything we believe may be false or wishful thinking. Or it may be equally true. As Pascal said, the skeptic loses nothing if God does not exist, but the believer gains everything if He does. Taylor asserts that meaning in life comes only from finding an "idea" that one can "live and die for." That idea, for the reflective and non-reflective Christian alike, is found in the God who manifested Himself in Jesus Christ.

As a reflective Christian, prone to periodic "seizures of agnosticism" (as my pastor so aptly put it), I found *The Myth of Certainty* invigorating. Taylor affirms my right to question, but he doesn't pander to my tendency to nurse doubts like "sick puppies" or to look down on my less reflective brethren. He recognizes my latent desire to serve God and suggests that if I wait until I have absolute certainty, I will never contribute to the advancement of God's Kingdom—which, after all, is what I want more than anything.

Reviewed by Jay Valusek, Houston, TX 77084.

BACKGROUNDS OF EARLY CHRISTIANITY by Everett Ferguson. Grand Rapids, MI: Eerdmans, 1987. 515 pages. Paperback; $24.95.

Everett Ferguson, Professor of Bible at Abiline Christian University, has written an analytical and systematic introduction to New Testament backgrounds. In it he presents the religious context of Christianity as fashioned by Roman government, Greek philosophy, and Jewish religion. Although Palestine was the setting of the ministry of Jesus and his apostles, the diaspora synagogues became the entry points of early Christianity into the Roman world. Therefore, in describing the cradle in which Christianity was born and grew, Ferguson presents the political, social, literary, and religious setting of the Roman Empire in the first century.

The production of this book has been a lifelong involvement for the author. His interest in the subject began when he was an undergraduate student, continued through his graduate study at Harvard University, heightened in his teaching of a graduate course in New Testament backgrounds, and culminated in preparing this material for publication. Ferguson intends this volume to be used as a textbook, and he has packaged it in an analytical format. He attempts to introduce the reader to as many primary sources as possible; abundant bibliographic information is scattered throughout the book. Other useful features include subject and scripture indices, footnotes, and appropriate black and white pictures.

Backgrounds is written for the neophyte. Beginners with little knowledge of Hellenism or Judaism can profit from the introductory material presented. Even a New Testament scholar will pick up some fresh insights in this book's six chapters (which are very thoroughly outlined): Political History, Society and Culture, Hellenistic-Roman Religions, Hellenistic-Roman Philosophies, Judaism, and Christianity in the Ancient World. Ultimately, a person who is familiar with the contents of this book will be prepared to understand the New Testament better.

This is certainly one of the finest one-volume books of this kind available today. There are a lot of books extant on New Testament backgrounds, but many of them are dated, or poorly written, or disorganized, or too brief, or high on graphics and low on content. Ferguson has provided a splendid resource, one which is well balanced, up-to-date, and full of useful information presented in an interesting fashion. It is recommended for all serious, dedicated, and disciplined students of the New Testament.

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

SCALING THE SECULAR CITY: A Defense of Christianity by J.P. Moreland. Grand Rapids, MI: Baker Book House, 1987. 267 pages. Paperback; $12.95.

There are two quite different evangelical approaches necessary to present the Gospel effectively to the non-Christian. The first of these is the tearing down of misleading caricatures of Christianity through intellectual and factual reasoning. The second is the recognition of the character of Christianity as a personal relationship with Jesus Christ. Insofar as this book by Dr. J.P. Moreland is effective, it is almost exclusively in the first of these categories. The author holds a Ph.D. degree from the University of Southern California, helps to train the staff of Campus Crusade for Christ in

apologetics, and teaches apologetics at Liberty University's School of Religion.

According to the author, the purpose of the book is essentially to show that belief in Christianity is not self-contradictory, and that a rational person can believe in God and the record of Jesus Christ in the Bible. The author usually recognizes that this approach is limited in that it does not (cannot) establish that one *must* be a Christian to be rational, or even that one *should* be a Christian to be rational.

This book is a series of literally dozens of arguments, variations of arguments, counter-arguments, variations of counter-arguments, perspectives, and counter-perspectives. In places it becomes so intensely rationalistic and intellectual that one cannot help wondering whether any of the actual nature of the Christian faith and experience is being conveyed, even if the formal arguments are defensible and valid. Typically, the author expounds one particular argument at some length, and then having completed that argument says in effect, "Well, if you're not convinced by that argument, here's another argument that ought to be valid even if the first one isn't."

