PERSPECTIVES on Science and Christian Faith

JOURNAL OF THE AMERICAN SCIENTIFIC AFFILIATION

In this issue . . .

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

VOLUME 44, NUMBER 1

MARCH 1992

Perspectives on Science and Christian Faith

MEMBER epa EVANGELICAL PRESS ASSOCIATION

MANUSCRIPT GUIDELINES

The pages of *Perspectives* are open to any contribution dealing with the interaction between science and Christian faith in a manner consistent with scientific and theological integrity. Papers published in *Perspectives* do not reflect any official position of the American Scientific Affiliation.

1. All manuscripts (except Book Reviews) should be addressed to the Editor, P.O. Box 668, Ipswich, MA 01938.
2. Authors of *Papers* and *Communications* must submit **3 copies** of their paper for review purposes (an original and two copies).
3. Regular Papers should be accompanied by an *Abstract* of not more than 100 words.
4. All manuscripts should be typed double-space on good quality 8 1/2 x 11 paper (computer copies should be printed letter-quality).
5. References and footnotes should be collected at the end.
6. Figures or diagrams should be clear, black and white, line ink drawings or glossy photographs *suitable for direct reproduction*. Captions should be provided separately.

REGULAR PAPERS are major treatments of a particular subject relating science and the Christian position. Such papers should be at least 10 manuscript pages in length, **but not more than 20 pages**. Publication for such papers should normally take 12 to 18 months from the time of acceptance.

COMMUNICATIONS are brief treatments of a wide range of subjects of interest to *Perspectives* readers. Communications *must not be longer than 9 manuscript pages*. Accepted Communications should normally be published in 9 to 12 months.

DIALOGUE offers the opportunity for brief and timely debate of relevant issues.

BOOK REVIEWS are an important part of *Perspectives*. They serve to alert the readership to books of interest and provide a valuable source for reference. Readers are encouraged to review books in their scientific fields which have implications for the Christian faith. To avoid duplication of reviews, prospective reviewers must notify the Book Review Editor of their intentions. Guidelines for book reviewers are available from the Book Review Editor and should be obtained before submitting a book review. *All reviews should be sent directly to the Book Review Editor.* The viewpoints expressed in the books reviewed, and in the reviews themselves, are those of the authors and reviewers respectively, and do not reflect an official position of the ASA.

LETTERS to the Editor concerning contents of *Perspectives* may be published unless marked not for publication. Any letter submitted for publication is subject to editorial review. Letters selected for publication will be published within 6 months.

ADVERTISING is accepted in *Perspectives*, subject to editorial approval. Please address inquiries for rates or further information to the Managing Editor. The ASA cannot take responsibility for any orders placed with advertisers in *Perspectives*.

PERSPECTIVES ON SCIENCE AND CHRISTIAN FAITH
(ISSN 0892-2675) is published quarterly for $25 per year by the American Scientific Affiliation, 55 Market Street, Ipswich, MA 01938. Telephone (508) 356-5656. Second class postage paid at Ipswich, MA and at additional mailing offices.
POSTMASTER: Send address changes to: *Perspectives on Science and Christian Faith*, THE AMERICAN SCIENTIFIC AFFILIATION, P.O. Box 668, Ipswich, MA 01938.

Putting Things Into Perspective

Our first three papers in this issue complete the 50th Anniversary series focusing on the early history of the American Scientific Affiliation. Joseph Spradley first examines the thought of theologian Bernard Ramm, a major contributor on science-Christianity themes for three decades. Ramm's *The Christian View of Science and Scripture* (1954) offered a new direction for evangelicals seeking to relate science and Christianity. Dorothy Chappell next reviews the life of Russell Mixter, renowned biologist and educator at Wheaton College who provided early leadership to the ASA, including a stint as Editor of this journal. Chappell and Spradley then collaborate to discuss the contributions of three Wheaton faculty women to the ASA in the late 1940s and early 1950s. The under-representation of women in the work of the ASA and a typical evangelical college is forcefully illustrated.

The breakup of the Soviet Union, resignation of President Gorbachev and assumption of the leadership of the new commonwealth of republics by Boris Yeltsin has placed a new cast on world politics. Jack Swearengen discusses the place of arms control in the "new world order." In offering a foreign policy of "reconciliation" he seeks to overcome the extremes of "apocalyptic escatology" and "dominion theology."

Biologist Wilbur Bullock uses an historical analysis of the germ theory of disease to illustrate the problems which arise from too wide an application of a scientific concept. He then extends this analysis to the use of natural selection as "a theory of everything." Richard Bube aptly draws our attention to the insidious problem of self-serving group loyalty in his "The Many Faces of 'Tribalism.' "

Physicist Donald MacKay provided Christian leadership for three decades as a distinguished scientist and leader in faith-science discussion. His final work, *Behind the Eye*, is the substance of his Gifford Lectures, which were delivered shortly before his death in 1987. Walter Thorson offers an essay review of *Behind the Eye*, noting that MacKay broke new ground at a time when most writers would have been content with a rehash of old ideas. J. W. Haas, Jr. provides an accompanying biographical sketch of this influential evangelical.

The regular section of this issue concludes with a selection of book reviews and a letter. We welcome your comments! The final section of this issue is the ASA's Annual Report, which is being included in *Perspectives* for the first time.

—J. W. Haas, Jr.

Changing Views of Science and Scripture: Bernard Ramm and the ASA

JOSEPH L. SPRADLEY

Physics Department
Wheaton College
Wheaton, IL 60187

The relationship between theologian Bernard Ramm and the ASA for more than forty years has helped to shape much of evangelical thinking about Biblical interpretation related to science. His controversial 1954 book, The Christian View of Science and Scripture, *marked the return of evangelical theology to a positive and scholarly assessment of science in relation to the Bible after a half century of neglect and conflict. An examination of his theological writings on science and his involvement with the ASA reveal a series of changing views on science and scripture that has influenced evangelicals at each stage.*

Baptist theologian Bernard Ramm (1916-) has had a long and fruitful relationship with the American Scientific Affiliation for more than forty years. Perhaps more than any other evangelical theologian in the United States, he has maintained an interest in science and has influenced evangelical scientists by his Christian thinking about science and scripture. He submitted papers to three of the first four ASA national conventions (1946-49), which were published in the first issues of the *Journal of the American Scientific Affiliation* (*JASA*) (1948-50); and he published seven more articles in *JASA* over subsequent years (1963-75). He served as a consulting editor to *JASA* for nearly 20 years (1971-89). These contributions reveal an interesting progression of thought on science and scripture, especially in relation to creation and evolution. They are all the more remarkable in view of the fact that they constitute only a small fraction of his complete theological writings as listed by MacDonald (1990), including more than 20 books and 200 articles, notes, and book reviews.

When Ramm published his controversial book, *The Christian View of Science and Scripture* (1954), it was met with a variety of strong reactions, both positive and negative. Reviews by Buswell, Culver and Mixter in *JASA* (D 1955) were generally positive, and 25 years later several expressions of deeply-felt appreciation were published by ASA members in the Bernard Ramm Festschrift issue of *JASA* (D 1979) along with an interview with Ramm by Hearn (1979:179-185). Both positive and negative responses in the press were reviewed in that issue by Ann Hunt (189-190). A critical review by Joseph Bayly in *Eternity* (August 1955) pointed out the objection of some reviewers (*Sunday School Times* and *Christian Century*) to the use of the definite article in Ramm's title, which was actually chosen by the publisher (Hearn, 1979:179).

Ironically, Ramm's 1954 book did not present a single Christian view. One of its most helpful features was his description and careful documentation of several possible interpretations of biblical passages relating to science, followed by his own preferred view. In fact, it is possible to trace a progression of changing views of science and scripture in the writings of Ramm over the years as he has interacted with scientists and theologians and struggled with the problems of biblical interpretation. A review of his science-related publications reveals these developing ideas, which reflect some of the same trends in the thinking of many ASA members who have interacted with him.

Bernard Ramm was born in 1916 in Butte, Montana. He became a Christian two months before entering the University of Washington, where he had planned to study chemistry. His early interest in combining Christian faith and science continued when he shifted to philosophy as a preparation for the ministry. After graduating he completed a B.D. degree from Eastern Baptist Seminary. This was followed by an M.A. in 1947 and a Ph.D. in 1950 from the University of Southern California while teaching at the Bible Institute of Los Angeles. (He suggested the name "Biola" when it changed into a college).

After briefly heading the philosophy department at Bethel College and Seminary (St. Paul, Minn.), he became director of graduate studies in religion at Baylor University in 1954. Later he taught at California Baptist Seminary (Covina), Eastern Baptist Seminary (Philadelphia), and the American Baptist Seminary of the West (Berkeley). He studied under Karl Barth in Basel during a sabbatical (1957-58), taught at Haigazian College in Beirut during a second sabbatical (1966-67), and taught at Singapore Bible College during a third sabbatical (1984).

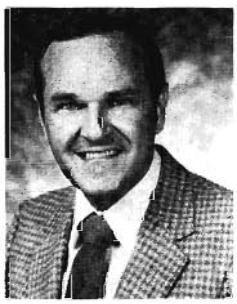
Like many Christians in scientific professions, I have been greatly helped by Ramm's writings and other ministries. As a graduate student I eagerly read his 1954 book, and found it to be a good guide when I began my teaching career at Wheaton College. During a year of personal association with Ramm in the Middle East, I was able to audit his philosophy of science course and observe his lifelong pattern of early morning research and writing. It was evident that he was always testing and developing his ideas. This development is reflected in his changing views of science and scripture, and provides a good case study in the progress of evangelical thinking about science over the last four decades. I will review three stages in Ramm's thinking that are suggested by his writings about science and the Bible.

Critical View of Science and Scripture (1946-50)

Ramm came into contact with the ASA through F. Alton Everest, the first president of ASA, while pursuing his graduate studies at the University of Southern California. He presented a condensed version of his M.A. thesis (1947) to the second national convention of the ASA at Taylor University in 1947. This condensation was published in the 1948 "Yearbook" of the ASA in mimeographed form as the first precursor of *JASA*, under the title of "The Spiritual Interpretation of Science by Jeans and Eddington." Here he carefully distinguishes naturalism as "the view that the universe is self-contained ..." from idealism as the view that "the universe cannot be explained without recourse to such a concept as God, mind, or spirit." He summarizes Jeans' idea that "the stuff of the universe is far secondary to (its) mathematical design," and Eddington's notion that "all the energy, movement, and design in the universe must be ultimately derived from a Person." Their argument that "objective idealism is the only metaphysical position that can account for the nature of modern physical science, and the indisputable facts of consciousness" (1948:1-4) leads Ramm to the following conclusion:

> Nobody is more certain than we are, that there is still a considerable gap between the position of Jeans and Eddington and Christian theism. But on the other hand we should welcome with a spirit of gratitude the work of every scientist that endeavors to break the steel trap of naturalism ... American science must subject itself to the same vigorous self-analysis with a description of its assumptions and limitations that it expects of the theologian (1948:6).

This critical evaluation of science is applied to the theory of evolution in Ramm's second contribution to the ASA, presented (in absentia) at the third ASA national convention at Calvin College in 1948. It was published in volume 1 of *JASA* (June



Joseph Spradley is Professor of Physics at Wheaton College, Illinois. He received his B.S., M.S., and Ph.D. degrees at UCLA in engineering physics and worked for four years at Hughes Aircraft Company. He has taught at Wheaton since 1959 except for six years on leaves of absence, including his current year at the American University in Cairo, Egypt, two years as Acting President of Haigazian College in Beirut, Lebanon, two years as a USAID science specialist at Ahmadu Bello University in Nigeria, and a recent semester at Daystar University College in Nairobi, Kenya. He is co-author of the book The Making of a Christian Mind.

1949:15) under the title "The Scientifico-Logical Structure of the Theory of Evolution."

Bernard Ramm

After discussing the nature of scientific knowledge, he arrives at the following applications:

> Bold pronouncements then as to the finality of evolution as the ultimate theory of biology are not in keeping with the nature of scientific knowledge ... As a hypothesis it can only survive when it can be shown that no logical inconsistency is involved ... and no material inconsistency develops .... It cannot categorically state at the same time the following: (a) Life comes only from life; (b) Life arose spontaneously ages ago. Nor can it state categorically: (a) offspring tend to keep within the normal spread of variations, and (b) mutations arise that jump outside the normal spread of variation. Again, evolution must be revised or altered if it can be shown that it runs into difficulty with material implication. If no mechanism for evolution can be demonstrated then the theory stands in grave danger (June 1949:13).

Although Ramm takes a critical stance toward evolution here, he suggests that Genesis 1 is a broad enough sketch of "the successive creative acts of God" that it leaves "considerable room for the empirical determination of various and diverse facts." He continues:

> Secondly, there is no advance upward apart from the creative activity of God. There may be horizontal radiation of life but no vertical. This is precisely the point where this view differs from theistic evolution. Evolution, theistic and naturalistic, believes in the radiation of life from lower to higher forms, from the simple to the complex. According to our view radiation can only be horizontal ... there is only unraveling of gene potentialities — no upward evolution. And this seems to be in keeping with the fact that we do have in geology no demonstrable vertical radiation but plenty of horizontal radiation (p. 15).

He concludes that such an interpretive concept "would replace the evolutionary one because it can account for all that evolution tries to account for ... and for the things that evolution cannot," since Genesis 1 "is a divine revelation." Thus, in these early articles, Ramm not only criticizes science, but views scripture as a supplement to scientific explanation.

Ramm applied his critical skills to psychology in his third contribution to the ASA, presented to the fourth national ASA convention at the Bible Institute of Los Angeles in 1949, where he served as the host representative for 75 registrants. This article was published in volume 2 of *JASA* (M 1950:28-31) under the title "Behaviorism and Philosophical Psychology." Here he criticizes behaviorism for its denial of the soul, which he believes "cuts the nerve of religion" (p. 28) and leads to the demise of ethics and immortality. Among the "sins of behaviorism" is its "adoption of naturalism and evolution" and it is thus "enmeshed in metaphysical presuppositions" (p. 30). In conclusion he calls for a volume on philosophical psychology demonstrating "the bipartite nature of man" (p. 31).

In 1948 Ramm presented the mid-year lectures of Western Baptist Theological Seminary (Portland), which were published as his first book with the title *Problems in Christian Apologetics* (1949). The last chapter contained Lecture IV on "The Limitations of the Scientific Method" (pp. 73-92). Here he lists ten criticisms of tendencies in science that lead to scientism, which are still relevant and can be briefly summarized. (1) Science exempts itself from scrutiny while complaining of the limitations of philosophy and religion. (2) Science confuses its method with metaphysics when it espouses positions such as naturalism. (3) Science rules out the personal dimension in its objective methodology, as in behaviorism. (4)

Science assumes that the world of abstraction is the real world, leading to reductionism. (5) Science eliminates much of human experience in restricting its field of investigation. (6) Science uses mental constructs that cannot be directly observed. (7) Science cannot solve philosophical problems. (8) Science has no adequate doctrine of beginnings (creation) or endings (eschatology). (9) Science is based on assumptions and presuppositions. (10) Science depends on moral rules that are suprascientific.

His final conclusion is that "revelation and science must* ultimately *tell the same story," so that "when the final interpretation of the Bible is made, and the last law of science is formulated, that the answers will be the same."

In spite of these criticisms and conflicts, Ramm concludes with the recognition that science is a legitimate sphere of human activity. He warns against the "wholesale castigation of science found in some evangelical literature ... not in keeping with the best of the conservative tradition." His final conclusion is that "revelation and science must *ultimately* tell the same story," so that "when the final interpretation of the Bible is made, and the last law of science is formulated, that the answers will be the same" (1949:91-92). These positive attitudes toward science, perhaps partly a result of his ASA associations, were a preview of the next stage in Ramm's thinking about the relation between science and scripture.

Concordist View of Science and Scripture (1950-57)

Publication of Ramm's *The Christian View of Science and Scripture* (1954) was one of the most important events in the postwar emergence of evangelicals from nearly a half-century of conflict with science. In a rather critical review, Bayly conceded that "In general the book does represent the view, delineated but not originated by Dr. Ramm, which is accepted by a sizable segment of the American Scientific Affiliation." He notes a general reaction to the book that "seems to be a sigh of relief that the quarter-century of identification with William Jennings Bryan, Harry Rimmer, George McCready Price, et al, is now ended. Christians have come of age in science" (1955:4). Bayly criticizes Ramm for attempting to distinguish between "cultural" and "transcultural" elements in the Bible by identifying references to nature as cultural and theological statements as transcultural.

From the first pages of the book, it is evident that Ramm has shifted from a critical view of science to an emphasis on the need for a harmony between Christianity and science. One evidence of ASA influence on his thinking is his listing of the ASA-sponsored book *Modern Science and Christian Faith*, edited by Everest (1950), among "books of outstanding merit" in his classified bibliography (1954: 355). Ramm's scholarship is especially impressive in his careful outlining and documentation throughout. Even more surprising is the fact that this book is one of four major works he wrote in about the same number of years (1950, 1953a,b, 1954) while carrying a full teaching schedule.

From the first pages of the book, it is evident that Ramm has shifted from a critical view of science to an emphasis on the need for a harmony between Christianity and science.

