PERSPECTIVES on Science and Christian Faith

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In this issue . . .

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

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Putting Things in Perspective

In January 1989 the evangelical publication ETERNITY closed its doors after 40 years of providing the Christian public with both challenging and informative analysis of news and issues. In spite of the plethora of evangelical magazines—some general, some with a very selective agenda—ETERNITY will be missed. I think it is fitting, therefore, although not originally planned as an "obituary" to another publication, that we have as a guest editorial in this issue of *Perspectives on Science and Christian Faith*, R.C. Sproul's column from the November, 1988 issue of ETERNITY. Dr. Sproul writes: "As Christians assimilate new discoveries in natural sciences, it is important that they approach the problem with a sound concept of the providence of God." These are words that get at the heart of what ASA is all about. As we recognize that "nature is a book of revelation that is to be studied with no less care than is demanded by sacred Scriptures," we need to be constantly reminded of our finite and often fallible interpretation of both nature and Scripture. We need to be hesitant about defending our pet ideas of nature and/or Scripture, and appreciate that in both areas our finite minds are wrestling with and trying to apply infinite truth. Thank you Dr. Sproul and ETERNITY.

Some of the subject areas with which ASA and this journal are concerned (philosophy of science and evolution, for example) are of tremendous importance in our sometimes feeble efforts to establish paradigms that are truly biblical. These deliberations are important as we seek to resolve differences between Christian and nonchristian and even among fellow members of the Christian community. However, to this editor, who has been a biologist for fifty years, the most alarming danger facing this earth and the human race is the rapidly increasing deterioration of our global environment. When I read the "pessimists" (the realists?) I am convinced that, even if they are only half correct, I as a Christian as well as a biologist must be concerned about what we sinful human beings are doing to God's creation, including our "neighbors" all over the world. When I read the optimists—rarely, if ever, are these people biologists!—I get angry at their callous disregard for the obvious: pollution, overpopulation, and unjust use of God-given resources are increasing before our very eyes. The optimists just fail to read the clear handwriting on the wall. Human society has been weighed in the balances and found wanting. At a time when we should be Daniels or Josephs, we are all too often like Belzhazzar or Pharaoh before his dream.

Having expressed this deep personal concern about the future of our selfish, materialistic, and hedonistic culture it should not be surprising that I was pleased with the positive editorial reviews of the lead paper in this issue. Edwin Squiers, using the incident of Belshazzar's feast in the book of Daniel, reminds us of some of the apocalyptic possibilities of our greedy lifestyles. Even if the "greenhouse effect" is not an absolute certainty, there is enough evidence of global warming and awareness of the possible factors involved that we should at least be concerned. Deforestation and wholesale species extinctions should alarm us. The well-documented depletion of the ozone layer and its almost certain relation to specific human activities should cause us to consider changing at least some of our profligate habits. The obvious dependence on Middle East oil should warn us, even if we are not pessimistic premillenialists, that this is a dangerous and explosive situation. Dr. Squiers clearly compares the handwriting on the wall of Daniel's time with these signs of our time. I, for one, echo his cry: "Somebody go get Daniel."

The major theme for the ASA's Annual Meeting this year, scheduled for Indiana Wesleyan University in August, is bioethics. (That our technologically sophisticated society is faced with awe-inspiring ethical dilemmas is evidenced by, among other events, the ten-part series presented earlier this year on public television: "Ethics in America.") Lewis Bird of the Christian Medical and Dental Society discusses some of the basic principles of bioethics as they apply to the problem of

genetic engineering. Noting that, "Like many twentieth-century technologies, genetic engineering can become yet another power struggle," he quotes C.S. Lewis' wise remark that "what we call Man's power over nature turns out to be power exercised by some men over others with Nature as its instrument." It is certainly imperative that Christians realize the existence of these problems, familiarize ourselves with their complexities, seriously wrestle with how we should respond in an ethical and compassionate manner. Dr. Bird gives us some important guidelines for this task.

To many people, educated as well as uneducated, theology (or religion) and science are two opposing camps competing for our allegiance. Furthermore, science is often deified to the exclusion of religious faith, and biblical Christianity is often presented by its adherents with propositions that ridicule scientific endeavors. One of the leading figures who, on the basis of knowledge of both theology and physics, has written much on the integration of science and theology is Thomas Torrance. In this issue of *Perspectives*, Jim Neidhardt gives us a detailed analysis of the work of Professor Torrance with particular reference to a comparison of Torrance's approach to theology with the approach of James Clerk Maxwell to science.

Theologian and mathematician, Bruce Hedman concludes his discussion of "Mathematics, Cosmology, and the Contingent Universe" with the following:

> Modern scientific models of the universe offer a more hospitable arena for the discussion of Christian theology than did their predecessors in the last century. When the universe was thought of as closed, necessitarian, and incontingent certain questions basic to Christian thought were dismissed out-of-hand as invalid. An incontingent universe precludes any revelation from outside itself. Today scientific thinking about the contingent universe allows a rapprochement with Christian thinking, that together they may work toward an interdisciplinary understanding of the created universe.

Hedman demonstrates that such a conclusion is based on the three cosmological indicators of contingence: time, the finite extent of the universe, and Gödel's theorem.

John Armstrong, in a communication, relates his "re-discovery" of John Ray, seventeenth-century scientist and philosopher, through his reading of Ray's *Three Physico-Theological Discourses*—a "buried treasure." Raymond J. Seeger continues his biographical series of scientists and their religious faith with an informative communication on Francis Bacon, "Iconoclastic Herald."

Definitions of words are basic to our understanding of all major concepts, and this is especially true in controversial areas. Hence the importance of Richard Bube's regular column in this journal: "Penetrating the Word Maze." In this issue, his key words are "natural" and "supernatural," an important distinction and a distinction touched on in R.C. Sproul's guest editorial when he defines and illustrates the differences between the "mediate" and the "immediate" works of God. I trust that in ASA and in this journal, whether we are discussing evolution, creation, environment, ethics, or anything else, we will constantly strive to define our vocabulary carefully. Such a concern should be a major function of our reviewers and of our authors. And we can't be too careful! I recently received a letter in response to my comments on the criticisms of *Teaching Science in a Climate of Controversy*. The writer was justifiably concerned with my failure to define "special creation." I did not explain that I was using it in its original sense to refer to the creation of "*species*," and hence based on the no-longer defensible concept of the "fixity of species." And that goes back to a basic biological dilemma: "What is a species?" Modern quantitative, immunological, and genetic approaches to this problem have added an overwhelming amount of information to this question, but if anything, the answer is more elusive than ever. We can't define a "species" in a manner that satisfies all biologists, whether they work with viruses, worms, or birds. Therefore, the limitations of "speciation," "microevolution," or "macroevolution," cannot be spelled out to everyone's satisfaction. In ASA we need to recognize both the importance *and* the difficulty of defining key words, especially those that are so often used carelessly and even emotionally in the important controversies of our time.

WLB

Providence, Science and the Sovereignty of God

The ongoing struggle between naturalism and supernaturalism often revolves around our understanding of the relationship between divine providence and natural causes. Insurance companies still have room for "acts of God." But there seems to be less and less room for acts of God in our expanding knowledge of the inner workings of nature.

As Christians assimilate new discoveries in natural science, it is important that they approach the problem with a sound concept of the providence of God.

There is a crucial linguistic gap between the etymology of the word "providence" and its theological, functional usage. The word providence comes from a Latin root meaning "to see beforehand." But the doctrine of God's providence conveys much more than an insight into God's vision.

The doctrine of providence has to do with God's *government* of the universe. God does more than *observe* the universe. He must not be relegated in our thinking to the level of a mere cosmic spectator who creates a world and then sits back to observe what will happen. Such a deity would resemble Aristotle's Unmoved Mover more than Israel's Yahweh.

At the same time, the biblical God is not a do-everything king who refuses to delegate. He is a ruler who governs through means, via intermediate agents and forces.

In the 17th century René Descartes made an important distinction between *primary* and *secondary* causality. This distinction found its way into the Reformation creeds (most notably the Westminster Confession). Primary causality refers to God's act of creation as well as his ongoing work of sustenance over creation. His sovereignty stands over and above the created order at every moment. This makes him not only the Creator but the Lord of history as well.

Secondary causality refers to what we commonly call the laws of nature. These "laws" reflect not an independent power of nature but rather the ordinary manner by which God rules his creation. Nature's laws are God's laws. To discover them is to think God's laws after him.

What we call natural causes may also be called examples of ordinary providence. It is when we conceive of these secondary causes as being independent of God that we commit a form of idolatry.

It is not idolatrous for scientists to seek a more comprehensive understanding of ordinary providence. Indeed it may reflect a very advanced form of reverence.

There are times when scientists overstep their bounds and seek to exalt nature over God. Sadly, sometimes this stems in part from a reaction to a religious community that persecutes and oppresses scientists for pushing back the frontiers of mystery.

The Christian need not be threatened by any bona fide scientific discovery. Of all people we have an enormous investment in truth. Of course not all claims

by scientists represent truth. But where truth is found and truth is published, God is honored. The secondary causes bear witness to the primary cause. Nature bears witness to supernature. The heavens are still declaring the glory of God.

Another crucial distinction that closely resembles the distinction between primary and secondary causality is the distinction between the *immediate* and *mediate* work of God. The term "immediate" is not used here with respect to time. It does not so much refer to "suddenness" as to a work directly done without intervening means.

Let us illustrate the difference between immediate and mediate works of God. The parting of the Red Sea was a mediate act of God using an intermediate force. God caused a great wind to blow to separate the waters. Here was a bona fide miracle of timing. But God used the intermediate force of nature to bring about a supernatural event.

In the raising of Lazarus from the dead Jesus brought forth resurrected life immediately. He *called* Lazarus out of the tomb. No C.P.R., no mouth-to-mouth resuscitation, no medicine administered. Here the event was wrought by the immediate, primary cause of the power of God.

It is when the distinctions of primary-secondary causality, and immediate-mediate works of God are not observed that conflicts may arise between science and theology. Some want to explain everything in light of secondary causality, excluding God. Some want to explain everything in terms of primary causality, excluding science.

Nature is a book of revelation that is to be studied with no less care than is demanded by the sacred Scriptures. The same God is the author of both. What he reveals in nature is not contradicted by what he reveals in Scripture. The Lord of providence is also the Lord of truth.

R.C. Sproul

President, Ligonier Ministries
Orlando, Florida

Alleluia!

Praise the Lord from the heavens, praise him in the heights.
Praise him, all his angels, praise him, all his host.
Praise him, sun and moon, praise him, shining stars.
Praise him, highest heavens, and the waters above the heavens.
Let them praise the name of the Lord. He commanded: they were made.
He fixed them for ever, gave a law which shall not pass away.
Praise the Lord from the earth, sea creatures and all oceans,
fire and hail, snow and mist, stormy winds that obey his word;
all mountains and hills, all fruit trees and cedars,
beasts, wild and tame, reptiles and birds on the wing;
All earth's kings and peoples, earth's princes and rulers;
young men and maidens, old men together with children.
Let them praise the name of the Lord for he alone is exalted.
The splendor of his name reaches beyond heaven and earth.
He exalts the strength of his people. He is the praise of all his saints,
of the sons of Israel, of the people to whom he comes close.

Alleluia!

Psalm 148

Wealth and Waste and Writing on the Wall (or, Somebody Go Get Daniel)

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This paper uses the imagery of Belshazzar's feast, described in the fifth chapter of Daniel, as an analogy of the way affluent societies deal with the global issues revealed by scientific data. Daniel, the scientist-ethicist, is called upon to read and interpret the writing on the wall (the facts of science), written by the disembodied hand (the "value-free" activities of science), to the lords of the feast (all of us who believe that the wealth that technology produces may be possessed without responsibility or penalty). Four examples of modern "writing on the wall" are explored: 1) atmospheric carbon dioxide levels and global warming, 2) rainforest destruction and the loss of species diversity, 3) depletion of the ozone layer and the onset of skin cancer, and 4) world oil reserves and the threat of war. The paper concludes with the musings of a pair of early talmudic scholars, Rabbi Jonah ibn Janah of Saragossa and Rabbi Akiva, the latter a contemporary of the Apostle Paul.

What a party! All the right people were there, all the up-and-coming "yuppies." Everybody who was anybody was invited. Babylon's elite were assembled. Imagine the glitz, with a thousand nobles, their wives and lovers. The wine flowed like the waters of the Euphrates. Imagine being invited to dinner in the great banquet hall of the palace, where, reclining at the head table was Belshazzar, master of the kingdom, heir of Nebuchadnezzar, and lord of the feast.

We can imagine Belshazzar's eyes glowing with pride as he surveys the opulence of the occasion. A hush falls over the room and the mighty ruler speaks: "My friends, this year of my reign [539 B.C.] has been a very good year. To celebrate, let us drink a toast to the gods of real power, to the measure of the good life, to the gods of stone and wood, iron and bronze, silver and gold. Drink from the goblets set before you, my friends. These golden goblets were liberated by my forefather

from the god of the Jews. Raise them in a toast to the gods of reality."

Belshazzar's party was more than a single great occasion, more than one extravagant feast. If the ancient historian Herodotus is to be believed, it was a whole lifestyle, a lifestyle of wealth and waste and self-deception.

Then it happened, that mysterious writing on the wall. A terrified Belshazzar, knees knocking and pale as a ghost, watched a disembodied hand scratch the truth into the plaster: "*MENE MENE TEKEL UPHARSIN*." Was it part of the entertainment? No, the king was frantic: "What does it mean? Somebody tell me! I offer my golden amulet, my scarlet robe, third place in my kingdom, to anyone who can tell me what it means!" The lords of the realm and court officials and the counselors of the king all stood frightened and mute.

Of course, any who were educated could read the words. As nouns, they were simply coins of the realm: mina, 50 shekels; tekel, one shekel; and upharsin, one-half shekel. In the verb form, they were activities of science or economics: *mene*, to number; *tekel*, to weigh; and *upharsin*, to divide. There was one other clue: in the past tense, *upharsin* was read *peres* or *paras*, the Aramaic word for Persians.

Some in the banquet hall may have guessed the true meaning, but no one spoke. Then Daniel, the truth teller, was brought forward. He spoke to the quivering ruler: "Keep your gifts for yourself and give your rewards to someone else. I will read the inscription and I will make the interpretation." So Daniel interpreted the message that no one else dared read:

"**MENE**—God has numbered your kingdom and put an end to it."

"**TEKEL**—You have been weighed in the balance and have been found wanting."

"**UPHARSIN**—Your kingdom has been divided and given over to the Medes and Persians."

Shocked, Belshazzar offered Daniel the promised reward. By doing so, the king acknowledged Daniel's interpretation to be correct, at the same time demonstrating that he was blind to the truth that it held. The truth was simple: the feast was over. The kingdom no longer belonged to Belshazzar, who owned no reward to give. In fact, Belshazzar was slain and the kingdom lost that very night.

What a party! For those who survived, it was a night to remember.

The account of Belshazzar's feast in the fifth chapter of Daniel provides a haunting analogy of today's world. Garrett Hardin (1986) has suggested that the disembodied hand writing cryptic warnings on the wall has become the instrumented hand of science and technology. Daniel, as reader of the message, may be viewed as the generic, "value-free" scientist simply giving the facts. But Daniel does not stop with the facts. As interpreter of the message, Daniel fills the role of ethicist by comparing what is to what ought to be and by warning of the consequences of wrong actions. Although much of today's "writing on the wall" is complex, confusing, and even contradictory, some messages are being written with increasing clarity each passing year. We look briefly at four of these messages.

MENE: Atmospheric Carbon Dioxide Levels and Global Warming (or, "Burn, Baby, Burn")

Modern society survives by burning fossil fuel. Oil, coal, and natural gas are the fuels that produce our electricity; power our industry; fuel our automobiles, trucks, buses, trains, and planes; power our agricultural and commercial enterprises; heat and cool our homes; and, in large measure, allow us to live a lifestyle that even Belshazzar would envy. There are side effects to all this burning. Among them is the discharge of large quantities of carbon dioxide into the atmosphere. The problem is compounded by the fact that less atmospheric carbon dioxide is being recycled because of

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deforestation, particularly in the tropics. Atmospheric scientists have monitored the level of carbon dioxide in the atmosphere since the late 1950s and the writing on the wall is both striking and ominous (Figure 1).

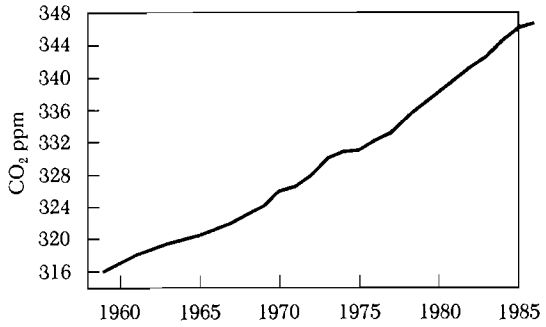

Figure 1. Average annual concentration of atmospheric dioxide measured at Mauna Loa Observatory, Hawaii 20° North Latitude (World Resources Institute and the Institute for Environment and Development 1986).

Numbered, numbered, weighed, divided

But what does it mean? To a "value-free" scientist, it is a fascinating global experiment. Researchers studying a phenomenon dubbed "the greenhouse effect" can now predict how the earth's climate will respond to ever higher concentrations of carbon dioxide. As the carbon dioxide content of the atmosphere goes up, the earth's ability to reradiate heat goes down, the delicate temperature balance is disrupted, and the earth's atmosphere warms up.

Although much of today's "writing on the wall" is complex, confusing, and even contradictory, some messages are being written with increasing clarity each passing year.

The consensus emerging among scientists is that if current trends continue, sometime around the middle of the next century the concentration of carbon dioxide in the atmosphere will reach twice the preindustrial level and the earth's average temperature will be between 2 and 5 degrees Celsius higher than it is today (Tangley 1988). A variety of complicating factors notwithstanding, that will almost certainly lead to the collapse of the Arctic pack ice and the melting of a substantial part of the Antarctic ice sheet. The subsequent rise in sea level could make life very uncomfortable for residents of Boston, New York, Tokyo, Shanghai, Amsterdam, Stockholm, and a number of other coastal cities (Barth and Titus 1984). Large areas of low-lying, fertile farmland, including such highly populated regions as the Ganges River delta in Bangladesh, will also be lost.

The calamity doesn't stop there. Recent research results indicate that the projected temperature increase could also lead to a substantial drying out of the mid-continent, mid-latitude regions of the northern hemisphere, principally in the United States, Canada, and the Soviet Union (Miller 1988). In the U.S. cornbelt, for example, the anticipated climate change could cut corn yields by 50 percent.

"Don't worry, if it gets warmer, we'll just turn up the air-conditioner."

Somebody go get Daniel.

MENE: Rainforest Destruction and Loss of Species Diversity (or, "Fast Food for Fast Times")

Consider the menu for our modern "feast." A burger and a soft drink provide fast food for fast times for millions of affluent people. Worldwide consumption of hamburgers now exceeds 10 billion burgers per year. In America and Europe, meat consumption has increased by more than 45 percent since 1960, an increase dwarfed by the increase among nations newly arrived at the feast (Myers 1984). Fashionable citizens of Japan now join their Western counterparts by matching them burger for burger, causing meat consumption in Japan to rise by 600 percent since 1960. Even the Chinese are pulling their chairs up to the banquet table, willing to pay a week's wages for a meal at an American-style fast-food restaurant. In 1960, all beef consumed in America was home grown. By the early 1980s, the nation was importing more than 10 percent of its total consumption, with three-quarters of that (over 100,000 tons annually) coming from Central America (Myers 1984). The tropical forest began to disappear and, lo, there was writing on the wall (Figure 2).

Numbered, numbered, weighed, divided

But what does it mean? Stretching across Central and South America, Africa, and Asia, the tropical moist forest forms the most diverse and complex ecological system on earth. Containing about one-half of all living species, tropical forests provide us with food, medicine, new energy sources, and germplasm stocks that are the

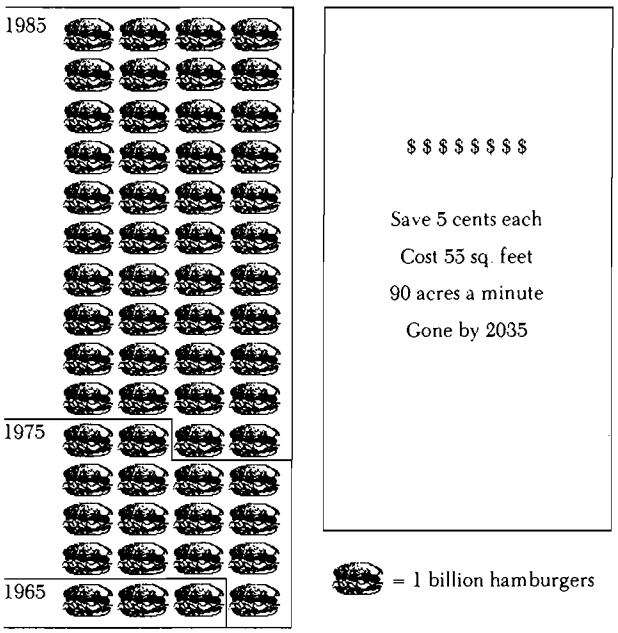

Figure 2. Hamburger sales at the largest fast-food restaurant chain in North America (adapted from Seymour and Girardet 1987) and selected data relating to tropical forest loss (see text for explanation).

raw material of genetic engineering. It has been estimated that the tropical moist forest may contain as many as 30 million different species, each a unique manifestation of life's diversity, each with its own genetic "fingerprint" (Wilson 1985). A comparison to temperate forests staggers the imagination. Whereas a square mile of Indiana woodlot might contain ten or fifteen kinds of trees, a similar plot in the tropical moist forest would contain hundreds of distinct tree species. The value of this magnificent ecological treasure cannot be overestimated, yet, it is being degraded and depleted faster than any other biome on earth.

Africa has lost more than 52 percent of its tropical moist forest, Asia 42 percent, Central America 37 percent and South America 36 percent (Miller 1988). Remote-sensing satellites now document a loss rate of about 90 acres per minute, or some 70,000 square miles each year. Conservative estimates suggest that if current loss rates continue, all of the remaining tropical forest will be gone or seriously disturbed by the year 2035. The causes of tropical deforestation are varied. In Africa and Asia the poor are gathering firewood faster than nature can regenerate it. Commercial logging by multinational companies is widespread, especially on the islands of the Pacific and in West and Central Africa. Poor people throughout the biome are also clearing forest lands to grow food.

In Central America and Brazilian Amazonia, large-scale ranching operations, underwritten by multinational corporations, are clearing the tropical forest. Cattle grazed on the cleared lands yield low-cost beef, primarily for export to the United States, Europe, and Japan. This is what Norman Myers (1984), a leading authority on this problem, calls "the hamburger connection" or the "hamburgerization" of the tropical forest.

The tragedy of the conversion of tropical forest to pastureland is compounded by the fact that the process can produce only short-term results. In as little as three to five years after clearing, the land will no longer sustain cattle and is abandoned to become infertile desert scrub (Miller 1988). To satisfy the demand for cheap beef, more forest is cleared and the cycle begins again. In Costa Rica alone, this process destroys between 125,000 and 175,000 acres of forest annually (Seymour and Girardet 1987). The scale of these operations is incredible. For example, in 1985 Coca-Cola Foods and its associates bought 13 percent of the land area of Belize for $200 million, which was $50 million more than the gross national product of that Central American country (Rainforest Action Network 1987). Perhaps such a deal was more than any government could resist. At the same time, Belize also received the U.S. Department of Agriculture certification necessary to export beef to the United States. Most North American fast-food chains vigorously deny using imported beef and claim to be using only domestic meat. In fact, all meat imported into the United States is classed as domestic by the USDA as soon as it leaves the point of entry. Hence, the beef in your next burger could be from Costa Rica and still be "domestic."

Fashionable citizens of Japan now join their Western counterparts by matching them burger for burger, causing meat consumption in Japan to rise by 600 percent since 1960.

Numbered, numbered, weighed, divided

When the calculations are done, each quarter-pounder made from beef imported from a country converting tropical forest into pastureland accounts for the irretrievable loss of about 55 square feet of this magnificent ecosystem (Miller 1988). Thus, while various groups of Christian believers debate the mechanism of creation, the very property and handiwork of God are

being destroyed. Why? So that we can pay five cents less for a burger. Are we stealing the "golden goblets" from the treasury of the Creator, using them frivolously at the peak of our feasting, and discarding them as if we owned them? It is estimated that if current trends continue we will be participants in the loss of between five and ten million species—the greatest mass extinction since the Ice Ages (Wilson 1985).

"What do you expect us to do? Give up burgers?"

Somebody go get Daniel.

TEKEL: A Hole in the Ozone Layer and Skin Cancer (or, "Smell Good, Be Cool, and Fry")

In 1985, a group of British scientists led by Joseph C. Farman published data indicating that the springtime amounts of ozone high in the atmosphere over the Antarctic had decreased by more than 40 percent between 1956 and 1984. The decline has recently been confirmed using satellite telemetry. The National Aeronautics and Space Administration now projects a 10 percent depletion of the global ozone layer by the year 2050 (Kerr 1988). More writing on the wall (Figure 3).

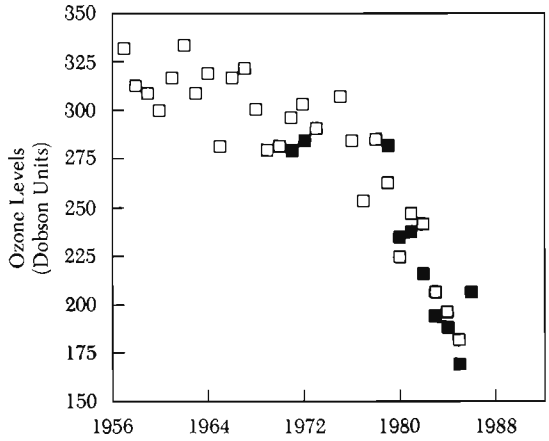

Figure 3. Mean October atmospheric ozone levels over Antarctica. Open boxes: British Antarctic Survey data. Closed boxes: NASA data (redrawn from Stolarski 1988).

Numbered, numbered, weighed, divided

But what does it mean? Ozone is a curious gas. In the lower atmosphere, it is a pollutant that makes smog more toxic, injures plants, and damages human health. On the other hand, high in the stratosphere, it acts to screen out most of the sun's harmful ultraviolet radiation. Current research (Stolarski 1988) indicates that the increased ultraviolet radiation that would occur with even a slight decrease in the ozone layer would cause a large increase in the number of cases of skin cancer, eye cataracts, severe sunburn, and suppression of the immune system. Other negative effects include damage to many terrestrial plant species, disruptions of ocean food chains, and the reduction of productivity in food crops like rice, corn, and wheat. A recent Environmental Protection Agency risk assessment study (January 1987) projected that continued disruption of the ozone layer will lead to some 40 million additional cases of skin cancer resulting in 800,000 deaths over the next 88 years. Despite some scientific uncertainty, rapidly accumulating evidence implicates chlorofluorocarbons as the major culprit in ozone-layer depletion.

Chlorofluorocarbons (CFCs) are molecules with a number of widely sought qualities. They are colorless, odorless, essentially nontoxic, noncaustic, noncorrosive, nonflammable, very stable, and they have relatively low boiling points. Best of all they are synthetic and dirt cheap. Discovered in the 1930s, their production expanded rapidly as they came into widespread industrial and commercial use. Their impact on our lifestyle and economy is hard to overestimate. CFCs are the coolants that air-condition our homes, offices, schools, and cars. They are used to make the plastic foam that, as insulation, improves energy efficiency and keeps our hot fast-food hot and our cold fast-food cold. They sterilize our medical equipment, freeze our perishable foods, clean our computer chips and circuit boards, and even make our furniture cushions soft. The final end-use value of installed equipment and products dependent on CFCs is about $135 billion annually (Cohn 1987). If these compounds are so beneficial, what's the problem?

This writing on the wall was rather faint at first. The debate began in the early 1970s when scientists began to suspect that CFCs released into the air would drift upward, be broken down by ultraviolet radiation, and destroy the ozone layer. Research quickly confirmed these suspicions and by 1978 a ban was placed on aerosol uses of CFCs in the United States. That ban, even though Canada and Sweden followed the U.S. lead, had little effect on the total release of CFCs into the atmosphere. Growing global markets and the expansion of industries using CFCs allowed the companies producing them to continue production at or above pre-ban levels. And there is an additional problem. The unusual chemical stability of CFCs means that when they are released into the atmosphere, they stay there for a long, long time. It is estimated that 95 percent of the CFCs released into the atmosphere will not break down for a hundred years (Stolarski 1988). Hence, even though we are now releasing CFCs at a rate of about 600,000 tons a year, the cumulative loading of CFCs

impacting the ozone layer is already nearing 15 million tons, up by a factor of 15 since 1960.

Concern over the ozone problem is growing, but the kind of expensive, global solution needed will be very difficult to achieve. EPA Administrator Lee Thomas has said that: "Despite the range of scientific uncertainty, there is substantial evidence of significant health and environmental effects. . . . If we wait for actual verification of the depletion, we will already be seeing the consequences of that loss" (Cohn 1987). On the other hand, Secretary of the Interior Donald Hodel, at a meeting of the Reagan administration's Domestic Policy Council in May of 1987, displayed the "give-Daniel-a-robe-and-send-him-away" mentality that environmental scientists have come to expect from the lords of the feast. Hodel, who describes himself as an evangelical Christian, flippantly suggested sunscreens and hats as an alternative to reducing CFC production (Spitler 1987). In other words, let the feast continue! By all means, don't stop the feast.

"You want me to give up my burgers *and* my air-conditioner? No way!"

Somebody go get Daniel.

PERES: Oil Imports and the Threat of War (or, "Over a Barrel Again")

Oil fuels the feast. Petroleum has probably changed the lives of more people in more ways than any other substance in all of history. It is the lifeblood of every modern industrialized society. Oil has transformed everything: our homes, jobs, entertainment, and our environment. It is the critical factor as decisions are made regarding the economy, agriculture, the structure of our nation's military, and the shape of our foreign policy. It has made the United States and the Soviet Union into superpowers, the automobile a way of life, OPEC a household word, and the 55-gallon drum the most recognized and widely distributed object in the world. In the United States, it takes more than 13 million barrels of oil each day to maintain our lifestyle (Gever et al. 1986). Oil fuels the feast, but there is writing on the wall (Figure 4).

While various groups of Christian believers debate the mechanism of creation, the very property and handiwork of God are being destroyed.