There are two basic ways of dealing with the nature of the world: its character and phenomena in it. In the deductive, abstract-philosophical mode, one attempts to understand the nature of the universe by arguing what it *must* be like in view of certain assumptions and presuppositions chosen at the beginning. In the inductive, critical-realistic mode, one attempts to understand the nature of the universe by looking at it to see what it *is* like. The major thrust of this book by Moreland lies strongly in the first of these approaches. Many conclusions are based on what "seems" to be correct. In many of these areas, however, we have learned the hard way that what "seems" to be correct often is not. There have been enough historically defined problems with this kind of method to make one cautious at best.

The topics dealt with include the arguments for the existence of God from cosmology, design, the existence of mind, and the meaning of life; the historicity of the New Testament and the resurrection of Jesus; the relationship between science and Christianity; and four final issues dealing with the visibility (or the hiddenness) of God, God as psychological projection, religious experience and moral relativism. The entire book is summarized in a 9-page conclusion, followed by an 8-page bibliography of works selected for further study.

The overall contents of the book can be described as falling into one of three categories: 1.) convincing and valid, 2.) acceptable but probably effective only to those already in agreement, and 3.) misleading and problem-causing, rather than problem-solving. In the remainder of this review, I will give a few particularly striking examples.

The flavor of the arguments offered is pictured rather accurately in the closing words of the first chapter on the cosmological argument: "It is most reasonable to believe that the universe had a beginning which was caused by a timeless, immutable agent. This is not a proof that such a being is the God of the Bible" (p. 42). The fact that it is reasonable to believe in such a universe establishes *only* that it is not unreasonable to believe in such a universe. Again, at the conclusion of his chapter on design the author says, "It seems to me that the design argument still has considerable force, but I leave it to the reader to weigh the evidence for himself." Although Moreland is usually careful not to overstep the bounds of his arguments, others following in his footsteps perpetuate the arguments and overlook the caveats.

Moreland takes a questionable attitude toward "natural laws." He states that "objects behave in accordance with the laws of nature," and that "simple natural laws govern almost all successions of events." Here he fails to appreciate that "natural laws" are human inventions, that they are descriptive and not prescriptive, and that they are the *cause* of absolutely nothing happening. "Natural laws" are, in fact, nothing more or less than *our* descriptions of God's normal mode of activity in creating and sustaining the existence of our universe.

Moreland does not do justice to the claim: the universe must have properties uniquely appropriate for the existence of human life because otherwise we would not be here to reflect on the issue. Whether or not the existence of human life has any apologetic value depends on a fundamental faith decision: the choice of either an infinite number of possible universes, ours being one (or maybe even the only one) suitable for the development of human life, or the choice of a Creator who shaped this particular universe for the particular purpose of bringing forth human life. One does not choose between these two options on a totally rational or intellectual basis without other input. If *existence* itself is the marvel, then *design* arguments are superfluous.

One of the weaker portions of the book is the argument for the existence of God from the existence of mind. Moreland indicates that the only choices are an absolute physicalism in which mind is superfluous, epiphenomalism in which mind is a non-interacting consequence of physical processes, or substance dualism in which body and mind are different substances. He fails to consider properly the nature of emergent properties from the appropriate, dynamically patterned interaction of physical parts in which mind is viewed as an actual, dynamic entity (a property of the whole), that does not exist by itself without the interacting parts, and that interacts on the parts through feedback mechanisms as well as being interacted on by the parts. He consistently incorrectly identifies this view with epiphenomenalism and laboriously attacks it. Other confusions in this argument stem from the apparent identification of "mind" with "soul," the construction of a "straw man" in constantly identifying the development of properties through natural processes as not being directed by a Superior Intelligence, and the assumption that one must choose between "either the origin of the mind from nothing or its emergence from potentiality in matter" (p. 103). To base an argument for the existence of God on substance dualism does not make an effective contribution to Christian apologetics.