In his preface Ramm refers to the "noble tradition in Bible and science, "especially in the nineteenth century, "of the great and learned evangelical Christians who have been patient, genuine, and kind and who have taken care to learn the facts of science and Scripture" (1954:9). He also acknowledges his debt to Wilbur Smith of Fuller Theological Seminary for making available his "large collection of books on Bible and science" (p. 10) . Smith's [8] evaluation of Ramm's book is quoted from *Moody Monthly* by Everest in *JASA*:

> The most important discussion of the problems involved in the vast and difficult subject of modern science and the ancient Scriptures that has appeared in this country in fifty years. It is the only book that I know of, by an evangelical scholar of today, that can be favorably compared with the masterly, learned works in this field which were produced in the latter part of the nineteenth century (D 1979:187).

After discussing the importance of harmonizing Christianity and science and an analysis of their con-

flict, Ramm develops principles for interpreting the Bible in relation to nature. He notes "that the language of the Bible with reference to natural things is popular, pre-scientific and non-postulational" (1954:76). As creator, "God is world ground to Nature" (p. 105) and "the Spirit of God ... is The Divine Entelechy of Nature" (p. 112). Ramm's concept of progressive creation as divine activity in nature, including occasional *de novo* creative acts, is an attempt to bridge the gap between "simple *fiat* creationism which is indigestible to modern science, and evolutionism which is indigestible to much of Fundamentalism" (p. 117). When he begins to apply these principles, he is able to clear the air of many foolish "anticipations of science in scripture," and to suggest alternative interpretations to many difficult biblical passages. One of the refreshing things about the book is the revelation that many scholars have struggled with these passages and Christians have arrived at many different conclusions.

At this stage in his thinking, Ramm's preferred interpretation of the Genesis account of creation is a "moderate concordism."

At this stage in his thinking, Ramm's preferred interpretation of the Genesis account of creation is a "moderate concordism." He rejects the literal six-day interpretation as inconsistent with scientific evidence. He also rejects the strict concordism of the age-day theory, even though he indicates "much sympathy for it, and held it for many years" (1954:220). He prefers the pictorial-day theory, in which creation is revealed in six days and the order of revelation is not strictly chronological, but partly topical or logical. In such a "moderate concordism ... man was the last creation of God so that the last creative act of God coincides with the geological record of the recency of man" (p. 223). Moderate concordism means "that geology and Genesis tell in broad outline the same story ... Both agree that the higher animals and man were the last to appear. The time element is not stated in the Genesis record and must by learned from the geological record" (p. 226). He reaches the following conclusion about creation:

> Almighty God is Creator, World Ground, and Omnipotent Sustainer. In his mind the entire plan of creation was formed with man as the climax. Over the millions of years of geologic history the earth is prepared for man's dwelling, or as it has been put by others, the cosmos was pregnant with man ... From time to time the great creative acts, *de novo*, took place. The complexity of animal forms increased. Finally ... he whom all creation anticipated is made, MAN, in whom alone is the breath of God (1954:227-228).

"The Bible does not teach final scientific theory, but teaches final theological truth from the culture-perspective of the time and place in which the writers of the Bible wrote."

In developing his idea of progressive creation, he notes "that the geological record does not reveal a continuity, an evolution, but that it reveals great gaps." He than suggests that "The geologist can record gaps and appearances and announce that he has no natural theory as to their origin. The theologian can inform the geologist of progressive creation" (p. 228). He distinguishes his view from "theistic evolution which calls for creation from within with no acts *de novo*." But he recognizes that theistic evolution is a valid Christian option if it views evolution "as a secondary law of biology, and not the metaphysics of creation, but viewed as part of the divine creation, an element in providence" (p. 292).

In his final epilogue, Ramm concludes that "It is not true that all evangelicals believe that evolution is contrary to the Faith .... we have given evidence to show that men whose orthodoxy is unimpeachable have accepted some form of theistic evolution or at least were tolerant toward evolution theistically conceived." He also affirms that "The Bible does not teach final scientific theory, but teaches final theological truth from the culture-perspective of the time and place in which the writers of the Bible wrote" (pp. 347-348). It is this position that he emphasizes in most of his later writings. In a recent evaluation of Ramm's work, Patterson concludes:

> Although Ramm's 1954 book was very influential among evangelicals, it made too many concessions to science. By combining elements of sudden *fiat* creation and graduation evolution, his form of "progressive creationism" turned Genesis 1 into a treatise in science to be evaluated, judged, and tested by science. But his "special creation," called in to provide the missing links left by natural evolution, is

merely a form of the "God of the gaps" hypothesis (1990:66-67).

Patterson also points to the last stage in the development of Ramm's changing views of science and scripture: "Ramm's continued studies on the religious use of language in the past three decades led him to see more clearly that Genesis 1 is a cosmological statement serving a theological purpose." In 1983 "he set forth a new paradigm of how best to relate science ... and ... the biblical text" (p. 67).

Contextual View of Science and Scripture (1958-1983)

In the 1957-58 academic year, Ramm devoted his sabbatical leave to study in Basel under Karl Barth. He felt "that of all contemporary theologians the one who was doing the best job of relating historic Reformed theology to the Enlightenment was Karl Barth" (1983:10). When he wrote *The Evangelical Heritage*, he still had reservations about Barth (1973:118-120). But by 1983 in *After Fundamentalism*, he publicly declared Barth's theological method to be the best paradigm for evangelical theology in the twentieth century, while not necessarily accepting all of Barth's conclusions (*After Fundamentalism*, Appendix 1). This approach emphasized that "If the writers of Holy Scripture are truly children of their cultures, then they express themselves in the terms, concepts, and vocabulary of their culture." At the same time it asserts "that embedded in the culturally conditioned Scripture is the witness to the Word of God or the divine revelation" (1983:47). With this contextual view of scripture, Ramm felt that many apparent conflicts with science could be avoided without forcing the biblical text into a modern mold.

With this contextual view of scripture, Ramm felt that many apparent conflicts with science could be avoided without forcing the biblical text into a modern mold.

In 1963 Ramm contributed an article on "Theological Reactions to the Theory of Evolution" to an issue of *JASA* (1963) on evolution, which was also adapted for publication in *Eternity* (1965). Here he emphasized that "the Genesis creation account is a great confession of faith," and that "The Christian doctrine of creation is not embarrassed by the empirical contributions of science" (1963:71). While noting that evolution has been used to support materialism and atheism, the theory in its essence is not a threat to a proper understanding of creation. The theological idea of creation is a relational rather than an empirical concept. Creation is continuous in the sense that God has a continuing relationship to his creation, which is completely dependent on Him for its continuing existence.

These ideas led Ramm beyond his earlier emphasis on gaps in the geological record (1954:228) to the conclusion that "God is not the God of gaps in scientific knowledge. God is not the yet-unexplained in scientific theory. God is not an empirical premise for any scientific theory" (1963:74). From this contextual view, scientific theories "neither confirm nor refute the biblical doctrine of creation. Nor are the six days of creation surveys of the history of geology or biology" (p. 76). This theological understanding of creation "views the theory of evolution with indifference ... That man is in the image of God is settled by the *Word of God* and not by human physiology, or comparative anatomy" (p. 77).

Science may so box itself in that the only way out is by an appeal to God ...

In his 1966-67 sabbatical year, Ramm taught at Haigazian College in Beirut, Lebanon, where I was serving at the time. In addition to auditing his philosophy of science course and interacting on campus, my wife and I had many enjoyable experiences with him and his wife Alta. Among notes I received from him at that time, he again repudiates "the God of the gaps", but he does reserve judgment at two points. First, science may so box itself in that the only way out is by an appeal to God, such as in trying to account for the richness of the activity of the mind, or if the period required for evolution is drastically limited by the age of the earth. Second, in redemption, God *is* the God of the gaps in that the total motion of revelation and redemption originates with God and so moves upon man.

In 1969 Ramm contributed the lead article to a *JASA* symposium issue on "The Relationship Between the Bible and Science" (D 1969). Here his contextual approach is evident in a section entitled the "Importance of Context" where he discusses problems related to biblical inerrancy. He notes that "the special nature of a document means that error must

be discussed within the context of the specialty of the document" (p. 100). He makes "a distinction between the structural and cultural forms that revelation comes through, and the revelation itself. The revelation does not dignify the structure into the category of the revelational." He concludes that "when we make a distinction between the modality in which a revelation comes and the teaching of the revelation itself, there is no contradiction between modern scientific pictures or models and Biblical revelation" (p. 101).

The contextual view is applied to the Genesis account of creation in Ramm's summary of Barth's approach to the issue of Genesis and science in *After Fundamentalism* (1983:152-154). "His first step is to let the Genesis record stand as it is, a product of the prescientific world with its prescientific cosmologies." Barth is not concerned about the different cosmological perspectives in Genesis 1 and 2 or other cosmologies throughout scripture. His second point is "that this multiplicity should not distress us. Christian theologians have used all kinds of cosmologies... There is no common cosmology behind sacred Scripture." This point recognizes the shifting paradigms throughout the history of science, so that the world view of the biblical writers need no longer be an embarrassment.

His third point is "that these texts (Genesis 1-3) are the Word of God. The Word of God is 'in, with, and under' the cosmology. The cosmology is not the Word of God, but the message within the cosmology is the Word of God. Revelation does not intend to teach science, and therefore the Word of God is independent of the cosmology." The fourth step is to remember that "If scientists do their work in theory construction within the limits of the data themselves, scientists will never say anything contrary to the Word of God," and "If theologians restrict themselves to the Word of God and pure theological statements ... then theologians will never say anything contrary to science." If science and theology are governed in their methodology by the nature and context of the subject matter they investigate "the conflict between science and theology" would be removed.

Conclusion

Most of Ramm's later contributions to *JASA* were applications of theology and ethics to new developments in science and technology. In an article entitled "Evangelical Theology and Technological Shock" (June 1971) first presented to the 25th annual convention of the ASA at Bethel College (St. Paul) in 1970, he reviewed scientific developments in areas like genetics, medicine and behavioral control, and suggested theological responses to possible conflicts. A second article entitled "A Christian Definition of Death" (June 1973) reviews three attempts to "bring theological insights to decision-making dilemmas in technologically advanced medicine" (p. 57). A third article on "An Ethical Evaluation of Biogenetic Engineering" (D 1974) evaluates four systems of medical ethics.

Bernard Ramm has been a helpful guide to the ASA and other Christians concerned about the relation between science and scripture. For four decades he has been on the leading edge of the renaissance in evangelical approaches to biblical interpretation and their application to a Christian understanding of science. His developing views of science and scripture over the years have matched the growing needs of evangelicals involved in science.

His early critical views of science in conflict with scripture helped Christians to emerge from isolation and begin to interact intelligently with scientific issues. The concordist approach developed in *The Christian View of Science and Scripture* set an example of outstanding Christian scholarship. It provided a biblical interpretation compatible with science that was an encouragement to a whole generation of evangelical scientists, even though it perhaps conceded too much to science. The contextual view of scripture that emerged in his later writings provides a new paradigm for relating science and modern biblical interpretation. It avoids unnecessary conflicts and allows the light of scripture to shine from its original context and illuminate our understanding of science. ✣

REFERENCES

Bayly, Joseph, T. 1955. *"The Christian View of Science and Scripture*: A Critical View of Bernard Ramm's Book." *Eternity*, 6,4-5,44-48, Aug.

Buswell, James, 0. 1955. "Review of Ramm, *The Christian View of Science and Scripture* on Anthropology." *JASA*, 7(4), 4-6, Dec.

Culver, Robert D. 1955. "An Evaluation of *The Christian View of Science and Scripture* by Bernard Ramm from the Standpoint of Christian Theology." *JASA*, 7(4), 7-10, Dec.

Everest, F. Alton, ed. 1950. *Modern Science and Christian Faith*. Second ed. Wheaton, IL: Van Kampen.

_____, 1979. "Personal Reminiscences." *JASA*, 31(4), 187, Dec.

Hunt, Ann H. 1979. "Response of the Press." *JASA*, 31(4), 189-190, Dec.

Hearn, Walter R. 1979. "An Interview with Bernard Ramm and Alta Ramm." *JASA*, 31(4), 179-186, Dec.

MacDonald, Murdina. 1990. "A Bibliography of the Writings of Bernard L. Ramm." *Perspectives in Religious Studies*, 17(4), 87-101, Winter.

Mixter, Russell L. 1955. "Review of Ramm's *The Christian View of Science and Scripture* on Biology." *JASA*, 7(4), 11-12, Dec.
Patterson, Bob E. 1990. "Modern Science and Contemporary Biblical Interpretation: Ramm's Contribution." *Perspectives in Religious Studies*. 17(4), 55-67, Winter.
Ramm, Bernard. 1948. "The Spiritual Interpretation of Science by Jeans and Eddington." *ASA Yearbook*, 1-7.
_____ June 1949. "The Scientifico-Logical Structure of the Theory of Evolution." *JASA*, 1(3), 11-15, June.
_____, 1949. *Problems in Christian Apologetics*. Portland, OR: Western Baptist Theological Seminary.
_____, M 1950. "Behaviorism and Philosophical Psychology." *JASA*, 2(1), 28-31, March.
_____, 1950. *Protestant Biblical Interpretation*. Boston: Wilde.
_____, 1953a. *Protestant Christian Evidences*. Chicago: Moody.
_____, 1953b. *Types of Apologetic Systems*. Wheaton, IL: Van Kampen.
_____, 1954. *The Christian View of Science and Scripture*. Grand Rapids, MI: Eerdmans.
_____, 1963. "Theological Reactions to the Theory of Evolution." *JASA*, 13(3), 71-77, Sept.
_____, 1965. "Science vs. Theology: The Battle Isn't Over Yet." *Eternity*, 16, 16-20, Oct.
_____, 1969. "The Relationship of Science, Factual Statements and the Doctrine of Biblical Inerrancy." *JASA*, 21(4), 48-124, Dec.
_____, 1971. "Evangelical Theology and Technological Shock." *JASA*, 23(2), 52-56, June.
_____, 1973. *The Evangelical Heritage*. Waco, TX: Word.
_____, June 1973. "A Christian Definition of Death." *JASA*, 25(2), 56-60, June.
_____, 1974. "An Ethical Evaluation of Biogenetic Engineering." *JASA*, 26(4), 137-143, Dec.
_____, 1983. *After Fundamentalism: The Future of Evangelical Theology*. San Francisco, CA: Harper and Row.

If I understand it aright,
... the world of the resurrection that is envisaged
by Christian theism is not to be reduced to
just "more of the same" at a later point in time.
I see no basis for insisting
that that is the thought model to which the Christian hope is pointing,
even though a lot of metaphors are used which would fit with that.
But there is also the insistence on the concept of a "new creation."
Here we are in deep water theologically,
but at least if the concept of creation is to be thought of
by any analogy with creation as we ourselves understand it —
as, for example, the creation of a space-time in a novel —
then a new creation is not just the running on and on of events later in the original novel:
it is a different novel.
A new creation is a space-time in its own right.
Even a human author can both meaningfully and authoritatively say
that the new novel has some of the same characters in it as the old.
The identity of the individuals in the new novel
is for the novelist to determine.
So if there is any analogy at all with the concept of a new creation by our divine Creator,
what is set before us is the possibility that
in a new creation the Author brings into being, precisely and identically,
some of those
whom He came to know in and through His participation
in the old creation.

Donald M. MacKay, *Behind the Eye*

Christian, Teacher, Scientist, Mentor: Dr. Russell L. Mixter

Visionary for the Role of Science in Christian Higher Education

DOROTHY F. CHAPPELL

Department of Biology
Wheaton College
Wheaton, IL 60187

Dr. Russell L. Mixter, Professor Emeritus of Zoology, served as faculty member for more than 50 years at Wheaton College (IL) and additional years at other institutions of higher education where he dedicated his career to Christian higher education. His role in co-educational Christian liberal arts colleges provided mentoring which combined high scholastic standards with devout Christian faith and practice. His career of teaching biology has been rated highly by students and peers. He also has enjoyed a professional and scholarly career that included serving as president of the American Scientific Affiliation (ASA) and Editor of the Journal of the ASA, *and as editor/author of several papers, including the monograph* Creation and Evolution *(1952, 1968) and the book,* Evolution and Christian Thought *(1959). His interaction with members of the Christian church and with para-church organizations where he integrated his faith and practice has brought credibility to the study and practice of science by Christians. Dr. Mixter's career has been marked with integration of the Christian faith, learning, and practice, and he has taken a proactive approach in addressing contemporary issues in biology.*

Listen, my sons, to a father's instruction;
pay attention and gain understanding.
I give you sound learning
so do not forsake my teaching.
When I was a boy in my father's house,
still tender, and an only child of my mother,
he taught me and said,
"Lay hold of my words with all your heart;
keep my commands and you will live.
Get wisdom, get understanding;
do not forget my words or swerve from them.
Do not forsake wisdom, and she will protect you;
love her, and she will watch over you.
Wisdom is supreme; therefore get wisdom.
Though it cost all you have, get understanding.
Esteem her, and she will exalt you;
embrace her, and she will honor you.
She will set a garland of grace on your head
and present you with a crown of splendor."
Listen, my son, accept what I say,
and the years of your life will be many.
I guide you in the ways of wisdom
and lead you along straight paths.
When you walk, your steps will not be hampered;
when you run, you will not stumble.
Hold onto instruction, do not let it go;
guard it well, for it is your life.