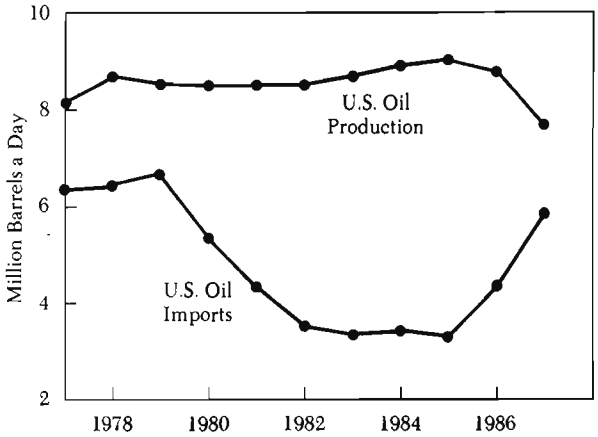

Figure 4. Oil production and oil importation by the United States (data source: U.S. Energy Information Administration, Annual Energy Review, U.S. Department of Energy).

Numbered, numbered, weighed, divided

But what does it mean? With one of the highest literacy rates in the world, the U.S. still seems to have trouble with mathematics, geography, and history. The math is not difficult. Divide the amount of oil we have used to date in history by the cumulative oil reserves and you realize that about half of the world's oil has already been used. In the United States, our proven reserves total 25.3 billion barrels (Tanner 1988). New discoveries of any size are highly unlikely because we have already thoroughly explored all of the most likely sites. For sake of argument, though, let us assume that we might discover three new oil fields the size of the Prudhoe Bay field in Alaska. This would add some 30 billion barrels to our reserves of 25.3 billion barrels. Then the question would be: "If we had 55.3 billion barrels of oil in reserve, how long would they last?" Again the math is simple. We use 13.5 million barrels a day, or 4.9 billion barrels per year. If we use no imported oil, our liberal estimate of 55.3 billion barrels is gone in a mere 11.3 years. What about the more realistic estimate of 25.3 billion barrels? At the present rate of consumption it will be gone in just over 5 years.

The policy of the Reagan administration was to end U.S. dependence on foreign oil by producing and using more American oil. That is a curious response. Trying to solve the problem of a limited oil reserve by using it up as fast as possible will only make us totally dependent on imports even sooner.

Now let's turn to geography. Since we almost certainly expect our feast to last more than ten or twelve additional years, we must ask: "Where will the oil come from?" The United States controls about 4 percent of

the known reserve, Mexico has 6 percent, the Soviets have 9 percent, the Chinese 3 percent, and the countries of OPEC (including Iran and Iraq) control 75 percent (Miller 1988). It is clear that most of the oil used during the rest of the Oil Age will come from the Middle East.

On to the history of events so recent that they hardly qualify as history. Less than two decades ago the world was thrown into economic chaos when OPEC turned off the spigot. The last time it happened the United States was importing less oil per year than we imported in 1988. Barring a national economic collapse, in 1989 we will produce less and import even more oil. Is it any wonder the United States has been willing to commit its navy to battle stations in the Persian Gulf?

Belshazzar's feast ended when the Persians diverted the waters of the Euphrates and entered Babylon along the dry river bed, past guards too drunk to notice. Could it be that history will read that America's feast ended when "the Persians" diverted the flow of oil?

Belshazzar's feast ended when the Persians diverted the waters of the Euphrates and entered Babylon along the dry river bed, past guards too drunk to notice. Could it be that history will read that America's feast ended when "the Persians" diverted the flow of oil? Could it be that we are too drunk, too satiated on feasting to notice?

How far will we go militarily to maintain our feast for a little longer?

Somebody go get Daniel.

Epilogue

From the writings of an eleventh century Hebrew philologist, Rabbi Jonah ibn Janah of Saragossa (Goldin 1957):

> A man is responsible for everything he receives in this world, and his children are responsible too. . . . The fact is, nothing belongs to him, everything is the Lord's and whatever he received he received on credit and the Lord will exact payment for it. This may be compared to a person who entered a city and found no one there. He walked into a house and there found a table set with all kinds of food and drink. So he began to eat and drink thinking, "I deserve all of this, all of it is mine, I shall do with it what I please." He didn't even notice that the owner was watching from the side! He will yet have to pay for everything he ate and drank, for he is in a spot from which he will not be able to escape.

Even earlier, Rabbi Akiva, a contemporary of the Apostle Paul and perhaps the greatest of the early talmudic scholars, set down his vision of the feast, the hand that writes, and personal responsibility (Birnbaum 1949):

> Everything is given on pledge, and a net is spread for all the living, the shop is open; the shopkeeper gives on credit; the ledger is open; and the hand writes; and everyone that wishes to borrow, let him come and borrow; but the collectors make their rounds continually every day, and exact payment of humanity with its consent or without its consent, for they have that on which they can rely; and the judgment is the judgment of truth; and all is made ready for the feast.

What a party!

Somebody go get Daniel.

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Universal Principles of Biomedical Ethics and Their Application to Gene-Splicing

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Given the prospects for gene surgery in the next decade, forethought must be given as well to moral guidelines for this new technology. This paper, given at the 1987 ASA conference on gene-splicing, relates relevant bioethical principles to gene-splicing therapy. Consideration is also given to six of the more common cliches and anxieties often associated with genetic engineering in the hopes of refocusing the debate.

When the President's Commission for the Study of Ethical Problems in Medicine and Behavioral Research issued its report in 1982, it concluded that "genetic engineering has become a target for simplistic slogans that try to capture vague fears."[1] One hopes that this paper moves beyond cliches and slogans to a larger understanding of truth and a clearer vision of what is possible in the future.

While I will have more to say later in this paper concerning religious responses to the awesome prospects anticipated in this field of research, suffice it to say here that the National Association of Evangelicals in 1981 passed a two-sentence resolution on this subject. It read: "The NAE reaffirms that the rights of the unborn child are sacred and not to be determined by personal desires of the parents. Human life is a gift of God and no one has the right to tamper with it in euthanasia or genetic engineering."[2] This statement is quite bereft of nuances or notions of ambiguity. One wonders about the sources of influence in NAE policy-making; surely lines of communication with the American Scientific Affiliation and the Christian Medical & Dental Society might have provided a more articulate position.

Fear of the unknown, fear of the future, and fear of scientific discovery have all posed their threats to modern man, whether religiously inclined or not, whether morally sensitive or not. Obviously, thoughtful Christians in the biological sciences must reflect on the ethical implications of genetic engineering as a necessary part of Christian vocational discipleship.

Since God was an incredible risk-taker in creating this world with man as male and female His designated vice-regents, modern scientifically creative man, no

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less than his forebears, must reflect on the implications of the Creation Mandate. "Having dominion over living things" (Genesis 1:28) is an awesome mandate, particularly in a fallen world where the human potential for devising evil is as much an option as doing good. The German Lutheran ethicist, Helmut Thielicke, frequently quoted Johann Goethe on this issue: "Mankind is forever progressing; man remains always the same."[3]

With the new knowledge gained in nuclear physics a generation ago came literally earth-shattering possibilities. Hiroshima marks our pathway as much as the gamma rays or radioactive iodine used at the nearby university medical center. Our ability to kill as well as to heal progressed side by side, with no decisive edge given over to beneficence. Writing on the history of recombinant DNA research, Sheldon Krimsky compared the public's early perception of atomic energy with genetic engineering:

> While the overriding national debate in the atomic-energy episode was over the nation's willingness and the ability to control the new power of the atom, there were also discussions on the kinds of controls necessary for the research activities of scientists who would be using radioactive materials to investigate atomic processes. The recombinant DNA controversy has focused mainly on the investigative techniques and far less on the use to which the techniques may be put.
>
> In both the atomic-energy and molecular-genetics debates we see what philosophers call "the egocentric predicament": the knower cannot understand the world without interacting with it, and thereby affecting it. Another way of saying this is that the knowledge-acquisition process is partially constitutive. One cannot know reality as a passive agent.
>
> As scientists investigate the world, they change it. If the system they work in is not closed, these changes will be released into the larger environment. It is certainly not new to science that the tools of investigation alter a portion of the reality being investigated.[4]

Most of us recognize that to taste of the fruit of the tree of knowledge does alter our perception of reality. We also are quite familiar with "the egocentric predicament," known more commonly as original sin and less commonly as copycat sin; every generation routinely repeats the sins and errors of its forebears in only a semi-original way.[5] For most of us, ethical controls derived from our Judaeo-Christian heritage matter more than government regulations, though one might suspect—and even hope—that their influence lingers behind some of this legislation. While what is legal may not necessarily be moral, it remains to be demonstrated that what is proposed is ethically justifiable; that is our central task. The law can always be changed.

After a decade of publishing research in genetic engineering, the editor-in-chief of the international journal *Gene*, Waclaw Szybalski, reported:

> I know I speak on behalf of us all when I express the hope that our efforts in genetic engineering will significantly contribute not only to pure science, but also to feeding the hungry, care of the sick, and cleaning-up of our environment, and thus should be enthusiastically supported by our society. It seems incredible that there still are individuals, either misguided or misinformed, who try to create roadblocks in both the scientific and practical applications of molecular genetics. As ever, it is very important that the public be informed about the real benefits modern biology and biotechnology have to offer, and about the absence of any proven risks (in contrast to imaginary scenarios). It is also important to provide some perspective on the insignificance of any hypothetical risks of inadvertent nature, relative to the real dangers to which we are exposed every day, such as tobacco and other carcinogens, addictive drugs (including alcohol), disease, traffic accidents and environmental pollution, to mention just a few. The real risks, as far as genetic engineering is concerned, are those misguided regulatory efforts which create new dangers (e.g., by mandating unnecessary exposure to harsh disinfectants and other environmental pollutants), while discouraging and delaying the delivery of benefits to mankind.[6]

Along with this rather optimistic assessment, Szybalski added as well a personal note with reference to the deaths over this ten-year period of two highly cherished contributing authors:

> Let us hope that the contributions of genetic engineering in general, and of research reported in *Gene* in particular, will help us to better understand and avert or alter the course of the genetically determined diseases. Ahmad and Jack might still be among us if the progress of research on gene-controlled circulatory diseases and leukemia had been more rapid.[7]

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One's perspective on research scientists is always enhanced when such personal goals are shared, when the theoretical is so well blended with the existential.

On a bit of a futuristic note, until genetic engineering can correct our inborn problems, Linus Pauling offered the suggestion about twenty years ago that since the test for the presence of the gene for sickle-cell anemia in heterozygotes is extremely simple, "there should be tattooed on the forehead of every young person a symbol showing possession of the sickle-cell gene (or other deleterious recessive gene), so that two young people carrying the same seriously defective gene in single dose would recognize this situation at first sight, and would refrain from falling in love with one another [at first glance]."[8] With such a projected scenario we would be most uncomfortable, and rightly so. Why, with the prospects of intervening with genetic diseases and curing them, are we still so uncomfortable? As some have suggested, gene-splicing represents but another form of microsurgery.

Obviously, the concern to do no harm has implications for laboratory research as well as for clinical trials.

Universal Principles

Four years ago the Working Group on Human Gene Therapy, an interdisciplinary sub-committee of the NIH Recombinant DNA Advisory Committee (RAC), drafted a document known as *Points to Consider in the Design and Submission of Human Somatic-Cell Gene Therapy Protocols.*[9] In their effort to reflect a consensus amongst the task force of three laboratory scientists, three medical clinicians, three ethicists, three attorneys, two public policy specialists, and one lay person, this group identified five key areas of concern:

1. The objectives and rationale of the proposed research;
2. The research design, anticipated risks and benefits:
   i. Structure and characteristics of the biological system;
   ii. Preclinical studies;
   iii. Clinical procedures, including patient monitoring;
   iv. Public health considerations;
   v. Qualifications of investigators and adequacy of facilities.
3. The selection of patients;
4. Informed consent;
5. Privacy and confidentiality.[10]

These concerns derive from such codes of ethics as the Declaration of Helsinki and other similar ethical codes dealing with clinical human experimentation.[11]

In 1973, having reviewed the major codes of medical ethics from Hippocrates onward, in both the Western and the Eastern traditions, I published an essay on seven "Universal Principles of Medical Ethics" derived from those codes.[12] It became chapter one in Claude Frazier's book, *Is It Moral to Modify Man?*—a title the essence of which still haunts us. Permit me to list these seven universal principles:

1. *Primum, Non Nocere* ("First of all, do no harm")
2. The Sanctity of Human Life
3. The Alleviation of Human Suffering
4. The Confidentiality of the Physician-Patient Relationship
5. The Right to Truth
6. The Right to Informed Consent
7. The Right to Die with Dignity

For years now, these principles have rung in my ears in the processing of issues in biomedical ethics as well as in the teaching of new generations of students as they pause to reflect on ethics in medicine. The first three have particular relevancy to the clinician, while the latter three are quite germane to patient interests. The middle principle, the confidentiality of the physician-patient relationship, serves as a bridge between the clinician and the patient. For our purposes here, the first six principles have obvious implications for genetic engineering. My concern in this paper will be with the prospects of gene-splicing therapy in treating genetic disease in humans.

I. *Primum, Non Nocere* ("First of all, do no harm")

As a universal principle of biomedical ethics, *Primum, Non Nocere* is at least as old as the Oath of Hippocrates: "I will use treatment to help the sick according to my ability and judgment, but never with a view to injury and wrong-doing."[13] Confucius gives this principle in another form, known as "The Silver Rule": "What you do not want done to yourself, do not do to others."[14] Most of us know the positive form of this principle as "The Golden Rule" of Jesus: "In everything, do to others what you would have them do to you."[15] The rule to do no harm has particular relevancy for recombinant DNA (rDNA) research.

In assessing the concerns expressed over the potential hazards of rDNA research, Sheldon Krimsky has reviewed the record and reached this conclusion:

> Some have argued that the public and the NIH overreacted to the potential hazards of rDNA technology. Among their reasons

> for this judgment are that no one has been known to become ill from such experiments and that there is no evidence to support the view that a product of rDNA research could be more hazardous than any of its component elements. It is certainly the case that the furor precipitated by rDNA research was due to the spectre of disaster generated by hypothetical scenarios rather than hard evidence. . . . Was there sufficient suggestive evidence that gene splicing could introduce additional hazards? Certainly, the record shows there was considerable agreement among leading scientists that, left unregulated, rDNA technology could be hazardous.[16]

Obviously, now with the work of the Recombinant DNA Advisory Committee as well as with the creation of institutional biosafety committees in place, appropriate controls have been put in place.

Frank Young, in a letter to the editor in *Science* in January 1987, reminded the public that the safety record of rDNA technology used in industrial facilities as well as for environmental and agricultural applications has been remarkable. He concluded:

> The real value of the OECD [Organization for Economic Cooperation and Development] document is, we believe, not simply that it articulates useful principles for the oversight of organisms manipulated by recombinant DNA techniques, but that it places new biotechnology in perspective; that is, as an extension, refinement, of conventional biotechnology applied to industry, agriculture, and the environment, with which we have substantial experience and success.[17]

Obviously, the concern to do no harm has implications for laboratory research as well as for clinical trials. Whether in cell cultures or animal trials, whether in developing human fetuses, in children or in young adults, appropriate cautions are mandated by one's ethical regard for one's fellows. So far the record is commendable; with the prospects of increasing rDNA capabilities, we may need to review more precisely our definitions of both harm and cure, of doing good and of creating evil.

II. The Sanctity of Human Life

The principle of the sanctity of human life is deeply embedded in the Judaeo-Christian ethic, from the creation narratives through the Ten Commandments to the Sermon on the Mount. Its clearest affirmation derives from the knowledge that man as male and female has been created in the image of God. The author of Genesis writes that "whoever sheds the blood of man, by man shall his blood be shed; for God made him in His own image" (Genesis 9:6). Princeton bioethicist Paul Ramsey has commented on this theme of *Imago Dei*, so central to moral concerns in medicine or in any other field of human endeavor: "The value of a human life is ultimately grounded in the value God is placing on it. . . . Thus, every human being is a unique, unrepeatable opportunity to praise God. His life is entirely an ordination, a loan, and a stewardship."[18]

In July 1975 at Wheaton College, the American Scientific Affiliation cosponsored with the Christian Medical Society a symposium on control technologies.[19] Genetic control was one of the three reviewed (the others were brain control and behavior control). Reporting on those proceedings for the *ASA Journal*, Dr. Robert L. Herrmann correctly cautioned the reader with this necessary observation: "The notion that science, because it describes phenomena in terms of mechanisms, must inherently dehumanize and depersonalize, is mistaken."[20] One can celebrate the principle of the sanctity of human life as joyfully in the laboratory as in the sanctuary. Sanctity implies awe and respect, care as well as caution, healing as well as investigating.

The alleviation of human suffering has been characteristic of Hebraic-Christian compassion.

Our task today is to continue to reflect, "to think God's thoughts after Him,"[21] to continue to relate deeply held human needs and values with truly valid genetic endeavors. For, put in other terms, the central moral question before us asks whether or not clinical, genetic intrusions at so deep a level of human life will ultimately enhance or ultimately degrade human dignity; the dignity of both the patient as well as that of the scientific investigator.

The principle of the sanctity of human life is as applicable to rDNA technology as to reproductive technology, as significant for human life under the electron microscope as for human life under the lights of the surgical amphitheater. Sanctity need not imply inviolability, a ban on intrusions on human life forms. Modern surgery frequently intrudes in order to cure; the microsurgery of gene-splicing can parallel other surgical interventions.

The Catholic bioethicist, Bernard Haring, brings an affirmative note to this research:

> I cannot see why it should be immoral for man to intervene consciously with planning and corrective foresight. The image of God as revealed in the Old and New Testaments does not allow us to accuse man of pride and rebellion if he is constantly searching and seeking to decode the secrets of nature, to apply all his knowledge and art to serve his own development and human vocation.
>
> The physician of today no longer defines his role by the Hippocratic notion of "servant of nature" or servant of the ordered potentialities and powers of nature. He is acquiring a

> greater consciousness of his own creative status. He increasingly considers himself an architect and sculptor of the given stuff of nature.[22]

Lest he be accused of both genetic and moral naivete, Haring writes further:

> A realistic appraisal of information on scientific progress and responsibility obliges us to sound a warning against unlimited eugenic engineering and utopian dreams such as the euthenic utopia of breeding selectively particular types of men through the choice of sperm or ovule donors without any respect for man's vocation to marriage and family life. There are bounds set by limited knowledge and techniques, and others arising from man's dignity.[23]

Only the future will tell us where the genetic boundaries really lie; perhaps from the past—from the wisdom literature of Scripture—we will learn quite precisely where the moral boundaries lie as well.

Whenever one stands on the threshold of a new therapy, with the principle of the alleviation of human suffering in one hand and a risky, new procedure in the other, caution would be prudent.

III. The Alleviation of Human Suffering

At the conclusion of our 1975 Wheaton conference on control technologies, Professor Donald M. MacKay, distinguished brain physiologist from the University of Keele in England, was asked to provide a summary paper of his reflections on those proceedings. His reaction then:

> How should Christians view human engineering? Seeking the way of humility, our first reaction might be strongly negative: "I'm content with what God gives me; I don't want to interfere." This reaction may be reinforced by sheer inertia. "It's dangerous. We don't know enough. Where will it all lead? Best keep out . . . let the world get on with it if they will."
>
> But will this do? "He that knoweth to do good and doeth it not, to him it is sin." It appears from these new developments that the sum of misery in the world is reducible. God is the Giver of the new knowledge. It is He who will one day ask: "What did you do with it?"
>
> At the outset, Dr. Callahan raised the key question: "Do we have a positive obligation to do good, or is our obligation only to avoid doing harm?" In response it was generally agreed that the Christian cannot stop at avoiding harm. We do have an obligation to do good, if the good is well-identified and in our power.[24]

Ever since the curse of disease and disability has befallen the human race, the alleviation of suffering has been a central task. Whether it be the Lord God delivering the Israelites out of the land of Egypt or a midwife in Israel delivering a firstborn son to Jacob, whether it be one of the themes of Isaiah or one of the tasks of Jesus, whether it be in the hospitals begun by monks or in the hospice movement begun by moderns, the alleviation of human suffering has been characteristic of Hebraic-Christian compassion.

Now, through the prospect of gene-splicing, often fatal and usually debilitating genetic diseases may possibly be cured. Such a strategy for the repair of human somatic cells would be a Godsend—another gift from God through the creative insight of scientists who have discovered yet another therapeutic technique to bring relief from suffering. From the discovery of penicillin to the creation of the polio vaccine, from the benefits of neurosurgery to the benefits of microsurgery, from the techniques of the laser to the techniques of the viral vector, medical science has been steadily advancing. Previous strategies from ether before surgery to heart transplants, from psychotherapy to gene therapy have met with considerable resistance within the generation first exposed to the possibilities of the new treatment plan. A gifted few have had an adequate view of the future to sustain hope, to build moral boundaries, to answer anxieties, and to shape the process of scientific advance. Be encouraged to be a part of that vanguard in genetic intervention.

Obviously, where the introduction of gene therapy with patients proves to be either ineffective or further crippling, the intention of the alleviation of human suffering has not been met. Hopefully, sufficient experiments with tissue cultures and animal research will reduce the risks for humans. Whenever one stands on the threshold of a new therapy, with the principle of the alleviation of human suffering in one hand and a risky, new procedure in the other, caution would be prudent. But prohibition in anticipation of unwarranted futuristic scenarios would be both immoral and distracting.

IV. The Confidentiality of the Physician-Patient Relationship

Confidentiality is built into the medical codes of antiquity. The Oath of Hippocrates promises that "whatsoever I shall see or hear in the course of my profession, as well as outside my profession in my intercourse with men, if it be what should not be published abroad, I will never divulge, holding such things to be holy secrets."[25] In the Hebrew Oath of Asaph, the practitioner is admonished: "Ye shall not disclose secrets confided unto you."[26] The modern

Declaration of Geneva declares: "I will respect the secrets which are confided with me."[27] The Wisdom Literature of the Old Testament acknowledges that there is "a time to keep silence and a time to speak" (Ecclesiastes 3:7).

A patient's right to privacy when clinical trials are being conducted should be self-evident. The patient and family stresses of coping with severe illness are sufficient of themselves. The intrusions of media should be resisted through institutional spokespersons who can divulge what the public may reasonably expect to know at a given point in the course of treatment. Otherwise, the experimental series should be conducted with appropriate privacy; the circus atmosphere attendant to some recent surgical interventions should be resisted with vigor.

When the "Bubble Boy," David, died in late February of 1984 of severe immunodeficiency (SCID), little was known of his personal life and less of his family.[28] Since many of the patients who will be candidates for gene-splicing, when this technique comes of age, will be young children, both they and their families deserve the protection of privacy. In sufficient time, the scientific community can learn the results of clinical trials through medical conferences and journals. The lay public can be advised of progress when useful data are available. Where fetuses are treated *in utero*, pregnant women deserve protection from the invasion of their privacy. Obviously, one dimension of confidentiality is privacy.

Experimental series should be conducted with appropriate privacy; the circus atmosphere attendant to some recent surgical interventions should be resisted with vigor.

The claim of confidentiality protects both patient and clinician from extraneous intrusion. The records of the patient merit protection, and confidences exchanged between clinician and patient deserve the sanctuary of privileged privacy. With the advent of genetic screening, when some sickle cell trait individuals were identified in one screening program, some of their insurance rates were changed.[29] What threats to the continued use of clinical trials will ensue if breaches of confidence are discovered where gene-splicing experiments are being conducted on informed, willing patients?

As with the more traditional forms of medical treatment to which we have become accustomed, confidentiality merits protection when gene-splicing therapy for human genetic diseases becomes refined. With the safeguards constructed in the "Points to Consider" document of the NIH's RecDNA Advisory Committee, patient protection is reasonably secured.

V. The Right to Truth

The patient who submits to any gene-splicing procedure has a right to the truth in processing the risk-benefit, cost-benefit, and burden-benefit calculi of this protocol. The medical clinician has a right to truth from the laboratory scientist in understanding the possible risks, the potential side-effects, the time line changes, and the indications of progress that may reasonably be expected in the development of a patient protocol. The family has a right to truth in order to know what to anticipate and how best to support the patient. Public policy officials have a right to the truth in the fashioning of whatever legislation may be warranted to protect the interests of both the patient and the public. Sloganeering, "red herring" arguments, and science fiction futuristic scenarios from unscientifically qualified individuals serve neither the interests of the truth nor of the human community.

Truth-telling is a hallmark of civilization from time immemorial. The mandate from the Ten Commandments "not to bear false witness" (Exodus 20:16) merely describes the other side of the coin of truth-telling and warns appropriately of counterproductive behaviors. The words of Jesus, "You shall know the truth and the truth shall make you free" (John 8:32), remind us of an atmosphere where the fresh breath of full scientific and ethical disclosure liberates the human spirit to make wiser decisions.

The principle of truth-telling, the principle of not bearing false witness, and the principle of truth-knowing for freedom in decision-making are three slightly different yet very crucial dimensions to understanding truth; a kind of three-legged stool with very carefully nuanced legs, each of the same length and strength but with slightly different craftsmanship. Truth-telling emphasizes factual integrity; not bearing false witness emphasizes personal integrity; and truth-knowing for freedom in decision-making emphasizes logical integrity. The first principle focuses on the facts, the second focuses on the folks providing the data, while the third principle focuses on the freedom to decide derived from sound knowledge.

Only in an atmosphere of truth and full disclosure can physician and patient make responsible decisions. In an essay in *Christianity Today* on "The Inevitability

of Death," Dr. Rob Roy MacGregor, professor of medicine and chief of the infectious diseases section of the University of Pennsylvania School of Medicine, underscored the words of Jesus on truth-knowing when he wrote: "The truth can set one free both from false guilt and from the need to utilize unwarranted therapeutic maneuvers. Appropriate care balances a respect for the sanctity and uniqueness of each human life with respect as well for the process of dying."[30] With reference to gene-splicing and paraphrasing Dr. MacGregor, the truth can set us free both from false or wild expectations and from the need to utilize unproven therapeutic maneuvers. Appropriate care balances a respect for the sanctity of human life with respect for the informed risk-taking of innovative techniques.

VI. The Right to Informed Consent

While it will be reserved for later in this paper to reflect upon "slippery slope" argumentations, it is worth noting here that the patient's right to informed consent in human experimentation derives largely from the horrible mismanagement of medical skills experienced under the notorious Third Reich in Hitler's Germany. The subsequent trials in Nuremberg resulted, in part, in the formulation of the Nuremberg Code of Ethics in Medical Research. Point one reads: "The voluntary consent of the human subject is absolutely essential."[31]

From the 1949 International Code of Medical Ethics to the Declaration of Helsinki of 1964 (revised in 1975), the theme of informed consent for patients resonates with a fresh urgency. Interestingly, in St. Paul's conference with the slave, Onesimus, Paul commented: "I preferred to do nothing without your consent in order that your goodness might not be by compulsion but of your own free will" (Philemon 14).

In a classic essay in *The New England Journal of Medicine*, editor Franz J. Ingelfinger wrote of "Informed (But Uneducated) Consent."[32] Hear his perspective:

> The trouble with informed consent is that it is not educated consent. . . . It would be impractical and probably unethical for the investigator to present the nearly endless list of all possible contingencies; in fact, he may not himself be aware of every untoward thing that might happen. . . . When a man or woman agrees to act as an experimental subject . . . his or her consent is marked by neither adequate understanding nor total freedom of choice. . . . The subject's only real protection, the public as well as the medical profession must recognize, depends on the conscience and compassion of the investigator and his peers.[33]

Clinicians walk a fine but not impossibly greased line in balancing all they know about a procedure with what they must tell a patient. To be a professional in a service profession is to live with this kind of trust. The goal of full disclosure, informed consent, truth-telling, and truth-knowing is fully warranted so that a patient might freely decide to undergo gene-splicing therapy where the promise of benefit is reasonably valid.

With experimental trials on humans yet in the future, the initial groups of patients have every right to understand as clearly and as fully as they can comprehend what lies before them. Hopefully, extensive animal trials will have progressed to the point where human trials are fully warranted.

Using everyday terms and conceptual models that lay people can understand, the patient population deserves the benefit of the sensitivity to patients' rights and feelings . . .

With so delicate a procedure, neither medical paternalism nor medical arrogance is justified. Using everyday terms and conceptual models that lay people can understand, the patient population deserves the benefit of the sensitivity to patients' rights and feelings that have been the focus of so many recent medical essays, editorials, and pronouncements.

Medical Cliches

Having reviewed these six universal principles of medical ethics and their relevancy for gene-splicing therapy, it may be helpful to analyze three common cliches used with reference to genetic engineering.[34]

Whether in reading the literature or in listening to media broadcasts, one constantly hears references to "playing God," "the slippery slope," and "if it can be done, it should be done" kind of arguments. Please permit a quick review and some brief comments on each.

1. Playing God

Should doctors "play God"? Are we playing God with the issues, the dilemmas, the decisions that modern biomedical technology places before us? This theme has not gone unaddressed in the medical literature. At least three book titles exploring issues in biomedical ethics have incorporated this cliche phrase in their titles: Leroy G. Augenstein's work, *Come, Let Us Play God*,[35] published in 1969; Claude A. Franzier's book, *Should Doctors Play God?*,[36] published in 1971;

and Ted Howard and Jeremy Rifkin's volume on genetic engineering, *Who Should Play God?*,[37] published in 1977. In a recent news report on gene therapy in *Science*, the phrase was used twice.[38]

Roman Catholic moral theologian, Richard A. McCormick, has addressed this cliche question in one of his essays on "To Save or Let Die." Hear his wisdom:

> If our past experience is any hint of the future, it is safe to say that public discussion of such controversial issues will quickly collapse into slogans such as: "There is no such thing as a life not worth saving;" or "Who is the physician to play God?" We saw, and continued to see, this far too frequently in the abortion debate. We are experiencing it in the euthanasia discussion. For instance, "death with dignity" translates for many into a death that is fast, clean, painless. The trouble with slogans is that they do not aid in the discovery of truth; they co-opt this discovery and promulgate it rhetorically, often only thinly disguising a good number of questionable value judgments in the process. Slogans are not tools for analysis and enlightenment; they are weapons for ideological battle.[39]

Probably the best advice comes from physician-ethicist Howard Brody, M.D., Ph.D.:

> The accusation, "If you do so-and-so then you're playing God," is heard with amazing frequency in discussions of medical ethics, considering that it is almost totally devoid of meaning. Such a statement only makes sense if we assume a picture of a God who takes an active interest in, and [regularly] intervenes in, the daily lives of individual human beings. It then follows that either medicine is totally ineffective in accomplishing its goals, or else that physicians are "playing God" every time they interfere in the "natural" course of an illness—in fact, every time they practice medicine. If you do not object to "Playing God" by giving antibiotics for a sore throat, you have no business objecting to "playing God" when the question of allowing to die comes up.
>
> If it were agreed upon to forbid the use of the expression "playing God" in all arguments on medical ethics, the quality of such discussions could be enhanced significantly.[40]

With that suggestion I strongly concur.