The author's arguments based on the meaning of life start out positively in dealing with four views of this meaning, but

founder on the repeated assumption that one must choose between evolution and the existence of God. The reader, with Romans 12 in mind, will gasp to read that our belief in retributive punishment is an intrinsic feature of our moral life: "We sometimes feel that we should pay back evil for evil" (p. 124), with the "should" in that quotation having the force of a moral imperative. The chapter ends with an endorsement of Pascal's wager (i.e., if there's no God, the Christian loses nothing, but if there is a God, he gains everything; so why not be a Christian?), which, at least to my mind, violates the whole essence of Christian commitment.

Once the author leaves behind his attempts to interact with science and goes on to discuss the historicity of the New Testament and its accounts of the life, death and resurrection of Jesus Christ, he moves onto surer ground. He provides an excellent summary of the usual apologetic arguments made in this area, important information that helps to remove many caricatures that non-Christians hold.

In the chapter on science and Christianity, he returns, however, to the former troubled waters and finally confuses things further by choosing the creation/evolution debate as the example for integration of science and Christianity. He identifies his own position as that of scientific realism, but in the several categories described, he does not really come to grips with the view of critical realism. He wisely advocates an eclectic position and warns against identifying any particular scientific theory with absolute truth.

It is when Moreland comes to criticize the complementarity perspective, in which science and Christian theology are viewed as providing complementary insights into the nature of reality, that he becomes tangled up in the desire to maintain the Bible as a source book of scientific information. This leads him to the startling statement: "the Bible implies that gaps do in fact exist in natural explanations, and the existence of such gaps is a part of the case for God." This statement throws him immediately into a defense of the God-of-the-Gaps, which he recognizes as a possible criticism. From here Moreland moves on to the defense of the thesis that "creation science" is indeed a science, and concludes summarily: "Opinions to the contrary (i.e., that 'creation science' is not a science) are either uninformed or represent mere bias." Moreland regards the interpretation of Genesis 1 and 2 consistent with the possibility of creation by evolutionary process (although he never actually recognizes this as a formal category) as one that "fails to take the biblical text seriously, and therefore . . . not an option for an evangelical" (p. 216).

The approach taken by Moreland in this book is characteristic of an effort to approach the science/theology interaction with the tools of past centuries, but without an understanding of the current relationship between these two areas. Obviously, others do not agree. One of the comments on the book jacket, for example, cites the fact that "Moreland's special strength lies in philosophy of science, and the book makes a real advance in the interface between Christianity and science." It is the judgment of this reviewer that it is in the interaction of science and Christian biblical theology that Moreland's approach is most lacking. I fear that Christians who follow this lead will bring harm to their witness rather than strength.

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

APPLYING THE SCRIPTURES: Papers from ICBI Summit III by Kenneth S. Kantzer (ed.). Grand Rapids, MI: Zondervan (Academie Books), 1987. 514 pages. Paperback.

This book is a collection of papers and responses to them from the third summit conference of the International Council on Biblical Inerrancy (ICBI), that was held in Chicago in December of 1986. The authors of the papers and responses are among the most articulate and respected evangelical scholars and writers in the English-speaking world. They include Gleason Archer, Edmund Clowney, Norman Geisler, Carl Henry, John Montgomery, Roger Nicole, J.I. Packer, Robert Preus, John White, Ralph Winter, Thomas Zimmerman, and many others.

The book begins with four papers about: the Living God, the Savior and His Work, the Holy Spirit and His Work, and the Church. The remaining three-fourths of the book deal with ethical and social issues: sanctity of human life, marriage and family, divorce and remarriage, sexual deviations, the state, law and justice, discrimination, war, economics, work and leisure, wealth and poverty, stewardship of the environment, and the role of God in history.

The papers and their responses are clearly written, very readable, and deal directly with the topics indicated and their knotty issues. In general, the responses to papers are by people with different theological perspectives than those of the papers' authors. Yet, all approach their subjects with a reverence for the Scriptures and a commitment to their inerrancy. This book would be a valuable part of every serious evangelical Christian's library.