Proverbs 4:1-13 (NIV)

This paper was presented at the 50th anniversary meeting of ASA held at Wheaton College in July 1991.

Contemporary Christian liberal arts colleges maintain that academic excellence, Christian faith, and practice are essential in the education and stewardship of the mind, soul, and body. These high ideals are reflected in the curriculum of such colleges, the types of faculty and staff who are hired to teach and administer the colleges, and in the types of students who are admitted into the college programs. Indeed, many Christian liberal arts colleges "exist to help build the church and improve society worldwide by promoting the development of whole and effective Christians through excellence in programs of Christian higher education."[1] Christian liberal arts education at its best trains individuals to effectively relate and respond to issues of contemporary significance. Some contemporary matters are temporal; others are more foundational to the tenets of the faith and involve our limited understanding of the created order of the universe, how humans are to effectively live and serve in the creation, and how humans relate to other humans and the creator of the universe.

Christian students with childlike faith and a strong sense of purpose who enter the "halls of academe" in Christian liberal arts colleges are bombarded with new ideas, marvelous spiritual awakenings, and an ever increasing circle of friends and acquaintances, not the least of which is the faculty. Those faculty serve as disciples of the Lord Jesus and attempt to bring to bear on students the perspectives they have in their respective disciplines and their own life experiences. Noble attempts are made by faculty to integrate faith, learning, and practice, and to model such integration before their students, peers and supervisors. The faculties of Christian liberal arts colleges of the last two decades even enjoy seminars and specially designed courses where they study and analyze faith, learning and practice.

This is the story of an individual who didn't need to learn integration of faith, learning, and practice through seminars and courses especially designed to increase sensitivity to those issues. This colleague, Dr. Russell L. Mixter, Professor Emeritus of Biology at Wheaton College, has successfully led a life integrating faith, learning and practice in total response to the call of his Lord and Savior, Jesus Christ. He has inspired students and colleagues who have heard him speak or read his writings.

A graduate of Wheaton College in 1928 (B.A. in literature), Michigan State University (M.S. in genetics) in 1930, and the University of Illinois (Ph.D. in anatomy) in 1939, Dr. Russell L. Mixter's service to Wheaton College (Illinois) as a faculty member completely spanned five decades. In addition to his service at Wheaton College, he also served as a faculty member at Trinity College, Barat College, Judson College, and the West Suburban Hospital School of Nursing Program (1946-77) bringing his total time of teaching in higher education to more than 50 years. He served as Chairman of the Department of Biology at Wheaton College for 25 years (1947-72), Chairman for the Science Division for 19 years, on the faculty of Wheaton College for 50 years (1928-79), and as editor of the *Journal of the American Scientific Association* for five years (1964-68). He authored at least eight articles, reviews, or editorials for *JASA*, including an article for the first volume in 1949, and was featured in other ways including photographs, responses to his writing, and other items that related to or demonstrated his interest in and support for scholarly activity in at least several dozen other issues of the *JASA*.

The Russell L. Mixter who taught at Wheaton College for fifty years seldom let a smile drift from his face, but also carried (as he does to this day) a twinkle in his eye, talk of sincere dedication to his Lord and Savior, tenacious wit, discerning wisdom, and thorough resolve to discover and represent truth. When Dr. Mixter was introduced (with other new faculty) in the Trinity College campus newspaper, the student reporter said "Next on the agenda

Dr. Dorothy F. Chappell earned her undergraduate (B.S.) degree in biology from Longwood College in Virginia, her master's degree (M.S.) in biology at the University of Virginia, and Ph.D. in botany at Miami University of Ohio. Dr. Chappell has published papers in national and international journals on the evolution of green algae and land plants and in integrative journals on contemporary issues related to biology. She was awarded a Fulbright Research Award to conduct research in New Zealand and Australia for nine months duiring 1989-90. She is in her eleventh year of serving as Chair, Dept. of Biology at Wheaton College and her fifteenth year on the faculty of Wheaton College.

is Dr. Mixter, whose credentials are just phenomenal," and she enumerated his many accomplishments. She included this quote from Dr. Mixter: "Teaching's fun, no problem. Couldn't imagine an easier job."

Lines like "Life worth living depends on a liver" or "Education is the inculcation of the inscrutable into the ignorant by the incompetent" infused wit into his lectures and demonstrate some of his clever uses of words to stimulate student minds.

Testimonies to his goodness and of his care for individuals abound. For example, he is known, in his typical benevolent fashion, to have offered fiscal help to a faculty colleague whose plans for international travel didn't materialize in the expected time, and to have painted, without pay, a single woman's house in a summer. Dr. Mixter has lived by the verse, "Let your light so shine before men, that they see your good works, and glorify your Father which is in heaven" (Matthew 5:16). He continues service honoring his Heavenly Father in many interesting ways. He has known very well dependence upon his heavenly Father in times of need, like the time Wheaton College couldn't pay its faculty. (Although it finally did pay its faculty salaries, they were significantly late.) He knew what it meant to keep a part-time job during the World War II days. He was quoted in one newspaper article saying, "I remember one time in the 1940s when our finances were tighter, when a student sent me a tie, saying he was tired of seeing the same one every day. We're a lot better off now." In surveying archival and personal materials in preparation for this article, I could not help but be inspired with the many spiritual notes that Dr. Mixter has made. Each one has a wealth of inspiring information. The prominent theme, though, lies in the truth that "*God* is our refuge and strength." Dr. Mixter clearly believes that we are what we are by God's grace and not by our "fancy doings!"

Acclaimed by Wheaton grads who went on to medical school as a teacher who gave them a strong foundation for medical study, he has touched the lives of many students and patients. He was given the Teacher of the Year Award by Wheaton College in 1969. It is no secret that he has never had an attendance problem in his classes. Another delight in his teaching career was teaching the women at Wheaton College's affiliate West Suburban School of Nursing. Throughout his career, he has been known as a youthful, vivacious, and witty professor who used quips to enhance his teaching. Lines like "Life worth living depends on a liver" or "Education is the inculcation of the inscrutable into the ignorant by the incompetent" infused wit into his lectures and demonstrate some of his clever uses of words to stimulate student minds. His students have honored him with their long term success and in other memorable ways, including writing about him, as in these excerpts from an "Ode" dedicated to him in 1979 at his induction as a West Suburban Nursing School Alum.

Ode To Dr. Russell Mixter

(Excerpts)

The first day we made your acquaintance
We thought you looked "good for your age."
But now that we've gotten to know you
We only hope we'll reach that stage.

In addition to all of the nerve tracts,
Cell membranes and long lists of germs,
You taught us new ways of pronouncing
The old-fashioned technical terms.

Your involvement among us surpasses
The role of teacher alone!
You've transported students to Wheaton
And passed love letters from Rhonda Bone.

And on Valentine's Day in '78
You stole all our hearts away
As dressed in disguise with a gift for us all
The role of Sir Cupid you played.

You've infected us with your humor
And transmitted equally well
More graciousness and information
Than any of us singly could tell.

So as over the years you've become one of us,
Sharing your wisdom and knowledge and fun
We'd like you to know we think you deserve
To be considered a West Sub "Alum."

The students also honored him by dedicating the Wheaton College album, *The Tower*, to him in 1950. As current Wheaton College personnel travel throughout the world and interact with Wheaton College alumni, they are nearly always asked "How is Dr. Mixter? Where is he now?" His reputation as Christian, teacher, and scholar reminds those who

know him of the rich fulfilled life one can lead as a faculty member in Christian higher education.

The Lord has been Dr. Mixter's motivator to use his innate abilities, mind, heart, hands, and soul for the work of the Kingdom. Viewing him and his contributions in the service of the Lord, he seems so naturally integrated that it is almost unnatural to separate out the qualities that contribute to his wholeness.

"Scripture does comment on the observable world. The writers observed the sea and sky and their denizens, although their purpose was to use these as stimuli to reverence rather than to analyze them in the scientific manner of classifying and explaining the mechanics of their processes."

Dr. Russell L. Mixter's scholarship has been exceptional. At a time when it was not particularly "fashionable" for Christians to publish, he entered a realm of publishing scientific articles in internationally refereed journals like *Genetics* and the *American Journal of Anatomy* and what we have in recent years called "integrative writings," like those published in the *Journal of the ASA*. He had no mentor or administration pushing him to accomplish a certain amount of publishing. The research record he established centered in biological sciences and closely related contemporary issues.

The *American Men and Women of Science* lists his research as "macrophages of connective tissue, flexed tail in mice, evolution, and spiders of the Black Hills." To that list, clearly, should be added a category for Christian attitudes toward scientific explanations. Verbally and in writing, Dr. Mixter has wisely advised those who seek truth that,

> The attitude an honest man should have toward differing views of the implications of facts is to evaluate all opinions and hold to the one that is harmonious with the information from both revelation and reason.
>
> Scripture does comment on the observable world. The writers observed the sea and sky and their denizens, although their purpose was to use these as stimuli to reverence rather than to analyze them in the scientific manner of classifying and explaining the mechanics of their processes. Seeds die, the sun rises, the heart believes. These phrases obviously make sense when understood in the manner in which they are used.

He advises us that:

> Scripture and science are partners. The Bible reveals the personality of the one who is the 'infinite and perfect Spirit in whom all things have their source, support, and end.' And science tries to find how he made things, and when, and of what they are composed.[2]

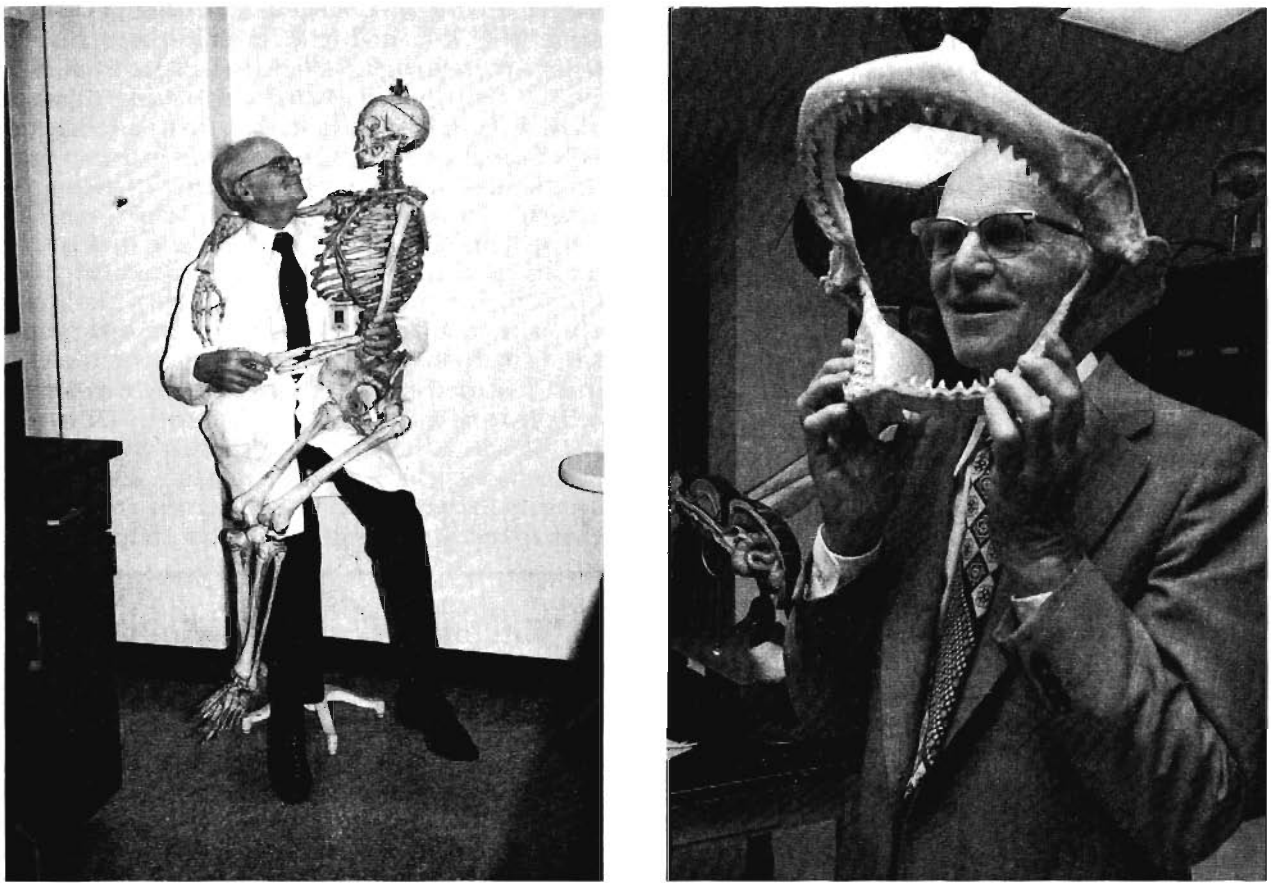
Colleagues, as well as students, remember fondly Dr. Mixter's days of teaching. Two female science instructors at Wheaton College tell of his unprejudiced and wholehearted acceptance and professional treatment of them. "*Encourager* is a good word to describe him," says Cordelia Erdman Barber, who taught at Wheaton College as Instructor of Geology from 1949-1954, and Marie Fetzer Reyburn, Instructor of Anthropology at Wheaton College from 1948-1951.[3] "He (Russell Mixter) never spoke to me on a lower level; he always treated me as a colleague" says Cordelia Barber. These two women who practiced science at Wheaton College after attending Columbia University emphasized their excellent collegial relationship to Dr. Mixter and praised him for his mutual appreciation and respect for them. Cordelia Barber also clearly remembers Dr. Mixter "as a clear thinker with a heart for truth and people, not a confronter in personality but a confronter in truth." Marie Fetzer Reyburn says she was always accepted and treated as a professional by Dr. Mixter and he was always ready to consult with her as a professional. This type of acceptance and encouragement for women scientists was rare and was not even found at the larger Columbia University.

"Encourager *is a good word to describe him."*

Dr. Mixter's teaching career spanned five decades when many significant developments took place at Wheaton College, on national and international grounds, and in the scientific and theological realms of academia. Wheaton College was accredited by the North Central Association in 1929, one year after Russell Mixter took his faculty position there. Numerous buildings and programs were added to Wheaton College. Many monumental advances have

occurred in science during his career: humans have discovered penicillin, walked on the moon, visited the depths of the ocean, created freeze dried foods, sent the Word of God around the world in microwaves, isolated genes, spliced genes into other "kinds" of organisms, observed the explosion of stars, and cured "incurable diseases." We can now isolate the genes that code for flexed tailed mice like the ones Dr. Mixter studied at Michigan State University. The work and flexibility required for a faculty member to keep up with all of these changes is immense, and the continued success of the students whom Dr. Mixter taught for five decades is a testimony of his flexibility, thoroughness, and ability. This versatility should have been obvious to everyone when he, a literature major and graduate of Wheaton College in 1928, entered graduate school and completed both a master's degree and Ph.D. degree in biology!

He successfully kept up with the changes in his field through personalized study, attendance at professional societal meetings, and through attendance at workshops. Throughout this exciting career he developed a burden for issues in science and began writing in a way unheard of for a biology professor. He "integrated his faith, learning, and practice" and crossed the classical discipline boundaries to offer perspectives and advice on matters where his Christian faith could be brought to bear. A search of *JASA* reveals a number of articles and reviews on matters of faith and learning. They include his exposé on "Biology and Christian Fundamentals" where he builds an argument for biology providing evidence for a purposeful, intelligent creator and that the natural order contains diversity;[4] "An Evaluation of the Fossil Record;"[5] "The Science of Heredity and the Source of Species;"[6] and "The Scriptures and the Scientific Method"[7] where he discussed some



Dr. Russell L. Mixter has served as Christian, teacher, and professional scientist for over 50 years and is well known for being witty and vivacious. His wisdom and teaching pedagogies are creative and have enhanced his students' experiences. He is seen here captivated by human skeletal anatomy (left) and speaking through the jaws of a specimen being studied in a Comparative Anatomy lecture (right).

advantages and limitations of science and cautioned humans about their own wisdom. Here he suggests that ...

> ...one should be such a good astronomer as to know all of the stars from Aldebaran to Vega and also follow the Star of Bethlehem which leads men to Christ; one should be such a good botanist as to know all of the flowers from Agaratum to Zinnia but should also possess the fragrance of the Rose of Sharon and the Lily of the Valley. A chemist who knows all the combinations of the elements from aluminum to zinc needs also to be preserved by the Man of Galilee who is the Salt of the Earth.

"A chemist who knows all the combinations of the elements from aluminum to zinc needs also to be preserved by the Man of Galilee who is the Salt of the Earth."

He strongly suggests in this paper that ...

> ... he is confident that Christians do not need less science to keep them faithful but will increase in faith as they see more and more of science and how it is consistent with a Purposer and Sustainer in the universe.