In formal logic, questions of this kind fall into the category of the "fallacious complex question" according to distinguished logician, Irving M. Copi.[41] This class of questions exhibits four characteristics:

1. They employ loaded terminology.
2. They combine legitimate concern with illegitimate reasoning.
3. They collapse several levels of inquiry into one short-handed question.
4. They require a simple "yes" or "no" answer in the face of a complex, multi-layered issue.

Einstein once observed that "we should make reality as simple as possible, but no more simple than it really is."[41] Obviously, one should avoid fallacious complex questions.

From a psychiatric point of view, anyone presuming to "play God" could be defined as hypo-manic, whose reality testing ability is severely impaired and whose delusions of grandeur border on the psychotic. Obviously, such an individual has lost the ability to determine what is real from what is not. At best, such an individual could be accused of narcissistic character disorder; at the worst, of being completely crazy. Bed rest is the proper prescription here, not bedside consultation. Mentally healthy individuals know who they are, and they also know rather profoundly that they are not God.

From an ethical point of view, life and death decisions are not reserved to the medical profession alone. Judges, generals, admirals, politicians, presidents, premiers, and a host of other professionals also make decisions in life which will alter the life, lifestyle, and death of countless individuals. Such decisions are awesome, difficult, hard, risky, and subject to human error. In the discussion of difficult cases, where different principles clash, where different therapies are advocated and yet where a decision must be made, the phrase "playing God" is essentially useless.

In the discussion of difficult cases, where different principles clash . . . and yet where a decision must be made, the phrase "playing God" is essentially useless.

Our task is to be Christ's faithful disciples pursuing the Creation Mandate to "have dominion over living things" (Genesis 1:28). Our real role is to serve as "God's vice-regent under the Divine Providence," to use the phrase of J. Oliver Buswell, Jr.[43] Our task is to exercise stewardship over all of God's creation, to subdue, to transform, and to reshape the "animated organisms" of life on balance with other biblical principles.[44]

2. The Slippery Slope

When one hears the slippery slope theme, the mind quickly returns to the classic essay on medical abuses under the Third Reich written by psychiatrist Leo Alexander in *The New England Journal of Medicine*,

July 14, 1949, entitled, "Medical Science Under Dictatorship." Interestingly, while this phrase does not occur there, the parallel phrases of "the entering wedge" and "the infinitely small wedged-in lever" do appear.[45] The article does chronicle the utilitarian slide in German medicine from medical idealism to the euthanasia movement, where the attitude that "there is such a thing as life not worthy to be lived" arose.[46] This article should be read and digested by all contemporary health care professionals.

What does one make of "the slippery slope" kind of argument? Jewish historian, Lucy Dawidowicz, in her essay on "Biomedical Ethics and the Shadow of Nazism" in *The Hastings Center Report*, speaks with uncommon candor on slogans of this kind:

> I am quite clear in my mind about this. I do not think we can usefully apply the Nazi experience to gain insight or clarity to help us resolve our problems and dilemmas. There has been a lot of shoddy thinking and writing, making such facile comparisons. I suppose that we here, as part of the intellectual and academic community, have an obligation to be historically responsible, to serve as a kind of "truth squad" with regard to the subject matter under discussion, and to make the important distinctions that need to be made. . . .[47]

Mark Twain once commented that "history does not repeat itself, it only rhymes."[48] For the serious historian, historical parallels are often illusive. The gift of discernment should accompany any effort to draw historical parallels in medicine or to suggest that any given action will inevitably slide downhill like a snowball to its automatically foreordained outcome. Such thinking often characterizes fundamentalist efforts to think through moral issues; i.e., drinking wine, attending the theatre, playing with cards, playing pool, viewing Hollywood movies, watching television, *etc.*

While some may see dangers in medical technology, any serious effort to draw historical parallels should be reviewed by professional historiographers or medical historians if validity and reliability matter. The central problem with phrases such as "playing God" and the "slippery slope" is that such linguistic shortcuts to logical reasoning soon become mental shortcuts as well. Employing slippery slope terminology can only have legitimacy where cause and effect can clearly be demonstrated, where historical parallels are clear, where medical protocols are in clear violation of morally accepted methods of treatment, and where ethical review of each stage of technological development has been absent.

3. *If It Can Be Done, It Should Be Done*

This alarmist cliche raises anxieties that new medical technologies are somehow usually possessed of a steamroller effect that automatically steams full speed ahead, unaccompanied by moral reflection. While some clinicians may be little more than medical technicians, and while this phrase may have popular coinage with journalists, most experienced physicians recall the intense conversations in doctors' lounges and clinical seminars that usually accompany innovative procedures. With the increased attention new technologies are receiving through conferences and journals devoted to moral reflection on these issues, combined with the growing number of landmark legal cases that are precedent setting, this phrase is commanding less allegiance.

The central problem with phrases such as "playing God" and the "slippery slope" is that such linguistic shortcuts to logical reasoning soon become mental shortcuts as well.

It might be more worthwhile to separate this phrase into its four component parts: namely, (1) if it can be done, it *must* be done; (2) if it can be done, it *will* be done; (3) if it can be done, it *should* be done; and (4) if it can be done, it *may* be done. Of the first level—if it can be done, it *must* be done—little defense would be forthcoming either from clinicians or from ethicists. With the second perception—if it can be done, it *will* be done—one always must live with the fact that in some overlooked, unregulated laboratory, whether in this country or abroad, someone, somewhere will try any semi-reasonable experiment. Both society and the law will judge the results. On the third level—if it can be done, it *should* be done—our most familiar form of this cliche emerges. However, both clinical experiences and family reactions combined with court rulings are beginning to undermine any alleged confidence in this cliche. The high moral ground, the middle ground, the place of careful reflection resides in the fourth perception: if it can be done, it *may* be done. Here is the place for the careful construction of the ethical criteria necessary to make an informed, morally justifiable decision.

Three Common Anxieties

In addition to the presence of these three vexing cliches, there are three common anxieties associated with gene-splicing: (1) fear of the future; (2) the possibility of human cloning; and (3) the possibility of germ-line therapy.

1. *Fear of the Future*

With regard to the first—the fear of where this new technology may take us—every recent generation has had to live with this anxiety to some extent, albeit our generation has been rather overloaded with technological burdens. Wild speculations over where genetic engineering may be taking us are of little value. Futuristic prognostications are always difficult, reminding one of the Chinese proverb Alvin Toffler chose to include in his introduction to *Future Shock*: "To prophesy is extremely difficult—especially with respect to the future."[49] Two observations may be useful. (1) Prognostications based upon unscientific speculations and lacking historic perspective should be avoided, discounted, and regularly rebutted. (2) The greater focus of attention should be on the near future and the ethical concerns generated by realizable, short-term goals. Of telling consequence is the review and comparison of the President's Commission for the Study of Ethical Problems in Medicine and Biomedical and Behavioral Research with the Panel on Bioethical Concerns of the National Council of Churches of Christ as they each address genetic engineering. This review appeared in *The Hasting Center Report* (April, 1983). The title tells it all: "Splicing Life, with Scalpel and Scythe."[50]

"If you do not object to 'playing God' by giving antibiotics for a sore throat, you have no business objecting to 'playing God' when the question of allowing to die comes up."

2. *The Possibility of Human Cloning*

In time it may be possible to biologically clone higher mammals, even man. It may also prove to be a biological barrier in nature. However, since we are the products of both nature and nurture, the only way to truly clone man would be to create a controlled environment—one that reminds me to some extent of the "Bubble Boy," David. Each individual would have to be raised on his or her similar quota of Mozart, Bach, and Beethoven, selections from the Great Books of the Western World, exposure to the same athletic and musical skills, travel to the same cultural shrines, *etc.* Such a controlled environment would prove to be almost impossible to attain, given the generational, longitudinal, psychological, sociological, and ethical difficulties such an arrangement would face. Consequently, human cloning will prove to be impossible and is a red herring to worry about. Bernard Davis of Harvard offers this sage advice:

> For our purpose it is especially pertinent that the most interesting human traits—relating to intelligence, temperament, and physical structure—are highly polygenic. Indeed, man undoubtedly has hundreds of thousands of genes for polygenic traits, compared with a few hundred recognizable through their control over monogenic traits. . . . Education on the distinction between monogenic and polygenic inheritance is clearly important if the public is to distinguish between realistic and wild projections for future developments in genetic intervention in man.[51]

C.S. Lewis wisely warns that "what we call Man's power over nature turns out to be a power exercised by some men over others with Nature as its instrument."

3. *The Possibility of Germ-Line Therapy*

Anxieties over germ-line therapy have attracted considerable attention. Just two caveats here. (1) If attention is focused on short-term goals—moral insight might accompany the developments in gene-splicing therapy as it progresses and we may begin to ascertain where some of the moral limitations and boundaries may prove to be. (2) If it is biologically and morally permissible to cure diabetes in a patient, why is it somehow inherently immoral to cure such a disease in one's offspring? Obviously, one must be concerned with the transmission in the germ-line of deleterious traits. We surely do speak for and against the future well-being of our children in so many other fields.

Conclusion

Two basic perspectives seem to attach themselves to the possibilities in genetic engineering, the first well put by Dr. Philip Leder of Harvard Medical School: "We're just starting to lift a very dense curtain from a beautiful scene."[52] The second perspective raises a valid caution; biologist Robert Sinsheimer, Chancellor of the University of California at Santa Cruz, inquires: "Do we really wish to replace the fateful but impartial workings of chance with the purposeful self-interested workings of human will?"[53]

Like many twentieth-century technologies, genetic engineering strategies can become yet another power

struggle. C.S. Lewis wisely warns that "what we call Man's power over nature turns out to be a power exercised by some men over others with Nature as its instrument."[54]

Remarkable thinking clearly contributed to the construction of the double helix model which is becoming increasingly well understood by scientists. It will take equally remarkable reflection to construct the kind of rigorous moral criteria that will evaluate wisely the direction gene therapy takes. That is our continuing task, and the Lord Christ has promised to be with us in the process, even unto the end of the world.

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Thomas F. Torrance's Integration of Judeo-Christian Theology & Natural Science: Some Key Themes

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A major integrating aspect of Thomas F. Torrance's study of theology-natural science interrelationships is his interest in the relevance of Albert Einstein's understanding of natural science as manifest in special and general relativity. Accordingly, this paper examines Thomas F. Torrance's integration of Judeo-Christian theology and natural science with respect to seven key themes.

> From a long view of the history of mankind—even from, say, ten thousand years from now—there can be little doubt that the most significant event of the 19th century will be judged as Maxwell's discovery of the laws of electrodynamics. The American Civil War will pale into provincial insignificance in comparison with this important scientific event of the same decade.[1]
> (Richard P. Feynman, 1964)

Every time you turn on a light, watch TV, or use a microwave oven, you are experiencing the practical implications of Feynman's prophecy. But those implications, which originate in natural science—particularly physics, properly understood as a true liberal art—are far more profound. James Clerk Maxwell, a 19th-century Scottish physicist, formulated a theoretical framework which enables today's scientists and engineers to understand in a *unitary* way such complex and diverse phenomena as:

- electric motors and generators,
- communication by radio waves or microwaves,
- signals from distant stars received by radio telescopes,
- medical X-ray photographs, and
- visible light's behavior in cameras, microscopes, and telescopes.

A *unitary understanding* of physical phenomena enjoys such an inner simplicity that it can master enormous complexity by means of a few carefully chosen words or equations. This inner simplicity is the goal and content of truly creative science, including theology. $E=mc^2$ or *Jesus is Lord* (probably the first

An earlier version of this paper serves as the Introduction to the American, expanded edition of Thomas F. Torrance's The Christian Frame of Mind, *Helmers & Howard Publishers, P.O. Box 7407, Colorado Springs, CO 80933, publication date—Spring 1989. This essay collection of Professor Torrance focuses on the distinctive contribution of the Christian frame of mind to human life and thought, especially in the area of the development of modern science.*

Christian creed) are very "simple" statements, but unpacking their intellectual and life-transforming content—with that content's ability to master awesome complexity—requires a life of dedicated work by scientist and theologian alike.

Theologian Thomas F. Torrance is a modern heir to this spiritual and intellectual tradition. Early in his long, varied, and creative career, he recognized that a sympathetic willingness to study natural science can be helpful for the redemptive betterment of humankind. He is one of the few major theologians who have edited seminal, scientific texts—in Torrance's case, James Clerk Maxwell's *A Dynamical Theory of the Electromagnetic Field*. What Torrance has written concerning Clerk Maxwell's pioneering work in natural science is reflected in his own creative, theological work. The deep appreciation that Torrance has for Clerk Maxwell springs from a sympathetic, intuitive linking of kindred spirits that goes far beyond their common Scottish roots. Torrance writes of Clerk Maxwell:

> . . . he was persistently aware of the 'vastness of nature and the narrowness of our symbolical sciences.' No human science, he felt, could ever really match up in its theoretical connections to the real modes of connection existing in nature, for valid as they may be in mathematical and symbolic systems, they were true only up to a point and could only be accepted by men of science, as well as by men of faith, in so far as they were allowed to point human scientific inquiry beyond its own limits to that hidden region where thought weds fact, and where the mental operation of the mathematician and the physical action of nature are seen in their true relation. That is to say, as Clerk Maxwell himself understood it, physical science cannot be rightly pursued without taking into account an all-important metaphysical reference to the ultimate ground of nature's origin in the Creator. Thus while Clerk Maxwell never intruded his theological, and deeply evangelical, convictions into his physical and theoretical science, he clearly allowed his Christian belief in God, the Creator and Sustainer of the universe, to exercise some regulative control in his judgment as to the appropriateness and tenability of his scientific theories; that is, as to whether they measured up as far as possible to the "riches of creation."
>
> It was in that spirit that he put forward his own theories, always with reserve and always with the demand that they must be put to the test of fact, for his Christian faith would not allow him to fence off any area from critical clarification or to make any other claim for his theories than that they were of a provisional and revisable nature. . . .[2]

In the preceding quotation, if God as revealed through Jesus Christ were substituted for "nature," and if formal theological systems were substituted for "mathematical and symbolic systems," I believe these words about Clerk Maxwell could equally apply to Torrance's theological contributions.

Torrance's search for a unitary approach to theology comparable to Clerk Maxwell's unitary physics is succinctly captured in the advice he has given to young pastors. Note in what follows Torrance's connection between home and gospel as well as his unifying perspective on evangelism and ecumenism:

> If I were starting again as a young minister entering his first charge, I would do my best to engage in a Christ-centered ministry; i.e., one in which Christ has supreme place over all institutions. I would preach the gospel of unconditional grace, of reconciliation through the incarnation, passion, and resurrection of Christ, and seek to find ways of working that out in the life of the church and the community. Evangelism and ecumenism go together. . . . I would make pastoral visitation central, in which I read the Bible and prayed with people in their homes and gave them the opportunity to let me minister to them in personal ways. Only as they open their hearts to me like that can I understand the human heart in the light of the gospel, and only then can I preach to them the gospel in such a way that it strikes home to their own personal and practical needs. . . . It is only when the pulpit and the home are interconnected in this way that the gospel proves to be intimately and profoundly relevant.
>
> But I would do all this while seeking to understand the astonishing changes in the modern world through the advance of our scientific knowledge, for that would be ministering in a universe which God has created and means us to understand: The universe in which his Word became incarnate and in which Christ will come again to change and renew.[3]

A major integrating aspect of Torrance's study of theology-natural science interrelationships is his interest in the relevance of Albert Einstein's understanding of natural science as manifest in relativity theory. I believe a good way to gain insight into Torrance's distinctive integration of theology and science is

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through a consideration of some key themes of Torrance's theology as related to Einstein's relativity theory. These seven key themes should enable the reader to appreciate better Torrance's pioneering efforts.

Torrance's Integration of Judeo-Christian Theology and Einstein's Relativity Theory: Seven Key Themes

1. The Unitary Character of Theological and Scientific Knowledge.
2. Relativity Theory: The Absolute Underpinning of the Relative.
3. In Creative Science, the "Invisible" Explains the "Visible."
4. The Physical Universe, a Relational Rather Than Container Model.
5. Field Theories: An Expression of the Relational Character of Reality.
6. The Universe: A Multi-Leveled Yet Integrated Whole.
7. Theology and Natural Science: Allies Rather Than Foes.

1. The Unitary Character of Theological and Scientific Knowledge

Both relativity theories, special and general, emphasize the unitary character of scientific knowledge. Empirical and theoretical factors are inseparably integrated, representing a unitary epistemological (epistemology meaning the study of the nature and the origins of knowledge) structure that should be characteristic of good physics and good theology. Torrance emphasizes two important factors regarding the unitary character of scientific knowledge.

(a) All creative science is an *integration* of practice and theory, where integration is a form of unifying, of creating a whole, which was heretofore unrecognized. Integration functions as a spontaneous organization of natural coherences embedded in nature, which we grasp only through non-analytical (informal) acts of knowledge. These acts of knowledge arise through intimate contact with—and mental reflection on—a discipline's subject matter.

(b) Theology, properly understood and practiced, is indeed a *creative science*. To understand the intent of Torrance's two-fold thrust in the context of the unitary implications of Einstein's work, one must first understand how Torrance interprets Einstein's scientific method and ultimate goal as fully compatible with those of evangelical theology.

Torrance, in agreement with Einstein's insight, suggests that all theory or doctrine comes about as a result of reflecting upon experience in the light of one's intuition and basic intellectual convictions concerning reality. From such theoretical reflection the scientist and the theologian make a jump of imaginative insight, an informed speculative and bold leap to postulate a logically-not-obvious new theoretical structure. The validity of this new theory or doctrine cannot be directly tested. Only specific theoretical propositions deduced from it can be subjected to empirical testing. Thus, one is brought back to the realm of experience. In this ongoing, cyclic methodology originating from and terminating in the realm of experience, new theories or doctrines emerge as free creations of the human mind. Upon successful empirical testing, such theory or doctrine reveals a hidden intelligibility that undergirds the realm of confusing and often seemingly contradictory human experience. The discovery of such hidden intelligibility is the principal motivation and final goal of all science—natural, social, and theological. Such *intelligibility*—shared among human observers conceptually, rather than as a matter of *sensibility* or *pictorialization*—is the cornerstone of a realistic objectivity that is grounded in and guided by today's creative science. The shared character of the awareness of any particular "reality" grounds its objectivity: for even though different observers do not experience the same sensory experience of the "reality" in question, through their diverse sensory experiences, they are able to acquire a *shared or common understanding* of it. This shared intelligibility is the linchpin upon which scientists and theologians build a consensus.

I believe that Torrance is in agreement with the distinguished particle physicist and Anglican priest, J.C. Polkinghorne, who states:

> If it is true, as I think it is, that intelligibility is the ground on which fundamental science ultimately makes its claim to be dealing with the way the world is, then it gives science a strong comradeship with theology, which is engaged in the similar, if more difficult, search for an understanding of God's ways with men.[4]

If all creative science, including theology, is really a search for a hidden, objectifiable intelligibility which progressively becomes revealed through experiential interaction with reality, then Torrance's recognition of the unitary character of scientific knowledge is one plausible consequence of such an underlying rationality. Many examples exist of such integrated wholeness with respect to the theoretical and empirical components of any science. In the methodology of natural science, observation-experiment and theory statements are inseparably interrelated. All observational-experimental facts are "theory-laden," for they have only been discovered and made intelligible in a particular theoretical framework. On the other hand, theory in science is empty without an empirical underpinning;

all theory is conditioned by the "facticity" of reality.

With respect to theology, even a cursory reading of Karl Barth's monumental *Church Dogmatics* reveals Barth's recognition that dogmatic theology and the everyday concerns of church people are always intimately related. Torrance has clearly recognized the exacting congruence between Karl Barth's unitary integration of practice and theory in all his theological work and similar unitary patterns in the scientific epistemologies of pioneering physicists. Foremost among these physicists were James Clerk Maxwell, who discovered the hidden unity of electric and magnetic phenomena manifesting themselves in the electrodynamic field, and Albert Einstein, who built upon Maxwell's work in creating special relativity theory. Special relativity displays the unity of Clerk Maxwell's electrodynamics, thereby completing his unifying insight. Building on this work, Einstein then developed general relativity in which geometry and mechanics form an integrated unity.

Torrance suggests that the invariant *character of physical laws is grounded in the faithfulness, constancy, and utter dependability of God's love manifest in all of his Creation.*

Professor Torrance's vision of a truly unitary scientific epistemology is succinctly captured in Karl Barth's discussion of the task of dogmatic theology:

> I propose that by science we understand an attempt at comprehensibility and exposition, at investigation and instruction, which is related to a definite object (the living God or physical reality), and a sphere of activity (the church or scientific community). No act of man can claim to be more than an attempt, not even science. By describing it as an attempt, we are simply stating its nature as preliminary and limited. . . . In no science is it a matter of pure theory or pure practice; on the one hand, theory comes in, but also, on the other hand, practice guided by this theory.[5]

Torrance provides a striking theological analogy which captures succinctly the unitary character of relativity—*the homoousion of physics*. The Church Fathers at the Council of Nicea found concepts borrowed from Greek philosophy, in particular the term *homoousion* (consubstantial, of one being) to be extremely helpful in formulating a creedal statement that would do full justice to the ample biblical evidence for the substantial unity of Father and Son in the Godhead; i.e., it is the one true God who is present in Jesus (and by being so providentially guided, they may have preserved the church). In Torrance's words:

> The *homoousion*, then . . . is of staggering significance. It crystallizes the conviction that while the incarnation falls within the structure of our spatio-temporal humanity in this world, it also falls within the Life and Being of God. Jesus Christ is thus not a mere symbol, some representation of God detached from God, but God in his own Being and Act come among us, expressing in our human form the Word which he is eternally in himself, so that in our relations with Jesus Christ we have to do directly with the ultimate reality of God. As the epitomized expression of that fact, the *homoousion* is the ontological and epistemological linchpin of Christian theology. With it, everything hangs together; without it, everything ultimately falls apart.[6]

It is precisely this kind of intimate interrelation of the theoretical and empirical that is contained in general relativity's integration of the space-time continuum (commonly called space-time) and energy-mass structure (matter): "Space tells matter how to move; matter tells space how to curve (thus determining matter's motion)." Torrance uses an analogy from theology, the *homoousion* interpretive framework, in order heuristically to reveal the intrinsic unity of a major physical theory, general relativity. Thus, he sheds light on the congruence existing between the unitary structures embodied in scientific and theological intelligibilities.

2. Relativity Theory: The Absolute Underpinning of the Relative

In his theory of relativity, Albert Einstein rejected the notion that space and time are absolute; rather, he defined them in terms of their relation to the human observer's physical frame of reference. Doing so, he did by no means abandon objectivity. Instead, he was deeply convinced that the basic laws of nature are always and everywhere the same, regardless of their respective physical frame of reference. In his relativity theory, Einstein primarily stressed the *invariant*, that is, the unchanging nature of physical law which, secondarily, results in the relativism of observational details with respect to different observational frames of reference. Torrance points out that, although Einstein abandoned the absoluteness of space and time, he did not view the simplicity and order of nature as mere constructs of the human mind, a misinterpretation of many idealist philosophers. Interpreting Einstein's insights from a Christian perspective, Torrance suggests that the *invariant* character of physical laws is grounded in the faithfulness, constancy, and utter dependability of God's love manifest in all of his Creation.

The striking character of the notion of *invariance* must be emphasized: mathematical laws that retain

their form under mathematical coordinate transformations faithfully represent the dynamic behavior of physical reality. Why is there this unusual appropriateness of mathematics in physical science? Torrance argues that natural science is made possible by the remarkable correlation existing between thought patterns intrinsic to the scientist's mind and lawful structures associated with the contingent intelligibility embodied in physical reality. Theologically this remarkable correlation is but one manifestation of God's transcendent, loving intelligibility as expressed in the utter faithfulness by which he freely created and continually sustains both human minds and the physical universe.

It is necessary to recognize the distinctive character of dissimilarity within similarity in an analogy of relatedness between physics and theology.

Finally, Torrance perceives natural science as emerging in the context of the contingent intelligibility intrinsic to physical reality. Contingency refers to the fact that a physical entity is never haphazardly formed but exists as one of many possibilities. He looks upon contingent intelligibility as a direct consequence of God's free, rational agency toward his Creation. Torrance's many writings agree with and further extend Eric Mascall's seminal insight:

> There is a very close connection *de jure* between the Christian belief in a God who is both rational and free and the empirical method of modern science. A world which is created by the Christian God will be both contingent and orderly. It will embody regularities and patterns, since its Maker is rational, but the particular regularities and patterns which it will embody cannot be predicted *a priori*, since He is free; they can only be discovered by examination. The world, as Christian theism conceives it, is thus an ideal field for the application of the scientific method, with its twin techniques of *observation and experiment*.[7]

3. In Creative Science, the Invisible Explains the Visible

A third theme drawn from Torrance's integration of theology and relativity theory is that physical theory at its best develops "invisible" conceptual "objects" that explain the behavior associated with observable, "visible" phenomena. In other words, in any truly creative scientific theory the invisible explains the visible rather than the visible explaining the invisible. The same is true in creative theology. Torrance's theme can be illustrated with two examples, one scientific, the other theological.

The space-time metric of general relativity is an excellent example of what Torrance considers to be a key invisible conceptual "object" of natural science. It is a mathematical construct that determines the "curvature" of space-time. This curvature, in turn, guides the visible motion of all observable matter in the universe. As Torrance puts it:

> In scientific thinking we do not reject the fact that we are observers who operate inescapably with appearances and images relativistic to themselves as observers. We all engage in primitive subject-object experience. Observational images, therefore, have a place in our thinking, but they are intersected, as it were, by the pattern of relations at a deeper level by which they are objectively controlled and made to refer beyond themselves. Scientific thinking and understanding moves to that deeper level, refusing to rest content with the surface patterns of observational experience. To be rather technical for a moment, what we are concerned with here are the invariant yet dynamic objective structures of the space-time metrical field, which, though inherently invisible and intangible, control all observational phenomena. Hence we do not offer explanations deduced from appearances, but we explain why things appear in such and such a way from their objective grounds. That is why scientific theories are not *argumenta ad hominem*, but are grounded upon deep object-object relations that hold good on their own, independent of appearances and observations. Thus in scientific thinking we are not concerned with appearances as such, but with objective structures in the light of which we understand appearances, and we do not consider that we can understand objective structures from appearances. . . .[8]

In theology, God's grace may be thought of as an invisible conceptual object defined as "God giving himself to humankind, so that they can know him and love him, so entering into a relationship with him which totally exceeds the relationship of creature to creature, and is therefore totally undeserved."[9] Or, Torrance perceives it as "the constant and ceaseless out-flow of the Love of God which has no other reason for its movement than the Love that God is, and is therefore entirely without respect of persons and irrespective of their reactions."[10] Accordingly, God's grace *grounds* and *guides* all of God's creating, reconciling, and redeeming interaction with humankind as revealed in the Old Testament's history of Israel, God's chosen people, and supremely in the New Testament's documentation of the words and acts of Jesus Christ.

God's grace is not "visible" in the Old and New Testament accounts of God's activity toward humankind, at least not in the sense that it is continuously acknowledged. Rather, the concept of grace brings "invisible" meaning to these accounts. Torrance has often pointed out how both fundamentalist and liberal exegetes miss the point of Jesus's parable of the laborers in the vineyard (Matthew 20:1–16). The parable makes

no sense whatever unless one has truly recognized the revolutionary, transforming nature of the unconditional grace of God.

In summary, this theme contrasts sharply with the commonly held layperson's view that natural science's progressive growth, a good indicator of its realist character, is a direct consequence of science being an activity where the "visible" guides one's interpretation of the "invisible." For the typical man or woman "on the street" natural science is made possible by its practitioners using "visible" observational patterns to guide them toward a greater understanding of the "invisible" patterns which give reality its diverse structure.

What Torrance has done, following the lead of physicist-philosopher Michael Polanyi, is to recognize that great scientists have made their discoveries through an imaginative postulation of "invisible" hidden patterns which explain the "visible" observational patterns. Such innovative leaps are grounded in and guided by the creative scientist's convictions regarding the form of nature's intrinsic creative order. In other words, Torrance recognizes that all good science must be based upon observation, but a less obvious and appreciated aspect of good science is also true: only observation grounded in and guided by theoretical insight is likely to uncover the deep regularities undergirding observational phenomena.

Thus, both natural science and theology are perceived by Torrance to be truly creative disciplines when the "invisible" guides one's interpretation of the "visible." It is worth noting that Judeo-Christian theology has always emphasized the epistemological principle that the creature is seen correctly only by the Creator's light; i.e., temporal and visible things are meaningfully understood only in the light of God's eternal and invisible truth.

4. The Physical Universe: A Relational Rather Than Container Model

The theory of relativity understands the space-time continuum on the basis of a relational, as contrasted with a container, perspective. What is meant by this distinction?

In the container model of the space-time framework, the physical universe is conceptualized as a huge bucket which serves as a receptacle in which all the energy-mass structures that constitute being (material objects and events) are poured. On the other hand, in the relational universe's model of the space-time framework, the physical universe represents a stage forming the expanding outer boundary of interactional relations between the objects and events that constitute its being.[11] Torrance argues that Einstein's relational understanding of the space-time framework is congruent with the ideas of some ancient Church Fathers (Athanasius, Hilary) who were responsible for the development of Christological truth contained in the Nicene Creed. The biblical affirmation that the Creator of the space-time universe entered into his own creation—i.e., in the Incarnation of Jesus Christ—is made more comprehensible by using a relational, rather than a container, understanding of the space-time continuum. In his early major book relating theology and science, *Space, Time, and Incarnation*, Torrance exactly addressed these questions. The relational character of uncreated reality (the Godhead as a unitary, triune community of divine love) and created reality has been an ongoing theme of his attempt to integrate theology and natural science.

5. Field Theories: An Expression of the Relational Character of Reality

The theory of general relativity is a "field theory." Torrance argues that field theories, constituting a relational understanding of physical reality, have a number of structural elements that are analogous to concepts in Judeo-Christian theology. One analogy is that of personhood, understood in a relational context (compared with an elementary particle), considered as a relational (field) entity.

The material of which the entire cosmos is constituted (heaven and earth) is an orderly and interrelated continuum, a structural unity.

If this difficult affirmation of Torrance is to make sense so that its radical implications for our culture can be creatively recognized and explored, some clarifying discussion is in order. It must be made clear that Torrance almost exclusively uses the concept of analogy in a *disclosure* rather than a *pictorial* manner. Theologically speaking, analogy is a *God-created correspondence* existing between two knowledge structures representing distinct objects or relationships of reality. Analogy is defined as similarity within dissimilarity, a commonality arising from certain aspects of the entities being compared. An analogy thus represents a partial likeness or reflection which is true but not exhaustive.