Having said that, I would share a few observations. First, the use of "international" in ICBI implies more than the English-speaking world. In particular, the views of evangelical Christians from Third World countries regarding biblical teachings about justice, war, economics, poverty, *etc.* would have been a valuable contribution for this volume. It is easy to be blind to our cultural presuppositions, especially those shared by nearly all English-speaking countries. Second, the papers on ethics and social subjects do not have the cogency of the initial four papers on more traditional theological topics. I suspect that this is because discussion of these subjects of more recent attention has not been refined over the centuries, as have the more usual theological ones. Third, this book helps us to remember that God's truth about complex reality cannot be reduced to overly simplistic concepts—and the divergent views on some subjects, by men and women of equal devotion to God and commitment to the Bible, should keep us both humble and cautious when we disagree with our brethren.

I find the effort of ICBI to build a firm foundation of scholarly, pertinent, and balanced writings from a broad base of evangelical Christianity admirable. As American society becomes increasingly secular, and as non-Christian religions and ideologies compete more vigorously with biblical truth for the minds of Americans, it becomes increasingly important for the Church, in its witness to the world, to present as united a front as possible on Christian thought. The responsible interchange of ideas and views found in this book, with its overt and consistent emphasis upon the relevance and authority of the Bible, can help that to occur.

Reviewed by D.K. Pace, Principal Professional Staff, The Johns Hopkins University Applied Physics Laboratory, Laurel, MD 20707.

THE RISK OF INTERPRETATION: On Being Faithful to the Christian Tradition in a Non-Christian Age by Claude Geffre (translated from the French by David Smith). Mahwah, NJ: Paulist Press, 1987. 298 pages. Paperback; $12.95.

This book is a collection of essays, the core of which had been published or presented earlier in various forums over the previous decade, by a professor of theology at the Institut Catholique de Paris. Professor Geffre is intimately familiar with modern developments in Catholic theology, the philosophical and theological evolutions of liberal Protestant thought, and modern secularism. He divides his book into three parts. The first addresses theology as hermeneutics (not in the more simple classical sense of principles of interpreting the written Scriptures, but in the more complex sense of "creating new historical figures of Christianity at different times and places," as that term has been used in modern Protestant liberalism).

The second part of the book addresses the role of the Church (and Scripture) as the interpretative testimony to faith, and even includes a chapter on Ernest Bloch's atheistic hermeneutics of the title "son of man." The third, and largest, part of Geffre's book is concerned with how the practice of Christians reinterprets Christianity. It is in this section that the primary mission of the Church becomes clear. Basically, it is to promote human rights. The book concludes with an epilogue that reviews the contributions of French Catholic theological writers before and after Vatican II.

I found this book to be fascinating and very informative because it deals with an area of thought to which I do not expose myself extensively. However, I did not find it very helpful personally. For me, theology properly helps to interpret the context of the Scripture and nature as it manifests God's creation. For Geffre, theology is "a creative reinterpretation of the Christian message." Geffre sees theological pluralism (by which, at times, he seems to accept as valid non-Christian religions such as Islam) to be the historical destiny of the Western Church, and believes that the future of Christianity is not to be found principally in the West (Europe/USA).

Geffre's challenge for the Church to seriously promote the cause of human rights is one which evangelical Protestants need to heed, as well as the Catholic intellectuals for whom Geffre's challenge is intended. He makes a very valid distinction between the "mission" of the Church and its evangelism, which is only part of its mission. While this is part of Geffre's belief (that theology has moved from theologies of the word to theologies of history and politics), it is well for all who proclaim Christ as Lord to remember that they should be concerned about the political and social systems that perpetuate gross injustice and poverty and act to change them, as well as to proclaim the gospel message of salvation through faith in Christ.

I do not believe that Geffre's book will be of general interest to ASA members. However, it is a convenient introduction to a major direction of thought among French Catholic intellectuals, and should be of interest to all who wish to know more about them.

Reviewed by D.K. Pace, Principal Professional Staff, The Johns Hopkins University Applied Physics Laboratory, Laurel, MD 20707.

THE ATLAS OF MYSTERIOUS PLACES by Jennifer Westwood (ed.). New York: Weidenfeld and Nicolson, 1987. 240 pages, illus., index. Hardcover; $29.95.

The mysterious places written about in this volume fall into four categories: sacred sites, symbolic landscapes, ancient cities, and lost lands. The origin, significance, and structure of many of the sites presented justifies their being called mysterious. The readers of this journal will be interested in some of the biblical places discussed under sacred sites. They include Malta (which Paul visited on his voyage to Rome), Giza (which is the location of the Great Pyramid, already 3000 years old when Joseph, Mary, and Jesus visited Egypt), Babylon (where the Jews were taken as captives in 586 B.C.), and Jerusalem (referred to as the Holy City of God).