1959 marked the 100th anniversary of the publishing of Darwin's *Origin of Species*, and many articles were published within the scientific community. Paul Bechtel's *Wheaton College, A Heritage Remembered* (1860-1984)[8] records that ASA commissioned a volume of studies, published in 1959, and edited by Russell L. Mixter, which appeared under the title, *Evolution and Christian Thought Today*.[9] The quality of the publications and their content interested the Wheaton College faculty to the extent that they held a symposium to discuss the issues raised by the published series. The discussions were rich and insightful but led to some trauma for those who taught at Wheaton College. According to Bechtel, some ill-founded charges were made regarding the position of some faculty members on the origin of man. Some members of the Wheaton College constituency called for clarifications on the issue of origin of man. President Edman published several statements assuring the Wheaton College constituency of the science faculty's theological orthodoxy and competence in science. Dr. Mixter's wisdom and leadership of the Science Division and insight in subsequent publications brought to light more issues of integration as related to origins and evolution. Also noteworthy is his monograph, Creation and Evolution,[10] published by the American Scientific Affiliation. Although the concern over this issue led to an addendum to the statement of faith to be signed by faculty of Wheaton College, Dr. Mixter's persistence in publishing and speaking on the phenomena of origins and evolution clarified the position that scientists who are Christians can take without making the compromises associated with misunderstanding the issues.

These publications are mentioned to demonstrate Dr. Mixter's commitment to advocating the truth and attempting to clarify issues that may have provided stumbling blocks to scientists who consider Christians too conservative to be logical in matters of science. As a result of Dr. Mixter's clear articulation of matters of origins and evolution, he became a nationally known speaker and was invited to speak in InterVarsity Christian Fellowship groups at many colleges and universities, including the "Big Ten" universities. In fact, perhaps there are readers of this article who are from a "Big Ten" university where Russell Mixter has been invited to speak at InterVarsity Christian Fellowship Groups on matters of integration of faith and learning.

Dr. Mixter has demonstrated an ongoing commitment to advocating the truth and attempting to clarify issues that may have provided stumbling blocks to scientists who consider Christians too conservative to be logical in matters of science.

Perhaps some of Dr. Mixter's professional associates best express the gratitude that we feel for the example of this brother in Christ. The first is from Dr. Robert W. Morris Director of the Oregon Institute of Marine Biology to a Wheaton College administrator re: Dr. Mixter:

> I am pleased to advise you that a member of your staff, Dr. Russell L. Mixter, was awarded a National Science Foundation stipend for participation in our summer Institute in Marine Biology. In my opinion, the stipend could not have been better invested. Dr. Mixter was a diligent worker and applied himself to the studies with purpose and enthusiasm. Any recognition you may give Dr. Mixter

> for the excellent representation he gave your school will be genuinely appreciated.[11]

Another letter in the archives of Wheaton College expresses something of the magnitude of Dr. Mixter's contributions to the Kingdom. This came from President Hudson T. Armerding to Dr. Mixter on the occasion of his relinquishing the chairmanship of the Department of Biology.

> It is with mixed feeling[s] that I received the recommendation from Dr. Baptista that your successor be appointed in the chairmanship of the Department of Biology. It will be scarcely the same not to have you giving quiet but competent direction to that part of the program.
>
> It is simply not possible adequately to express to you the gratitude of all of us for your years of service. To me, you will always be a splendid illustration of one who worked tirelessly to challenge and assist the students but with no endeavor to gain personal glory in the process. This is a rare quality of life that is pleasing to the Lord and inspiring to your colleagues.
>
> As one who had the privilege of being a student of yours and through the years has valued your friendship and fellowship in the work here, I speak on behalf of our colleagues as well as myself in expressing appreciation. I know that the numerous generations of students you have taught would endorse this word of commendation.[12]

Viewing Dr. Mixter's career is a bit like viewing a "Man for All Seasons" in the Christian tradition. He entered his teaching career at a college where his faith could actively count as he dedicated himself to helping develop one of the most precious resources of our time, the life of the Christian mind. He served by being an excellent teacher, counselor, advocate for women in science, administrator, scholar in pure science and integrative issues, and mentor of Christian character for scientists. He strongly supported and has been active in the ASA, which was founded 50 years ago by evangelical scientists concerned with the attributes of Christian witness on science and religion. It is noteworthy that the leadership and traditions maintained by Dr. Mixter, Dr. Paul Wright, and others in the Science Division of Wheaton College, were and are of such outstanding quality that a recent analysis of the degrees awarded shows that one out of every four graduates of the Science Division during the last twenty five years has received a doctorate in some field of science. A tremendous challenge has been set before scientists who are Christians: to follow this example of stimulating students to accept science as legitimate study for Christians, mentoring the Christian lifestyle while maintaining families and effective fellowship, and worshipping the Lord of the universe.

As you might imagine, a number of student scholarships have been set up in honor of Dr. and Mrs. Mixter. They celebrated their 60th wedding anniversary in June of 1991 and they continue to actively honor their Lord and Savior, Jesus Christ, in every aspect of their lives. It is a joy to honor Dr. Russell L. Mixter as an effective servant of Jesus Christ, as a scientist who continues to heed God's words in Proverbs 4:1-13, and as one whose total servanthood to the Lord of the universe remains his highest priority. ✣

NOTES

1 Inform Bulletin of Wheaton College (Wheaton, IL: 501 E. College), 1990-91, 4

2 Russell L. Mixter. *Christian Attitudes Toward Scientific Explanations* (unpublished manuscript)

3 Personal conversation, July 25, 1991

4 Russell L. Mixter. "Biology and Christian Fundamentals," *JASA* 2(1):20-23

5 Russell L. Mixter. "An Evaluation of the Fossil Record," *JASA* 11(4): 24-27

6 Russell L. Mixter. "The Science of Heredity and the Source of Species," *JASA* 1(3):1-6

7 Russell L. Mixter. "The Scriptures and the Scientific Method," JASA 4(1):6-8

8 Paul M. Bechtel 1984. *Wheaton College, A Heritage Remembered (1860-1984)* Wheaton, IL: Harold Shaw Publishers. 415 pages

9 Russell L. Mixter (Ed.) 1959. *Evolution and Christian Thought Today.* Grand Rapids, MI: Wm B. Eerdmans Pub Co. 222 pages + illustrations

10 Russell L. Mixter. *Creation and Evolution.* Monograph Two: American Scientific Affiliation

11 Letter from Dr. Robert W. Morris, Director of the Oregon Institute of Marine Biology to a Wheaton College Administrator: Wheaton College Archives, Buswell Library

12 Letter from Dr. Hudson T. Armerding, President, Wheaton College to Dr. Russell L. Mixter: Wheaton College Archives. Buswell Library

Wheaton Women in the Early ASA

JOSEPH L. SPRADLEY and DOROTHY F. CHAPPELL

Wheaton College
Wheaton, IL 60187

Among nearly 200 contributors to the first 15 volumes of the Journal of the ASA *(1949 - 1963), only four were women, and three of these were Wheaton College teachers. Their professional lives and contributions provide interesting case studies of the role of women in the early years of the ASA, and in the sciences at Wheaton at the time. In this article, particular attention will be given to the work of Cordelia Erdman and Marie Fetzer in helping to convince fellow ASA members and their students at Wheaton of the validity of the fossil record and its biblical interpretation.*

As is often the case in much of the field of science, the American Scientific Affiliation (ASA) has been a male dominated institution. Of the more than 30 papers presented at the first three annual conventions (1946 at Wheaton College, 1947 at Taylor University and 1948 at Calvin College), none were by women. The annual convention programs for several years described the ASA as "[a] group of Christian scientific men ... " A change to "an association of men and women" first appeared in the *Journal of the ASA* (*JASA*) in March 1974. The 1948 membership list included 73 men and no women.[1] The largest institution represented on this list was Wheaton College with five members, followed by Calvin College with three members. Christian colleges accounted for 23 of the 73 members, while 22 were from other colleges and universities.[2]

Active participation of women in the ASA first became evident at the fourth annual convention in 1949 at the Bible Institute of Los Angeles. All three of the women contributors at this meeting were from Wheaton College. Among some 17 papers presented at this meeting, one was by Dr. Angeline Brandt,[3] Associate Professor of Mathematics, and one by Cordelia Erdman,[4] Instructor in Geology. Both papers were published in the *JASA*. The third Wheaton College woman was Marie Fetzer, Instructor in Anthropology, who read a controversial paper attacking flood geology by Dr. J. Laurence Kulp, who was unable to attend in person.[5] During the 1950s Erdman and Fetzer presented four more papers at annual ASA conventions, published five articles in the *JASA*, and contributed two chapters to ASA-sponsored books. After a brief discussion of the role of women in the ASA and at Wheaton College over the years, we will describe the early contributions of these Wheaton women.

Participation of Women in the ASA

At the first 22 annual conventions of the ASA, from 1946 to 1967, only one other woman presented a paper out of a total of about 300 presentations.[6] Dr. Alta Schrock, Professor of Biology at Goshen College, read her paper on "Conservation: A Christian Responsibility," at the fifth annual convention at Goshen College in 1950. Similar concerns about environmental responsibility did not appear in the *JASA* until the late 1960s. During the 1950s a total of four women published seven articles out of about 250 appearing in the *JASA* (see Table I, p. 23), including only one by a non-Wheaton woman.[7] Dr. Russell Mixter was the only male contributor in the natural sciences from Wheaton, along with four men from the social sciences. By 1950 the total ASA membership was 131 (see Table II), including seven women (5%) and seven Wheaton faculty members. Membership had increased to 670 by 1956, including 37 women (still 5%) and 12 Wheaton faculty members.[8] By comparison the membership today is about 2200, including about 220 women (10%) and 21 Wheaton faculty members.[9] In 1955 *American Men of Science* (9th edition) included about 5-6% women. By 1990 *American Men and Women of Science* (17th edition) included about 9-10% women.

Participation by women in the ASA actually decreased in the 1960s, including none from Wheaton College. Only one woman presented a paper out of about 130 presentations at national conventions, and just three women published articles out of about 350 appearing in the *JASA*.[10] The 1970s showed a little improvement with seven women presenting papers out of about 240, but only one from Wheaton. The 1976 annual convention at Wheaton College featured three papers by women, the largest number at any meeting during the decade. Articles in *JASA* were published by 14 women out of about 350 total. Some further improvement was evident in the 1980s with women contributing about 10 papers out of about 400 at national conventions, and some 21 articles in the *JASA* out of about 220 articles (plus about 120 communications).

In the light of contemporary editorial standards on non-sexist language, some contributions to *JASA* by women before 1980 seem rather amusing. Sandra Wetther's interesting poem in 1967 on personal identification with the creation of Adam was entitled "God's Man is Who I Am," in which each verse ended with the line "I am God's Man."[11] Mary Newton's 1970 article arguing against the idea that "man is only a complex machine" was entitled "The Man Who is There" in a take off from Francis Shaeffer's book *The God Who is There*.[12] Dawn Ward co-authored an article with Jack Balswick in 1977 on "The Nature of Man and Scientific Models of Society."[13] And in 1978 Susan Walker published a communication on "Evolutionary Thought and the Morals and Dignity of Man."[14]

The unusual contribution of Wheaton College women to the ASA in the early years is reflected to some extent in certain faculty statistics at Wheaton in 1950 as compared to later years (see Table III). Out of 113 faculty members in 1950, 41 were women (36%) including nine women out of 35 in the sciences (26%). Out of 156 faculty members today, only 31 are women (20%), including nine out of 62 in the sciences (15%). This represents a decrease in the percentage of women by more than 40% in the last 40 years. The larger number of women in 1950 may have been the result of the displacement of men from academic positions during World War II.

Cordelia Erdman and Marie Fetzer

The most significant early contributions by Wheaton women to the ASA were made by Cordelia Erdman and Marie Fetzer. Both came from Presbyterian backgrounds, were 1946 graduates of Wheaton College, and received master's degrees from Columbia University. They were strongly influenced by geochemist Kulp, a 1942 Wheaton graduate and postdoctoral fellow in geology at Columbia, who by 1950 had established a radiocarbon dating laboratory at Columbia. They joined Kulp in helping to convince fellow ASA members and their students at Wheaton of the validity of the fossil evidence for the development of animal and human life forms over long geological periods of time. Their work was a key element in shifting the ASA away from flood geology and young-earth creationism toward a more positive assessment of scientific evidence and its implications for biblical interpretation.

Cordelia Erdman was born in 1924 of Presbyterian missionary parents in Taegu, Korea. She grew up in Philadelphia after her parents returned to the U.S. She attended Wheaton College from 1940 to 1943, first as a music major, but later changed to geology. After a period of illness, she transferred to King's College and completed her B.A. in geology in 1945 under L. Allen Higley, who taught the gap theory of ruin and restoration between the first two verses of Genesis. Returning to Wheaton in 1946, she completed a B.S. in geology by taking her last courses at the Wheaton Science Station in the Black Hills during the summer, where she met Marie Fetzer. With encouragement from Kulp, she enrolled as a graduate student in paleontology at Columbia under the evolutionist professor Norman D. Newell, who

Joseph Spradley is Professor of Physics at Wheaton College, Illinois. He received his B.S., M.S., and Ph.D. degrees at UCLA in engineering physics and worked for four years at Hughes Aircraft Company. He has taught at Wheaton since 1959, except for six years of leaves on absence, including his current year at the American University in Cairo, Egypt, two years as Acting President of Haigazian College in Beirut, Lebanon, two years as a USAID science specialist at Ahmadu Bello University in Nigeria, and a recent semester at Daystar University College in Nairobi, Kenya. He is co-author of the book The Making of a Christian Mind.

was also a curator at the American Museum of Natural History where George Gaylord Simpson was the Head Curator. During the summer of 1947 she studied biology at the University of California at Berkeley. Among the four or five other women graduate students in the geology department at Columbia, complaints were voiced about some geology professors who treated women badly, making it difficult for them to earn good grades.[15]

After completing her M.S. degree in 1949, Erdman returned to Wheaton College as an Instructor in Geology even though her salary dropped to $2000 from the $2600 per year she had earned at the American Museum. Although she was well trained in evolutionary theory and affirmed the data of geology and paleontology concerning long-term changes in life forms, on her Wheaton appointment questionnaire she stated her position that evolution is "merely an unsubstantiated theory, which has been unjustifiably propagated as truth because it is the only alternative to Special Creation." During five years as an instructor at Wheaton, from 1949 to 1954, her special emphasis was in historical geology and invertebrate paleontology, where she tried to present a variety of options for correlating science and Scripture.

Erdman offered her resignation in 1951 to pursue missionary work in France, but reconsidered due to the unavailability of a replacement to fill her position. The summers of 1951, 1952 and 1953 were spent as a Park Ranger Naturalist at Grand Canyon, Arizona, only the second woman ranger at the Canyon and among the first few in the US. There she met Dean Barber, also a geologist and ranger, and they were married early in 1954 and shared in teaching her classes during her last semester at Wheaton. Although she was offered tenure in 1954, she resigned when they decided to move to the West Coast where her husband pursued graduate studies. Her high level of activity in the ASA diminished after 1954, but she was listed as Cordelia E. Barber on an evolution panel chaired by Mixter at the 1956 national convention at Wheaton, and served on the editorial board of JASA from 1963 to 1965. Today the Barbers reside in Washington state where her son does geological work for a soil foundation company and her daughter is a ranger for the Forest Service in Idaho.

Marie Fetzer was born in 1925 and grew up as a Presbyterian in Reidsville, North Carolina. She entered Wheaton College in 1942 and completed her A.B. in anthropology in 1946. She continued her study of anthropology and social science at Columbia University, where she shared a room with Erdman. The program at Columbia was strongly influenced by women such as Ruth Benedict and Margaret Mead. Fetzer's master's thesis was on methods of dating hominid fossils, including a chapter on radiocarbon dating written with the assistance of Kulp, who encouraged her to apply for a teaching position at Wheaton.

Fetzer was hired by Wheaton College in 1948 as an Instructor in Anthropology. Her starting salary was also $2000, only $76 more than she earned as a part-time secretary while she was completing her M.A. A recent check has shown that three married men hired by Wheaton the same year with nearly equivalent preparation were paid about 35% more than Fetzer and Erdman. Fetzer taught from 1948 to 1951, including a course in Physical Anthropology emphasizing the "origin of man," and a team-taught course with Mixter on Biological and Cultural Evolution, which included "[t]he so-called proofs and mechanisms of evolution."[16] In her appointment questionnaire, she stated her position that she did not "believe there is evidence sufficient to hold the theory of evolution as fact; it remains a theory."[17]

In the summer of 1949 Fetzer studied field archaeology as part of the program for a Ph.D. degree, and in the summer of 1950 she studied linguistics with Wycliffe's Summer Institute of Linguistics. She resigned from Wheaton in 1951 and married William

Dr. Dorothy F. Chappell earned her undergraduate (B.S.) degree in biology from Longwood College in Virginia, her master's degree (M.S.) in biology at the University of Virginia, and Ph. D. in botany at Miami University of Ohio. Dr. Chappell has published papers in national and international journals on the evolution of green algae and land plants and in integrative journals on contemporary issues related to biology. She was awarded a Fulbright Research Award to conduct research in New Zealand and Australia for nine months during 1989-90. She is in her eleventh year of serving as Chair, Dept. of Biology at Wheaton College and her fifteenth year on the faculty of Wheaton College.