Torrance's analogies are always *across* logical levels of reality; they are *heuristic* (exploratory, discovery-oriented, stimulating further investigation) in character. Each of them establishes a *disclosure* relationship between entities at different logical reality levels. This contrasts with the kind of analogy that establishes a purely *formal* correspondence between entities at the *same* logical reality level.

Torrance argues, rather, that in the integration of natural science and theology, how *and* why *questions occur in both disciplines and cannot be separated.*

In Torrance's work, an analogy, with its capacity for *disclosure*, represents a heuristic *pointing from one level to another* occurring *between* similar aspects of two objects or relationships that either represent or constitute elements of different reality levels. Finally, it is necessary to recognize the distinctive character of dissimilarity within similarity in an analogy of relatedness between physics and theology. Torrance always emphasizes that theological concepts concerning relatedness have a life-transforming and life-directing quality of much deeper personal dimensionality than the analogous concepts associated with physical relatedness. Thus, when *disclosure analogies* are used, both the similarities and the dissimilarities are heuristically instructive. As does Torrance, I believe it cannot be emphasized enough that all truly creative thinking has an analogical component.

Building on this understanding of Torrance's use of analogy, one can fruitfully explore his use of the physicist's field theories to illuminate theological structures. Field theory in physics came into being through the efforts of the two great 19th-century physicists: Michael Faraday and James Clerk Maxwell, both devout Christians whose lives exhibited a remarkable unity of service to others, integrated with spiritual and intellectual insight. Faraday's experimental studies of the complexity of electric and magnetic phenomena led him to reject the conventional wisdom derived from Newton that charged particles or magnets attracted or repulsed one another acting instantaneously across an intervening empty space. Faraday rather envisioned charged particles or magnets as interrelated to one another by *invisible lines of force-fields which fill all space.*

Clerk Maxwell developed a mathematical theory that consistently represented the two fields—electric and magnetic—which fill all space when charges or magnets are present. All electrical and magnetic phenomena and their interrelations can be understood by these two interacting fields. From Clerk Maxwell's theory a revelation came: changing magnetic fields generate electric fields and changing electric fields can generate magnetic fields. Furthermore, a disturbance in one field affects the other in such a way that a self-perpetuating cycle of electric and magnetic fields is created. *A disturbance in the fields thus can take on a life of its own.* Once the process gets started, it does not need help from the outside (from charged particles) to keep it going. Electric and magnetic fields can thus have their own reality apart from the matter that created them. This dynamic disturbance represents an integration of electric and magnetic fields called the electromagnetic field. Clerk Maxwell identified this dynamic field disturbance as light (either visible or invisible, as in, say, radio waves or X-rays), and his famous four equations brought electricity, magnetism, and optics together in a unitary theoretical framework.

How does Torrance understand Clerk Maxwell's seminal field theory, and what wider theological implications does he recognize? Torrance sees Clerk Maxwell as searching for a deeper way of interpreting nature that was not linked to the classical, Newtonian notions of mechanical necessity as manifested in isolated particles interacting externally and causally with one another. This search led Clerk Maxwell, as a mature scientist, to develop his theory of the electromagnetic field, an idea which brought about a paradigm shift in scientific understanding. In this theory the field concept was first formally articulated as a *relational* way of describing particles as inseparable from their interactions. The relationship between particles—as represented by the continuous, space-filling electromagnetic field—were an *intrinsic part of what particles really are.* Thus, this relational notion of fields of radiation and their structure become an independent reality in their own right.

> The relations he [Clerk Maxwell] referred to were not just imaginary or putative but *real* relations, relations that belong to reality as much as things (particles) do, for the interrelations of things, are, in part at least, constitutive of what they are. Being-constituting relations of this kind we may well speak of as 'onto-relations.'[12]

This field concept of physical reality introduced by Clerk Maxwell is heuristically analogous to the biblical concept of the *person* as developed by the early Church Fathers in order to understand the biblical evidence pointing to the triune nature of God. Central to this theological understanding of the person is *the reality of*

human relationships as an integral part of what persons really are. You as a person are not a cut-off, isolated individual, like the Newtonian particle, separated from other autonomous particles. Rather, you as a person are interrelated with others, your parents, your friends, even people with whom you disagree. These *interrelationships constitute the very stuff of personal being.* Torrance suggests that it was this Christian theological understanding that played a motivating role in Clerk Maxwell's development of the relational notion of the electromagnetic field to describe particles as never separable from their interactions.

A final word about fields. Building upon Clerk Maxwell's synthesis of electricity, magnetism, and optics as differing aspects of one electromagnetic field, Einstein was able, in the first place, to develop relational field structures which brought about a more unitary understanding of electrodynamics (the study of electric and magnetic fields in interrelationship with one another, particularly how they vary with time) and mechanics (the study of systems of particles and their resulting motions as a consequence of force interactions between them) resulting in the equivalence of mass and energy (special relativity). Secondly, he created a perception of the physical universe as an integrated whole of matter and space-time in dynamic interrelation with one another (general relativity).

Today, physicists continue to pursue the vision of unification that began with Clerk Maxwell's synthesis by creating quantum field theories. Such theories replace the Newtonian vision of a universe filled with discrete particles, each existing independently, by a universe permeated with a few interpenetrating fields, lines of force filling space. And when such fields are excited, concentrations of energy are produced, field "quanta" if you like, that represent discrete particles. Quantum field theory is not a finished story without problems, but its partial success does motivate physicists in attempting to discover the ultimate unification: a single field from which all fields, electromagnetic, nuclear, and gravitational originate—in other words, a *grand unified field theory.*

Professor Torrance recognizes the physicist's goal of ultimate *unification* as consistent with and, rightly understood, motivated by the first article of the Nicene Creed where Christians affirm their faith in "one God—the Father Almighty, Maker of Heaven and Earth, and all things, visible and invisible." This confession emphasizes a profoundly biblical theme—God's guarantee of the trustworthiness and wholeness of Creation. The material of which the entire cosmos is constituted (heaven and earth) is an orderly and interrelated continuum, a structural unity. Its very reality, its wholeness and trustworthiness, is a revelation of the unique, unitary character of God in what he has brought into being. Perceived through the "ears and eyes of faith," *the Creation is not God but has imprinted in it the trace of his nature.* It is worth noting that in biblical theology, hearing has primacy over seeing—Torrance emphasizes the primacy of auditory cognition in both theology and natural science.[13]

6. The Universe: A Multi-Leveled Yet Integrated Whole

Another theme in Professor Torrance's development of theology-science integration is that the universe is comprised of interrelated levels of being, each of which is far from closed in upon itself, but is open to and explainable in terms of its immediately higher level and, indeed, of the whole multi-leveled character of the universe. In Torrance's words:

> The universe that is steadily being disclosed to our various sciences is found to be characterized throughout time and space by an ascending gradient of meaning in richer and higher forms of order. Instead of levels of existence and reality being explained reductionally from below in materialistic and mechanistic terms, the lower levels are found to be explained in terms of higher, invisible, intangible levels of reality. In this perspective the divisive splits become healed, constructive syntheses emerge, being and doing become conjoined, an integration of form takes place in the sciences and the arts, the material and the spiritual dimensions overlap, while knowledge of God and of his creation go hand in hand and bear constructively on one another.[14]

Torrance's heuristic vision of the universe has a number of principal sources: the theology of the early Church that reached creative expression in the Nicene Creed, Michael Polanyi's heuristic understanding of science, and Ilya Prigogine's irreversible thermodynamics seen in light of relativity theory. The latter two sources may not be as well known as they should.

Michael Polanyi was a distinguished physical chemist who became a philosopher of science. He developed an understanding of science as a human enterprise carried out not through continual, critical doubting, but rather an exploratory attempt by the scientific community to work out, through theoretical and experimental questioning of nature, a fuller understanding of their basic, intellectual convictions concerning the universe's intrinsic order. According to Polanyi, natural science is, like theology, a human endeavor where "faith is in search of greater understanding." Polanyi further saw natural science as revealing the universe to be multi-leveled with successive levels of reality interrelated by *a principle of marginal control.* In this principle, the higher level's laws and structures are dependent upon the laws and structures of the lower level for their

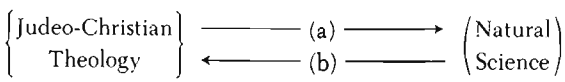
being. But the laws of the higher level are not reducible to those of the lower level (cannot be accounted for on a lower level), and these higher level laws control the behavior of the lower level.[15]

Ilya Prigogine's work on the thermodynamics of open systems—systems where energy, matter, and information can flow across system boundaries—has provided a credible theoretical description of how a multi-level reality structure can come into being. His theory suggests how such highly ordered, complex systems as living organisms can emerge in a universe in which irreversible (one way, dissipative-frictional) processes usually lead to an increase of entropy (a quantitative measure of a system's disorder) signifying more disorder.[16]

Torrance perceives that an underlying unity exists between relativity theory and irreversible thermodynamics, in that both theories suggest the universe is dynamic in character; i.e., both point to the historicity of the cosmos. General relativity predicts that the universe is expanding*, and such an expansion in the context of irreversible thermodynamics may result in the emergence of ever more complex matter-energy structures resulting in a hierarchical, multi-leveled physical reality (pointing to and open to a transcendent reality beyond it that provides meaning).

7. Theology and Natural Science: Allies Rather Than Foes

Much of the spirit of Torrance's integrative work with respect to Judeo-Christian theology and natural science can be understood as a transformational extrapolation of Einstein's famous remark, "Science without religion is lame; religion without science is blind." The extrapolated form of the remark is that Judeo-Christian theology motivates and gives meaning to natural science, which in turn sharpens and clarifies theology. This insight may be schematically represented as follows:



(a) = Motivates, gives meaning to
(b) = Sharpens, clarifies

In this schema, the different parentheses, { } and ( ), symbolically represent the distinctiveness of the two disciplines, while the arrows going both ways, represent the mutual reciprocity of interrelation between the two disciplines, made possible by honest and open dialogue between theologians and scientists. Such dialogue is properly grounded in the recognition that both disciplines are concerned with the discovery of a *shared intelligibility* (see theme 1) resulting from, on the one hand, the divine order primarily revealed in God's redemptive historical interaction with humankind and, on the other hand, the contingent order revealed through humankind's exploration of the expanding (historical, time-embedded) physical universe. Thus, both disciplines represent distinct shared intelligibilities which interpenetrate each other in significant ways. After all, theologians and scientists are both integral components of the space-time universe that natural science investigates. Dialogue between theologians and scientists, respecting one another as allies rather than foes, enables the interpenetration to be better understood. Such clarified interrelationship integrates theology and natural science into a greater whole, whose unitary intelligibility is grounded in the relation between divine and contingent order.

In this new unity of theological and scientific insights, which the schema represents, many old dualisms will be transformed and healed. In particular, the schema *does not* represent the old dualist separation of natural science and theology into *how*-questioning and *why*-questioning disciplines. In such a dualist's perspective, as Torrance suggests, natural science is primarily concerned with questions of *how* the physical universe works in terms of causal mechanical processes, while theology is primarily concerned with questions of *why* the universe exists understood in terms of humankind's beginning and final end. Torrance argues, rather, that in the integration of natural science and theology, *how* and *why* questions occur in both disciplines and cannot be separated. Furthermore, *how* and *why* questions in each discipline are transformed, acquiring new meanings when they are linked together. In other words, both theology and natural science are properly concerned with *how* and *why* questions concerning all reality and the form, function, and meaning of such questions for each discipline will be transformed when both disciplines are understood as integrated together pointing toward a larger unitary intelligibility.

As one example of such transformational unity, Torrance cites the fundamental role that time plays in current physical theory. In today's physics, time is seen to be a central constitutive element of the physical universe, forcing physicists to ask basic questions concerning the universe's beginning and final end. Today the physical universe and many of its constitutive components are perceived as having a history in the same sense that humanity has a history. Hence, the *why* questions of theology, forged primarily in response to biblical revelation concerning human origins and human destiny, help the physicist in formulating simi-

*Strictly speaking, general relativity—without a cosmological constant—only tells us that the universe is not static. It could be contracting, as far as Einstein's field equations are concerned. Astronomical observation has confirmed the validity of expanding solutions of the field equations.

lar questions concerning the physical Universe's beginning and end.

Finally, Torrance argues that the integrated intelligibility of theology and natural science in interrelation is grounded in the *relation* between Divine and contingent order. Torrance perceives that *relation* to be the loving intelligibility of the living God which is supremely revealed in the entering of the Creator into his own space-time Creation. The incarnation of Jesus Christ, his life, death, resurrection, and ascension, particularly his sharing in and redeeming human creaturehood on the Cross, is a central component of all Torrance's efforts to integrate into a larger whole scientific and theological intelligibilities. The following extended quote deserves careful reading, for it summarizes the theological unity of the Old and New Testaments which undergirds all of Professor Torrance's integrative efforts with respect to theology and natural science:

> The doctrine of the creation of the world out of nothing, of course, had its roots in the Old Testament and the Jewish understanding of the one God, who is the source of all that is outside himself, and who remains transcendent Lord over all that he has made, so that if he were to withdraw his creative and upholding presence from the creation it would lapse back into chaos and sheer nothingness. This teaching carried with it a conception of the free (non-necessary) relation of God to the world, by which its contingent nature is constituted, and a unitary outlook upon the world creatively regulated by God's Word, which calls into question all forms of religious, cosmological, and epistemological dualism. The creative act which brought the universe into being and form was not regarded as limited to its impulse, but as remaining unceasingly operative, preserving, unifying, and regulating all creative existence which conversely was contingent in every respect of its nature and in no sense divine. Thus Judaism contributed to a profound understanding not only of the absolute beginning, but of the continuity, stability, and uniformity of the natural world as grounded beyond itself in the constancy, faithfulness, and reliability of God its Creator and Preserver.
>
> However, it was Christian theology which radicalized and deepened the notion of contingence and gave reality to the notion of contingent intelligibility, through thinking out, in critical and constructive discussion with Greek science, the relation of the creation to the incarnation of God's Word in Jesus Christ within the spatio-temporal realities and intelligibilities of contingent existence in this world. The incarnation made it clear that the physical world, far from being alien or foreign to God, was affirmed by God as real even for himself. The submission of the incarnate Son of God to its creaturely limits, conditions, and objectivities carried with it an obligation to respect the empirical world in an hitherto undreamed-of measure.[17]

Hence, nature is indeed real! Accordingly, the seemingly small details of nature are important—worthy of detailed study. It is not a waste of culture's finite resources for some people to worry about such things as how small versus big stones fall.

> On the one hand, clear differentiation between the incarnation as the personal embodiment of God's Logos being embodied in it, shattered the Greek idea that the intelligible order of the world is to be understood as a general embodiment of the divine Logos immanently within it; i.e., as its necessary, inner cosmological principle. That was to have very far-reaching effects in liberating the world from its inward bondage to divine changelessness in virtue of which it was held to be impregnated with final causes, and thus in liberating nature from the iron grip of sheer necessity that resulted from them. On the other hand, the interrelation of the Logos and the creation of all things, visible and invisible out of nothing by that same Logos, called for a profound rethinking of the relation between God and the world . . . in which it is recognized the incarnation has the constant effect of affirming the contingent intelligibility of the Creation, reinforcing the requirement to accept it as the specific kind of rationality proper to the physical world, and as the only kind capable of providing evidential grounds for knowledge of the universe in its own natural processes.[17]

Conclusion

In this paper, I have tried to help the reader acquire a Christian theological instinct for key themes in Thomas F. Torrance's distinctive integration of theology and natural science. I hope that an understanding of these themes will help the reader to better appreciate the range, comprehensiveness, and creative truthfulness of Torrance's thought with respect to this aspect of the encounter between Christ's Church and contemporary culture.

One might wonder, why would a theologian be willing to commit valuable time and effort to acquire substantial understanding of another discipline; i.e., natural science? All of Torrance's efforts to integrate theology and natural science are grounded in and guided by the recognition that the early Christian church not only communicated the Gospel to the Graeco-Roman world but also transformed the prevailing cultural framework, thereby allowing the Gospel to take deep root and grow from within. As then, so for every age, the gospel's creating, reconciling, and redeeming power can have a renewing-transforming impact upon the whole frame of human culture, science, and philosophy.

Today, Torrance suggests, such transforming healing will again take place when theologians and scientists, reconciling in friendship, recognize that there are indeed basic interconnections existing between the structures of theological and scientific knowledge. In particular, Torrance perceives that Karl Barth's creative reformulating of the Trinitarian faith of the early church, and James Clerk Maxwell's, Albert Einstein's, and Michael Polanyi's contributions to basic science, both in content and method, *share* interconnected concepts and *bear* structural, epistemological congruences with one another. A wider recognition of such interconnections and knowledge congruences by theo-

logians and scientists engaged in cordial, serious dialogue will result in a transformation and convergence of thought that can do much to heal the fragmentation which denies the unity God intends for our scientific-technological civilization.

Professor Torrance, by prayerfully motivated and guided thought, and by his willingness to befriend, listen, and converse with the scientific community, has contributed significantly to advancing such healing transformation. He has been particularly helpful through his emphasis that careful, precise thought is essential in order that basic interconnections and congruences of thought between theology and natural science not be pushed further than they naturally go. As an integrative thinker, he clearly recognizes that theology and natural science truly are integrated redemptively only when the distinctiveness of each God-motivated discipline is preserved as the deep unity of interrelationship between disciplines is recognized, understood, and explicated.

This creative interrelationship between the two disciplines can be illustrated by using a concept borrowed from Torrance's theology. Early Christian theologians used the Greek word *perichoresis* to discern the way in which "the Divine and human natures in the one Person of Christ interpenetrate each other without the integrity of either being damaged by the other" (Torrance, *The Ground and Grammar of Theology*). The word indicates a sort of dynamic, mutual containing, or mutual involution, of realities which is often spoken of as a *coinherence* (the root *chora* is also present in choreography, which describes the orchestration of dancers, indicating the word's dynamic aspects).

Such a dynamic coinherence between theology and science would preserve the integrity of both disciplines while healing the breach that has opened up between them. Our age is saturated with scientific-technological achievements, but strongly lacks a coherent sense of overall meaning and the necessary moral leadership to use such achievements wisely. Only a very confused culture can uncritically accept the legitimacy of both astrology and the findings of satellite-based astronomy. A clarified understanding of the *perichoresis* between theology and natural science could have a substantial healing impact upon our scientific-technological society, for such a refined understanding would restore the sense of purpose and moral guidance our civilization lacks.

Professor Torrance's integrative framework provides many creative insights into the *perichoretic* interpenetration of theology and natural science; this framework serves as a base for both scientists and theologians as they build bridges between their disciplines. Furthermore, it is a base which may be modified as such exploratory activity clarifies and enriches both theological and scientific knowledge. Such healing understanding can come about if both scientific and theological communities are willing, as Professor Torrance has graciously done, to sacrificially commit the time and effort required for serious dialogue. Such demanding dialogue will succeed only as each community trusts and respects the other's basic convictions, while at the same time honestly and openly articulates those areas where real divergences of understanding exist. Christian love manifesting itself in mutual tolerance and total honesty is one "leaven" that can guarantee the fruitfulness of such dialogue.

Christian love is particularly manifest in one component of Thomas Torrance's work with the scientific community that is "invisibly" present and grounds the "visible" accomplishments of his integration of theology and natural science. That "invisible" component is the sincere friendship which he has cultivated with many members of the scientific community, including this writer. His willingness to give unsparingly of his time as a sympathetic yet always critical listener, his shared enthusiasm for basic science, his ability to offer wise counsel, and his perceptive humor in tense moments are all aspects of true friendship, a quality essential for any civilization's creativity and well-being. Torrance's life[18] and thought is a unity grounded in the realization that "all meaningful knowledge is for the sake of action, and all meaningful action is for the sake of friendship" (John MacMurray—Scottish theologian-philosopher).

Friendship is an attribute that Thomas Torrance perceives as essential in helping the human family, all God's children, become "Priests of Creation"—loving stewards of God's good creation. It is a consequence of humankind being made in the image of God, thereby reflecting something of the Triune God's interrelational character, a unitary community of love.

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NOTES

[1]Richard P. Feynman (Nobel Prize-winning American Physicist), *Lectures On Physics*, Volume II. (Reading, MA: Addison-Wesley Publishing Co., Inc., 1964), p. 11.

[2]James Clerk Maxwell, *A Dynamical Theory of the Electromagnetic Field*, edited by T.F. Torrance. (Edinburgh, Scotland: Scottish Academic Press, 1982), p. x.

[3]Thomas F. Torrance, "If I were starting again," *The Presbyterian Outlook*.

[4]John C. Polkinghorne, *The Way the World Is*. (Grand Rapids, MI: Eerdmans Publishing Co., 1983), p. 11.

[5]Karl Barth, *Dogmatics in Outline*. (New York: Harper & Row, 1959), p. 9.

[6]Thomas F. Torrance, *The Ground and Grammar of Theology*. (Charlottesville, VA: University Press of Virginia, 1980), pp. 160–161.

[7]E.L. Mascall, *Christian Theology and Natural Science*. (New York: The Ronald Press Company, 1956), p. 94. Torrance has acknowledged Mascall's pioneering contribution as one of the first theologians of this century to grasp the grounding of natural science in God's free, rational agency. See, in particular, Mascall's discussion of Christian Theism and contingency contained in Chapter three, pp. 91–98.

[8]Thomas F. Torrance, *The Ground and Grammar of Theology*, pp. 120–121.

[9]Alan Richardson and John Bowden (eds.), *The Westminster Dictionary of Christian Theology*. (Philadelphia, PA: The Westminster Press, 1983), p. 245.

[10]Thomas F. Torrance, *Christian Theology and Scientific Culture*. (New York: Oxford University Press, 1981), p. 84.

[11]Newtonian physics forms a good example of a "container" model of the universe. Basically, Newton *separated space from what happened in it* and suggested the idea of an infinite receptacle formed by space *and* time, which he held to be the container of all physical being. Space and matter were understood dualistically, space and time had an absolute status independent of material existence, but causally conditioning its character and qualities as an inertial system. Einstein's general theory of relativity is an apt example of a relational model of the universe. In general relativity, space-time is a continuum existing in inseparable relation to mass-energy structures; i.e., mass-energy objects determine the curvature of space-time. That curvature, in turn, controls the motion of the masses. Thus, mass-energy structure and space-time geometry are dynamically, integrally related. For Professor Torrance's perspective see Thomas F. Torrance, *Space-Time Incarnation*. (New York: Oxford University Press, 1969).

[12]Thomas F. Torrance, "Christian Faith and Physical Science in the Thought of James Clerk Maxwell," in *Transformation and Convergence in the Frame of Knowledge*, edited by Thomas F. Torrance. (Grand Rapids, MI: William B. Eerdmans Publishing Co., 1984), p. 230.

[13]Thomas F. Torrance and Walter Thorson argue that human knowing takes place primarily through three cognitive modes—auditory, visual, and manipulative—with the auditory mode "awakening" and guiding the other two cognitive modes.

Auditory Cognition—Hearing and Listening

Hearing and listening places primary emphasis on "the other" rather than the activity of the knower. "The objective other" consists of those objects and/or persons that exist external to the knower (external reality). Hearing and listening is primarily a Hebrew notion, both Old and New Testaments emphasize hearing and listening to the Word of God; the believer listens when "thus says the Lord" is pronounced by a prophet or finally by Jesus, himself. This mode is primarily a passive process. It is significant that Jesus Christ, The Eternal Creative Word and True Man, is reported to have said that to truly know him you must become as a little child. This was a favorite quote of the great agnostic, Thomas Huxley. He argued by analogy that a scientist must intitially stand as a little child before nature listening to its behavior in a fully trusting, expectant, responsive and open fashion in order to gain insight into the intrinsic order that undergirds physical reality. It is by hearing and listening that we become "tuned in" to a "speech" embedded in reality beyond ourselves. In this manner we become aware of those ultimate commitments which motivate and guide all specific acts of understanding in any given discipline, theology, natural science, history, and so forth. It is by hearing and listening to all human experience (including religious) that natural scientists have developed the strong conviction that behind the rich, complex regular yet sometimes chaotic behavior of physical reality there are intrinsic patterns of contingent order that can be discovered; i.e., revealed by patient theoretical and experimental analysis with "beautiful" mathematical structure often "faithfully" representing physical reality. Every natural scientist is motivated to formulate specific working commitments or theories by the hope that this ultimate commitment provides. Note also that hearing and listening may allow us to recognize intuitively a specific intrinsic pattern of order, thereby making a specific discovery concerning external reality.

The auditive mode of cognition, listening and hearing, functions only as we are *responsive* and *obedient* to what is beyond ourselves. It may be characterized by two distinctive features: (a.) This passive process awakens an awe and an attitude of humility toward external reality. No deliberate attempt is made to impose our preconceived notions upon the reality being observed. In this passive mode of cognition we allow external reality to reveal its intrinsic structure not distorted by our attempts to manipulate or alter such structure as would happen if we were to engage in active questioning. (b.) The auditory mode allows an intuitive comprehension of reality to develop, intuition being defined by Calvin as "direct knowledge of an acutally present object, naturally caused by that object and not by another [or our own preconceived ideas]." In other words, by first listening we allow the object being observed to control our understanding. Note that Thomas F. Torrance, following Michael Polanyi, defines intuition as "not the supreme immediate knowledge called 'intuition' by Leibniz, Spinoza or Husserl but the inexplicable apprehension or insight into hidden occurences or intelligible order . . . the spontaneous process of sensing and integrating clues in reponse to some aspect of reality seeking realization in our minds."

Visual and Manipulative Cognition—Seeing and Grasping

Seeing, a Greek mode of knowing, is basically an active recognition of form and pattern motivated and guided by one's ultimate commitments to the existence of order and the possibility of finding "faithful" modes of representation of that order whether numerical, geometrical or more qualitative in character. Such wholistic pattern recognition is central to theory formulation. It must always be tested against external reality as it can easily become self-centered and passive. This testing pattern may be looked upon as a grasping process.

Grasping, a Roman mode of knowing, is controlling and manipulative, being guided by one's working commitments and theories concerning external reality. It is indeed active but can easily become just a form of self expression. Taken together, seeing and grasping allow a knower to discover partial but potentially objective knowledge about reality, such knowledge can then be "feedback" to enhance and alter the seeing and grasping process.

Specific references to Professor Torrance's insights into auditory cognition are: Thomas F. Torrance, "Theological and Scientific Inquiry," *Journal of the American Scientific Affiliation*, Vol. 38, No. 1, pp. 2–10 (1986); Walter Thorson, "Scientific Objectivity and the Word of God," *Journal of the American Scientific Affiliation*, Vol. 36, No. 2, pp. 88–97 (1984).

[14]Thomas F. Torrance, *Reality and Scientific Theology*. (Edinbugh, Scotland: Scottish Academic Press, 1985), p. ix.

[15]The following references discuss Polanyi's *Principle of Marginal Control* and its wider implications: Michael Polanyi and Harry Prosch, *Meaning* (particularly the chapter entitled "Order"), (Chicago: The University of Chicago Press, 1975); Michael Polanyi, "The Structure of Consciousness" and "Life's Irreducible Structure," in *Knowing and Being: Essays by Michael Polanyi*, edited by Marjorie Grene, (Chicago: The University of Chicago Press, 1969); Drusilla Scott, *Everyman Revived: The Common Sense of Michael Polanyi*, (Lowes, Sussex, U.K.: The Book Guild Limited, 1985); Howard H. Pattee (ed.), *Hierarchy Theory*, (New York: George Braziller, 1973); Thomas F. Torrance, "The Place of Michael Polanyi in the Modern Philosophy of Science" and "The Open Universe and the Free Society," in *Transformation and Convergence in the Frames of Knowledge*, (Grand Rapids, MI: William B. Eerdmans, 1984), pp. 107–189.

[16]Prigogine has shown how order can arise in open systems far from equilibrium. In the systems studied by Prigogine, that order controls only a few degrees of freedom such as found in convection currents or wave patterns of chemotactic activity; i.e., the Belousov-Zhabotinski Reaction. His nonlinear themodynamics doesn't begin (at the present time) to account for the information content (millions of degrees of freedom) found in living systems. It does, however, serve as a heuristic model to enlarge our understanding of living systems. See: A. Babloyantz, *Molecules, Dynamics and Life: An Introduction to Self-Organization of Matter*, (New York: John Wiley & Sons, 1986); Ilya Prigogine and Isabelle Stengers, *Order Out of Chaos*, (Toronto: Bantam Books, 1984); Ilya Prigogine, *From Being to Becoming*, (San Francisco: W.H. Freeman & Co., 1980); Paul Davies, *The Cosmic Blueprint*, (New York: Simon & Schuster, 1988).

[17]Thomas F. Torrance, *Divine and Contingent Order*. (New York: Oxford University Press, 1981), pp. 32–34.

[18]A helpful biographical interview that gives an overview of Professor Torrance's personal life and ministry is found in *The Reformed Review*. I. John Hesselink, "A Pilgrimage in the School of Christ—An Interview with T.F. Torrance," *The Reformed Review*, Vol. 38, No. 1, pp. 49–64 (1984).

Mathematics, Cosmology, and the Contingent Universe

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To say that the universe is "contingent" means that it need not be the way it is. A contingent universe does not contain within itself a sufficient explanation of itself. Although the doctrine of contingence is an article of faith which transcends scientific demonstration, modern cosmology has made new discoveries and is asking new questions which point to the contingent character of the universe. Does the universe have a "beginning?" Is the extent of the universe finite? Does mathematical undecidability preclude any system from containing within itself a sufficient explanation of itself? Classical physics thought of the universe as closed, necessitarian, and incontingent. Thus, certain questions basic to Christian thought were dismissed out-of-hand as invalid. An incontingent universe precludes any revelation from outside itself. Modern scientific models of the universe offer a more hospitable arena for the discussion of Christian theology.

Purpose

I propose to indicate: 1) ways in which modern cosmology points to the contingence of the universe; and, 2) guidance of the doctrine of contingence can lend to cosmological thinking.

Definitions

To say that the universe is "contingent" means that it need not be the way it is. Its particular space-time structure is not a necessary consequence of its existence. Alternately, an "incontingent" universe would possess a necessary structure; such a world would be uniquely determined by just the requirement of self-consistency. A contingent universe does not contain within itself a sufficient explanation of itself. For an incontingent

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universe one conceivably could find a single, consistent theory from which one could deduce uniquely the structure of the world, including the numerical values of all constants of nature. A contingent universe will here be termed "open;" an incontingent universe will be termed "closed."