Sites in Jerusalem considered important to Judaism (the Western Wall), Christianity (the Church of the Holy Sepulchre) and Islam (the Dome of the Rock) are briefly discussed. Westwood thinks the evidence for the Church of the Holy Sepulchre being the location of Jesus' burial is substantive, since Hadrian built a temple to Venus over it in the second century and Saint Helena knew where to look for it when she came to Jerusalem in the fourth century A.D.

In addition to the 60 mysterious places discussed in the text proper, the locations and significances of 54 additional ones are presented in a gazetteer. A glossary which defines difficult terms encountered in this book, a very thorough index, and a succinct bibliography are also included.

Jennifer Westwood, a graduate of Oxford and Cambridge Universities, is a specialist in Anglo Saxon and Old Norse

language and literature. Her interest in myth and legend resulted in the writing of several books for children before this one was produced.

This is a very attractively packaged book with drawings and photographs illustrating every site (most in color), large nine-by-eleven inch pages, a map indicating the location of each mysterious place, and a clearly written text which discusses the significance of each area. I recommend it to anyone who is interested in history, archaeology, philosophy and religion. For those who like to travel, this could point them to some unusual spots. This book would make an appropriate gift, but be sure to get two copies. You will want to keep one for yourself.

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

Letters

Responding in Love and in Humility

Comment on Richard Bube's Guest Editorial, "Responding in Love to Naive Heretics." May I suggest, Dr. Bube, that it is equally important to respond with humility. What you, or I, may perceive as a naive statement violating, for instance, "the very integrity of authentic science," may well be our own faulty perception of either the speaker's intent or motivation. He is speaking in the Light that he has, at the moment. We must not be sure our Light is the only illumination possible!

Comment on Dr. Greenberg's review of *It's a Young World After All*. In addition to similar comments to those above, may I suggest that I perceive more sarcasm than love in your review? I am totally unable to conceive of Jesus ever saying: "What better credentials. . . . !" Nor can I fathom why you would poke fun at a fellow Christian's "conversion," even though it was a conversion of a different kind than we usually think about!

Of course, Dr. Ackerman does present some interesting data on the "young earth" hypothesis. And, it is true, counter-arguments to nearly all (all?) of them exist in the literature. The presence of a counter-argument in the literature scarcely, however, means the argument is settled! To Dr. Ackerman's credit, he, himself, cites many of these counter-arguments in the book!

Finally, a general plea to all who write for this, or other, journals. Surely it is best to not only write/criticize both "in love" and "in humility," but also in the very sure knowledge that the person whose ideas we discuss may well be spending a very long time in fellowship with us in the ages to come!

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Origin Science

Those present at the Tuesday evening session of this year's annual meeting will recall Geisler's strong denial of Van Till's accusation that *Origin Science* argued for a God-of-the-gaps. Geisler is right, provided we restrict matters to "operation science" (Norman L. Geisler and J. Kerby Anderson, *Origin Science: A Proposal for the Creation-Evolution Controversy*. Grand Rapids, MI: Baker Book House, 1987, pp. 17, 28, 65f, 113f). But the area of "origin science" is different. There the argument (I change the language) runs that, since we cannot explain the ylem which underlies the Big Bang, its source must be God (*Ibid.*, pp. 133–136; cf., pp. 29, 107, 109, 118, 123). Since we cannot explain the origin of life, it must be ascribed to God (*Ibid.*, pp. 137–147). Since we cannot explain the apparently sudden appearance of diverse phyla, they must spring from God's activity (*Ibid.*, pp. 147–156). This is clearly a God-of-the-"origin-science"-gaps. It could hardly be more explicit. Where it counts, Van Till is right.

Any God-of-the-gaps view is deistic rather than theistic. Geisler and Anderson properly, overtly, reject the deistic view. But improperly, tacitly, they make it the basis of "origin science." So they must be classified as crypto-deists denying deism. Such is the end of trying to defend the indefensible—self-contradiction and nonsense.

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VOLUME 40 NUMBER 2 **JUNE 1988**