Reyburn, who completed a Ph.D. in linguistics in 1952. They then began missionary work in Ecuador. Although this effectively ended her activity in ASA, she was listed on the program for the 1953 national ASA convention at Grace College as Mrs. William Reyburn for a paper sent from the field on "Anthropological and Linguistic Problems in Ecuador." From 1954 to 1959 she served on the Editorial Committee of the missions journal *Practical Anthropology*. The Reyburns continued with missionary work in Africa for over a decade, followed by service with the United Bible Society in the Middle East and Latin America for another 10 years. Today they reside in Georgia.

Contributions of Erdman and Fetzer to the ASA

Although Kulp led the effort to steer the ASA away from flood geology, the foundation for a more scientific understanding of the fossil record was largely contributed by Erdman and Fetzer. Between 1948 and 1952 five papers by Kulp were presented at national conventions of the ASA, mostly dealing with the new techniques of radiocarbon dating he helped to pioneer. However, his most important paper was presented at the fourth annual convention at the Bible Institute of Los Angeles in 1949 entitled "Deluge Geology," and it was the only paper published by Kulp in *JASA*.[18] In the opening paragraph he defines deluge geology as the theory that Noah's "... [f]lood was the direct or indirect cause of most of the major geological features of the earth." After discrediting its author, George McCready Price, he proceeds to show that the theory "is in complete disagreement with the conclusions of trained geologists the world over."[19]

Although Kulp led the effort to steer the ASA away from flood geology, the foundation for a more scientific understanding of the fossil record was largely contributed by Erdman and Fetzer.

Actually, Kulp was unable to attend the L.A. meeting. Alton Everest, president of ASA, considered the paper "the backbone of the convention" but he was "scared to present it if ... trained geologists were not present."[20] To complete the paper, Kulp stayed up most of three nights and confessed that "the paper probably shows it."[21] In the end the paper was read by Fetzer who, according to Kulp, "unscrambled the last few pages ... and made sense out of it." She also had to contend with the elderly Dr. Price sitting in the front row.[22]

Erdman's paper was published in* JASA *along with the discussion following her paper, in which Mixter responded to the more unkind questions, such as one that inferred that anyone who called Eohippus "a horse is a jackass."

Fetzer's presentation was preceded by Erdman's paper on the "Fossil Sequence in Clearly Superimposed Rock Strata," which was later published in *JASA* and provided graphic evidence of geological strata, including a series of slides from the Grand Canyon.[23] In her view, these revealed "on a vast scale and in an accessible form ... a completely unprejudiced account of ancient life." (p. 13) Perhaps the effective presentations of these two young women disarmed Price, who responded in the question period with only a brief but polite comment.[24] In a subsequent issue of *JASA*, Erdman provided a witty two-page report on the L.A. Convention, but noted that "The absence of several of the authors of papers was a source of regret inasmuch as ... discussion was impeded."[25] A one-page comment on Kulp's paper by an anonymous ASA member in the same issue complained that he was "too much influenced ... by the orthodox geological viewpoint" and "also that Miss Erdman is perhaps too much committed to the orthodox viewpoint."[26]

Undaunted by such criticism, Erdman presented a paper on "The Paleontology of the Horse" at the fifth annual convention of the ASA meeting at Goshen College in 1950. She was supported by Mixter, her friend and mentor from Wheaton College, who followed her paper with one on "Heredity and Fossil Horses." Erdman's paper was published in *JASA* along with the discussion following her paper, in which Mixter responded to the more unkind questions, such as one that inferred that anyone who called Eohippus "a horse is a jackass."[27] After a careful review of the "unusual abundance of horse remains" and stratigraphic evidence "that horses were constantly in a state of flux and that their changes exhibited a significant amount of pattern even in minor trends," Erdman suggested the possibility "that a certain amount of evolution has taken

place, and further, that this evolution has not been haphazard but has proceeded along well-defined paths." (p. 30) She concludes that "the horses have given us a strong indication that directional change has occurred." (p. 31) In the ensuing discussion, Mixter accepts "descent with modification (as) the simplest explanation of their origin," but in regard to the fossil record he maintains "that the great gaps between the orders indicate that the first members of each of the orders was a creation." (p. 33) This progressive creationism made it possible to accept the evidence for evolution without conceding a complete evolutionist position.

The importance of fossil evidence was extended to human antiquity in a paper by Fetzer at the same convention in 1950. She reported on "Recent South African Fossil Finds" with a careful analysis of the methodology and material in the scientific literature, publishing her results in a later issue of *JASA*.[28] Although she treats the data seriously, she concludes "that the excavations in South Africa have not been carried out in the strictest scientific procedure" and recommends further study of "these fossils from both a morphological and a chronological aspect." (p. 8) In a brief discussion period Kulp acknowledged the pioneering work of Fetzer by suggesting that more interdisciplinary work needed to be done between anthropology and geology. (p. 10) A brief summary of the 1950 convention written by Erdman was again published in *JASA*.[29]

Marie Fetzer (left), Cordelia Erdman, and Alta Schrock contributed greatly to the 1950 ASA convention at Goshen College.

Later in 1950 the second edition of the ASA-sponsored book *Modern Science and Christian Faith* was published. An earlier chapter in the 1948 edition on physical anthropology by George Horner was now replaced by a new chapter by William Smalley and Marie Fetzer.[30] In Horner's 35-page chapter only 10 pages discussed fossil evidence, claiming that all hominid fossils were, in fact, homo sapiens. The new 95-page chapter included a 27-page section on human paleontology by Fetzer, defending the fossil evidence for human antiquity: "The past 100 years since the finding of the Gibraltar skull has witnessed much activity in the search for human fossils, and this search has been rewarded with an amazing degree of success. Fossil man cannot be pushed aside or regarded as spurious." She concedes that "since each of the fossil types (up to Cro-magnon) has been disqualified as a progenitor of present Homo sapiens, the origin of our ancestors remains unknown." (p. 163) After a careful discussion of the new radiocarbon dating methods, she concludes that "There is strong evidence, which is constantly increasing, for the antiquity of fossil man." (p. 183) Several biblical interpretations of the data are suggested, but she feels that "an early Adam... would appear to harmonize better with the present evidence of great antiquity of fossil man" and suggests that "God created Adam instantaneously at a very early point in time, and since that time the physical form of man has varied considerably in space and time." (p. 186)

The fossil record was explained and defended one more time at an ASA convention held in 1952 at the Wheaton College Science Station in South Dakota. Cordelia Erdman presented a paper on "Stratigraphy and Paleontology," which also appeared in *JASA*.[31] Here she traces the history of geology in the 19th century and the principles for determining the geological timetable. She narrows down the alternative explanations of the fossil sequence to either "thorough-going evolution or modification within successively created categories." (p. 4) In the ensuing discussion, one respondent stated that "the

paper by Miss Erdman is a fair statement of the position of the standard geologist. However the standard geologist is an evolutionist. I appreciate this paper very much for there is a great deal of truth in it; however, in some respects I must be very critical." (p. 11) The final response was by Kulp who agreed with Erdman that "the total fossil picture ... is clear and undebatable and this is exactly the sequence which is described in Scripture." (p. 11) Erdman made one further contribution to the ASA in the late 1950s under her married name. She was listed on the program for the 1956 national convention at Wheaton College as a participant in a panel discussion on evolution organized by Mixter. This led to her last article in *JASA* on "Fossils and Their Occurrence," which later appeared as a chapter in the ASA symposium *Evolution and Christian Thought Today* edited by Mixter.[32] Here she reviews the formation, categories and distribution of fossils, and the history of their discovery and interpretation. She concludes that fossils neither prove nor disprove evolution, but "[t]hey certainly suggest that considerable amount of descent with modification has transpired." (p. 9)

Erdman suggested that perhaps "each gap in the fossil record indicates a point where God intervened directly to start a new group on its way." In countering objections to this view, she points out that the evolutionist "crosses the gaps by faith in the principle of evolution."

In seeking to correlate the fossil record and the scriptural record, Erdman observes that in Genesis "God is the initiator of myriad forms of life on earth in their original condition" and that "God's creative activity was a process involving time and materials," especially in the case of man. As to the six days of creation, she suggests that they were "literal ones upon which God revealed some phase of his creative activity to a particular individual who presented them arranged according to topic and in poetic form." (p. 9) In regard to the phrase 'after its kind', she suggests some sort of genetic boundary that might be correlated with the "profound and persistent gaps (in the fossil record) between otherwise reasonably complete sequences," and that perhaps "each gap indicates a point where God intervened directly to start a new group on its way." (pp. 9-10) In countering objections to this view, she points out that the evolutionist "crosses the gaps by faith in the principle of evolution." But she also observes that if "the phrase 'after its kind' refers to some laws of reproduction whose functioning is not necessarily discernible from the fossil record ... (then) there is no limitation at all upon the amount of evolution which could be compatible with the Genesis account." (p. 10)

Conclusion

Women have played an important role at Wheaton College, even though their numbers have decreased over the last 40 years from 41 (36%) to 31 (21%). This was in spite of the fact that in the 1950s women were paid substantially less that married men, although this was eventually rectified by a published salary scale introduced in the late 1960s. Even though their teaching careers were short, Erdman and Fetzer made substantial contributions both to Wheaton and the ASA. They are remembered by their colleagues for their youthful enthusiasm and concern for Christian understanding of their disciplines.

Two other Wheaton women professors at the time are worthy of brief mention by way of comparison in terms of life-long service. Fannie Boyce and Angeline Brandt both taught mathematics, each for 32 years at Wheaton, and they were among the first women listed in *American Men of Science*. Boyce earned her Ph.D. from the University of Chicago and taught from 1930 to 1962. Brandt was a Wheaton alumna with an M.R.E. from Gordon College and Ph.D. from the University of Michigan. She taught from 1936 to 1968 and in 1960 she became the first recipient of the Wheaton College "Teacher of the Year" award. Although not active in ASA, she did present a paper for the 1949 ASA convention entitled "Spiritual Truths in Mathematics," which was later published in *JASA*.[33]

Even though their teaching careers were short, Erdman and Fetzer made substantial contributions both to Wheaton and the ASA.

Women have had even less involvement in the ASA than at Wheaton, although the percentage of women members has doubled over the last four decades from about 5% to 10%. Wheaton women had

a unique role in the early years of the ASA. Although their professional careers were short, Erdman and Fetzer set a good example as the first women to contribute to the ASA. Their abilities and energies were enhanced by the encouragement and mentoring of men such as Kulp and Mixter. A network of several Wheaton alumni recruited by Kulp at Columbia University stimulated their efforts, which were further rewarded by active participation in the ASA. Their work was significant in helping to guide the ASA into responsible evaluation of the fossil record, and in attempting to interpret it within a Christian framework. The commitment of the ASA to Christian "men and women" in the sciences deserves enhancement by recognizing, supporting and recruiting Christian women into scientific professions. ✣

NOTES

[1]*The Yearbook of ASA (unnumbered), 1948, pp. 11-16. Annual convention programs are in the ASA Collection of the Wheaton College Archives.*

[2]1948 Membership List, *JASA* 1 (3), p. 3, June 1949.

[3]Brandt, Angeline, "Spiritual Truths in Mathematics," *JASA* 2 (2), 13-17, June 1950.

Table I. Participation of Women in the ASA

Years	Annual Convention Papers				JASA Articles & Communications		
	Women	*Total **	*Percent*		*Women*	*Total **	*Percent*
1946-59	7	200	3.5		7	250	2.8
1960-69	1	130	0.8		3	350	0.9
1970-79	8	240	3.3		16	390	4.1
1980-89	20	400	5.0		13	340	3.8

**Approximate counts include most contributions except book reviews.*

Table II. Membership of Women in the ASA

Year	Women	Total	% Women	Wheaton College*
1948	0	17	0.0	5
1950	7	131	5.3	7
1956	37	670	5.5	12
1972	110	1720	6.4	17
1990	220	2200	10.0	21

** All Wheaton College ASA members are men except for four women.*

Table III. Women at Wheaton College in the Sciences

Year	Natural Sciences				Social Sciences				FTE Faculty		
	Women	Total	%		*Women*	*Total*	%		*Women*	Total *	% *
1950	4	20	20.0		5	15	33		41	113	36
1970	1	23	4.3		4	17	23		24	120	20
1990	3	27	11.0		6	35	17		31	156	20

** Totals include men and women; "%" is women as a percent of total.*

[4]Erdman, Cordelia, "Fossil Sequence in Clearly Superimposed Rock Strata," *JASA* 2 (3), 19-22, Sept. 1950.
[5]Letter from Kulp to Everest dated Sept. 26, 1949, in ASA Collection at Wheaton College.
[6]Official programs for national ASA conventions, 1946-1967.
[7]Dow, Vivian, "Christian Faith and the Public Schools," *JASA* 11 (4), 31-33, Dec. 1959; 12 (1), 26-27, March 1960.
[8]*JASA 2 (4), 1-10, N50; JASA* Supplement 8 (4), Dec. 1956.
[9]*1990-91 Directory of Members, (Ipswich, MA: ASA, 1990).*
[10]*JASA Index, Volumes 12-21 (Contributions by Marie Berg, Sandra Wetther and Elizabeth Zipf).*
[11]Wetther, Sandra, Poem: "God's Man is Who I Am," *JASA* 19 (2), 64, June 1967.
[12]Newton, Mary Jeanne, "The Man Who is There," *JASA* 22 (4), 145-147, Dec. 1970.
[13]Balswick, Jack and Dawn Ward, "The Nature of Man and Scientific Models of Society," *JASA* 28 (4), 181-185, Dec. 1976.
[14]Walker, Susan, "Evolutionary Thought and the Morals and Dignity of Man: Some Inconsistencies," *JASA* 30 (1), 44-45, March 1978.
[15]Information in these paragraphs are from telephone interviews with Cordelia Erdman Barber on June 26 (JS) and July 25 (DC), 1991, and from Erdman's personnel file in the Wheaton College Archives.
[16]*Bulletin of Wheaton College, April 1950, p. 45 (Anthropology 345); Salary information from several telephone interviews, July 1991.*
[17]Information in these paragraphs are from telephone interviews with Marie Fetzer Reyburn in July 1991 (JS) and on July 25, 1991 (DC), and from Fetzer's personnel files in the Wheaton College Archives.
[18]Official programs for ASA annual conventions, 1948-52.
[19]Kulp, J. Laurence, "Deluge Geology," *JASA* 2 (1), 1-15, March 1950.
[20]Letter from Everest to Kulp dated July 3, 1949, in ASA Collection.
[21]Archival material, Buswell Library.
[22]Letter from Kulp to Everest dated Sept. 3, 1949, in ASA Collection.
[23]See note 4.
[24]Letter from Everest to Kulp dated Sept 13, 1949, in ASA Collection.
[25]Erdman, Cordelia, "Fourth Annual Convention," *JASA* 2 (2), i-ii, June 1950.
[26]Anonymous ASA member, "Comment on the 'Deluge Geology' Paper of J.L. Kulp," *JASA* 2 (2), 2, June 1950.
[27]Erdman, Cordelia, "The Paleontology of the Horse," *JASA* 2 (4), 25-31, and "Discussion," 32-36.
[28]Fetzer, Marie, "Recent South African Fossil Finds," *JASA* 3 (1), 4-9, March 1953.
[29]Erdman, Cordelia, "Memoirs of a Convention," *JASA* 3 (1), 27-28, March 1951.
[30]Smalley, William and Marie Fetzer, "A Christian View of Anthropology," Ch. 5 in *Modern Science and Christian Faith*, 2nd edition, F. Alton Everest, ed., (Wheaton, IL: Scripture Press, 1950), pp. 98-193.
[31]Erdman, Cordelia, "Stratigraphy and Paleontology," *JASA* 5 (1), 3-6, March 1953.
[32]Barber, Cordelia Erdman, "Fossils and Their Occurrence," *JASA* 9 (1), 2-10, March 1957; also Ch. 8 in *Evolution and Christian Thought Today*, Russell Mixter, ed., (Grand Rapids, MI: Eerdmans, 1959), pp. 136-153.
[33]See note 3.