The contingence of the universe has played a crucial role in the development of modern, experimental science. The majority of scholars in the ancient world did not appreciate the contingent character of the world, and so attempted to reason about the world *a priori*. Modern experimental science owes a debt to the Medieval doctrine of contingence, as scholars recognized that to answer questions about nature required asking nature itself. Although Newton himself denied that "the world exists by necessity and by the same necessity follows the laws proposed," Newtonians interpreted his laws as determining the entire structure of the "closed" universe.[1] This reductionism was recognized as inadequate only in the wake of field theory, which appealed to non-particle structures, "fields," as first suggested by Michael Faraday and later formalized by James Clerk Maxwell. Today, contingence is an issue between the two options considered by theoretical cosmologists with regard to the way the universe began. Is there only one type of universe that is logically possible, which would uniquely determine all the presently unexplained values of the fundamental constants of nature? Or are there arbitrary elements in the composition of both the structure of the universe and its fundamental constants?[2]

Limitations

If the universe is contingent, and so does not contain within itself a sufficient explanation of itself, it would seem odd were we able to prove this fact from within the universe itself. The doctrine of contingence is an article of faith, which, I believe, transcends scientific demonstration, and is implied by God's sovereignty in the *creatio ex nihilo*. Aquinas held that the very idea that the world did not always exist could be known only by revelation and not reason.[3]

Likewise, incontingence begs proof. Those who favor a "closed" system tend to believe in the "eternity of the universe," which has been called the "first article of the secular faith."[4] Incontingence has often been a tacit presupposition of many scientists, but is not inherent to the scientific method.

Our convictions about the contingent nature of the universe grow out of God's dynamic and free activity rooted in the revelation of Jesus Christ. Christians believe that the Incarnation was a unique event which cannot be understood just in terms of this world, as the Arians had tried to do. The Incarnate Christ transcended this world, and, far from being explained by it, became the explanation from which the world itself drew its meaning. The Logos entered into this world, taking upon himself human nature, and became the Word of God incarnate, speaking to us from within, but above, the created order.

> It is because all contingent realities . . . have their final truth in God's Word rather than in themselves, that in their employment by the Word himself they may serve the communication to us of a knowledge of God that is quite beyond us. But because these created realities which God uses as the medium of his communication have their final truth in his Word rather than in themselves, they are in themselves far different from what they are in our knowledge and formalization of them.[5]

I do not believe that the contingence of the universe can be decided by the scientific method. In particular, we should avoid any attempt to "prove" *creatio ex nihilo* by an appeal to "Big Bang"-type theories. At present, cosmology has no adequate explanation of the origin of the Big Bang. Some cosmologists theorize that the Big Bang resulted from quantum relativistic effects in the virtual vacuum.[6] Although this model has some experimental support, it remains controversial among cosmologists. Yet, an appeal to a "God of the gaps" as the source of the Big Bang (i.e., "The Big Banger"?)

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only invites criticism and retraction if a quantum theory of gravity is successfully formulated.

Cosmological Pointers to Contingence

Although the contingence of the universe is not decidable scientifically, nevertheless modern cosmology has made new discoveries and is asking new questions which point to the contingent character of the universe. These changes in the foundations of cosmology have far-reaching implications for a unitary understanding of the created universe.

Those who favor a "closed" system tend to believe in the "eternity of the universe," which has been called "the first article of the secular faith."

Through most of the nineteenth century, mechanists thought of the universe as closed, self-contained, and self-explanatory. Such an eternal and divine nature bars the possibility of revelation.[7] Questions about origin and purpose, which contingence raises, were not even considered legitimate by the mechanists. Today, however, such questions are discussed in scientific papers and are regarded as amenable to scientific inquiry. Questions about first and final causes, which were excluded by a single-minded emphasis on efficient causes, have returned in discussions about the Big Bang and the Anthropic Principle.[8]

The first cosmological indicator of contingence I want to discuss is time. Mechanists thought of the universe, and hence of time, as without a beginning. This eternity of space and time is a corollary of incontingence, as otherwise one is forced to seek an origin of the universe outside of the universe itself. However, today modern cosmology has found evidence indicating a finite age of the universe of about 10 to 20 billion years. This age was arrived at by studying the transformation of the galaxies as we now observe them. The scientific account "does not go beyond that, to the singularity when there was nothing and then suddenly the inconceivably energetic seed for the universe abruptly came into being. Here science seems up against a blank wall."[9]

The strongest evidence for the finite age of the universe is its observed expansion, one of the "great intellectual revolutions" of this century.[10] Mechanists thought of the universe as static. Einstein's *General Theory of Relativity*, published in 1916, predicted an expanding or contracting universe. But such a conclusion was so unthinkable that Einstein introduced the "cosmological constant," a hypothetical anti-gravity force, so that a static universe would result.[11] But in 1922, the Russian physicist Alexander Friedmann mathematically formulated general relativity without the cosmological constant, and advocated the expansion of the universe. This idea received observational support in 1929 when Edwin Hubble analyzed the red shift in the light earth receives from the stars, and concluded that all galaxies are moving away from earth at a speed directly proportional to their distance from earth. By extrapolating backwards from this expansion, one arrives at a singular point of infinite density some 10 to 20 billion years ago, the point of origin of the observable universe from which all matter and energy were thrown out in the "Big Bang." Alternative theories have been suggested to explain the observed recession of the galaxies. However, these have failed to account for two further observations, as can the Big Bang theory: the isotropic background radiation of 2.7° K (for which discovery Arno Penzias and Robert Wilson of Bell Laboratories were awarded the Nobel Prize in 1978), and the apparent percentage of hydrogen and helium in the universe.

Not only do modern cosmologists consider space-time as having a beginning, but they recognize a property of time which is difficult to explain within the universe itself. Physicists speak of "arrows of time," a term, like "vector," which implies unidirectionality. In at least two ways the universe induces a direction upon time which so far appears irreversible. First, by its very origin and subsequent expansion the universe has an "absolute clock" which distinguishes between prior and subsequent events.[12] Secondly, the Second Law of Thermodynamics implies that all closed systems proceed to states of increasing entropy, or disorder. Attempts to explain the irreversibility of time have not been successful.[13] Time irreversibility is an important characteristic for those who see the universe as an arena

We should avoid any attempt to "prove" creatio ex nihilo *by an appeal to "Big Bang"-type theories. . . . An appeal to a "God of the gaps" as the source of the Big Bang (i.e., "The Big Banger"?) only invites criticism and retraction.*

for some higher purpose, or teleology, toward which history moves.

A second cosmological indicator of contingence I want to discuss is the finite extent of the universe. The mechanists of the last century thought of the universe as being of infinite extent in all directions. The infinity of space is a corollary of incontingence, as otherwise, one is forced to consider a "boundary" to the universe and ask about what lies "beyond" that boundary. General relativity predicts the universe has finite mass and is finite in extent. Light is no longer thought of as traveling indefinitely in a straight line, but follows a closed geodesic path whose curvature is determined by the shape of space-time. If the cosmological estimates of the Big Bang are correct, and if light speed is the universal maximum velocity, then the observable universe has a radius of 10 to 20 billion light years.

A third and final indicator of contingence I want to discuss is the implication of Gödel's theorem for cosmology. Toward the end of the nineteenth century, the "formalist" school of mathematical interpretation sought to reduce all of mathematics to a single, logical system. In 1900 David Hilbert posed twenty-three unsolved questions which were to guide the progress of mathematics into the present day. His second question asked for a demonstration of the consistency of the axioms of arithmetic. A decade later Bertrand Russell and Alfred North Whitehead published *Principia Mathematica*, a minutely detailed program which showed that all known results of pure mathematics could be derived from a small number of axioms. But this left Hilbert's second question unanswered. In 1931 Kurt Gödel published the surprising result that a finite, internal proof of the consistency of the axioms of arithmetic was impossible. He showed that, in any system large enough to contain at least the arithmetic axioms, there are statements in the language of that system whose truth value is undecidable by that system. If then an undecidable statement is merely appended to that system as an axiom, that now-larger system will again contain other undecidable propositions. That is, undecidability cannot be simply "legislated" away.

The far-reaching implications of Gödelian theorems are still being realized. For mathematics, Gödel's result meant the end of a purely formalistic interpretation of mathematics as a logical system. Mathematical truth is larger than any axiomatic system. Stanley Jaki appears as the first to have developed Gödelian implications for cosmology.[14] There will always be truths about the universe which are beyond any formal cosmological theory. Seemingly, this supports the contingent character of the universe, as no single theory could determine completely the structure of the world. "Doomed also, as a result [of Gödel's theorem], is the ideal of science—to devise a set of axioms from which all phenomena of the natural world can be deduced."[15]

There will always be truths about the universe which are beyond any formal cosmological theory.

John Barrow has questioned the relevance of Gödel's theorem to science.[16] The type of undecidable proposition guaranteed by Gödel is self-referencing. Alfred Tarski suggested limiting admissible statements to only those which do not mix language with meta-language. Given this restriction, Barrow then asks how we know that there will be significant undecidable cosmological statements.[17] He asks rhetorically for just one example of an undecidable proposition which had stumped mathematicians and had led to a significant scientific breakthrough. In answer I cite the parallel postulate, the undecidability of which led to the creation of new geometries which eventually became the language of relativity theory. Another significant undecidable proposition is the Continuum Hypothesis.[18]

Guidance Contingence Lends Cosmology

The great problem confronting particle physics is the unification of the four known forces in the universe—electromagnetism, gravity, weak, and strong interaction—the so-called "unified field theory." Such would have profound implications for cosmology, as it would explain the particle interaction during the cosmic "cooking" of the cosmic "yolk" in the Big Bang at which temperatures and density gravitational attraction between subatomic particles becomes significant. Such a unifying theory between electromagnetic and weak forces has been experimentally confirmed ("electroweak theory") in recent years at the European Center for Nuclear Research (CERN). A promising unification between electroweak and strong forces has been proposed (the "Grand Unification Theory" or GUT). Accelerators do not have the energy to simulate the temperatures of the cosmic cooking needed to unify the GUT forces with gravity, which at normal temperatures are 10^{39} times weaker than electromagnetic force. A unified field theory does not appear to be readily forthcoming, but nevertheless may be achieved someday.

We must, however, make a distinction between a unified field theory and a "Theory of Everything,"

which claims to explain the structure of the universe uniquely and completely. A Theory of Everything is not possible in a contingent universe. A belief in such a Theory of Everything appears "unashamedly in scientific papers, but it is essentially a religious or metaphysical view, in the sense that it rests only upon an unstated axiom of faith."[19]

In 1965 Steve Hawking realized that if he reversed the direction of time in Roger Penrose's theory about black holes he could describe the Big Bang singularity. He published a joint paper with Penrose in 1970 which developed the mathematical techniques to prove that there must have been a Big Bang singularity provided only that general relativity is correct and the universe contains only as much matter as we observe.[20]

It is ironic that the cosmologist who worked so hard to convince others of the Big Bang singularity has now changed his mind. For the last ten years, Hawking has speculated about a quantum theory of gravity which would permit the absorption of a black hole. Furthermore, he surmises that a time-reversal argument similar to his 1970 paper will account for the appearance of the Big Bang from quantum gravitational effects in the virtual vacuum. He seeks, then, to avoid any singularity or beginning to the universe. In his own words:

> The quantum theory of gravity has opened up a new possibility, in which there would be no boundary to space-time and so there would be no need to specify the behavior at the boundary. There would be no singularities at which the laws of science break down and no edge of space-time at which one would have to appeal to God or some new law to set the boundary conditions for space-time. The universe would be completely self-contained and not affected by anything outside itself. It would neither be created or destroyed. It would just BE.[21]

Although today it has little experimental support, such an integration of the quantum and relativity theories would be a revolutionary intellectual triumph. But Hawking claims too much for it as he elevates such integration to a Theory of Everything. In his attempt to get behind the Big Bang singularity, he thinks he can remove all singularities. I believe that the doctrine of contingence in a Gödelian form would lead us to expect the scientific enterprise to generate an unending hierarchy of widening theories, earlier theories being limiting cases of their successors. Singularities, or points where a theory breaks down, play a vital role in the pursuit of broader theories. Thus, scientists should seek to get behind singularities, as they expand their understanding of nature, but should not expect ultimately to remove all singularities by achieving some comprehensive Theory of Everything. We are exploring a universe "open" to an ever-widening understanding of its infinite pattern and simplicity, not "closed" within any one self-contained model of its structure.

Conclusion

Modern scientific models of the universe offer a more hospitable arena for the discussion of Christian theology than did their predecessors in the last century. When the universe was thought of as closed, necessitarian, and incontingent certain questions basic to Christian thought were dismissed out-of-hand as invalid. An incontingent universe precludes any revelation from outside itself. Today, scientific thinking about the contingent universe allows a rapprochement with Christian thinking, that together they may work toward an interdisciplinary understanding of the created universe.

NOTES

[1]Quoted in Barrow, John D., *The World Within the World*, (London: Oxford University Press, 1988), p. 323.
[2]Barrow, *op. cit.*, p.360.
[3]Aquinas, Thomas, *Summa Theologica* III, 46, 2. "The reason for this is that the newness of the world cannot be demonstrated from the world itself. For the principle of demonstration is the essence of a thing."
[4]Jaki, Stanley L., *Cosmos and Creator*, (Edinburgh: Scottish Academic Press, 1980), p. 108.
[5]Torrance, T.F., *Christian Theology and Scientific Culture*, (New York: Oxford University Press, 1981), pp. 128–129.
[6]Hawking, Stephen W., *A Brief History of Time*, (New York: Bantam, 1988), p. 136.
[7]Jaki, *op. cit.*, p. 68.
[8]For an excellent survey, cf. Neidhardt, W. Jim, "The Anthropic Principle: A Religious Response," *Journal of the American Scientific Affiliation*, Dec. 1984, pp. 201–207. This paper portrays the contingence of the universe as intimated by the enormous degree of its specificity, the fascinating details of which I do not have space here to discuss.
[9]Gingerich, Owen, "Let There Be Light: Modern Cosmology and Biblical Creation," in Frye, R. (ed.), *Is God a Creationist?* (New York: Charles Scribners, 1983), p. 128.
[10]Hawking, *op. cit.*, p. 39.
[11]This term, however, does have contemporary use in regards to an "anti-gravity" phase among the GUT forces in the inflationary model of the universe.
[12]This term is used in Barrow, *op. cit.*, p. 234.
[13]Barrow, *op. cit.*, p. 367. Boltzmann has offered a subtle argument in favor of time-reversibility. But this is a technical question, over which there is little consensus. The interested reader is referred to the following: Davies, P.C.W., *The Physics of Time Asymmetry*, (Berkeley: University of California Press, 1974); Brush, Stephen G., *Statistical Physics and the Atomic Theory*, (Princeton: Princeton University Press, 1983); DiFrancia, G. Toraldo, *The Investigation of the Physical World*, (Cambridge: Cambridge University Press, 1976); Prigogine, Ilya and Stengers, Isabelle, *Order Out of Chaos*, (Toronto: Bantam Books, 1984).
[14]Jaki, Stanley L., *The Relevance of Physics*, (Chicago: University of Chicago Press, 1966), pp. 127–130.
[15]Boyer, Carl B., *A History of Mathematics*, (New York: John Wiley, 1968), p. 656.
[16]Barrow, *op. cit.*, p. 258.
[17]At the Consultation on Theology/Science at the Center of Theological Inquiry, Princeton, Dr. Christoph Wassermann, of the University of Geneva, pointed out the inherent significance of self-referencing statements. Whereas a scientific theory may be able to avoid self-referencing statements within itself, as soon as the theory claims to be true it has made a self-referencing statement. At the same Consultation, Dr. David Wilcox, of Eastern College, St. Davids, Pennsylvania, actually used self-referent statements in his proposed model of the code sequence for amino acids on the DNA. The definition takes the form of a large riboprotein which can recognize both the code words and the amino acid which it represents.
[18]Cohen, P.J., "The Independence of the Continuum Hypothesis," *Proceedings of the National Academy of Science*, 50(1963), 1143–1148; 51(1964), 105–110.
[19]Barrow, *op. cit.*, p. 338.
[20]Hawking, *op. cit.*, p. 50.
[21]*Ibid.*, p. 136.

Communications

Rediscovering John Ray

Unemployment enhanced my study of the interaction between historical science and biblical interpretation, allowing my 1987 readings to range across three centuries. I may have been the first borrower of at least one classic book in the Gallagher Geological Library: John Ray's *Three Physico-Theological Discourses*; a buried treasure.

John Ray (1627–1705) became a teaching fellow of Trinity College, Cambridge in 1649, an ordained Church of England minister in 1660. His Puritan sympathies, however, prevented him from signing an agreement with 1662 restrictions upon liturgy under the Act of Uniformity, so that his employment ended (Faul & Faul, 1983, p. 47). Turning to science, he produced the major botanical reference of his generation, met and corresponded with leading scientists across Western Europe, and tutored for a wealthy family. Honesty, thoroughness, humility, and gentleness pervade his writings: he repeatedly acknowledged incomplete understanding and demonstrated a willingness to revise his opinions whenever evidence warranted a different interpretation.

Theology and science, religion and politics, were intertwined during the seventeenth century. No one suggested any significantly longer historical timescale than that which John Lightfoot and Archbishop James Ussher had calculated from biblical genealogies as well as from ancient traditions. However, Steno (1669) had traced six stages in the geological history of Tuscany, while William Whiston, in *A New Theory of the Earth* (1696), assumed that planetary rotation began at the Great Flood—so that previously days and years might have been synonymous terms.

Medieval synthesis applied astrology and Aristotelian ideas and regarded fossils as inorganic "sports of nature" imitating shapes of living things. Diluvial theories were starting to displace this interpretation. Thomas Burnet's *Sacred Theory of the Earth* (1681) relied upon natural processes divinely synchronized to foreknown history, rather than "the direct hand of God," and supposed that a few places were untouched by the Flood (Greene, 1959, pp. 48–52; Faul & Faul, 1983, pp. 48–50). This controversial work, together with critical replies, proved to be immensely popular. John Woodward responded stridently in *An Essay Toward a Natural History of the Earth* (1695, 282 pages), in which he held the Flood responsible for all major changes since Creation, rejected almost every concept leading toward modern science, but did recognize the organic origin of fossils. John Ray argued more rationalistically, showing the flaws in every available theory, and keeping his own views cautiously tentative, almost to indecision. He expanded a collection of sermons into *The Wisdom of God Manifested in the Works of Creation* (1691), then used a second collection to produce *Miscellaneous Discourses Concerning the Dissolution and Changes of the World* (1692) which developed into *Three Physico-Theological Discourses* (Faul & Faul, 1983, p. 51). These discourses deal with: Chaos and Creation; the General Deluge; Dissolution of the World and Future Conflagration.

John Ray followed St. Augustine's tradition of progressive creation, saying:

> For Moses, in the History and Description of the Creation, in the first Chapter of Genesis, saith, not that God created all Things in an instant in their full State and Perfection, but that He proceeded gradually and in Order, from more imperfect to more perfect Beings, first beginning with the Earth, that is, the Terraqueous Globe, which was made *tohu vabohu*, without Form, and void, the Waters covering the Face of the Land, which were afterwards separated from the Land, and gathered together in one place. Then He created out of the Land and Water, first Plants, and then Animals, Fishes, Birds, Beasts, in Order, and last of all formed the Body of Man from the Dust of the Earth. (1713, p. 5).

He considered species to be fixed, intransmutable, all created by the time of mankind's appearance (1713, pp. 387, 388). Thus, this view of creation was not the same as theistic evolution, as some creationists in this century have asserted. Ray wondered whether the days were to be taken literally (p. 172), and cited several instances wherein "Figurative and Metaphorical Sense" should be applied (pp. 317, 394–396). In contrast to many modern creationists, he separated scriptural authority from literalism, and sought explanations requiring fewest miracles and most reliance upon natural laws. (For example, on page 120, referring to a concept that the deluge was caused by pressure upon the oceans, he preferred to postulate a shift in centre of gravity, declaring: "But because there must be another Miracle required, to suspend the Waters upon the Land, and to hinder them from running off again into the Sea; this is far more unlikely than the former account.") Today's literalists/inerrantists charge that any other view exalts humanity, but Ray's different interpretation did not: "It seems to me to be too great Presumption, and over-valuing ourselves, to think that all this World was so made for us, as to have no other End of its Creation or that God could not be glorified but by us" (p. 414).

He could not assume that extinction had ever occurred, considering the care taken to preserve two or more representatives of each species (Genesis 6–9), yet Ray admitted the possibility because ammonites were unknown apart from fossils. He hoped that living examples might be recovered from other regions, when the planet could be totally explored (1713, p. 173).

Inorganic explanation of fossils "put a Weapon into the Atheist's Hands, affording him a strong Argument, to prove, that even Animals themselves are casual Productions, and not the Effects of Counsel or Design. For, to what End are these Bodies curiously figured and adorned? If for no other, but to exhibit such as Form, for the Ornament of the Universe, or to gratify the Curiosity of Man; these are but general Ends: Whereas the Parts of every Species of Body are formed and fitted to the particular Uses and Conveniences of that Body" (1713, p. 168). This teleological reasoning would lead to Cuvier's correlation principle, basic to comparative anatomy and vertebrate paleontology (cf. Cuvier, 1817); a variation echoes in Charles Darwin's emphasis upon natural selection and adaptation to habitat (Darwin, 1859).

Burnet had stressed continuing change and decay, against the Aristotelian notion of an eternal universe. (Nathanael Carpenter had introduced this "entropy" argument early in the seventeenth century—what is now called an appeal to the Second Law of Thermodynamics—as Suzanne Kelly noted, in Schneer, 1969, pp. 223, 224.) Ray agreed, but thought that the rate of change was diminishing. The posthumous Third Edition added: "In this Conjecture I find myself mistaken. For since the Writing hereof there have happened as terrible and destructive Earthquakes as any we read of in History" (1713, p. 291). Perceiving a balance between uplift, erosion, and deposition, he anticipated James Hutton's perspective (Hutton, 1785, 1788) and modern geology. Ray accepted reports that uplift by earthquakes occurred in the Andes (p. 13), as Woodward denied but Darwin would later observe (Darwin, 1962, p. 312).

Ray concurred with Burnet and Whiston that climate had changed from generally benign antediluvian conditions (Woodward rejected this, along with continuing change) but criticised their speculated causes, and considered that longevity had reduced as an effect (1713, p. 122). However, Burnet had also regarded the present world as "a dirty little planet" and a disorganized jumble, assuming that the primeval condition must have been a pristine sphere devoid of rough topography or seasonal variations. Ray protested that the world is admirably suited to its diverse inhabitants: that mountain ranges are more beautiful than uninterrupted smoothness, as well as useful to the water cycle (1713, pp. 34–37).

Woodward had denied the water cycle, assumed that springs, rivers and deluge were all supplied by a subterranean abyss. Ray dismissed the abyss on the basis of Genesis 1 (1713, p. 9): precipitation could explain the source of rivers.

Steno (1669) showed that strata normally occur in sequences from oldest at the bottom to youngest at the top of sections, while Woodward (1695) presumed that sequences were in the order of specific gravity, due to hydraulic sorting of suspended diluvial sediments (a concept adapted by Whitcomb and Morris, 1961, and other modern creationist literature). Ray observed that outcrops rarely matched the order implied by Woodward; rather, he supported Steno (Ray, 1713, p. 167).

Although Ray accepted a universal deluge, he ascribed most strata and their fossils to other causes. Marine sequences included fossils in growth position, indicating long-term deposition, so that he suggested origins in the millennium and a half (estimated) between Creation and Flood. On the other hand, logs from British peat bogs had most likely been cut down as recently as the Roman conquest (1713, pp. 146, 147, 172, 241).

Thus, John Ray represents a middle ground, maintaining both scientific and theological mainstreams. He expressed remarkably modern perspectives for his time, steered between extreme speculation and dogmatism when both were particularly rife, and influenced future investigators. His open-minded willingness to follow evidence, remain flexible, admit and correct error, sets an example for biblical scholars and scientists alike. Beyond that, he set a standard for useful, creative unemployment, deeply appreciated by this unemployed geologist.

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F. Bacon, Iconoclastic Herald

John Evelyn's frontispiece in the "History of the Royal Society" (1667) by Thomas Sprat, Bishop of Rochester, depicts a bust of Charles II, Founder and Patron, on a pedestal: on the left is the figure of the first F.R.S., the Irish mathematician William Brouncker; on the right, that of Francis Bacon, Artium Instouratio (restorer of the arts). In the preface the poet Abraham Cowley F.R.S., in his "Ode to the Royal Society," wrote: "Bacon, like Moses, led us forth at last." Sprat confessed that he himself would have preferred "no other preface but some of Bacon's writings." Bacon was basically a contemplative philosopher, but he chose to be a man of affairs in the world—he had two conflicting ambitions, to hold books and to raise a gavel. Although he became successfully Sir Francis at 42, Baron Verulam of Verulam (after the capital of Roman Britain) at 57, and Viscount St. Albans at 60, he is represented more truthfully by his burial monument in St. Michael's Church, St. Albans, with the inscription: "sic sedebat" ("thus he used to sit").

He was born January 21, 1561 in York House, London. His father, Sir Nicholas, was Lord Keeper of the Seal. He was from landed gentry; his favorite abode was Gorhamsbury, 2 miles from St. Albans. At 13 Francis entered Trinity College, University of Cambridge; a stronghold of the English Protestant Reformation. A good, but not outstanding student, he left without a degree two years later. He was unreliable with his many benefactions to Trinity, but a statue of him stands in its ante-chapel. His *Novum Organum* was dedicated to the University. At 18, upon the decease of his father, who willed him little (thus causing him disastrous financial straits throughout his life), he occupied his father's chambers at Gray's Inn. At 23 he qualified as a barrister; he was a competent lawyer. He was, however, more interested in theory than his arch rival and enemy, the practical jurist, Sir Edward Coke.

Concerned primarily with worldly success, at 23 he became a member of Parliament. Never a great favorite of Queen Elizabeth I, possibly owing to his ill-fated friendship with Robert Dererleue, Earl of Essex, and with Sir Walter Raleigh, he was appreciated more by the good natured, pious James I, who succeeded Elizabeth in 1603. At 42 he was knighted; two years later he was appointed Attorney/General. At that time he made a marriage of convenience with a 14-year old heiress, Alice Barnham—no children were born. (Bacon showed love only to his father and to his younger brother, Anthony.) Clever and crafty, restless and ambitious, at 59 he was charged with bribery by the House of Commons and impeached by the House of Lords; he was sentenced with a fine, confinement in the Tower, and disqualification for any public office. He did not contest the indictment; his crime consisted chiefly of a careless acceptance of gifts which had implications of expected favors. Despite his impeachment at 60, the King forgave the fine and had him released from jail within a few days. He died truly a Renaissance man at 65, after devoting his last years to writing.

"I have taken all knowledge to be my province," he had written at 31 to Lord William Cecil Burghley. At the same time he began a diary, which resulted in the publication of his *Essays* at 36. In general, he approached a subject simply and originally. His prose was rich, ornate, and supple. His life-time vision was the "Magna Instauratio" ("The Great Renewal"). This vision included, at age 59, the publication of *Novum Organum* (New Instrument) with aphorisms concerning the "Interpretation of Nature and the Kingdom of Man." At 62, he amplified *The Advancement of Learning* (published at 44) in Latin as "De Dignitate et Augmentis Scientiarum" (about the worth and increase of knowledge).

Bacon had formed a distaste for Aristotle's *Organon* (Instrument) while at college. He became opposed to the use of the syllogism for deduction and the later vices of the scholastics. He was, however, attracted by Aristotle's inductive method of logic—formulated more completely by the English economist, John Stewart Mill in the 19th century.

Aphorism 95 of the *Novum Organum* told of three methods of handling knowledge: (1) that of experimentalists, like the ant which only collects and uses; (2) that of reasoners like the spider, which makes cobwebs out of its own substance; and (3) that of middle-way persons like the bee, which transforms material from flowers and digests it by self-power. It was said that Bacon "rang the bell which called the wits together." His influence extended even to the French 18th-century Encyclopedists.

Bacon himself was not a scientist. William Harvey (Bacon's physician) said: "He wrote philosophy like a Lord Chancellor." Bacon did not even recognize the great scientists of his own time: e.g., Harvey, Andreas Vesalius, Galileo Galilei. He rejected Copernicus and spoke insolently of the work of William Gilbert, which illustrated his own views.

Strictly speaking, there is no so-called scientific method, but rather a scientific attitude, which embodies observation of nature, analysis, and synthesis. Bacon's primary contribution was his emphasis upon a systematic collection of facts. In this connection he recommended observational checks. (The Latin word for such trials is "experimentum," from which we get "experiment." Our modern meaning, however, has little in common with the Roman use.) His own method is well exemplified in his analysis of heat. One makes a list of all hot bodies, another list of cold bodies, a third list of those that are uncertain. Each list is then perused for common factors, called a Form or Vintage. One forms new lists in search of general laws by a process of elimination. Unfortunately, judgement is requisite in the very arrangement and selection. What is lacking, indeed, is the necessary insight and imagination—not to mention quantitative aspects leading to the future potentiality of mathematics, as well as the doubt about the usefulness of instruments. It is not surprising that not a single discovery was ever attained by Bacon's method. His celebrated, "Heat is not a substance, in itself, but motion" was merely a happy surmise, as well as his conjecture about the finite velocity of light. His suggested "experiments" were usually absurd. His major scientific contribution was to "think things, not words." His chief objective was the adage, "Knowledge is power." He regarded "the true and lawful goal of the sciences is none other than this: that human life be endowed with new discoveries and powers."

Bacon took as his own motto that which was inscribed above the Gorhamsburg fireplace: "Monita Meliora" ("Instruction Brings Improvement"). His *New Atlantis* (published unfinished a year after his death) is a remarkable vision of the modern research organization. His allegorical Salomon's House is "The College of the Six Days Works, dedicated to the study of the Works and Creatures of God." "The End of our Foundation is the knowledge of Causes and secret motives of things, and the enlarging of Human Empire, to the effecting of all things possible." There were many specialized facilities: deep caves, high towers, parks and enclosures for beasts and birds, perspective-houses, sound-houses, perfume-houses, and even a mathematics-house!—almost a description of the Naval Ordnance Laboratory at White Oak, Maryland, where I was once employed. The senior staff consisted of merchants of light, depredators, mystery-men, pioneers, compilers, Dowrey-men, Lamps, and Interpreters of Nature.

Bacon was not exceptionally moral or wicked. He was, at best, a nominal Anglican. In his 30's, his Puritan mother remonstrated her younger son to pray regularly twice a day—not like his negligent brother. (She herself had translated an ecclesiastical tract, published by the Bishops.) He did, however, have an interest in religion. When the Pope excommunicated the Queen in 1580, he advised her to proceed along a middle way between Anglicanism and Puritanism. He advocated so-called "double-truth"(cf. Averroes), i.e., reason and revelation. He kept philosophy separate from theology. He sought efficient rather than teleological causes. At 36, in the sixteenth of his *Essays* (3rd ed.), "Of Atheism," he wrote, "I had rather believe in all the fables in the Legend, and the Talmud and the Alcoran than that this universal frame is without a mind." He believed religion can prove the existence of God. "God never wrought miracles to convince atheism, because his ordinary works convince it." The third Essay is "Of Unity in Religion."