Arms Control and God's Purpose in History

JACK C. SWEARENGEN

1151 Vienna Street
Livermore, CA 94550

From 1988 through 1990 a series of events transpired worldwide which generated rising hopes for global peace. The "Cold War" came to an end, and democracy was declared the winner. An array of international agreements to reduce armaments took shape, and for his role Soviet Premier Mikhail Gorbachev was awarded the Nobel Peace Prize. The optimism lasted less than two years, however, ending abruptly with Iraq's invasion of Kuwait; next, the arms treaties moved to the rear of the world stage because of the economic and political collapse of the Soviet Union. Some think that the West missed a golden opportunity for lasting peace by not inking arms treaties while Gorbachev was still able to deliver. However, the need for arms control — especially in the nuclear age — supersedes the ebb and flow of world politics. In this paper the author examines the pursuit of arms control as an application of the biblical principle of engagement for healing. *This principle provides a basis for Christian participation in the process of public policy formation, with arms control a particularly graphic contemporary application. Alternative perspectives concerning Christian involvement — or* noninvolvement *— in public policy processes do not take healing into account and therefore cannot provide a satisfactory motive for arms control.*

When President Reagan and Premier Gorbachev signed the Intermediate-Range Nuclear Forces (INF) Treaty in 1988, the only immediate meaning was that two historical adversaries were agreeing to remove from their arsenals and destroy an entire class of nuclear weapons. Few would have forecast that the nuclear arms race of forty-five years duration was ending. The confidence of US security policymakers was bolstered when the Soviets began to withdraw their army from Eastern Europe in 1989, for it was that presence which had driven US nuclear policy for forty-five years. Gorbachev's acquiescence that year to the election of a Solidarity government in Poland was key, because the demonstrations which followed in Leipzig led directly to the fall of the Berlin Wall. The Strategic Arms Reduction Agreement (START) was signed in 1991, and then trumped by President Bush's announcement of sweeping unilateral cuts in US tactical nuclear forces.

Prospects for avoiding nuclear holocaust and global war seem brighter than at any time in this century. In 1988 Margaret Thatcher proclaimed V-CW day, announcing that "the Cold War is over; we won."[1] The *Atomic Scientists* turned back their "Doomsday Clock" three times, from 11:59 to 11:54 to 11:50 and then to 11:43 PM, declaring that the world is farther removed from nuclear holocaust than at any time since World War II.[2] Secretary of State James Baker observed, "We face the clearest opportunity to reduce the risk of war since the dawn of the nuclear age."[3] Charles Krauthammer wrote that, "Gorbachev represents the greatest imperial self-transformation since Constantine converted to Christianity,"[4] and in 1990 Gorbachev was awarded the Nobel Peace Prize. On December 25, 1991, Gorbachev resigned, swept aside by the very forces of change that he had unleashed. *Perestroika* had been his great contribution. Only time will reveal

whether the realm which Ronald Reagan once called "The Evil Empire" has ceased to exist, or has simply assumed a different form.

In addition to INF and START, several other arms reduction treaties were either signed or in negotiations at this writing, including the Conventional Forces in Europe Agreement (CFE); a bilateral Chemical Weapons Agreement (CW); and verification provisions for the Threshold Test Ban Treaty (TTBT) and Peaceful Nuclear Explosions Treaty (PNET). Some of these arms accords include provisions for destruction of weapons, provisions which seem to qualify as acts of beating swords into plowshares (Isaiah 2:4; Micah 4:3). Under the INF Treaty, for example, some transporter-erector-launchers (TELs) for the Soviet SS-23 missile have been converted into lumber haulers; others were offered for sale (for nonmilitary purposes) at a Moscow auction. Warsaw Pact tanks are being converted into tractors and fire-fighting vehicles. ICBM stages rendered excess by a START Treaty are to be used as space launch boosters (for example, to place communications satellites into orbit). The CFE agreement will require soldiers (perhaps as many as 1,000,000 US troops) to be integrated into the civilian economy.

The purpose of this paper is to communicate a biblical perspective on arms control. The first draft was developed during the author's participation in the START negotiations in Geneva, and at that time most people believed that nuclear arms control — properly verified — was a critical element of the quest for world peace. The dramatic changes that have transpired in the Soviet empire, however, have caused some security analysts to question not only the need for the START Treaty,[5,6] but also to suggest that the need for arms control in general has been "overcome by events."[7] When arms control is defined more broadly than negotiations involving nuclear superpowers and their interests, it becomes clear that the endeavor is very much in need today. Missing, however, is a properly biblical framework that will transcend the evolution of political and military events and provide context for Christians to approach the subject.

Historical Purposes of Arms Control

Pursuit of arms limitation agreements may proceed with a greater sense of urgency between adversarial nuclear superpowers, but it is by no means limited to this framework. Nations have been seeking to limit the war making capability of their adversaries for thousands of years.[8] (Table 1, p. 27.) One of the earliest recorded "agreements" is described in I Samuel, where the Philistines banned the practice of blacksmithing in Israel. The Philistine objective was to ensure that the Israelites did not have access to agricultural instruments made of iron, because these could be fashioned into weapons that would far outperform their bronze substitutes.

As is evident from the table, arms control is not limited to negotiated agreements like INF and START. Controls imposed by the victor upon the defeated, as terms of surrender (e.g. the Philistines upon Israel, Allies upon Germany, United Nations upon Iraq) are more common variants. Confidence building measures such as open military maneuvers, exchange inspections, and export of safety and use-control technologies also fall within the broad definition of arms control. Provisions for verification of compliance by means of on-site inspection presume a significant degree of cooperation, as in UN International Atomic Energy Agency inspections for the Nuclear Non-Proliferation Treaty. Unfortunately, we have learned recently how easy it is for one nation to avoid detection of its clandestine nuclear weapons development program.

Jack C. Swearengen has worked in a Department of Energy nuclear weapons design laboratory for twenty-one years. From 1988 through 1990 he served as Scientific Advisor for Arms Control in the Office of the Secretary of Defense, where he was responsible for developing technical means to verify arms control treaties. He participated in the formulation of US arms control policy and negotiated with the Soviets in the Strategic Arms Reduction Talks (START) in Geneva, Switzerland. At the present time he is developing environmentally safe means to dispose of hazardous components from dismantled *nuclear weapons. Jack holds the Ph.D. degree in mechanical engineering from the University of Washington, and serves as Elder in his local church.*

TABLE I: HISTORY OF ARMS CONTROL	
1269 BC	Earliest known peace treaty (Egypt and the Hittites) cemented by the marriage of Ramses II to a Hittite princess.
1100 BC	Philistines restrict the use of iron by the Israelites. (I Samuel 13:19-20)
800-700 BC	"...And they shall beat their swords into plowshares ... neither shall they make war anymore." (Isaiah 2:2-4; a prophesy)
546 BC	A "cessation of armaments" ends 72 years of hostilities in the Yangtze River Valley in Honan Province, China.
500-400 BC	Athens and Sparta agree to dismantle fortifications although during the negotiations the Athenians hedged by continuing to build their ramparts "high enough to be defended." (*Peloponnesian War*, Thucydides)
450 BC	Socrates to Glaucon — no use of poisoned weapons or poisoned water (*The Republic*, Plato)
400-300 BC	No weapons concealed in wood, no barbed or poisoned points, no points "blazing with fire" (*Book of Man* — India)
202 BC	After the Battle of Zama, Carthage is required to surrender all war elephants to Rome and is forbidden to train others. (*Book XXX*, Livy)
950-1027 AD	The European nations define noncombatants and other "rules of war" in the *Peace and Truce of God*.
1139 AD	The Second Lateran Council prohibits the use of crossbows against Christians. (Their use was encouraged against "infidels"!)
1609	The use of poison or pollution of drinking water is banned. (*On the Law of War and Peace*, Grotius)
1817	The *Rush-Bagot Agreement* between the US and the UK demilitarizes the Great Lakes.
1868	The *St. Petersburg Declaration* bans "400-gram projectiles with fulminating or flammable substances."
1899-1907	The *Hague Peace Conference* bans dum-dums and poison gas.
1907	*Hague Declaration XIV* prohibits discharge of projectiles and explosives from balloons or by other "new methods of similar nature."
1922	The *Washington Treaty* bans "noxious gases."
1925	The *Geneva Protocol* bans first use of chemical weapons.
1920-1926	Stringent inspection provisions, including anytime, anywhere suspect-site inspections fail to prevent post World War I German rearmament.

Calculated unilateral arms reduction initiatives with expectation of reciprocity — as in Bush's moves of September, 1991 — have been rare. Unilateral disarmament moves are likely only in an environment of cooperation and trust, because then the benefit is perceived to outweigh the risk. Calls from the "antiwar activist" community for unilateral initiatives by the US during the height of the Cold War and even toward its end were not well-received in the national security community.[9] Nevertheless, during the Cold War arms control negotiations provided important confidence-building measures for the superpowers.

Is Arms Control Imprudent?

Depending upon one's world view, the events of the past few years can be viewed either with suspicion, or as cause for celebration. During the INF and START negotiations, some "hard liners" warned that *perestroika*[10] was a brilliantly conceived Soviet strategy to divide NATO, "Finlandize" western Europe, obtain access to western technologies, and revitalize the Soviet economy.[11] Margaret Thatcher cautioned that "Euphoria is a bad master; when the ice breaks up it can be very dangerous."[12] (Mrs. Thatcher did not mention Alexis de Tocque-

ville, who earlier had penned a very similar thought regarding the breakup of dictatorships.[13]) Secretary of Defense Richard Cheney said, "Those who would slash defenses are like folks who would give away their coats on the first sunny day in January."[14] General John Galvin, Supreme Allied Commander in Europe, appealed to Isaiah 11:6-9 (without citation) by noting that "The lion is not yet lying down with the lamb, and security is the number one responsibility for political leaders."[15]

It seems likely to this author that the root cause for progress in superpower arms control was Gorbachev's realization that the Soviet Union was at the threshold of economic collapse.

From the author's personal discussions, it seems clear that many evangelicals hold similar views today. It is believed by many Christians to be only a matter of time until the former Soviet government is once again seized by militants, and the revitalized Empire becomes the "Magog" of Ezekiel. Liberals cite the failed coup of August 18, 1991 against Gorbachev as proof that the former Soviet Union has moved too far toward democratization ever to return to totalitarianism, while conservatives use the attempt as evidence that the future is far from certain and the West must remain armed and vigilant. Extreme conservatives suggest that the coup attempt was an extension of the elaborate hoax described earlier, intended to continue misleading the West into complacency.

Conservatives — Christian and secular — also credit President Reagan with bringing the Cold War to an end. The 1988 edition of Soviet Military Power noted that, "The strength of our collective response has resulted in the Soviets' return to serious and realistic negotiations."[16] Ronald Lehman III, President Reagan's Assistant Secretary of Defense for International Security Policy, said, in reference to the INF Treaty, that "Ronald Reagan's success in arms control is directly the consequence of high standards, careful preparation, tough bargaining, and steadfastness of purpose in the face of sharp and shifting political winds."[17]

It seems more likely to this author that the root cause for progress in superpower arms control was Gorbachev's realization that the Soviet Union was at the threshold of economic collapse. As then Soviet Foreign Minister Eduard Shevardnadze was to acknowledge concerning fifty years of centralized socialist economic planning, "We have ruined the Country!"[18] Nevertheless, arms control stands on its own merits. During the coldest times of the War, arms control negotiations often provided the only functional point of contact between the adversaries.

The objective of arms control is to reduce the capability of states to wage war. Reducing their incentive to war will be addressed in the subsequent sections. However, from the reduced capability objective alone, several reasons can be identified for continuing pursuit of arms control. The first reason is to reduce the potential for damage from war. Although the most graphic illustration is provided by nuclear weapons, chemical and biological weapons are similarly indiscriminating. In terms of absolute reductions, unfortunately, the INF and START negotiations fared poorly. As a result of continuing buildup by both sides during the seven years of START negotiations, at the end of 1991 the Soviet nuclear arsenal numbered approximately 27,000 warheads; about half were strategic weapons (land and sea-based missiles, and long-range bombers) still targeting the USA. The START reductions will decrease strategic arsenals to roughly their magnitude at the outset of negotiations. And with whom is the agreement to be implemented? As the Soviet Union has been replaced by a commonwealth, central control of the nuclear arsenal will be replaced by "collective" control.

During the coldest times of the War, arms control negotiations often provided the only functional point of contact between the adversaries.

A second reason for continuing arms control is to limit proliferation of weapons of mass destruction (nuclear, chemical, biological, and the missiles to deliver them). The worldwide changes in the past three years have shifted the focus of arms control from bilateral to multilateral. As threatening as the bipolar world seemed, the mutually assured destruction (MAD) doctrine turned out to be stable, in the sense that no global or strategic wars occurred. However, in the post-Cold War world of the 1990s, no such paradigm for stability is in evidence. The "new order in global politics" that was proclaimed at the fall of the Berlin Wall lasted less than two years,

ending abruptly with Iraq's invasion of Kuwait on August 2, 1990. Next, the victory by the UN forces over Iraq was identified as the beginning of a "new world order." Since then, the foreign policy crises that have engaged US policymakers most intensely have been the result of animosities among nationalist groups. Unions which were held together by force and communist ideology since World War I in Europe and within the former Soviet Union are struggling to realign according to commonalities in religion, culture, or spoken language.

Should the US support retention of national boundaries and strong central governments as long as they are moving toward democracy, or should we champion independence movements? Which is the most promising path to peace and stability?

This fragmentation matches literally Jesus' prophesy in Matthew 24:27, "Nation (ethnos) will rise against nation," and "kingdom (basileia) against kingdom." The two terms used together imply both ethnic and governmental conflict. The dilemma which fragmentation poses for US national security policymakers is this: should the US support retention of national boundaries and strong central governments as long as they are moving toward democracy, or should we champion independence movements? Which is the most promising path to peace and stability?

The stakes are highest with regard to control of the Soviet nuclear arsenal. Soviet strategic warheads remain in Russia, Byelorussia, Ukraine, and Kazakhstan, and the tactical arsenal is dispersed throughout the fifteen republics. Disintegration of the Union not only means that thousands of nuclear weapons may fall into the hands of nationalist forces in the independent republics, but also that economic crises may tempt the republics to sell the weapons or the technology to the highest bidders. There is a sense of urgency in the US to help the Soviets disable and dismantle their nuclear weapons before such action can occur. President Bush's arms reduction announcement of September, 1991 was motivated as much by concern about control of Soviet nuclear weapons as by decreased Soviet aggressive intentions and the emergence of a free press which would make cheating on treaties more difficult. Nevertheless, if the US wants the commonwealth republics to de-nuclearize themselves, we will probably have to offer a nuclear incentive: further reductions in our own considerable arsenal.

Threats confronting the US in coming years may include not only "chaos and civil war" in the former Soviet Union and Eastern Europe, but also acquisition of weapons of mass destruction by Iraq, Libya, Syria, and North Korea. The discovery of Iraq's nuclear weapons program raises concern that an additional epilogue to the Cold War may be an age of nuclear proliferation. Of special concern are states whose leaders have shown by their behavior that they are willing to use every weapon that they can lay their hands on. Nuclear and chemical disarmament by the *have* nations may be a prerequisite to persuading the *have not* nations from seeking such weapons for themselves.

Finally, the possibility of accidental launch must be considered. Statistical probability of accident rises with the number of deployed weapon systems. From a purely analytical perspective, if arms control efforts succeed in simply reducing the *number* of weapons (aside from reducing their destructive capacity), the likelihood of accidental war declines.

Christian Participation in Public Policy

Most popular and philosophical definitions of history presume that it consists of an essentially random sequence of events — there may be some principle of transient cause-and-effect, but no enduring purpose. This stands against the Christian belief that God is in control of history.

If arms control efforts succeed in simply reducing the number of weapons (aside from reducing their destructive capacity), the likelihood of accidental war declines.

The philosopher Georg Hegel is given credit for the idea that history is an evolving process. This idea culminated, during his lifetime, in the establishment of liberal democracies, as embodied in the ideals — but not necessarily the practices — of the

French and American revolutions.[19] Karl Marx then developed the idea of the evolution of history into his well-known philosophy that civilization was moving inexorably forward through class struggle, the outcome of which would be a classless Utopia.

In 1989, a State Department employee named Frances Fukuyama attracted considerable attention with an article entitled, "Are We at The End of History?"[20] With reference to Hegel and current world events, he suggested that history may be cyclical, punctuated by cataclysmic events. He identified several ideological forces which are likely to compete with liberal democracy in shaping the future world: nationalism, resurgent communism, Islamic fundamentalism, and "the evil side of human nature." It should, by the way, be sobering to the Church to note that Islam was included in Fukuyama's list of forces, but not Christianity.

A number of scientific cosmological theories have also been developed to describe the passage of time. These theories do not deal with human history *per se*, but rather seek to identify natural laws to which all things are subject. Such theories include ideas of an eternal cosmos, in which time proceeds in either a steady or an unsteady fashion; oscillating (recurring) history; and the "Big Bang," wherein time has a beginning but no end.[21] Physicist Stephen Hawking describes three theories of time by using the analogy of three "arrows" of time: cosmological, wherein time runs in the direction in which the universe is expanding; psychological, where time is associated with human memory in a cause-and-effect relationship; and thermodynamic, wherein time moves in the direction of increasing disorder.[22]

Events and sequences contain moral significance because God continues to act in his creation, and because He has given human beings the power to choose.

Hawking, however, did not acknowledge that there is a fourth arrow of time, namely, the outworking of God's purpose in history — i.e. the theological arrow of time. (See, for example, Isaiah 46:8-11.) The Bible teaches that there does indeed exist a flow of history, and this flow is time-order-discernable and significant.[21] Events and sequences contain moral significance because God continues to act in his creation, and because He has given human beings the power to choose. Notwithstanding this power to choose, nothing happens to the child of God that will not be used by God for the achievement of his purposes for the believer (Isa. 46; Rom. 8:28). God's plan is to develop perfect people without destroying free will.[21]

Although all evangelicals would acknowledge the stark contrast between the biblical and secular world views described here, neither they nor the rest of Christendom are unified in their views concerning God's involvement in his creation, nor have they developed a unified genuinely biblical theory of public life.

Although all evangelicals would acknowledge the stark contrast between the biblical and secular world views described above, neither they nor the rest of Christendom are unified in their views concerning God's involvement in his creation, nor have they developed a unified genuinely biblical theory of public life. Dean C. Curry[23] has grouped the various approaches Christians have to public policy into three major categories: the purely secular (which, of course, he rejects as an legitimate option for the believer); the separatist, in which a believer disengages himself as much a possible from "secular"affairs — the idea of "Christ against culture"; and the search for a purely biblical third way. Curry rejects all of these, and argues that the Bible does not prescribe a single political option. He believes that extrabiblical options (such as blanket condemnation of capitalism, US foreign policy, and Western culture and values) have been invoked by every so-called biblical prescription to date. Curry argues for a return to a dualism which he ascribes to Aquinas, Augustine, Luther, and Calvin, where nature and grace are separate, if not distinct, such that the Kingdom of God operates only in the spiritual realm and has nothing to do with the affairs of this world.

Figure 1 (opposite) portrays a secular perspective on the future: the variety of potential conflicts in the world and how likely they are to occur, from the viewpoint of the Joint Chiefs of Staff in 1991.[24] The trend of recent events is optimistic: away from nuclear holocaust, and toward the left of the graph.

When God's work in history is not acknowledged, forecasts such as this one provide the only means available for policymakers' planning purposes. If the millennium were included on the chart, Christians would have to assign to it the highest probability: indeed, it is a certainty. However, the Joint Chiefs are reckoning probabilities without the aid of biblical prophesies. On the other hand, populist end-times sermons and books of the 1960s and 1970s which identified Soviet Russia as "Gog" or "Magog" of biblical prophesy and the now-defunct European Common Market as the "Ten Nation Confederacy" have been discredited.[25] Even sermons from 1991 which gave prophetic significance to Saddam Hussein because of Baghdad's proximity to Babylon already are dated.

Advocates of Curry's second category — the separatist, "Christ against culture" theology — often arrive at a pessimistic eschatology: the failure of deterrence is seen to be inevitable because a global nuclear holocaust is identified with the picture of the end times portrayed in the Book of Revelation. Thus, this theology offers no satisfying basis for national participation in arms control negotiations, since the opposite initiative, arms buildup, is seen as necessary for the fulfillment of apocalyptic prophecy. Chuck Colson argues that this can become a self-fulfilling prophesy.[26]

The Bible does not require a monotone descent into tribulation, unlike Hawking's third arrow, which moves inexorably into chaos. Neither the rate nor the path toward tribulation is proscribed in scripture. Periods of remission, peace, or improvement in the human condition are entirely admissible. A failure to understand this could be a tragic mistake (and is most likely the cause of many premature sermons on the immanence of the end times.)

Because of this fatalistic view, "Christ against culture" advocates generally limit their involvement in public life to what might be called "rescue operations." Many praiseworthy activities of the church have been produced by such a theology: rescue missions, hospitals, shelters for battered women, the Salvation Army, and many others. However,

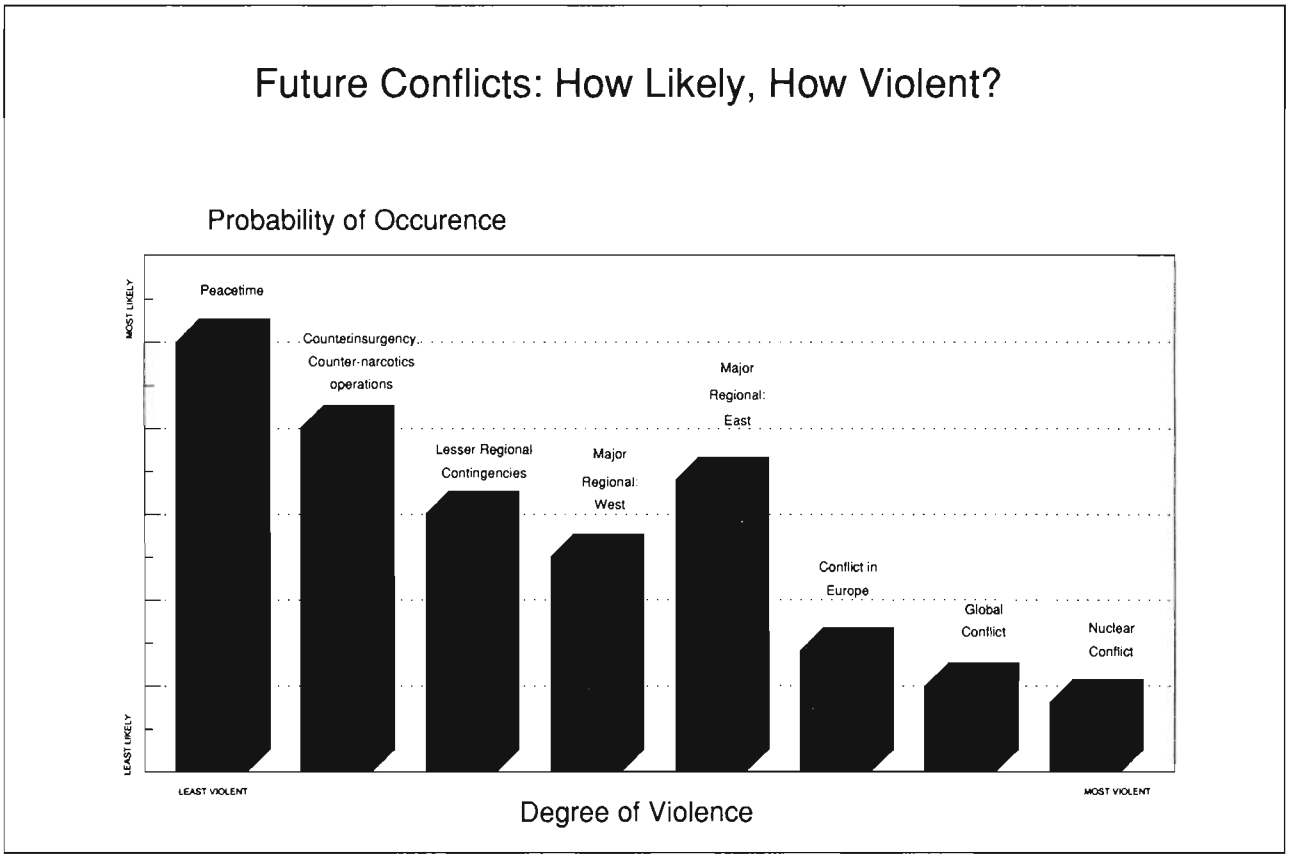


FIGURE 1: The variety of potential conflicts in the world and how likely they are to occur, from the viewpoint of the Joint Chiefs of Staff in 1991.[24]

there is no real attempt to change the social structures of society, which are seen as unredeemable.

Reconstructionist writers oppose signing treaties of any sort between "covenant" (Christian) and "non-covenant" nations; covenant nations are to seek peace through strength...

Curry's third category (the "search for a biblical third way") includes "Reconstructionism" (or Dominion Theology); "Politics of Biblical Justice," and "Kingdom Politics." These three philosophies are popular with different groups of Christians today.

According to Reconstructionists, Christians are to implement God's Kingdom on earth (empowered by the Holy Spirit, of course) by bringing God's Law to operate on all human institutions. God's Law is taken to be the civil and moral laws given to the nation of Israel in the Old Testament records.[27] Reconstructionism appeals to the Christian Right because of its conservative foreign policy agenda.

Reconstructionist writers oppose signing treaties of any sort between "covenant" (Christian) and "non-covenant" nations; covenant nations are to seek peace through strength, unless the adversary also comes under God's covenant. Arms control negotiations are rejected on similar grounds, so that Reconstructionists and Apocalyptic Eschatologists are in substantial agreement in this area.

Reconstructionist teaching on international politics draws upon the idea that the object of the Great Commission (Greek *ethnos* in Matt. 28:19) refers to governments, thus contrasting radically with the separatist apocalyptic perspective.[28] However, as noted earlier, Matt. 24:17 sets forth a clear distinction between peoples (*ethnos*) and governments (*basileia*). The two Greek words used together imply that the end times will witness ethnic group conflicts as well as conflicts between governments; consistent exegesis requires that the Great Commission directs the Apostles to take the gospel to all *peoples* rather than all *governments*. Reconstructionists resolve this dilemma by arguing that missionaries and businessmen should carry the gospel to the people, who then reconstruct their governments on covenant principles.

The goal of the "Politics of Biblical Justice" group is to bring about a biblically-based transformation of society, with liberal democracy being the best response to this age between the first and second comings of Christ. Curry rejects this theology because, in his view, it does not provide adequate basis to deal with the pervasive nature of sin in this age "between the times." In Curry's mind, politics, as the process of compromise, often requires an untenable accommodation between absolutes, i.e. between biblical and unbiblical positions.

In "Kingdom Politics," Christ stands against culture, and his followers must speak in judgment of it. However, in "Kingdom Politics" the biblical message becomes one of economic and social liberation from earthly injustice. As a result, it is easy to lose sight of individual human sinfulness here, and attribute evil only to economic and social institutions. Liberation theology provides a familiar example of this.

None of the theologies described in Curry's collection offers a satisfying basis for Christian participation in arms control in particular, or public life in general. Indeed, he believes that no such basis exists. I believe, however, that a biblical framework *does* exist. Curry rightfully argues for a biblical dualism, but it is the wrong one! To this writer the only dualism taught in scripture is the coexistence, for now, of good and evil in the plan of God, *not* the separation of nature and grace. The need to verify arms control treaties ("trust, but verify") reflects this duality. However, even the good/evil dualism is temporary — a day is coming when God's redemption will be complete.

In Curry's mind, politics, as the process of compromise, often requires an untenable accommodation between biblical and unbiblical positions.

A robust basis for Christian involvement in public life can be derived from the four-fold flow of biblical history: from Creation (good); to the Fall (evil); to Redemption (renewal); and to Consummation (glorification).[28,29] These elements comprise the biblical world view and provide a framework for interpretation of world events. In contrast to Curry's appeal for dualism, all of life is religious. The Bible teaches that creation *is* going somewhere: the Exodus is the Old-Testament paradigm for redemption, and the

Promised Land is a picture of the promised consummation, the end of history.

All things were cursed after the Fall (Gen. 3:17; Isa 24:5; Hosea 4:1-3), resulting, according to Francis Schaeffer's assessment, in a three-fold alienation: man from God, man from nature, and man from man.[30] However, all things — after separation of the unrepentant — are to be redeemed (Rom. 8:19-23; II Cor. 5:18,19; Eph. 1:10; Col. 1:20; 2 Pet. 3:13; Rev. 21:1). The redemptive message of the Bible is that individuals need to repent, and their culture needs healing. The direction of healing is toward justice and righteousness in society (Micah 6:8).

Christians are to be part of God's program of healing — in fact, they are to be his agents (Eph. 2:10). By acting out our lives as light and salt, Christians effect a present reality of the Kingdom of God which will reach its culmination in the future.[31] God's Kingdom is now, and is coming. The calling is not passive. Our assignment moves from proclamation to demonstration of Kingdom values. This assignment means becoming part of God's plan for healing; living lives that serve to redeem, rescue, reclaim, repair, and restore from the effects of the Fall. We are called to work for transformation; and in Francis Schaeffer's terminology, the result will be *substantial healing — now!*[32]

A robust basis for Christian involvement in public life can be derived from the four-fold flow of biblical history: from Creation (good); to the Fall (evil); to Redemption (renewal); and to Consummation (glorification).

Christians should be active in national, state, and local governments, schools, committees, corporations, and any other arenas where biblical principles might be brought to operate on man's affairs. Retreatism, separatism, or isolationism with the sole objective of purity, holiness, or personal piety are not biblical positions. The motive for Christian political involvement is to obey God's command to care for his creation, to anticipate the consummation with the assurance that the principalities and powers of the present age do not have the last word.[33] Participation is not to be undertaken with the idea of creating a perfect society or implementing the Kingdom of God, but simply as a redemptive endeavor. Failure to do so amounts to abandonment of man's institutions to the kingdom of Satan. At the very least, participation might prevent some of the evil that would be done if institutions were left untouched.

Political participation is not to be undertaken with the idea of creating a perfect society or implementing the Kingdom of God, but simply as a redemptive endeavor. Failure to do so amounts to abandonment of man's institutions to the kingdom of Satan.

The biblical view of time provides further interpretive insight. The time for consummation — the culmination of healing — God alone knows. Hebrew and Greek words and phrases concerning *time* in Scripture refer to an *appointed time or season* e.g., *eth* (Eccl. 3) and *kairos* in the New Testament Greek; whereas *yom* (Hebrew) and *chronos* (Greek) refer to the passage of clock time. Advocates of the deterrence doctrine believe that despite its high economic cost, survival of Western and possibly global civilization has been the benefit. However, God may have brought about a new *kairos* by allowing, or causing, monumental changes in the Soviet empire. Because the window may not remain open, Christians must seize the opportunity to spread the gospel and initiate healing. Arms control can be a vehicle for this endeavor.

From Deterrence to Reconciliation

Alberto Coll has argued that "prudence" is the highest form of morality in US foreign policy.[34] Senator Mark Hatfield suggested that *reconciliation* should become the new foundation of foreign policy,[35] meaning that we should work to alleviate the incentives for nations to go to war. President Bush's foreign policy advisors believe that the surest path to global peace is the export of democracy and market economies. Which of these positions best matches God's purpose in history?

In the era of Soviet expansionism, US national security policy was *political containment* and *military deterrence.* Arms control has been intermittently included as a means, but never an end as a policy

objective. That deterrence may have prevented global war for forty-five years cannot be disproved, and, as such, deterrence qualifies as a policy of prudence. However, when viewed from the perspective being developed here, several serious deficiencies are evident.

First, although deterrence may not have stimulated the arms race, it certainly did not prevent it. The world became steadily more dangerous with the proliferation of nuclear, chemical, biological, and conventional arms. Local wars and "low-intensity conflicts" (see Figure 1, p. 31) have continued unabated, and one doesn't need to be reminded of the growth of terrorism as an instrument of foreign policy. The prophetic cry of Jeremiah "the prophets cry 'peace, peace' when there is no peace" (Jer. 6:14) rings true. MAD doctrine produced a false peace.

Congressional estimates of the cost to the US for defending Europe in 1990 was $160 billion, or $1600 per taxpayer, similar to the budget deficit.

The economic and social costs of the arms race provide a second concern about security policy based on deterrence. Shortly after his inauguration, President Dwight Eisenhower observed that "every gun that is made, every warship launched, every rocket fired signifies, in the final sense, a theft from those who hunger and are not fed, those who are cold and not clothed."[36] Ironically, his administration subsequently presided over the formative stages of the nuclear arms race. Congressional estimates of the cost to the US for defending Europe in 1990 was $160 billion, or $1600 per taxpayer, similar to the budget deficit.[37] In 1989, according to the International Labor Organization, global spending on armaments was $1.9 million per minute, employing 55 million people. At the same time, in the "developing world" there was one soldier for every 240 persons and one physician for every 1,950 persons. During the two years of optimism in 1989-90 it was popular to anticipate that the reduction of military spending made possible by arms control would free up resources (a "peace dividend") to invest in the social infrastructure. The Persian Gulf War dashed those hopes for a while, because the war was estimated to cost over a billion dollars per day. Although President Bush's nuclear arms reduction speech renewed hopes for a peace dividend, a new arms rush is underway as US and European companies seek to replace reduced Western purchases with sales to eager Middle Eastern and Eastern European customers!

Arms control is more redemptive in nature than is deterrence because it can reduce the capacity to wage war, control arms races, and reduce damage if deterrence should fail.

Finally, deterrence as the basis for security policy has been questioned on more direct moral grounds.[38] The concept of nuclear deterrence was implemented largely on the basis of economic expediency; and the basic theme is, if not vengeance, at least punishment. Vengeance remains God's responsibility (Deut. 32:35; Rom. 12:19; Heb. 10:30), even though God sometimes used armies to bring judgments against his enemies. Vengeance does not provide a moral foundation for foreign policy. At the very least, application of the principle of nuclear retaliation first requires sorting out the differences between ancient Israel's theocracy under law and the secular democracy of the US today.

A Foreign Policy of Reconciliation

Arms control is not *necessarily* part of God's plan for redemption; neither is it sufficient by itself as a foreign policy. Clearly, however, arms control is more redemptive in nature than is deterrence because it can reduce the capacity to wage war, control arms races, and reduce damage if deterrence should fail. Deterrence is consistent with recognition of the Fall: it acknowledges human evil and seeks to hold it in check. However, deterrence as a policy contains no element of redemption, which, as we see above, is the third element of the biblical flow of history. By contrast, arms control contains an element of redemption. It can do this without sacrificing the deterrence element if the arms control results in "build down"; retaining deterrence while reducing damage potential.