The sincerity of his religion has been questioned. In his will, he did leave a bequest to each of the nine parishes where he had lived. There is, however, certainly a ring of truth in his confessional prayer at the lowest point of his fall: "My soul hath been a stranger in the course of my pilgrimage"—a regret for the mistaken use of talents for the things for which he was least qualified.

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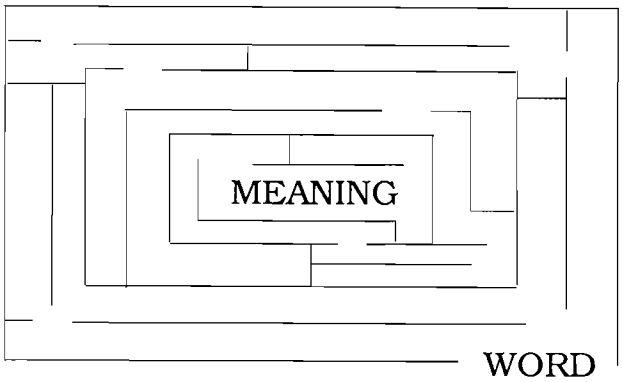
Twenty-fifth in a series by Raymond J. Seeger about scientists and their religion.

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 words are: "supernatural/natural."

The Dictionary definitions: ***supernatural:*** *"of or relating to an order of existence beyond the visible observable universe; departing from what is usual or normal, esp. so as to appear to transcend the laws of nature."* ***natural:*** *"being in accordance with or determined by nature; occurring in conformity with the ordinary course of nature; not marvelous or supernatural."* [Webster's Ninth New Collegiate Dictionary, Merriam-Webster, Springfield, MA (1979)].

* * * * *

People get into more misunderstandings because they think they know what "supernatural" and "natural" mean, but really don't. If the words are taken as being mutually exclusive, and "supernatural" means an act of God, then what does "natural" mean? The common conclusion is that "natural" means an event that is not an act of God. No wonder we get into trouble!

If our evidence for the existence and activity of God in the world is identified with specifically "supernatural" events, then every increase in our understanding that suggests a "natural" description of an event that previously had no such "natural" description appears to be a threat to our faith.

The dictionary is not very helpful to us. It tells us that the "natural" is "determined by nature," but as a matter of fact "nature" does not "determine" anything. It tells us that the "natural" occurs "in conformity with the ordinary course of nature," but what we mean by "the ordinary course of nature" depends at least as much on our current opinion of what that "ordinary course" is, as it does on what phenomena actually occur. It removes the "natural" from the domain deserving of awe or reverence by saying that the "natural" is not "marvelous."

The dictionary definitions for "supernatural" are reasonably consistent with its definitions for "natural." They make the "supernatural" and the "natural" refer to two quite separate realms. If an event is "usual or normal," then it is "natural;" if it "appears to transcend the laws of nature," then it is "supernatural."

The common approach to "supernatural" and "natural" supposes that they represent mutually exclusive concepts. If an event is "natural," then it has no "supernatural" component; similarly, if an event is "supernatural," it defies "natural" description.

If we are going to unravel this dilemma, we must start with the recognition that every event must be simultaneously considered in two ways, one expressed from a natural perspective and one from a supernatural perspective.

One way is to ask: What is the description of this event in terms of natural cause and effect categories? This is equivalent to asking: What is the scientific description? To say that an event is "natural" is to affirm that it is susceptible to scientific investigation. To say that an event is susceptible to scientific investigation does not imply that a scientific description provides all of the information of value about the

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

event, only that the event is such that some information can be obtained about it from a scientific investigation. To say that an event is intrinsically "supernatural," is to claim that no relevant scientific description can be given of it.

Another way is to ask: What is the meaning of this event? What is its purpose? How does this event relate to God, to His purposes, to the flow of history, and to ultimate reality? To consider such questions is to focus on a supernatural description for the event. It is a description that does not arise out of the event itself or its scientific description, but from a total context beyond it within which the event must be viewed.

It is essential, therefore, for us to realize two distinguishable ways of treating these two terms, "natural" and "supernatural." In one way, they express whether or not a particular event is appropriate for description through scientific investigation. This is a categorization of the kind of event. The transformation of a caterpillar into a butterfly, a sunset seen from a mountaintop, and the disappearance of electrical resistance of some superconductors when the temperature is lowered sufficiently are all natural events. That they are marvelous, few would debate. They are seen as members of that set of events that can be meaningfully described by scientific investigation. The Resurrrection of Jesus, and the many miracles He and His disciples performed to heal disease and demonstrate power over forces in the world, are examples of supernatural events. As far as we know, it is not meaningful to seek to express scientific mechanisms for their occurrence.

But at the same time we must remember that whenever we speak of any event in this world, we are speaking of a manifestation of the power and activity of God. Thus, a natural event is never one that occurs without the activity of God, but rather is one that represents our perception of God's normal or regular activity. Every natural event must be interpreted within a supernatural context as well as a natural one. The coming of rain can be described in terms of air pressure and temperature, but it can also be described in terms of answer to prayer. A cow may be seen as an example of bovine biology, but how we treat the cow will depend on whether we see it as a creature made by God for specific purposes or not.

In addition, we recognize the possibility and historical occurrence of the special activity of God that does not follow His normal pattern: acts that we recognize by the name "miracle."

All events that take place in the created universe are manifestations of the free activity of God. A natural event is one that is susceptible to scientific description, but also to interpretation within the context of a larger supernatural perspective. An intrinsically supernatural event is one that is not susceptible to scientific description, but brings out of its own context a particular revelation of God and His purpose.

Do you agree that it may be natural to wonder at the supernatural, but it is no less supernatural to wonder at the natural?

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Book Reviews

THE EMERGENCE OF LIFE: Darwinian Evolution from the Inside by Sidney Fox. New York: Basic Books, 1988. 208 pages, index. Hardcover; $17.95.

Biochemist Sidney Fox directs the Institute for Molecular and Cellular Evolution at the University of Miami. He believes that proteins came first (i.e., before nucleic acids) in a stepwise transition from nonliving matter to the first cells capable of true Darwinian natural selection. He has parlayed "thermal copolymerization of amino acids to a product resembling protein" (the title of his 1958 *Science* paper with K. Harada), into an ever-expanding model of how life began. In *The Emergence of Life*, he tells the general reader how the model developed and why it is profoundly significant.

Fox's apologia pictures him as the natural leader of the protein-first school of origin-of-life (OOL) researchers. Why so few followers? Because, he says, the "channeled thinking" of neo-Darwinian biologists forces them to deny that Fox's pre-DNA "protobiology" has anything to do with real biology. Chemists, channeled into analytical, reductionist thinking, are slow to appreciate his "constructionist" approach.

My appreciation for Sid Fox goes back to his 1945 review in *Advances in Protein Chemistry*, which stimulated my interest in peptide chemistry and influenced the course of my research. His 1955 move to Florida State opened up a post for me at Iowa State and space for my students in his old labs. And in the flurry of excitement following Stanley Miller's

1953 OOL experiments, I applauded Fox's preference for experimentation over speculation.

Yet Fox's writings, including this book, have disappointed me ever since he discovered that aqueous treatment of his proteinoids yielded rather uniform microspheres. He immediately dubbed them "protocells" and began referring to their protometabolic and protocommunicative properties.

Fox easily forgets (or wants us to forget) that he's describing a mere model, dropping the prefix or making excessive claims with no hint that they are intended as metaphors. He speaks of molecules making *choices* (p. 4). For Fox, human cooperation has its basis in the *co*-polymerizing of amino acids (p. 59). To his credit, when discussing the social life of protocells, he puts the "dating" and "mating" behavior of "adult" members of the community in quotation marks (p. 84). From the attraction shown by his microspheres, however, "a moralist can deduce that friendship rather than hostility is a natural evolutionary legacy for mankind" (p. 86).

Obviously, nothing is "mere" about Fox's model. He chides others for saying that DNA copies it*self*, but harps on the *self*-ordering of amino acids. Indeed, *selforganization* (written without a hyphen) forms the basis of a whole new evolutionary paradigm (for which he claims a share of the credit) and of the book's subtitle. "Inside" Darwinian evolution, a fundamental nonrandomness operates before random mutation or any other source of variation (or even DNA) appears.

Three "Conversations," in which the author answers questions about his work, and a few other first-person passages are quite readable. Elsewhere, Fox's unique way of referring to himself obliquely comes across as a blurring of the facts rather than as modesty or objectivity. His account of the moon-rock analyses seems almost deliberately confusing (pp. 15–18; FN 8 on p. 186). Readers cannot judge claims for the catalytic activities of proteinoids (p. 101), or even their chemical characterization (FN, p. 168).

The selfcongratulation in this book is less blatant than in Fox's chapter in Ashley Montagu's *Science and Creationism* (1984, p. 229). There, as one "mode of recognition of the state of the proteinoid art," Fox cited an "encyclopedic listing of what is equivalent to 'laboratory synthesis' of a primitive organism." The citation was to *Who's Who in the World*—whose biographees write their own entries.

As his contribution to philosophy and quantum physics, Fox seems to have found the evidence Einstein lacked to show that the world is deterministic (pp. 159–169). Yet cooking up animo acids produces "an array of thermal protein molecules of sharply limited heterogeneity," so the world's determinism must be "soft." Fox rejects Oparin's coascervates as models for protolife because the materials of which they were composed came from already highly evolved organisms. A good bet is that Fox uses animo acids purified by highly evolved organic chemists.

After reading *The Emergence of Life*, I suspect that Sidney Fox would readily accept the Nobel prize. I can't say whether or not he deserves it, or whether receiving it would improve his writing style. I *can* say that a much better way to learn about Fox's work is to read the "Bubble, Ripples, and Mud" chapter in Robert Shapiro's *Origins: A Skeptic's Cuide to the Creation of Life on Earth* (Bantam Books, 1987).

Reviewed by Walter R. Hearn, editor, ASA/CSCA Newsletter, 762 Arlington Ave., Berkeley, CA 94707.

SCIENCE HELD HOSTAGE: What's Wrong with Creation Science *AND* Evolutionism by Howard J. Van Till, Davis A. Young and Clarence Menninga. Downers Grove, IL: InterVarsity Press, 1988. 189 pages. Paperback.

This book results from the participation during 1984–85 of its three authors in the Calvin Center for Christian Scholarship at Calvin College, where Van Till is Professor of Physics, and Young and Menninga are both Professors of Geology. Of the nine chapters in the book, five are written by Van Till, together with an introduction and an epilogue, two are written by Young, and two by Menninga. Van Till served as general editor for the study.

The authors are well known for their consistent contributions to a Christian appreciation of the guidelines for integrating inputs from authentic science and from authentic biblical theology. It is primarily their desire to maintain the integrity of authentic science that motivates them in this book, knowing that the practice and interpretation of authentic science and theology are closely interrelated.

Part 1 of the book consists of two chapters dealing with "Science as Practiced by Scientists," written by Van Till following the outstanding presentation he has previously given in *The Fourth Day: What the Bible and the Heavens Are Telling Us about the Creation*. These chapters present a clear and concise delineation of what it means to do authentic science today. The crucial message is summed up:

> Science held hostage by any ideology or belief system, whether naturalistic or theistic, can no longer function effectively to gain knowledge of the physical universe. When the epistemic goal of gaining knowledge is replaced by the dogmatic goal of providing warrant for one's personal belief system or for some sectarian creed, the superficial activity that remains may no longer be called natural science. (p. 41)

It is the central purpose of the book to illustrate how the pursuit of authentic science has been corrupted both by those who would subject science to metaphysics and theology, as well as by those who would attempt to base their metaphysics and theology upon science.

Part 2, "Science Held Hostage by Creationism," discusses four cases in which so-called "scientific creationism" has departed from authentic science while claiming the support of science: the shrinking sun (Van Till), the depth of dust on the moon (Menninga), age determinations from analysis of seawater (Menninga), and interpretations of the geologic column (Young). These chapters can at times become rather

technical, but the degree of such technicality is necessary for the full demonstration of the message.

Part 3, "Science Held Hostage by Naturalism," considers examples of well-known writers who have claimed to derive philosophical conclusions from science, but have really used science to defend and justify their own philosophical convictions. Young considers Isaac Asimov's *In the Beginning*, and Douglas Futuyama's *Science on Trial*. Van Till analyzes P.W. Atkins's *The Creation* and Carl Sagan's popular television series, *Cosmos*.

Others in the past have referred to activity that claims the support of science but violates the integrity of science as "pseudo-science." Van Till chooses the softer sounding "folk science," an effective analogy with "folk medicine." He says:

> Creationist folk science (more commonly called "creation-science") strives to warrant its belief in a particular concept of divine creation by means of unconventional interpretations of selected empirical data. Naturalistic folk science seeks to warrant its belief in reductive materialism by constructing arguments which have the appearance of being logical extrapolations from the results of professional natural science. In neither case are the boundaries of the domain of natural science honored. In both cases science has become indentured in the service of an ideological or religious commitment. (p. 153)

This is an important message, well worth repeating in the often confused climate of today.

This book is an excellent learning device for those interested in understanding the relationship between science and Christian faith. I heartily recommend it to readers from a wide variety of backgrounds.

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

THE EARLY EARTH: An Introduction to Biblical Creationism (revised edition) by John D. Whitcomb. Grand Rapids, MI: Baker Book House, 1986. 174 pages, index, bibliography. Paperback.

John Whitcomb, professor of theology and Old Testament at Grace Theological Seminary, and perhaps best known for *The Genesis Flood* which he wrote with Henry Morris, has revised and expanded *the Early Earth* which was first published in 1972. The subtitle correctly identifies the subject as biblical creationism, not scientific creation. For anyone confused by the creation-evolution debates, the simple and straightforward approach to origins by Whitcomb might be very appealing. Whitcomb believes that "The fundamental issues, in the matter of ultimate origins, is whether one puts his trust in the written Word of the personal and living God who was there when it all happened, or else puts his trust in the ability of the human intellect" (p. 52). Trust in the written Word means to accept the Genesis account of creation as historically and scientifically accurate. Since creation was supernatural, it can be understood by the human mind only as the Holy Spirit gives insight through special revelation.

In *the Early Earth*, Whitcomb has presented supernatural instantaneous creation in six literal days of the creation week as the only logical and ultimately satisfying way to understand the harmony of God's written record and His revelation in nature. The five chapters of the book roughly follow God's activities during the six days of the creation week. Explanations are provided for some interesting questions, for example: "Why did God create the sun, moon, and the stars on the fourth day rather than the first day?" (p. 71). The main purpose of the book is to demonstrate that the literal six-day interpretation of the creation account of Genesis is the way in which God intended. "If God has told us of his creative methods, the order of events in the creation of various entities, and the amount of time which elapsed between these creative acts, we have no one to blame but ourselves for our ignorance" (p. 160). Whitcomb argues that the various attempts to accommodate belief to prevailing scientific theories, like the Double-Revelation theory, the Day-Age theory, the Ruin-Reconstruction theory and theistic evolution, or various interpretations of Genesis (e.g., the concordist interpretation or the literary framework) are ultimately unsuccessful and can lead to a destruction of the theological and historical credibility, not only of Genesis, but of the rest of the Old Testament (p. 70).

Whitcomb has well represented the case for biblical creationism in *The Early Earth*. That it is biblical creationism and not scientific creationism is illustrated by his four evidences for a literal seven-day creation week which are biblical evidences (pp. 28–40). Some science is discussed, e.g., in the presentation of nine of the basic problems that remain to be solved by evolutionary cosmogonists relating to the origin of the earth (pp. 57–62).

Several recent books including those by Blochers, Hummel, and Van Till are critically but briefly discussed. Whitcomb reviews the usual arguments presented against evolution but does not discuss what I believe to be perhaps the most important arguments from chemistry relating to the origin of life. I truly appreciate the faith and sincerity of men like Whitcomb, but I find that answers to questions in the realm of origins do not come quite as easy or simple for me. I personally believe that the theory of general evolution is not scientifically established and is very much a faith proposition, but I cannot easily set aside major positions of science as I believe Whitcomb does.

Reviewed by Bernard J. Piersma, Professor of Chemistry, Houghton College, Houghton, NY 14744.

THE GENESIS DEBATE by Ronald Youngblood (ed.). New York: Thomas Nelson Publishers, 1986. 250 pages. Paperback; $12.95.

Readers who want contrasting viewpoints of controversial issues will enjoy *The Genesis Debate*. Unlike the Bible-

question books that present many questions, each with a short answer from only one viewpoint, this book addresses only 11 questions and gives two different, more comprehensive, answers to each question. The pro and con viewpoints of each question were written by different persons who were allowed to read the essay on the other viewpoint and then modify their original answer if they wished.

All but one author were college faculty who taught in anthropology (2), geology (3), theology/religion/philosophy (4), or Old Testament/Bible (11). Youngblood, professor of Old Testament at Bethel Seminary West, is editor of the *Journal for the Evangelical Theological Society* and has previously written the books *Genesis 1-11* and *Evangelicals and Inerrancy.*

The subtitle to *The Genesis Debate* is *Persistent Questions About Creation and the Flood.* Youngblood selected what he considered to be "the most significant questions covering matters of interest to the widest possible range of readers." The questions are: (1) Were the days of creation 24 hours long? (2) Are the events in the Genesis creation account set forth in chronological order? (3) Was the earth created a few thousand years ago? (4) Was evolution involved in the creation process? (5) Is the doctrine of the trinity implied in the Genesis creation account? (6) Was Cain's offering rejected by God because it was not a blood sacrifice? (7) Were there people before Adam and Eve? (8) Did people live to be hundreds of years old before the flood? (9) Are the "sons of God" in Genesis 6 angels? (10) Did Noah's flood cover the entire world? and (11) Does Genesis 9 justify capital punishment? Each question is handled in a unique format with the "Yes" answer occupying the upper part of several pages and the "No" answer appearing in bold faced type on the lower part of the same pages.

The Genesis Debate presents an informative debate with enough balance and depth to satisfy most readers. It avoids superficiality and yet does not devote more space and time to these questions than they merit. They have much more interest to us than they have importance to the main gospel message. The strength of some arguments may prompt readers to wish that their (stronger) advocate had been one of the debaters. In general, the questions were handled rather well. I doubt that many will change sides of the argument but at least they have a chance to review the basis for their position and to learn why others believe as they do. Having at least two different viewpoints by different authors adds a broader perspective and also avoids much of the bias inherent when only one author tries to present opposing sides. Ample endnotes refer to more extensive treatment of each position.

I recommend *The Genesis Debate* for anyone interested in contrasting views of these 11 questions.

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

Books received and available for Review

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

D. Brooks and E. Wiley, *Evolution As Entropy,* (2nd ed.), University of Chicago

F. Bruce, *The Canon of Scripture,* InterVarsity Press

W. Carey, *Theories of the Earth and Universe: A History of Dogma in the Earth Sciences,* Stanford University Press

L. Crabb, *Real Change is Possible if You're Willing to Start from the Inside Out,* Navpress

R. Culver and P. Iannna, *Astrology: True or False?* Prometheus Press

G. Dalbey, *Healing the Masculine Soul: An Affirming Message for Men and the Women Who Love Them,* Word Books

R. Ferm, *Billy Graham: Do The Conversions Last?* World Wide Publications

E. Earle Fox, *Biblical Sexuality and the Battle for Science: Healing the Sexual Turmoil of Our Time,* Emmaus Ministries

C. Garrison, *Two Different Worlds: Christian Absolutes and the Relativism of Social Science*

I. Hexham and K. Poewe, *Understanding Cults and New Religions,* Eerdmans

J. Jividen, *Miracles from God or Man?* A.C.U. Press

J. Le Goff, *Your Money of Your Life: Economy and Religion in the Middle Ages,* Zone Books

J. Masson, *The Assault on Truth: Freud's Suppression of the Seduction Theory.* Farrar, Straus and Giroux

V. Matthews, *Manners and Customs in the Bible,* Hendriksen Publishers

M. Muggeridge, *Confessions of a Twentieth-Century Pilgrim,* Harper and Row

D. Patten, *Catastrophism and the Old Testament,* Pacific Meridan Publishing Co.

J. Perry, *Tillich's Response to Freud: A Christian Answer to the Freudian Critique of Religion,* University Press of America

M. Phillips, *What Every Christian Should Know about the Supernatural,* Victor Books

R. Proctor, *Racial Hygiene: Medicine Under the Nazis,* Harvard University Press

G. Rekers. *Counseling Families,* Word Books

J. Robbins, *Diet for a New America: How Your Food Choices Affect Your Health, Happiness and the Future of Life on Earth,* Stillpoint

J. Roberts, *Darwinism and the Divine in America,* University of Wisconsin Press

E. Skoglund, *A Divine Blessing: A Well-Kept Secret of Life's Second Half,* World Wide Publications

P. Vintz, *Sigmund Freud's Christian Unconscious,* Guilford

E. Wilson, *Counseling and Homosexuality,* Word Books

THE GOD WHO IS REAL: A Creationist Approach to Evangelism and Missions by Henry Morris. Grand Rapids, MI: Baker Book House, 1988. 85 pages. Paperback.

Henry Morris was for many years the Head of the Department of Civil Engineering at Virginia Polytechnic Institute, and since 1970 has been the Director of the Institute for Creation Research. He is perhaps most widely known for *The Genesis Flood,* written with John Whitcomb and published in 1961, and has been at the forefront of the Creation-Evolution debates for thirty years. Morris believes that modern man cannot be reached by preaching from the Scriptures since the Bible is rejected because of indoctrination into evolutionism and humanism. "Most of the leaders in our modern scientific

and educational establishments, as well as practically all New Age Organizations, still look toward such goals (a world government of socialism and a world religion of humanism)." This is why they oppose the modern creationist movement which wants to restore commitment to the God of creation. The basic thesis which Morris develops is that to reach modern man with the saving gospel of Christ, he must be approached on the basis of creationism, exposing the follower of evolutionary atheistic or pantheistic premises.

This thesis is developed in five short chapters: (1) The Impotent God of Chance, (2) The Immoral God of Pantheism, (3) Science and the God of Creation, (4) The God of the Bible, and (5) The God of all Grace. The first three chapters touch in a very brief way, many of the arguments presented by Morris in numerous other publications against evolution and for creation. For anyone not familiar with his work, Morris believes that the Genesis record is completely historical and scientifically accurate, and proper understanding requires Christians to accept a literal seven-day, approximately twenty-four hours per day, creation week. Theistic evolution "is not only completely contrary to the teachings of the Bible, but is also completely incompatible with an omniscient, merciful God" (p. 32). After arguing that evolutionism "will satisfy neither the data of science nor the spiritual needs of mankind" in the first three chapters, chapter four surveys "the history of God's dealings with the various nations of the world." Here Morris asks and then provides answers for several questions that help in understanding God's purpose for His creation. Chapter five provides some common ground for all Christian readers (although I expect Morris might disagree with me on this). We can certainly join in his closing prayer "that many readers will open their hearts and minds to the God who is real, the God who created them, the God who, in Christ, died to save them and rose again from the dead to assure them eternal life" (p. 80).

Reviewed by Bernard J. Piersma, Professor of Chemistry, Houghton College, Houghton, NY 14744.

ONE WORLD: The Interaction of Science and Theology by John Polkinghorne. Princeton: Princeton University Press, 1986. 114 pages, notes, glossary, index. Paperback; $7.95.

Are you an odd, incongruous mixture of incompatible elements? Nor am I, but what do your colleagues think? During a break on an archaeological excavation, a fellow graduate student shifted the conversation slightly by saying: "I don't think it is possible to be an anthropologist and also a member of one religion." This was no random remark; she knew that among those listening was one who thought himself both. Despite the special twist of cultural relativism, this may have a familiar ring to *Perspectives* readers. Why do so many believe science and religion are opposed? John Polkinghorne sees it as the result of misunderstanding both, and his book, *One World*, can be a valuable corrective.

There is only one world, and both science and theology are "concerned with exploring, and submitting to, the way things are" (p. 97). Polkinghorne traces the uneasiness in their relationship to the Enlightenment. While an emphasis on use of reason to understand an objective world did not logically deny the reality of religious experience, it made it seem irrelevant. But we have gone beyond the Enlightenment; the world known to the 20th century is more curious and complex. Chapters 2 and 3 describe science and theology. If one considers actual practice, science is removed from the "pedestal of rational invulnerability" and revealed as a subtle activity involving participant judgement. Yet it is more than socially conditioned speculation; our understandings are dictated by the way things are. The more personal a subject, the more we risk being trapped by our culture. But theology is rational reflection on religious experience, not unmotivated assertion. Thus, theology too concerns the way things are. Chapter 4 presents ten aspects of the physical world in the current scientific view, and 5 and 6 move on to how they relate. The heart of the book, this section draws directly on the base already set. The interaction of science and theology is covered under: (a) areas of perceived conflict, (b) natural theology, (c) mutual influence of habits of thought, and (d) levels of discourse vs. reductionism. Chapter 7 concludes.

It is clear that this professor of theoretical physics (now honorary) and Anglican priest, has thought deeply on those issues. He is also a good writer. Even those ideas I have heard before were here more fully digested and clearly presented. This is a book of sweeping synthesis, but Polkinghorne uses many examples to illustrate his often abstract points. He puts the concept of quantum-level uncertainty to good use as a analogy to help us understand a complex point, while largely avoiding the temptation to base metaphysical conclusions on these findings.

Specialized knowledge is not assumed, and the mingling of theology and physics is smooth and flowing, never strained, as if itself illustrating their compatibility. Yet this rapid synthesis and summation has its disadvantages: where he fails to convince on the first pass, he frustrates. For example, he notes Mackay's idea that chance means unknown causation, and all is in God's control, but asks: "Why has God chosen to hide his hand under the appearance of randomness?" (p. 68). His alternative has much to commend it, but I wonder if this does not miss the point. If I understand Mackay, chance is an artifact of limited knowledge; God does not need to hide his hand for the blind to miss it.

In another instance, he says he does not believe the sun stood still for Joshua to fight the Amorites. He gives no explanation, and I do not find his alternative satisfying. Though I wish for further clarification, Polkinghorne has moved on. Lest I give the wrong impression, he then states that the resurrection is at the heart of Christianity. And in dealing with miracle he characteristically seeks a perspective accounting for all relevant information, noting that one must consider why miracles do not happen more often, not merely why they happen; they must be part of a unity of divine action and purpose (p. 75).

When people ask how one can be a geologist *and* a Christian, they are often not asking at all but declaring it

impossible. My friend did the reverse; she phrased her remark as a statement but was really asking a question. I do not recall my answer (and it may be just as well), but I know it would have been both deeper and clearer had I read this book. There is no substitute for personal testimony, however halting, but *One World* will benefit both those called on to answer, and those asking these questions. It may be most illuminating for one who has not studied this area in depth, but it has none of the blandness of an introductory summary and should prove stimulating for its synthesis of thought and clarity of expression, even where one is familiar with the basic propositions.

Reviewed by Paul K. Wason, Instructor in Anthropology, University of Louisville, Louisville, KY 40214.

SCIENTIFIC GENIUS AND CREATIVITY by Owen Gingerich (ed.). San Francisco: W.H. Freeman, 1987. 110 pages. Paperback.

This book is a convenient collection of twelve brief articles published by *Scientific American* over the past thirty-six years. The editor, a Smithsonian astrophysicist, Harvard science historian, and ASA member, selected the articles. It is not clear why these twelve articles were chosen or why they had all appeared originally in one journal. Unfortunately, no check can be made with the original articles because specific references are not given. One would like to know if the synoptic sentences under each title, the photos, and the biographical paragraphs in the appendices are due to the editor. Not everyone may agree with his choice of Darwin's photo on the cover as representative of this group of scientific geniuses. It would have been helpful if the editor had expanded his one-page introduction to include a comparison of the scientific creativity exhibited.

Only two articles deal with the general nature of scientific creativity, which is not defined. This is not surprising, inasmuch as the title is an afterthought. The first one, "The Creative Process," is by the late mathematician Jacob Bronowski, who believes "a man becomes creative, whether he is an artist or a scientist, when he finds a new unity in the variety of nature." I do not, however agree with his dictum that "the creative activity lies here in the process of induction." The imaginative choice is made by speculation as to the sequential terms beyond our experience. The initial selection, however, of deduction axioms is equally imaginative. The last article, "Prematurity and Uniqueness in Scientific Discovery," by the biologist and bacteriologist Gunther Stent, agrees that there "is no profound difference between the arts and the sciences in regard to the uniqueness of their creations." I agree with his conclusion that "art is no less cumulative than science, in that artists no more work in a traditional vacuum than scientists do." I do not quite agree that paraphrases of great artistic creations generally require a genius equal to that of the original creator in contrast with scientific revisions (cf., Einstein and Newton).

Nine articles are essentially biographical sketches which contain illustrations of their scientific creations. William Harvey was "the first biologist to use quantitative methods to demonstrate an important discovery," viz., the circulation of the blood. Robert Boyle was novel in "his notation that one could prove a scientific theory by experiment." Lavoisier was the founder of modern chemistry. Carl Friedich Gauss did for number theory what Euclid had done for geometry. Evariste Galois was the author of group theory, and was killed in a duel at the age of twenty. Joseph Henry discovered electromagnetic induction before Michael Faraday did. Darwin's *Origin of Species* is one of the great books of all times. Alfred Wegener was an astronomer turned meteorologist and geophysicist. Robert Millikan had a "penchant for controversy in subjects ranging from cosmic rays (which are still a mystery he named) to the support of science." The last article deals with Newton's discovery of gravity. I do not agree with the claim that this marked the beginning of modern science.

Reviewed by Raymond Seeger, 4507 Wetherill Rd., Bethesda, MD 20816.

THE NEW STORY OF SCIENCE by Robert M. Augros and George N. Stanciu. New York: Bantam Books, 1984. 184 pages, notes, index, bibliography. Paperback; $3.95.

The New Story of Science has value for all readers including scientists, persons curious about science, Christians, agnostics, and atheists. In recounting the return of the mind to a place of preeminence, the authors open minds with remarkably clear language refreshingly free of jargon or condescension. With its strong emphasis on science, as manifested through its Old and New Stories, the book's theme is actually historical and contemporary world views.

According to the authors, we are living in an era of transformation, leaving behind the exclusive materialism of the Old Story but not yet accepting the more spiritual New Story. The former, some 300 years old, is scientific materialism. According to this view, only matter has existence. Everything can and must be explained "scientifically"; i.e., exclusively in terms of matter. Free choice is an illusion, there is no purpose behind natural phenomena or entities. Scientists, moreover, are merely detached spectators.

The New Story, originating with the revolutionary thinking of Einstein, holds that the material concept of the natural order is insufficient. Certain phenomena stand outside the material world, transcending it. Primary among these is the human mind. The New Story holds mind and free choice just as real as material objects. Furthermore, there is a purpose in nature present from the moment of creation—the Big Bang.

Central is the Anthropic Principle, a conception of the cosmos as designed *from the beginning* with the exception that the mind of the *participating* observer will enjoy equal status with the material world. The thesis is advanced through a progression of precisely structured chapters, frequently drawing from the recorded thoughts of scientists.

The authors proceed from the basic premise of the Old Story: Newtonian physics. Time and space are conceived as

absolutes which are infinite, universal, and unchangeable. But then the progression opens to examine the mind, neatly paralleling the preceding structure with sharp analogies. Having re-introduced the mind, the authors enter into an insightful analysis of beauty from the scientist's vantage point.

To the analytical mind, beauty is a central principle of scientific endeavor. Beauty is non-existent or simply dismissed through the Old Story, but it is intrinsic to nature with the New. To proponents of the New Story, beauty is simplicity, symmetry, elegance, "*rightness*," universality—a certain harmony coupled with brilliance.

From the place of beauty in science the authors turn to the place of theology. While religion has always been significant to some scientists, those faced with the precepts of the Old Story are hard-pressed to find any place for theology. Not so the New Story with its cosmology of a universe expanding from a *beginning*. All those "coincidences" and "fortuitous" events in nature actually have direction and lead inevitably to the conclusion: "Though man is not at the physical center of the universe, he appears to be at the center of its purpose" (p. 70). That conclusion points inevitably to the mind directing the scientists' cosmology. Is God not equally inevitable?

The authors themselves confess no personal religious conviction. That is the province of the reader's own mind. And only the scientist who is also a believer in an immanent God can fully appreciate their extraordinary message. It is a tribute to the authors' succinct yet poetic prose that anyone fortunate enough to discover this volume should come away with a freshened outlook.

Ironically, the Old Story *depends* largely upon imagination but cannot transcend it. In the New Story, mind transcends the material through *escaping* restrictions of the imagination. The exquisite irony is that, while the Old Story represents hard-headed acceptance of "reality," the New is more intellectual and, therefore, the more demanding world view. Since the Old Story would exclude the spiritual side of humanity, a sense of poetic justice emerges from the more inclusive concept of reality of the New.

The remainder of the text is almost anticlimactic. But it remains for the authors to allow the New Story to lift mankind out of sterile behaviorism into the fullness attending the primacy of the human mind and will: ". . . In the New Story of Science, the ordinary man, the scientist, and the philosopher can know the world, and the artist can render the fullness and richness of that world in his art" (p. 139). All these endeavors are complementary. Furthermore, the New Story does not destroy but builds on the Old in reaching that most profound realization: Man is truly at home in the universe. The ultimate inferences are quite properly left to the individual reader.

Reviewed by Dorothy J. Howell, Adjunct Visiting Professor, Environmental Law Center, Vermont Law School, South Royalton, VT 05068.

TRANSCENDENCE AND PROVIDENCE: Reflections of a Physicist and Priest by William G. Pollard. Edinburgh: Scottish Academic Press, 1987. 264 pages, index. Hardcover; $17.00.

This collection of essays, written between 1956 and 1987, reflect the author's personal journey in the field of theology and science with a warmth and insight that allows the reader to sense the power of the providence of God in the life of one man. The sixth in a series of publications for the Center of Theological Inquiry at Princeton under the general editorship of the distinguished Professor Thomas F. Torrance, the book continues to call both scientists and theologians to seek afresh to apprehend the significance of "a vast shift in the perspective of human knowledge" upon the influence evident between theological science and natural science. The essays generally argue for a new appreciation of the unique singularity which is created reality and that transcendency which is necessary for grasping the truth of the wholeness of the nature of life.

A physicist turned priest, Pollard has argued that we must admit that the scientific culture of Western civilization would not have been possible without our biblical heritage. He claims the ground upon which those concepts necessary for the development of our probing into the nature of the universe are found in the Judeo-Christian tradition. The contingent intelligibility of the character of the world is thus bound up with the creative freedom of a transcendent God.

I enjoyed the way the essays move from the author's personal role in the discovery and making of the atomic bomb, through modern society's skepticism about any kind of scientific utopia and its guilt complex over its moral responsibility to the creation, into a fresh effort for a deeper appreciation of the roots of the Judeo-Christian tradition. The range of these essays allows our author to survey the state of the art across a wide spectrum of scientific disciplines, from quantum to evolution theories, with an effort that seeks to throw light upon the meaning and purpose of the scientific enterprise itself. I believe scientists will benefit from the author's arguments that would keep open the structures of scientific knowledge, and theologians will benefit from his call for realism in theological knowledge.

I do have one deep reservation about this book. In his effort to relate transcendent realities with those of physical nature, Pollard has resorted to articulating his encounter of God and the world by reference to Otto's *numinous* experience of the *mysterium tremendum*. I believe this is a mistake that is rooted in our tendency to divorce word from being, a mistake against which the early fathers of the Church fought. I would suggest that Karl Barth's discussion of the incomprehensibility of God is much more to the point here, since he does not allow throughout his *Church Dogmatics* the Word of God to be understood except as rooted in the very being of God Himself. I believe in this way appropriate guards are established which would help us avoid this tendency and allow us to be free and courageous in our efforts to articulate what we have been given to know of the great I AM.

Reviewed by John McKenna, Adjunct Professor, Fuller Theological Seminary, Pasadena, CA 91101.

HEALING THE EIGHT STAGES OF LIFE by Matthew Linn, Sheila Fabricant, and Dennis Linn. Mahwah, NJ: Paulist Press, 1988. 263 pages. Paperback; $6.95.

The eight stages of life referred to in the title of this book originated with psychologist Erik Erikson. Best known for his theory which charts the course of human development throughout life, Erikson expanded on Freud's theory of four psychosexual stages of development. His theory presents the psychosocial stages which individuals pass through from birth to death. The authors of this book like Erikson's theory because it emphasizes healthy development, the ability of individuals to heal past psychological wounds, psychosocial rather than psychosexual development, development as a lifelong process, and the balance between the assets and liabilities of life's stages.

This book integrates ideas from Erikson with those on the value of healing prayer for each stage of development which may have gone awry. To make the book relevant, the authors give many case studies and many pertinent quotes. The 23 pages of notes expand on the material presented in the book and also provide bibliographic information for further study. An appendix provides a helpful list of courses, books, and tapes. Each chapter ends with some suggestions for applying what has been discussed.

Some of the more interesting notions this book contains are that homosexuality may be the result of failure to establish trust with the same-sex parent, hell may be an abstract possibility which no one will experience, sexual abuse may occur as often with boys as with girls, and adults need 12 hugs a day for growth!

The authors work together as a team seeking to help people attain physical, emotional and spiritual wholeness through their writings and retreats. They have lectured in many countries and universities and authored many other books in this same general area of Christian healing and deliverance. This book, simply written, provides insight and inspiration. It can benefit psychology students, counselors, and Christian laypeople who want to heal past hurts and experience future growth.

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

THE BETTER HALF OF LIFE by Jim Geddes. Nashville, TN: Broadman Press, 1987. 192 pages, bibliography. Paperback.

Jim Geddes is a clinical psychologist and a Southern Baptist pastor with extensive experience in church planting in Canada. Much of the content of the book reflects his knowledge of psychological and sociological studies on the subject of aging. As he deals with attitudes toward the various stages of life, he presents the "scientific" point of view which is then complemented by the Christian perspective.

The book is divided into two parts: "The Aging Process" and "The Life Span." In the first five chapters, the author builds a case for optimism with such chapter titles as "The Second Half Is Better," "A Strategy of Joy," and "Old Brains Are Better." The second part looks at the stages of life. Chapter titles include "Mid-Life Crisis," "The Happy Time—Ages 55 to 65," and "The Crowning Years—A Study of Dying."

The bibliography contains fifteen entries, representing the field of psychology, the social sciences, and gerontology. The book contains many lists and charts. These deal with such topics as "phases of the second half of life," "rules for the first half and the second half," "The Longevity Commandments," "Jung's Four Stages of Life," and "Turning Anxiety into Motivation."

The main point the author makes is that life can be productive and joyful from childhood to the death bed, if people approach the several stages of life with proper attitudes. Much of the book consists of suggestions for adapting to the changing conditions of life. Many of the guidelines are based on scientific studies and apply equally to Christians and non-Christians; but Geddes makes it clear that only the Christian has the joy of looking forward to eternity with Christ.

The book probably would be more readable and useful if it had a narrower focus. Some suggestions are directed at young or middle adults: "We ought not to pursue joy, but joy will come as we pursue the prerequisites" (p. 25); "When youth is over, let it go" (p. 89); "Stop blaming others. Stop depending on them for so much" (p. 183). Others are directed at the relatives of older persons; they are advised to allow the aging relative as much independence as possible. A word of wisdom which seems meant for younger parents is: "Young people who have to struggle hard for their existence are usually spared many problems" (p. 68).

Nevertheless, *The Better Half of Life* has much to offer to older persons. Topics include deciding when to retire, hobbies, nursing homes, living with family, sharing one's experience and knowledge, exercising the body and the mind, dealing with depression, anxiety, loneliness, and boredom, and the fear of death and dying.

This reviewer doubts that this book will appeal to the typical older person because it has somewhat of a textbook style. It devotes much space to classifications of various life stages, and there is a good deal of repetition, probably designed to facilitate retention. On the other hand, anyone who counsels adults of *any* age, especially Christian adults, will find lots of ideas and illustrations that should prove very useful.

Reviewed by Ralph Kennedy, Retired, John Brown University, Siloam Springs, AR 72761.

COUNSELING THOSE WITH EATING DISORDERS by Raymond E. Vath. Waco, TX: Word Books, 1986. 215 pages, index. Hardcover.

A clinical professor of psychiatry at the University of Washington, Vath also has a private practice that has given him many successes with patients with anorexia and bulimia, under- and overeating. Chosen by editor Gary R. Collins to write this volume, fourth in a series on Resources for Christian Counseling, the author gives the bases for dealing with such patients and numerous illustrations from real life. Good advice on eating habits is also considered for each of us.

The nature, causes, and consequences of anorexia nervosa and bulimia are elaborated and the treatments of such disorders selected from both science and Scripture. The bibliography indicates the more useful books, and a national directory for sources of help (e.g., National Anorexia Society, Columbus, OH) is appended.

Vath lists the similarities between alcoholism and eating disorders, and "the illness's complexity makes it necessary that patients be treated in the context of a multidisciplinary team involving therapists, physicians, dieticians, and family and spiritual counselors." Specific medications are mentioned to combat the depression common in patients, who are ten to twenty times more often women than men. Treatment of anorexia involves mental, cardiovascular, digestive, kidney, blood cell, glandular, and musculoskeletal functions, and in bulimia all of these except kidney and blood cell functions.

The effects of starvation, both emotional and physical symptoms, are related as well as how recovery is obtained. There is "a confusing array of opinions presented in volumes of books" and a "false belief that there is one program that will work for everyone." The author emphasizes that love, truth, and compassion are essential in the counselor, who treats what every person with an eating disorder believes—that "I won't be loved unless I am perfect"—but each should be led to faith in God's forgiveness and awareness of the understanding of associates (who should possess the same qualities as the counselor). Causes of depression are treated with appropriate nutrition, exercise, rest, a positive mental attitude, and antidepressant medication.

"A noted characteristic of patients with eating disorders is secrecy and deception," frequently accompanied by shoplifting. Vath states how one is led from deception to truth, and how the family should react in cooperation with the counselor and patient. An example would be a family where the father is a critical persecutor and the mother a protective rescuer. Helpful hints are given to produce the signs of recovery: acceptance, love of self and others, appropriate womanliness or manliness, joy, open honesty, independence, and collaboration. Also well treated is the question: "What do you do if you know of someone with an eating disorder, especially if the person is reluctant to acknowledge the problem?"

An admirable book of interest to us normal folks, as well as those dealing with people with eating disorders.

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

HILDEGARD OF BINGEN'S MEDICINE by Wighard Strehlow and Gottfried Hertzka, M.D. Santa Fe, NM: Bear & Company, 1988. 189 pages, indices. Paperback; $9.95.

At age 16, Hildegard, a twelfth-century mystic, became a nun at a Benedictine convent in Germany. She wrote a number of books on theology, nature, and medicine. This volume contains many direct quotations, first written in twelfth-century Middle Latin and translated into German by the authors who evaluated her quotations, all translated into modern English by Karin Anderson, wife of Dr. Strehlow. Dr. Hertzka is a medical doctor, and Strehlow was a research chemist in the pharmaceutical industry in West Germany until he became successor to Hertzka's Hildegard Practice at Konstanz, West Germany in 1984.

In the foreword, David Frawley, O.M.D., says: "Now that the limitations of allopathy are clear to many of us, the validity of these traditional systems is again becoming apparent. . . . Hildegard shows us the direction to which we need to return." Hildegard employs psychological counselling and herbs from the East as well as the West; proper diet is essential.

The authors state that Hildegard advocates "a proper attitude towards life based on the strength and fullness of the Christian faith" as part of the protection against heart attack, rheumatism, and cancer. "If we had not had years of experience with Hildegard's healing art, we would not venture to make this book available to the public." They call her medicine "The Healing Art of the Future," a title for an introductory section which precedes 15 chapters on details of diagnosis and treatment of various parts of the body, plus discussions of colds and flu, digestion, diet, dreams, rheumatism, cancer, and fasting, followed by indexes of plants and herbs, symptoms and illnesses, and remedies. Beautiful black and while drawings adorn the beginnings of each chapter.

Let me sample for you details in a couple of chapters. After listing the causes of cardiovascular disease as malnutrition, high blood pressure, high cholesterol blood level, clotting of blood, smoking, coffee, alcohol, drug addiction, and obesity, Hildegard suggests a help for pain in parsley-honeywine and galangal (*Alpinia galanga*); in critical conditions, yellow gentian soup or gemstone jasper is to be pressed firmly over the heart. Avoid saturated fats, cholesterol, and salt. Limit alcohol a day to two ounces of dry wine or five ounces of beer. Eskimos of Greenland and the Japanese have found that their seafood diet protects them from heart disease. A spring tonic of vermouth, drunk before breakfast from May to October, prevents arteriosclerosis and cleanses the body of waste products. Chestnuts help prevent brain arteriosclerosis, including Alzheimer's disease.

The second summary is on Fasting. "During a fast, everyone will receive two strong healing forces," unlimited energy for holistic health and the power of defense to fortify resistance to overcome such diseases as cancer, AIDS, and multiple sclerosis. Fasting is "total abstention from eating—just drinking plenty of herb teas, spelt coffee, fruit and vegetable juices, and lots of spring or well water, minimum of three quarts a day." How to breakfast on the first recovery

day is detailed. At the end of this chapter, Hildegard is quoted: "In humans, God has completed all divine work . . . not only the four elements, fire, water, earth and air, are included in humans, but also the virtues of a happy person."

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

THE THEOLOGY OF MEDICINE by Thomas Szasz. Syracuse, NY: Syracuse University Press, 1988. 200 pages, index. Paperback; $10.95.

Thomas Szasz, a practicing psychiatrist and professor of psychiatry at the State University of New York in Syracuse, is well known for his critiques of modern medical practice, especially psychiatric and psychological treatments. In his latest book, a collection of essays written over the last 20 years, Szasz argues that medicine has increased in power until it has become a state-supported moralizing agent, an institution or religion able to decide for others what is right and wrong, proper and improper. Although our society would never allow a particular "religious treatment" prescribed by a cleric to be imposed upon a person against his or her will, even if we suspected that treatment would "cure" that person's spiritual problem, it is very willing to have a medical treatment imposed upon a person, even if that person does not seek help. We allow this denial of liberty, according to Szasz, because the medical expert, the physician, says the treatment is needed. The canon of this new theology comes in the form of mental health and public health laws which allow for involuntary hospitalization and treatment if authorized by the physician. In these essays, Szasz argues consistently, if not persuasively, against any form of imposed medical treatment.

Examples of Szasz's arguments can be found in his essays dealing with the ethics of suicide and addiction. Suicide is a moral not a medical problem to Szasz, and people have a right to die. "Treatment," or prevention, should not be prescribed without their consent. Szasz also believes that drug addiction is medically irrelevant, and that the medical community should treat addiction as it does masturbation, as a matter of personal lifestyle. He favors the free trade of drugs because the government has no business regulating what a person puts into his or her body. In true libertarian fashion, Szasz places freedom of the individual above all other concerns. The other essays continue the basic theme that the physician has been given too much control over the individual, and the field of medicine has become a powerful force in our society to the detriment of personal liberties.

A major flaw in the book is the author's fanaticism. Szasz identifies a potential problem with current medical practice—the patient not taking an active role in the decision making process—but carries his solution to an extreme (i.e., the individual assuming complete control over what kind of care he or she receives regardless of the concerns of society as a whole). Other weaknesses include Szasz's use of old references to support his position. In the essay on the ethics of addiction, Szasz cites a 1929 article suggesting that morphine addiction is not characterized by any "physical deterioration or impairment of physical fitness" (p. 34). A more recent article describing the cellular and biochemical changes that occur as a result of extended morphine use might have been more appropriate if conveying the truth of drug addiction was the aim of the essay. Also, Szasz includes statements that are just not true, an example being his saying that some drugs, such as insulin, are not dangerous (p. 37).

Szasz attempts to present the medical establishment as a tyrant, forgetting its duty to the patient, and serving only its own narrow self-interest. Although Szasz raises important questions that should be considered, he does not provide enough evidence to support his radical answers.

Reviewed by Kevin Seybold, Department of Psychology, Grove City College, Grove City, PA 16127.

THE RICH AND THE POOR: A Christian Perspective on Global Economics by Carl Kreider. Scottdale, PA: Herald Press, 1987. 156 pages, index. Paperback; $8.95.

Kreider was recently named Dean Emeritus of Goshen College and has served as Professor of Economics there since 1940. He has also served as dean of the College of Liberal Arts of International Christian University in Tokyo, and as a Fulbright Lecturer in Economics in Ethiopia. He has written extensively on the international commercial policies of the United States, and confesses that he writes "from a capitalist bias."

It is obvious from this book that Kreider knows not only the theory of Third World Development but also the practice, and his analysis and Christian insights are extremely valuable. It is his purpose to avoid two extremes: (1) "the poor countries are victims of forces over which they have no control," and (2) "the poverty of the poor countries is entirely their own fault."

The main body of the book is divided into eight chapters. Kreider first sets out to make clear just how poor the "poor countries" really are, and to give an idea of what life in the poor countries is like. Then, he treats major topic areas dealing with the growth of population, agricultural and rural development, education and health, industrial development, and international cooperation. In each case the author strikes a balanced and informed position.

The rapid growth of population in the poor countries is a serious problem. The solution does not lie, however, in self-righteous preaching of population control by the affluent nations alone but rather in limitations on our wasteful consumption of the earth's resources, especially those involved in military expenditures.

Christians can help in the agricultural needs of poor countries by receiving

> specialized training in tropical agriculture. . . . they would have to have additional study to adapt this background to the special soil and climatic conditions in the area where they serve. Above all, they would need to have a knowledge of the language of the people they were serving and a willingness to live and work at their side. (p. 83)

Any effort to be of real assistance depends upon an understanding of the real needs, the real resources, the real abilities, and the real interests of the people involved (introduction of "appropriate technology"), rather than simply attempting to import technology from the affluent nations.

There is a desperate need to come up with new and creative ways to deal with the debt problem of Third World countries. All of the poor countries are troubled by this problem, but it is the very worst for the very poorest countries. The problem is complex and can be dealt with only by an international economic conference dedicated to coming up with possible solutions.

The poorer countries would benefit tremendously if they could form an alliance together like that of the European Economic Community:

> It is one of the ironies of our time that already wealthy nations become still more affluent through regional integration. On the other hand, poor nations . . . have so often demonstrated their inability to develop effective cooperation. . . . where small size is accompanied by political hostility toward neighbors, the prognosis is poor. (p. 125)

Finally comes the major question, especially for the Christian: "What can I do?" There are many things that we can do—some of them not much more than symbolic. We can give food aid, eat less, boycott products of multinational corporations that exploit the Third World, work for political changes in the United States important for the poorer countries, or take a trip to one of the poorer countries (or to an American Indian community) to see first hand what the conditions are. When it comes down to the "bottom line," however, Christians can do one or both of two important things: (1) volunteer for dedicated service in the Third World, and/or (2) help support those who do volunteer.

> For those persons who cannot themselves give their entire lives to serving those who live in poor countries, I hope that this book will inspire them to give sacrificially to support those who are called to serve in long-term development efforts. This giving must be substantial and it must be long-term. The "emergency" will be with us throughout the lifetime of all of the readers of this book. (p. 153)

This is an important challenge for Christians. It provides "missionary" opportunities for many with a wide range of God-given gifts.

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

EDUCATION, CHRISTIANITY, AND THE STATE

by J. Gresham Machen. Jefferson, MD: The Trinity Foundation, 1987. 172 pages, index. Paperback; $7.95.

It is unfortunate the J. Gresham Machen's philosophy of education is presented in a hodge-podge collection of essays, riddled with outdated issues and archaisms. These essays were prepared for different purposes during a quarter century (1912–1934) by a busy seminary professor. Simply collecting them into a single volume results in excessive repetition and the book, of course, lacks unity. It would be more useful for a competent scholar to take the essays, together with additional biographical material, and write a lengthy journal article or, perhaps, a chapter in a composite work that would analyze Machen's educational philosophy. Quotations could be generous and part of Machen's Congressional testimony in 1926 could be appended.

As Professor at Princeton and Westminster Theological Seminaries, Machen insisted on a biblical base for scholarship. His speeches and essays raise fundamental questions as to the relationship and responsibility of the state in the education of a free people. It is impossible to have value-free education, of course, so which values are being taught? What ethical implications are present in the curriculum? What is the basis for those ethics? In Machen's day, government pamphlets based their appeal for right conduct in patriotism, that "which is considered right among boys and girls who are loyal to Uncle Sam. . . . " Machen observes that children should not be told, "Do not tell a lie because you are an American," but "Do not tell a lie because it is wrong to tell a lie."

In other words, ethics are absolute and should be treated as such. If the starting point of ethical discussions is relativism and individual or group autonomy, then the teacher has already made a most fundamental ethical decision, one that conflicts with the ethical teachings of Scripture.

Machen wondered if dilemmas like this meant that public education in a pluralist society was possible for Christians. Indeed, he strongly supported Christian schools and articulated a rationale in defense of them. Machen believed that public schools should be *less* involved in social issues and controversies, leave *explicit* teaching of ethics to families and churches, and concentrate on the factual content within each discipline.

Machen was opposed to Bible-reading in state-controlled schools, fearing a distortion of the content through the selection process. How, he asked, could non-Christian children pray, "Our Father, which art in heaven . . . " if they had not been redeemed by Christ and were, therefore, not children of God?

Machen believed that state-controlled schools should not seek to destroy the values and traditions of individual families, but could aid in a limited way in educating Christian children. The best direction for Christian parents, he believed, was in Christian schools because of fundamental differences as to meaning and purpose in life:

> While truth is truth however learned, the bearing of truth, the meaning of truth, the purpose of truth, even in the sphere of mathematics, seem entirely different to the Christian from that which they seem to the non-Christian; and that is why a truly Christian education is possible only when Christian conviction underlies not a part, but all, of the curriculum of the school. True learning and true piety go hand in hand, and Christianity embraces the whole of life.

Reviewed by William H. Burnside, Professor of History, John Brown University, Siloam Springs, AR 72761.

THE BIBLE AND RECENT ARCHEOLOGY by Kathleen M. Kenyon. (Great Britain: British Museum Publications, Ltd., 1978.) Revised by P.R.S. Moorey. Atlanta: John Knox Press, 1987. 192 pages. Hardcover.

Dame Kenyon, more than any other figure, was responsible for introducing northern European stratigraphic techniques into Near Eastern archeology. Her contributions to Palestinian archeology are comparable to those of Nelson Glueck and William F. Albright. The archeological identification of the Amorites was only one of her significant contributions to the field. The first edition of the work under review was her last published book before her death.

This book has been capably updated by Dr. Moorey of the Ashmolean Museum, Oxford. This work, or another similar to it, is "must" reading for every informed Bible student. It can be valuable for two reasons.

First, it updates the present state of biblical archeology. Despite the present political unrest in the Near East, archeological research continues. The new data must be assessed and published. Both summaries of new data and reassessments of old data are essential. This book accomplishes both. Ironically, this involves reassessing even some of Dame Kenyon's most characteristic views.

Some elements of new summary and update are the following. Based upon recent re-evaluation of archeological data concerning the Philistines, Moorey suggests that Alt's and Albright's theory about the Philistines needs to be updated. The older view, which has gained general acceptance, is that the Philistines settled Palestine after being driven away from Egypt (p. 60). Moorey suggests that the archeological evidence is just as compatible with the view that the Philistines settled Palestine first, and then turned against Egypt. Obviously, this is not a suggestion which would distress evangelicals.

Another significant reassessment involves the impact of the Babylonian invasions upon Palestine and Trans-Jordan. The generally accepted position—the one taught by the present reviewer to his students—is that Judah and all of Trans-Jordan were severely devastated and depopulated by the Babylonian campaigns in the early sixth century B.C. According to Moorey, more recent researches see areas of continued dense population and prosperity in Palestine and Trans-Jordan. Northern Judah, the coastal areas of Palestine, Trans-Jordan, and "perhaps also Galilee" maintained significant prosperity and population density (p. 143). The conclusion is reached that "only the hill country of Judah" was significantly depopulated by the Babylonian invasions. Probably the last word on this issue is still to come.

The book's analysis of the archeological evidence of the Hebrew settlement (pp. 77–84) gives an alternative to the Albright analysis of this data. For present purposes it is significant that Moorey, with all his skepticism concerning harmonizing the text and external evidences, still finds data which can be related to the emergence of Israel.

The second area of significant contribution is that this book illustrates several important methodological presuppositions in archeology. As might be expected, matters concerning methodology are more debatable.

Moorey displays a great skepticism concerning the reliability of the text (pp. 17–18). It is then understandable that he would minimize the possible significance of correlations or parallels between an unreliable text and archeological evidences. In the judgment of the present reviewer, it is quite correct to reject any method which attempts to "prove the Bible at any cost." But Moorey, in seeming to discount completely the value of the text as evidence, carries his incredulity much too far. This incredulity concerning the text becomes more striking when set beside Moorey's acceptance of the results of literary criticism as applied to the text (p. 26). An unreliable source is not made more reliable by being processed through an innately subjective, literary-critical methodology.

Moorey questions the general tendency in the Albright-Wright school of biblical archeology to date biblical passages on the basis of cultural parallels with places such as Mari, Ugarit, and Ebla (p. 37). Moorey argues, correctly, that differences must be noted as well as similarities. He says, "If similarities alone are cited, the culture of Mari will inevitably seem more like that described in Genesis than it really was." Moorey should be credited with a fair criticism of a one-sided usage of extra-biblical parallels. However, despite the truth of this criticism, there is still a valid presumption that the background for any complex sociological phenomenon is more likely to be found in a setting which demonstrates parallels to that phenomenon than in a setting which has no parallels.

In summary, Moorey has produced a competent, somewhat broad updating of Palestinian archeological studies. Any biblical student will be better informed and will have a better understanding of the field for having interacted with this book.

Reviewed by Andrew Bowling, John Brown University, Siloam Springs, AR 72761.

THE ARCHAEOLOGY OF THE JERUSALEM AREA by W. Harold Mare. Grand Rapids, MI: Baker Book House, 1987. 323 pages, index. Hardcover; $19.95.

Mare teaches New Testament and archaeology at Covenant Theological Seminary and is the author of many journal articles, contributions to reference works, *Mastering New Testament Greek*, and a commentary of I Corinthians in the *Expositor's Bible Commentary*. He is president of the Near East Archaeology Society and directs the excavation of Abila of the Decapolis in Jordan.

Mare takes up a twofold challenge to produce a book that will "not only add to the reader's knowledge of Jerusalem but also . . . will be of spiritual and inspirational help." Without a doubt, *Archaeology* does very competently add to the archaeological knowledge of the intended audience. The book begins with earliest prehistoric times and comprehensively covers the archaeology of Jerusalem, period by period, through the Turkish period. Historical details are culled from the Bible and other literary sources, such as Josephus, but the emphasis is primarily archaeological. For this reason, therefore, those who do not draw inspiration from descriptions of walls, tomb contents, and ruins of ancient churches will have to look elsewhere for spiritual edification and inspiration. However, Mare does a good job of presenting the contrasting viewpoints on controversial issues and the reader of this book will have a full outline and summary of the archaeology of Jerusalem.

The illustrations and editorial apparatus of an archaeological book are crucial to understanding the contents, and this book is generally well equipped. The detailed table of contents gives a rough guide to the bold face sub-headings in the chapters. The chart of archaeological periods in Palestine has a number of expansions for complex periods within relatively short time slots. This a is very helpful feature, but, unfortunately, the usefulness of this chart is hampered by its small print and crowded, hard-to-read appearance. Also, a ready grasp of the sweep of time and a comparison of time periods would have been greatly improved by a one-sheet fold-out format. The glossary of technical terms will be a real blessing to the non-archaeologist, although not all terms are included in it (e.g., "favissa" from p. 95 and "bullae" from p. 112).

The select bibliography provides about 6 pages of references to books and periodicals, mostly in English, through 1985. The 10-page index is very good, but, unfortunately, there is no index to the maps and illustrations.

Mare has provided us with a liberal supply of maps, plans of excavations, photographs, and drawings of artifacts, all black and white. While the photos are often sharp and clear, black and white does not bring out archaeological detail. For instance, the monumental stairway on page 154 is virtually impossible to see. I realize the need to keep costs down, but it is unfortunate that there could not have been some color, especially for an overall view of the excavated city and for some of the shots of excavations. While the maps of the city do serve as orienting devices, they do not provide an indication of topography and are virtually useless for comparison of the growth and spatial movement of the succeeding cities.

There are other books on Jerusalem; some by the excavators, such as *Digging Up Jerusalem* (Kenyon), *Jerusalem Revealed* (Mazor), and *Excavations of the City of David* (Shiloh); and others such as *Jerusalem, City of Jesus* (Makowski & Nalbandian) that are often more interestingly written and sumptuously illustrated. However, they are also older, mostly out of print, and provide only partial coverage. *Archaeology of the Jerusalem Area* is a good purchase for those who want a complete and competently done summary of the archaeology of Jerusalem, and a balanced and judicious exposition of the major controversies surrounding it.

Reviewed by Eugene O. Bowser, Technical Services Librarian, University of Northern Colorado, Greeley, CO 80639.

HISTORY AND FAITH: A Personal Explanation by Colin Brown. Grand Rapids, MI: Academie Books, 1987. 129 pages. Paperback.

Of what value is a religious head-trip that is not based on the reality of the external world? None, says Colin Brown in *History and Faith*. A biblical faith must affect lives, attitudes and actions, but it must also be rooted in the historical reality of what really happened, else it becomes merely an ethical system and a relational tool. Critics have understood this in seeking to undermine the historical foundations of the Christian faith.

Modern man is so conditioned to living in a closed system that he can only with great difficulty imagine that his model of the universe is fundamentally flawed and that everything cannot be explained in purely naturalistic terms. Even some Christians are such good children of the Enlightenment that they cannot really see the role of the supernatural as a causative factor in life and history.

There is much to be learned, however, from secular historians, though not without critical analysis. Take, for example, "the crucial question of analogy." It is insightful to observe how all of us use analogy constantly in our understanding of life and of history. As we observe phenomena, we automatically evaluate in terms of similar experiences we have observed in the past, although in a fundamental sense *every* event in history is absolutely unique because that particular event obviously has never happened before. Nevertheless, the patterns and similarities are evident. Complexity cannot be comprehended by finite man without categories for storage and retrieval.

Exotic cultures are sometimes difficult for Western man to comprehend, but with empathy he can do so vicariously; he does not automatically rule out the existence of those cultures simply because he has never experienced anything quite like them. Similarly, one should not automatically rule out the historicity of biblical miracles or the resurrection of Christ simply because he was not one of the first century eyewitnesses.

This thoughtful little book is an excellent tool for those interested in how historians approach the study of history. It deals with basic questions of God in history; of factuality and causation; of objectivity and moral judgments; and of history as art, craft, and, in its analytical skills, as science.

History and Faith is filled with discussion-provoking observations such as the inescapability of moral judgments in writing history. Brown contends that to suspend moral judgment is just as much a moral act as to make that judgment. Editing—e.g., changing all references to "murder" in history to the more neutral term "killing"—does not change the fact that a moral judgment has in fact been made by the historian.

With a text of only eighty-five concise pages, the forty-one pages of notes and bibliography is impressive and useful to the serious student.

Reviewed by William H. Burnside, Professor of History, John Brown University, Siloam Springs, AR 72761.

DEFENDER OF THE FAITH: WILLIAM JENNINGS BRYAN: The Last Decade, 1915-1925 by Lawrence W. Levine. Cambridge: Harvard University Press, 1987 (reprint of 1965 edition). ix + 386 pages, index. Paperback; $10.95.

Although William Jennings Bryan insisted that a man be judged by his life as a whole rather than by one part of it, historians studying "The Great Commoner" have focused greatest attention upon his last years. Most tell a story of the transformation of a crusading progressive reformer into a "champsion of anachronistic rural evangelism, cheap moralistic panaceas, and Florida real estate." Seeking to find out the cause of this transformation, Lawrence Levine undertook a detailed study of Bryan's life in the years between his resignation from Woodrow Wilson's Cabinet in June 1915 and his death in Dayton, Tennessee, in July 1925. His conclusion: "The very transformation I had set out to understand never really took place."

Levine successfully argues that a few basic themes acted throughout Bryan's career as unifying principles. Thus, he insists that those who claim to have identified a transformation in the latter years of Bryan's life "have seriously misread his entire career prior to 1920, and have mistaken a change in emphasis for a change in principle."

Throughout his career Bryan was a moral crusader, "a petitioner for, not a seeker after, truth." His strength of conviction rested upon a sincere faith in the truth of a few basic assumptions. The most important of these was "a belief in the existence of a Divine Law, which might be found in the teachings and precepts of the Bible, which men were obliged to consult and obey." This was coupled with a belief that a "harmony of interests" operated among nations and individuals; a belief that the United States was of all nations most heavily endowed with morality and Christian ethics and that it was destined to spread this moral code throughout the world; a belief in the "essential goodness of Man who would respond immediately and wholeheartedly to truth once he was made to see and understand it;" and finally, a belief in the democratic notion of majority rule as a guide to implementing God's will.

Applications of these principles are identified in both the ways Bryan chose and defended the causes for which he stood. As he championed the causes of peace, prohibition, women's suffrage, fundamentalism, and anti-evolutionism Bryan maintained a steady faith that he stood with God, the Scriptures, and the rural masses. Accordingly, there was no shift in his career from progressive reformer to fundamentalist reactionary. Levine is careful to point out that during the years of Bryan's public denunciations of evolution he also stood before political gatherings to plead for a host of liberal and progressive legislative measures. On the other hand, the heightened emphasis upon religious matters which characterized his public life in the twenties was a manifestation of the fundamentalism to which he had adhered since his youth. Levine concludes that Bryan was an unchanging Progressive rather than as an emerging reactionary.

For those mostly concerned with Bryan's role in the anti-evolution crusades of the 1920s, two chapters, "Brother or Brute?" and "The Last Battle," provide engaging narrative detailing the events leading up to Dayton and describing the trial itself. These chapters, like the rest of the book, are meticulously researched and well written. It is pleasing to see this important interpretation of Bryan's career brought into print once again. Levine has succeeded where too few historians do. He sympathizes with Bryan while at the same time leading the reader to ponder his beliefs and actions.

Among questions raised are those which challenge the validity of Bryan's assumptions. How is the Christian to evaluate Bryan's belief in the essential goodness of man? Is there basis for the assumption that fallen man will respond immediately and wholeheartedly to truth once he is made to see and understand it? Regarding Bryan's implicit faith in majority rule, what ground is there for believing that the voice of the people will consistently communicate the will of God? Although these questions are not given thorough treatment, Levine's narrative encourages the reader to consider them.

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

TELEVANGELISM: The Marketing of Popular Religion by Razelle Frankl. Carbondale, IL: Southern Illinois University Press, 1987. 155 pages, appendices. Hardcover; $19.95.

The first disappointment about this book is that it's outdated in relation to current events. That is, the material was gathered and written before the escapades of Jim Bakker,

Jimmy Swaggart, and the less notorious antics of Oral Roberts pushed televangelism onto the front pages of our newspapers almost daily.

The second disappointment is that the copy reads like a thinly disguised doctoral dissertation. Sources are quoted by surnames (LeHaye, Mills, Falwell, McBrien) without previous reference or identification. The writer received her Ph.D. in sociology from Bryn Mawr College in 1984, and is now an assistant professor and coordinator of human resources management at Glassboro State College in New Jersey.

Frankl finds the roots of televangelism in the urban revivalism developed by Dwight L. Moody and Billy Sunday. As she traces the strands of revivalism into the electronic church of the 1980s, she continues to measure it against the tenets of those early leaders. Sometimes that does not seem like the most interesting use of the rich data she accumulates. There are problems with terminology such as electric church and electronic church. And, when she states that Jimmy Swaggart and Jim Bakker do not use "persuasive appeals" in their ministries, the reader must back way off to think through her definition of that term.

In her review of early revivalism, the growth of radio and television, the marriage of preaching and broadcasting, the complex role of the Federal Communications Commission as marriage broker and counselor, the birth and development of televangelism, and the extensive literature of communications research, Frankl provides a useful service for all students and scholars interested in the televangelism phenomenon. Although the reader may suspect that Frankl's personal views are far toward the liberal end of the religious spectrum, her own biases do not often intrude into this book in an unfriendly fashion. She arrays her source material in logical order, and her conclusions seem well founded. Her insights can be helpful. Although she doesn't deal with the fall of Bakker and Swaggart, she highlights the enormity of the problem they now face: "In charismatic leadership, it is the preacher's credibility and worthiness, his extraordinary qualities, which serve to motivate the viewer to support his mission."

Frankl surveys the breadth of present-day religious programming, and does make distinctions among the several major televangelism strains. Many of them have strong political orientations, and some of them take vigorous positions on social issues. She builds a strong case that the electronic church is no longer primarily in the business of saving souls, but is engaged in the battle for the mind.

Reviewed by Fred Lollar, John Brown University, Siloam Springs, AR 72761.

FOUNDATIONS OF CHRISTIAN ETHICS by John Dwyer. Mawhwah, NJ: Paulist Press. 227 pages. Paperback.

The author is a professor at St. Mary's College in California. His use of the term "Christian ethics" rather than "moral theology' indicates his desire to reach Protestants as well as Catholics. This book "is really about the challenge to be human." Its purpose is to develop a method of finding good answers to the right questions about Christian conduct. Ethics is the science of human conduct. He is deeply opposed to situation ethics.

The introduction indicates that the author is in favor of objective norms of behavior. To follow one's conscience only makes sense if it is based on an outside standard. Our task is not to follow our consciences but to form them. In this section, Dwyer discusses natural law, moral imperatives, principle of the double effect, and original sin.

In subsequent chapters, Dwyer discusses the motive behind the act, objective and subjective elements in decision-making, foundational values which are givens, personality differences in decision-making, the role of individual responsibility, the moral responsibility resulting from a conscience, and the authority of the church in ethics.

As a Protestant layman, I found these essays interesting. I was surprised to find the author questioning the historicity of the creation account and of Adam and Eve. In view of the number of maverick Catholic priests and theologians, I would have preferred this book to have represented some authoritative Catholic group.

Reviewed by Raymond Seeger, 4507 Wetherill Road, Bethesda, MD 20816.

A TIME TO SPEAK: The Evangelical-Jewish Encounter by A. James Rudin and Marvin R. Wilson (eds.). Grand Rapids, MI: Eerdmans, 1987. 202 pages. Paperback; $11.95.

The proceedings from the Third National Conference of Evangelicals and Jews, *A Time to Speak* includes nineteen papers by scholars of the participating traditions. James Rudin (National Interreligious Affairs Director, American Jewish Committee) and Marvin Wilson (Professor of Biblical and Theological Studies, Gordon College) supply questions for group discussion at the end of each chapter. Their five-page bibliography is more significant to the individual reader, since the multi-faceted discussions within this volume will stir further explorations of similar gems.

Problems in defining membership of each tradition are examined by the first four authors, challenging stereotypes and enhancing understanding. It is refreshing to recognize the diversity or pluralism within these portions of the cultural/religious spectrum; humbling to note ambiguity about the record. This honest portrayal reflects the biblical basis, in contrast to any self-serving propaganda. A minor error occurs in the second paper's allusion to the Canadian mosaic, with reference to Commonwealth membership "until 1967" rather than its actual continuation. Otherwise, the context is American, and accuracy can be assured by the participants.

Jewish and Evangelical contributions to American society occupy two chapters. Evangelicals were associated with the rising tide of New Right politics at the conference time, in 1984, so that diversity needed emphasis. Some had also expressed widely quoted bigotry, including anti-Semitism, while others were militantly Zionist. Humanistic Judaism had been identified with exaggerations of secularist influence, adding fuel to tragic confrontations. Again, acknowledgement of the actual diversity cut through misunderstanding.

Two fascinating articles treat the closely related issue of what the religions teach about each other. Jewish curricula made slight reference to Christian interpretations, gentle allusions to the lifestyle and teachings of Jesus as exemplary Judaism. Sunday school curricula proved to be innocuous at junior levels, but apt to include insensitive insinuations about Judaism at the senior levels. For example, Pharisees continue to be identified with hypocrisy, externalizing the New Testament's criticisms which deserve to be applied within the church. One curriculum alluded to the profiteering moneychangers requiring Jewish money for Temple use; insensitivity was criticized, but the citation's inaccuracy deserved a challenge in that the Tyrian shekel standard was never Jewish.

Delicious irony counters the stereotypes in pairs of papers on "The Place of Faith and Grace in Judaism" and "The Place of Law and Good Works in Evangelical Christianity."

Expectations regarding future prospects for both religions, particularly in an American context, are intriguingly studied in two articles. Four authors examine the various attitudes to modern Israel, expressed among the complex divisions of each tradition. A fine essay by Hillel Levine reinforced the solidarity by reference to "Shared Nightmares and Common Cause."

Despite the range of topics and opinions, there is a remarkable unity to this book. A profound yet very readable, well-balanced exchange, it helps both mutual esteem and appreciation for our own tradition. Much more could be reserved for similar conferences, so that the reader may consider these discussions as an appetizer. Eagerly waiting the next course, this reviewer rejoiced to see that a fourth conference occurred in 1988, as reported in the October 7, 1988 *Christianity Today*.

Reviewed by John R. Armstrong, Deacon at St. Philip the Evangelist Anglican Church, 631-49 Avenue S.W., Calgary, Alberta, Canada T2S 1G6.

THE RIDDLES OF JESUS & ANSWERS OF SCIENCE: Modern Verification of His Wisdom & How It Can Help You by Osborn Segerberg, Jr. Kinderhook, NY: Regis Books, 1987. 265 pages, index. Hardcover; $21.95/Paperback; $14.95.

The title is a warning: Jesus didn't pose any "riddles" and, if He did, science wouldn't provide any "answers." This observation is symptomatic of the whole book. The author concludes that "Jesus was not a man of his time. His genius was so far ahead of his time that he is a man for our time" (p. 214). What he means by this is that Jesus' mystic insights into the nature of the world and life have finally been made intelligible to modern man through the findings of modern science.

On the positive side, one can agree with the author that many of the findings of the life and social sciences have indeed corroborated the basic teachings of Jesus; if the teachings were true, one would expect this. But on the negative side, it is hard to agree with the author when he finds all sorts of scientific precursors in the plain language teaching of Jesus, and suggests that we will continue to obtain new insights into the teachings of Jesus as our scientific understanding increases. He invokes the ultimate reductionism: he writes as if the straightforward personal and spiritual insights of Jesus drawn from everyday life are somehow not truly understood until we understand the scientifically describable mechanisms related to them.

The author, Osborn Segerberg, Jr., is described as "an author, science writer, investigative researcher and journalist." He has written for the news service in the three major television networks, United Press, and television and radio stations in New York City. It is said that this book "stems from ten years of research, thought, study and rethinking a lifelong experience with Christianity."

The format adopted is the proposal that what Jesus meant by "the kingdom of God" is cloaked in mystery: "during nearly two millennia Christianity has grown to be the world's largest religion without Christians knowing what is meant by the central tenet of Jesus' teaching" (p. 32). We are only beginning to understand that the kingdom of God is really a state of mind. "His insights were so profound that his kingdom could not be discovered until we gained the requisite knowledge about life" (p. 213). Hence, "all eschatological references to some kind of future supernatural transformation must be judged as overzealous interpolations to satisfy the commonly-held beliefs and credulity of the times" (p. 210). All biblical passages to the contrary can be explained away because "Kingdom of God, kingdom of heaven, the life or life are the only code phrases for his concept of the good life" (p. 211). Thus, "thy kingdom come" in the Lord's Prayer, and Jesus saying that His kingdom was not of this world, are "clearly" not describing what he meant by the Kingdom of God in general.

Part one of the book, "The Search for the Kingdom of God," involves a fair amount of historical detail describing other early religious beliefs: the Gnostics, the Essenes, etc. Part two offers "Keys from the Life Sciences," with one

section on proposed inputs from biology, a second on inputs from psychology and neurobiology, and a third on inputs from the social and ecological sciences. The author is apparently infatuated with the apocryphal Gospel of Thomas and invokes it on frequent occasions to clear up "confusions" or to supplement "inadequacies" of the canonical Gospels.

Readers who take the book seriously will have to believe that: the Parable of the Sower shows that Jesus had deciphered the principles of evolution and the survival of the fittest; His refusal under temptation by the Devil to throw Himself off the top of the temple was an acknowledgment that "God's law of gravity . . . prevails everywhere, forever, and cannot be abrogated" (p. 96); the parables involving vines and fig trees show that Jesus understood genetic invariance; the Parable of the Mustard Seed "emphasizes the power and accomplishment of growth itself" (p. 103); the Parable of the Talents was based on "a fundamental law of life . . . Grow or die" (p. 106); the miracles of the Loaves and fishes "expresses the principle of biological multiplication perfectly" (p. 108); "many are called, but few are chosen" is an expression of "the irresistible force of life's growth and . . . the inevitable consequences: enormous losses" (p. 114); Jesus' teaching, "For he that hath, to him shall be given: and he that hath not, from him shall be taken even that which he has," contains the secret of the selecting process in biological growth; and Jesus' words, "In my Father's house are many mansions" is "life's credo for successfully colonizing the planet" (p. 118). Finally, "Sometime after the parable of The Sowers was spoken the gospel of the kingdom was de-emphasized. Its place was taken by the Messiah. the audience was given what it wanted" (p. 127).

Actually, many of the insights cited in the last two sections of the book are much more in line with an appropriate harmonization of Jesus' teaching with some of the insights of modern scientific thinking in these areas. It is too little, too late. Soon the author returns to his principle theme outlined in the quotes given above.

There may be those who could find illustrations and sermon examples in this book, but the general reader will come away with only a very distorted view of Jesus, His teachings, and the kingdom of God.

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

NEITHER SLAVE NOR FREE: Helping Women Answer the Call to Church Leadership by Patricia Gundry. San Francisco, CA: Harper & Row, 1987. 151 pages. Hardcover; $13.95.

The title of Patricia Gundry's fourth book alludes to Galatians 3:28, a key verse to Christian feminists. These words could be removed from context in order to express frustration with traditional restrictions upon women's participation in church leadership, as covered by the author, as well as to reflect the transitions in status. Her previous works (*Woman Be Free!*, *Heirs Together: Mutual Submission in Marriage*, and *The Complete Woman!*) provided more detailed examination of biblical texts bearing upon the sexual equality issue. Here, she presents a biblical perspective rejecting vengeful female chauvinism and seeking mutual understanding no less than admission of equality for both halves of the human race. Coming from a fundamentalist tradition, Gundry is averse to the hierarchies of clergy, yet most of her opinions are shared by clergy of other denominations, such as the American and Canadian bishops in the Anglican communion. She stresses the example of Dwight L. Moody in church leadership, rather than those formally ordained.

The author has struggled to overcome limitations due to her tradition, learning to recognize that flexibility may offer strength rather than only compromise. Thus, church members who disagree with her are not condemned or bitterly attacked.

While history and hermeneutics are covered, this is primarily a personal account with frequent quotations from letters and appeals to experience. Her style is conversational; applying anecdotes, popular psychology, and offering simple advice. She supplies useful lists of literature and support groups, and gives fascinating case histories.

This reviewer became readily empathetic, despite all contrasts in background, because the pastoral concerns in this book were so well expressed with individual encounters. A fine sense of irony marked the story of being shouted down by a woman who vehemently insisted that their sex must remain silent. Cost of discipleship was underscored by traumatic experiences, particularly in regard to her husband losing his job when an anti-ERA group distorted the author's remarks on equality in a biblical context. That painful development increased her determination to maintain ethics which were neglected by well-intentioned special interest groups on each side of the issue.

The ethical concern, search for peace and justice, and theological considerations make this book relevant to other controversies. Patricia Gundry approaches a delicate issue carefully as well as honestly, in a pattern which is applicable to similarly divisive issues, such as the history of this planet. She distinguishes between God and the church, and notes that "we must also begin to separate truth from experience" (p. 70). These separations could be paralleled in science for improved understanding.

Admirably unpretentious, she speaks of the advantage from being without credentials and authority, having to be prepared and dependent upon the grace of God (p. 97). Invitations came to speak in places closed to higher-profile feminists, because she was non-threatening. Here again is a lesson for dealing with diverse issues: seeking peace amid confrontations.

Reviewed by John R. Armstrong, Honorary Assistant in Deacon's Orders, St. Philip the Evangelist Anglican Church, Calgary, Alberta, Canada T2S 1G6.

THE WELL-SPRING OF MORALITY by J.D. Thomas. Abilene, TX: Abilene Christian University Press, 1987. 112 pages. Hardcover.

The author says that the origin of our sense of right and wrong is the really important issue in this study. Thomas has served as an elder of a church, has written numerous books and articles, and has spoken in thirty countries of the world. Education, reason, pleasure for the many, Stoicism, and evolution do not produce an absolute ethical or moral standard but a "public moral standard, based upon the authority of God's revelation" is capable of doing it. He believes, since "human nature is basically the same in all ages . . . a universal moral standard is not at all illogical or unreasonable." It is reached by faith in God's revelation.

Thomas maintains that "the past thirty-five years, more or less, have witnessed a tremendous moral change in America." This change has resulted in the sexual revolution, home and family life disintegration, greater greed, the lust for power, and drug abuse. The ways of knowing the solutions are reason, empirical observation, intuition, and authority. A thorough study of authority, including aberrant perspectives, is made, and reasons for accepting the Bible as the ultimate authority are given. The Sermon on the Mount is considered the greatest moral summary ever delivered. After stating the major philosophical arguments for God's existence, Thomas analyzes principles of interpretation of the New Testament and ways of applying the standard of Christian morality to the ethical problems of today, as previously mentioned, as well as to abortion, gambling, and suicide.

At the end of each chapter, review questions stimulate one's memory and reaction to the chapter's ideas. A bibliography is appended, but no index is included. This valuable book will increase one's appreciation for today's moral dilemmas and their treatment.

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

Letters

Ananias, Sapphira, & Christian Community

I have received several letters similar to the one printed in the journal by David F. Siemens, Jr. (Vol. 39, No. 4, Dec. 1987, p. 250) about my Dec. 1986 *JASA* article on community, but hesitated to respond because it is my perception that my original discussion was not ambiguous in the least. I certainly did not imply, or even mean to imply, that Ananias and Sapphira died *because* they lacked community, and for this reason withheld part of what they had promised. I had always understood that it was because they, as the Scripture clearly states, lied to the Holy Spirit. I did not discuss this incident extensively, partly so as to fulfill the editor's requirements to reduce the length of my original manuscript. I not only did not state that they were killed because of not expressing community, but clearly stated that I used this passage only to *illustrate* that "community concern was not a Christian option, but a requirement that was practiced by all of the faithful." My sources for this conclusion were a number of Scriptures as well as the early Christian historical records which discuss extensively this behavior.

The issue is, why did Ananias and Sapphira feel compelled to give such a large amount of money to the church so that it could aid the community? It was obviously because they perceived that this act was a Christian obligation. Where did they get this view? It was due to the teachings of the early church, as recorded both in the Scriptures and in the early church writings penned by the early Christians themselves. They obviously had second thoughts about giving up so much, and if it were not for the values and norms as well as the pressure from the Christian community to donate money from their sale, they certainly would have not felt so compelled. We cannot assume that the prominent leaders in this church had deceitfully convinced Ananias and Sapphira that they were giving the money to God, but the church leaders were in fact appropriating it for their own use. I concluded that the above was obvious, and needed no elaboration in my article. I am thus rather surprised that one could so greatly misinterpret my discussion to the extent of claiming that I implied that their deaths were due to withholding "part of the sales' proceeds." I consulted a number of commentaries and Bible dictionaries and found that, without exception, all of those that I consulted fully support the interpretation discussed above. For example, *The Interpreter's Dictionary of the Bible* states that Ananias was a Christian who noted "the favorable attention bestowed upon those Christians who sold their property" and so brought the receipts of the property that they sold "to the Apostles for distribution among the believers" and with the connivance of his wife, Sapphira "held back a portion of the price, while pretending to give the entire amount to the Apostles for distribution." The act of giving to the poor was thus taught as highly laudatory by the church. Otherwise they certainly would not have felt the compulsion to, not only withhold part of their sale funds, but also to deceive others relative to their doing so.

Some commentators, such as *The Interpreter's Bible* vol. 9, p. 74, used this discussion as a basis to discuss the extreme importance of community in Christianity. The aforementioned reference noted that many persons "pursue their private ways with little or no concern for the rest of mankind" and that many of these "insulated units of humanity finally break down into lonely fragments of forlorn life." This discussion then notes that many people in the former state eventually come to the realization that community is, indeed,

important and crucial. They consequently then "look for a community where private enterprise will be redeemed by a concern for public benefit." As to the Christian church, this commentator concludes that it "can and must affirm the underlining principles which govern sound community life . . . but where private enterprise . . . monopolizes the fruits of the Earth which are meant to be shared by all men, and where it makes its way without regard to the welfare of the people at large, it must be checked either by the free consent of those concerned or by the legislated will of the people. The incentive for such a self imposed discipline is to be found where the first Christians found it, in Jesus; and the power to practice the discipline is the power of the living Christ."

The classic *Matthew Henry Commentary* (p. 1651) goes even further, stating relative to this account that the early Christians were "very liberal" in giving to the poor, adding that every Christian "was ready to distribute" material goods to those in need. The discussion here concludes that the norms of their community required giving for the purpose of helping one's brethren to the degree that "they abounded in charity, [and] they had all things in common" so that "there was not any among them that lacked." This commentary notes that *many* who had possession of land of houses sold them and the proceeds were distributed "unto every man as he had need." The commentator added that "great care ought to be taken in the distribution of public charity and that it be given to such as that have need. Those who have real need, above all, those who are reduced to want for well doing, ought to be taken care of, and provided for. That it be given to every man according as he has need, without penalty or respect of persons." How many is the "many" that this account refers to, it does not state, but the word "many," or its synonyms, is commonly used when this verse is discussed by both commentators and in the writings of the early Christians.

The italicized words, which Siemens notes I left out, were omitted only for reasons of brevity. These words in no way support the claim that I am trying to state that Ananias and Sapphira died because of a lack of charity. What bothers me most, though, are the totally unfounded accusations in his letter. I am not "revising" the Bible, not inferring that Ananias and Sapphira died because they "withheld part of the proceeds."

Jerry Bergman, Ph.D.

Christians & Creation Science

In the article "What Christians Should Think About Creation Science" Kenneth Kemp has argued against much more than merely the "young-earth" position of certain creationists. By defining creation as that act by which the universe came into being, and by defining evolution as the dispersal of life on earth, he is able to adhere to both systems of thought.

But can we limit creation and evolution in this way? For the Christian, creation must surely include the fact that mankind is different from the animal world because of a separate act of creation. And the evolution theory is not content to be limited to a series of events after divine creation. In high school science textbooks the whole area of the origin of the universe and of man's role in the entire scheme of life on earth is dealt with. From this they also draw a value-system for mankind. We see then a whole world-view, a religion that is in opposition to Christianity.

We may not agree with the "young-earth" position of ICR and of the CRS, but we do need to give them credit for their leadership in counteracting secular humanism in our schools and churches.

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More on Creation Science

Re: "What Christians Should Think About Creation Science" (*Perspectives*, Dec. 1988).

I have been a member of the A.S.A. and also of the Creation Research Society for about five years now. My interest in evolution science began during High School in the 1930's and has continued ever since. I read widely in science, such authors as, J. Bronowski, G. Ledyard Stebbins, Peter Farb, Arthur Koestler, Ilya Prigogine, Brian M. Fagan, etc., etc. My observations of natural phenomena and processes have also had a deep effect on my opinions. I do feel sad about the dogmatic (stubborn) attitudes that the Creation Research Institute has taken and I don't want to be understood as supporting them. However, I do expect more from some A.S.A. members than we are getting.

Some A.S.A. writers seem oblivious to the fact that the news media, popular science writers, museums, park guides, many school text books, movie producers, etc., state plainly that evolution has been proved, and that evolution proves that there is not God, and that all life has evolved by random chance. When these statements are not made explicitly, they are conveyed in a subtle manner which is just as effective. This situation makes some A.S.A. writers look ridiculous in the Christian world because they leave the impression that they fully accept the secular world's teachings about evolution.

The first point, then, is that theistic evolutionists should clearly define their terms. I have never read a definition of theistic evolution in your Journal, which allows the reader to define it any way he chooses. You are leaving yourselves open to criticism from all sides. If you read the writings of creationism you will find that they are very specific about what they believe, I must say this to their credit. The word "evolution" is the most heavily loaded word of our century and you can't afford to play loose with it.

The second point, the matter of ethics, is that Kemp fails to meet standards of honesty. He seems to accept evolutionary science without reservations, and without limitations (maybe it's his careless form of expression?), leaving the impression so often left by museum guides that all of the theory of evolution is true and has been proved. Very few atheistic evolutionary scientists go this far. I have found that in recent years many atheistic scientists have become more honest and ethical in their statements, due partly to critical examination of their previous writings by creationists. The theory of evolution is engulfed with problems on all sides, as expressed in books by atheistic scientists like: S.J. Gould, J. Gribbon, F. Hitching, J. Rifkin, G.R. Taylor, J. Goodman, Sir Fred Hoyle, F. Crick, etc. The *Scientific American* devoted the whole October, 1985 edition to eleven articles on the "Molecules of Life." It was a fantastic edition. After reading about the incomprehensibly complex nature of the living cell, I don't see how any scientist can still accept the theory of evolution as taught today. Science itself has shown the theory to be impossible. Many scientists are drifting away from "random chance" and moving towards "purpose" in evolution, although that inevitably leads to the "supernatural," which they tried to expunge at all costs during the previous century.

In closing I must say that I can easily imagine that God used a method of evolution in His work of creation, but if I put this into writing I would be very careful as to what I said and how I said it. I don't think the word "evolution" would need to enter into it at all.

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

INDICES to back issues of *Perspectives* are published as follows: Vol. 1–15 (1949–1963), *Journal ASA* 15, 126–132 (1963); Vol. 16–19 (1964–1967), *Journal ASA* 19, 126–128 (1967); Vol. 20–22 (1968–1970), *Journal ASA* 22, 157–160 (1970); Vol. 23–25 (1971–1973), *Journal ASA* 25, 173–176 (1973); Vol. 26–28 (1974–1976), *Journal ASA* 28, 189–192 (1976); Vol. 29–32 (1977–1980), *Journal ASA* 32, 250–255 (1980); Vol. 33–35 (1981–1983), *Journal ASA* 35, 252–255 (1983); Vol. 36–38 (1984–1986), *Journal ASA* 38, 284–288 (1986). Articles appearing in *Perspectives* are abstracted and indexed in the CHRISTIAN PERIODICAL INDEX, RELIGION INDEX ONE: PERIODICALS, RELIGIOUS AND THEOLOGICAL ABSTRACTS, and in GUIDE TO SOCIAL SCIENCE AND RELIGION IN PERIODICAL LITERATURE. Book Reviews are indexed in INDEX TO BOOK REVIEWS IN RELIGION. Present and past issues of *Perspectives* are available in microfilm at nominal cost. For information write University Microfilms, Int., 300 North Zeeb Road, Ann Arbor, Michigan 48106.

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LOCAL SECTIONS of the American Scientific Affiliation and the Canadian Scientific and Christian Affiliation have been organized to hold meetings and provide an interchange of ideas at the regional level. Membership application forms, publications and other information may be obtained by writing to: AMERICAN SCIENTIFIC AFFILIATION, P.O. Box 668, Ipswich, Massachusetts 01938, or CANADIAN SCIENTIFIC AND CHRISTIAN AFFILIATION, P.O. Box 386, Fergus, Ontario, N1M 3E2.

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