After war making capacity is reduced by arms control, there still remains the objective of reducing the incentive. The Bible teaches that there will be wars as long as the causes remain, and that no peace will endure in the absence of righteousness and justice. "Structural injustice," which is simply the outworking of human sin through institutions, provides

some of the causes. Structural injustice may be the system-level cause of extremes in wealth and poverty, hunger, economic exploitation, pollution, and colonialism; but simple greed is the root cause. Well-meaning Christians often participate unwittingly in many of these structures.

A foreign policy that sought to alleviate suffering and promote justice surely would please God. For example, suppose that, rather than selling arms to Persian Gulf nations, the US had been exporting health care, desalination technology, crops able to thrive in arid climates or alkaline soils, and economic policies that helped mitigate aggregation of extremes in wealth and poverty? The missing element during the Persian Gulf War was any call to national sacrifice in the US, creating the *de facto* energy policy of war before conservation. The "Harvest for Peace" campaign sponsored in Congress by Bread For the World provides a positive policy alternative: the initiative calls for legislation to direct the "peace dividend" into hunger relief, domestic and worldwide.[39] Until God's Righteous Kingdom, the presence of justice will not eliminate despots and megalomaniacs, but it would make it harder for them to recruit followers.

Epilogue

It is probably safe to say that policymakers don't particularly care what evangelicals are writing in the pages of *Perspectives* or speaking at the ASA annual meeting. I am not criticizing ASA here; the organization has real value as a place where we hammer out our theology in a climate of love and trust. However, policymakers *will* pay attention to evangelicals' participation in the public policy process, e.g. what they write to their Congressmen and to the editorial pages, how they serve the poor with love and practice justice for them, and what they do as participants in national policy processes, such as arms control. ✣

NOTES

[1]*Washington Post/Newsweek Interview, 1988.*
[2]*"Backing Away from Armageddon," Washington Post,* November 27, 1991, p. 3.
[3]*New York Times, October 25, 1989, p. 30.*
[4]*Washington Post, December 8, 1989, p. A19.*
[5]Charles Krauthammer, "Why Arms Control is Obsolete," *Time,* August 5, 1991, p. 68.
[6]Ellen Goodman, "The Summit of the Absurd," *The Oakland Tribune,* August 6, 1991, p. A11.
[7]R. Jeffrey Smith, "Comprehensive Arms Pact May be the Last of its Kind," *Washington Post,* July 18, 1991, p. 29.
[8]Table 1 compiled by John M. Taylor, Sandia National Laboratories, Albuquerque, NM, 1990.
[9]Jack C. Swearengen and Alan Peter Swearengen, "Comparative Analysis of the Nuclear Weapons Debate: Campus and Developer Perspectives," *Perspectives on Science and Christian Faith,* Vol. 42, No. 2, June 1990, pp. 75-85.
[10]Mikhail Gorbachev, *Perestroika,* New York: Harper and Row, 1987.
[11]Frank J. Gaffney, Jr. "Baker Snatches Defeat from the Jaws of Victory," *Wall Street Journal,* May 24, 1990, p. 14.
[12]*Wall Street Journal, December 11, 1989, p. 14.*
[13]Alexis de Tocqueville, *Democracy in America,* 1930.
[14]*Washington Times, December 1, 1989, p. F-3.*
[15] *Ibid, November 22, 1989, p. 9.*
[16]*Soviet Military Power: an Assessment of the Threat, US Government Printing Office, Washington, D.C., April 1988, p. 158.*
[17]Ronald Lehman III, "The Arms Control Legacy of the Reagan Administration: Focus on START," *Strategic Review,* Fall 1988, p. 13.
[18]From a speech by Soviet Foreign Minister Eduard Shevardnadze to the Party Congress, July 1990 (reported in *Wall Street Journal,* July 31, 1990, p. 12.)
[19]Georg Wilhelm Friedrich Hegel, *Encyclopaedia of the Philosophic Sciences,* 1817.
[20]Frances Fukuyama, "Are We at The End of History?" *Fortune,* Vol. 121, No. 2, Jan 15, 1990, pp. 75-78.
[21]Hugh Ross. *The Fingerprint Of God,* Orange, CA: Promise Publishing Co., 1989, pp. 108, 146, 171.
[22]Stephen Hawking, *A Brief History of Time,* New York: Bantam Books, 1988, p. 143.
[23]Dean C. Curry, "Biblical Politics and Foreign Policy," in *Evangelicals and Foreign Policy: Four Perspectives,* Michael Cromartie, Ed., Washington, D.C., Ethics and Public Policy Center, 1989, pp. 43-64.
[24]Based on the Joint Chiefs' 1991 "Military Net Assessment," reported by Peter Alsberg, *The Washington Post,* National Weekly Edition, May 27-June 2, 1991, p. 8.
[25]Edwin Yamauchi, *Foes From the Northern Frontier: Invading Hordes from the Russian Steppes,* Baker, 1982.
[26]Charles Colson, *Kingdoms in Conflict,* William Morrow/Zondervan, 1987, pp. 9-40.
[27]Gary North, *Healer of the Nations: Biblical Blueprints for International Relations,* Fort Worth: Dominion Press, 1987, pp. 56-58, 127-129, 164-170.
[28]The author is indebted to Denis D. Haack of Ransom Fellowship for calling his attention to this framework.
[29]John R.W. Stott, *Involvement: Being a Responsible Christian in a Non-Christian Society, Vol I,* Old Tappan, N.J.: Fleming H. Revell, 1985.
[30]Francis A. Schaeffer, *The God Who is There,* Chicago: InterVarsity Press, 1968, pp. 152-154.
[31]Jaques Ellul, *The Presence of the Kingdom,* 2nd ed., Colorado Springs: Helmers and Howard, 1989, pp. xli, 21-47, 65.
[32]Francis A. Schaeffer, *True Spirituality,* Wheaton, Ill: Tyndale House Publishers, 1971, pp. 123-138.
[33]Richard John Neuhaus, "Why Wait for the Kingdom? The Theonomist Temptation," *First Things,* May 1990, pp. 13-21.
[34]Alberto R. Coll, "Christian Realism and Prudence in Foreign Policy: a Challenge to Evangelicals," in *Evangelicals and Foreign Policy: Four Perspectives, loc cit.,* pp. 28-42.
[35]"An Agenda for Global Reconciliation," Essays by Mark O. Hatfield, George Weigel, John Lawyer, and Kenneth Kantzer, *Christianity Today,* June 18, 1990, pp. 29-39.
[36]Dwight D. Eisenhower, "The Chance for Peace;" address before The American Society of Newspaper Editors, April 16, 1953.
[37]Ruth Leger Sivard, *World Military and Social Expenditures,* Washington, D.C., World Priorities, 1989.
[38]*Challenge of Peace: God's Promises and our Response; Catholic Bishop's Pastoral Letter, 1983.*
[39]*Share the Harvest of Peace Resolution, Proc. 101st Congress, Vol. 36, No. 7: Senate Concurrent Resolution #91, House Concurrent Resolution #259.*

The Origin of Species and the Origins of Disease: A Tale of Two Theories

WILBUR L. BULLOCK

Professor Emeritus
Zoology (Parasitology)
University of New Hampshire
Durham, NH

The Germ Theory of Disease has provided a rationalistic explanation for many diseases, both individual and epidemic. Following its general acceptance there were some erroneous identifications of specific germs for some diseases. There were also suggestions that germs had replaced God. Likewise, the Theory of Natural Selection has proven a useful model for explaining much of the diversity of living organisms. However, it too has been involved in unjustified conclusions — scientifically, socially, and theologically. This paper examines the bases for both of these theories with the aim of illustrating the positive contributions and the inadequacies of human theories.

Charles Darwin's explanation of the origin of species by the processes of natural selection set off a controversy with which we are all familiar. Many people, not committed to a Bible-based Christian faith, saw this naturalistic/rationalistic explanation of origins as another proof that the Bible was wrong and that such a theory even gave evidence for the nonexistence of God. In reaction, some Christians turned to extreme literalism in their efforts to defend the Bible and to disprove evolution. Others have maintained that both extremes are wrong and that there are numerous alternative models for harmonizing science and Scripture. However, we are still a long way from final answers to even the basic sustaining processes God uses in his works of providence, to say nothing of our ignorance of much of the *how*, *when*, and *why* of his creative acts.

As a biologist, specializing in the study of parasites, their identification and diagnosis, and the natural history of infectious diseases, I have been intrigued by some of the parallels between natural selection — as a theory to explain the origin of species — and infectious organisms — as a theory to explain the cause of disease. In both theories there have been theological as well as rationalistic attempts to relate cause and effect in an oversimplified manner. In both theories there have been far-reaching proposals on the relationship, if any, between "natural" events and "divine" intervention.

Many religions have accounts of how things began, often with tales of rivalries among numerous gods. Some postulate no beginning and an ongoing pantheistic perspective on the world around us. As Christians we have the simple and beautiful assertion that: "In the beginning God created the heavens and the earth" (Genesis 1:1), an assertion that is repeated in many forms throughout Scripture. There is one Almighty God: Creator and Sustainer of the universe — from galaxies in the heavens (Psalm 19) to the lowliest creatures on this earth (Psalm 146).

Likewise, to understand and explain sickness, disease, and disastrous epidemics, there have been — throughout recorded history — assertions that disease is caused by the action of God or gods. Furthermore, such divine action is often a punishment

for human sin. In polytheistic, idolatrous cultures the occurrence of disease (in the individual or in the community) is frequently associated with gods, demons, witchcraft, curses and astrology. Divine intervention is clearly *one* major explanation of disease in the Bible, from Genesis to Revelation: God often uses war, famine, and *pestilence* to judge nations, including his own people.

Rationalistic Explanations of Disease

In ancient Greece and Rome numerous scholars (from Hippocrates to Galen) developed rationalistic explanations of how disease developed and, in epidemics, how it spread through the population. As in other scientific theorizing, several major paradigms, with fascinating overlaps, developed. In various forms these views persisted in medicine and in the general public's thinking until recent times.

A. Humoral Theory

The humoral theory was the dominant concept among medical scholars and practitioners of the ancient world and it was still a major explanation of disease in the western world in the eighteenth century. It was based on the assumption that there were not different diseases but, rather, diverse imbalances in the sick individual. The primary factors were considered to be four basic substances or *humors*: Blood, Phlegm, Yellow Bile, and Black Bile. In turn, each of these humors was associated with a major organ of the body, as follows:

Blood — from the heart
Phlegm — from the brain
(Anatomy was not well understood!)
Yellow Bile — from the liver
Black Bile — from the spleen

It is generally assumed that the inordinate emphasis on the spleen, usually a relatively inconspicuous abdominal organ, is an indication of a marked prevalence of malaria in the ancient world. In this insect-transmitted disease the spleen is usually enlarged and blackened with malarial pigment.

Under the humoral concept, treatment consisted of methods presumed to restore humoral balance. On the assumption that fever was related to too much blood, the most commonly used of these "treatments" was *phlebotomy* or bleeding. At times there were even arguments over the relative value of "artificial" versus "natural" bleeding methods: knives or scalpels for the former, leeches for the latter.

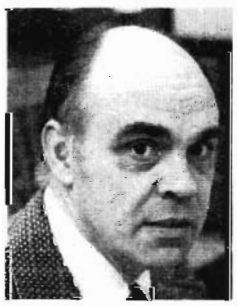
On the assumption that humoral imbalance was often related to too much of a poison or poisons, weird concoctions were used as purgatives and/or emetics. At times treatment was based on the objective of neutralizing such poisons by medication with another poison. Hence mercurous chloride (calomel) became a most popular form of therapy, even into the nineteenth century. Often both calomel and bleeding were used on the same patient! The chorus of a popular song (following the disastrous epidemic of yellow fever in New Orleans in 1953) alluded to this:

> And when I must resign my breath,
> Pray let me die a natural death
> And bid the world a fond farewell
> Without one dose of calomel![1]

No wonder there has been considerable speculation as to how many patients died from the treatment and how many died of the disease!

B. Miasmatic Theory

Humoral theory was inadequate when it came to explaining epidemics. How do we account for large numbers of people who are sick or dead from a similar malady in a short period of time and in a specific geographical area? Theologically, divine



Wilbur L. Bullock (Ph.D., Univeristy of Illinois, 1948) is Professor Emeritus, Zoology, University of New Hampshire where he taught courses in Verebrate Histology, Parasitology, and Natural History of Infectious Diseases. His research interests have been the taxonomy and the histopathology of several groups of helminth and protozoan parasites. Since 1972 he has also been an Honorary Research Affiliate of the Harold W. Manter Laboratory of Parasitology, University of Nebraska State Museum. He was Editor of Perspectives on Science and Christian Faith *from 1984 through 1989.*

wrath for real or imagined national sins was usually invoked. Rationalistic explanations for such dramatic involvement of large segments of a population tended to center around two major and often overlapping ideas of *miasms*.

***Rationalistic explanations for such dramatic involvement of large segments of a population tended to center around two major and often overlapping ideas of* miasms.**

1. Miasmatic hypotheses primarily emphasized what we today would refer to as "environmental" factors. These were thought of as mysterious forces, as chemical or physical entities, or as "seeds." Some ancient writers described the epidemiology of disease as a form of balance between "good seeds" and "bad seeds." Hence Lucretius (1st century B.C.) could write:

> Now what is the law of plagues, and from what cause on a sudden the force of disease can arise and gather deadly destruction for the race of men and the herds of cattle, I will unfold. First I have shown before that there are seeds of many things which are helpful to our life, and on the other hand it must needs be that many fly about which cause disease and death. And when by chance they have happened to gather and distemper the sky, then the air becomes full of disease. And all that force of disease and pestilence either comes from without the world through the sky above, as do clouds and mists, or else often it gathers and rises up from the earth itself, when, full of moisture, it has contracted foulness, smitten by unseasonable rains or suns.[2]

2. Other expressions of miasmatic theory focussed on objectionable odors from swamps or rotting garbage or other human wastes. Hence, during epidemics, such as yellow fever or cholera, there would be measures to clean up the foul air, water or earth or to neutralize the bad miasms. Some of the methods frequently used included spreading lime on the streets and in the homes, firing cannons, burning tar, or wearing masks saturated with various aromatic substances.[3] One way in which the vocabulary of miasm theory has come down to us today is in the name of two important diseases *influenza* (the influence) and *malaria* (bad air).

C. Contagia Theory

Somewhat intertwined with miasmatic concepts were various hypotheses that postulated the "bad seeds" as *contagia*. Such entities could be passed from one person to another through the air, water, soil, or fomites such as clothing, bedding, utensils, or other belongings of the sick. Hence the development of such measures as quarantine and the burning of the possessions of the dead during outbreaks of plague as well as other epidemics. Even in times when the medical scholars were theorizing and practicing humoral explanations of disease the general public seemed more inclined toward contagia principles, whether it be the isolation of lepers or deserting the sick in time of plague. Such thinking was also behind some of the attempts at germ warfare by a few American colonists as they left the clothing of smallpox victims in Indian villages. Smallpox became another weapon, because of the greater susceptibility of the Indians to this disease with which they previously had no contact.

Contagia *could be passed from one person to another through the air, water, soil, or fomites such as clothing, bedding, utensils, or other belongings of the sick.*

From the time of the great plagues of the fourteenth to seventeenth centuries there were numerous suggestions of particulate contagia that had some of the characteristics of living creatures — such as reproduction. Acceptance of this concept by the medical and scientific world of the time was made difficult by preconceived notions. Before the advent of the microscope and other technologies, such "living things" could not be demonstrated. Their possible existence was, therefore, often ridiculed. Thus John Astruc, physician to Louis XIV (1638-1715), reviewed the numerous theories regarding the cause of syphilis and commented on "living contagia" as follows:

> There are some, however, whom I forbear now to spend Time in imputing, such as Augustus Hauptman and Christian Langius, who *think that the Venereal Poison is nothing else but a numerous School of little nimble, brisk, invisible living things, of a very prolific Nature, which when once admitted, increase and multiply in Abundance*: which lead frequent Colonies to different Parts of the Body and inflame, erode, and

exulcerate the Parts they fix on; ... in short, which without any Regard had to the particular Quality of any Humour, occasion all the Symptoms that occur in the venereal Disease. *But as these are mere visionary imaginations, unsupported by any Authority, they do not require any argument to invalidate them...if it was once admitted, that the Venereal Disease could be produced by invisible living things swimming in the blood, one might with equal reason alledge the same Thing, not only of the Plague, as Athanasius Kircher, the Jesuit, formerly, and John Saguens, a Minim, lately have done but also in the smallpox, Hydrophobia, Itch, Tetters, and other contagious Diseases and indeed of all Distemper whatsoever; and thus the whole Theory of Medicine would fall to the Ground, as nothing could be said to prove the Venereal Disease depending upon little living things which might not be urged to prove that all other Diseases were derived from the like little living things though of a different species, than which nothing can be more absurd.*[4] (Italics mine.)

"...might be urged to prove that all Diseases were derived from the little living things, than which nothing can be more absurd."

Furthermore, even when such creatures could be seen, as in the case of parasitic worm infections, the general acceptance of the concept of spontaneous generation led many to the conclusion that these things were the result of the disease and not the *cause*. Such "chicken or egg" confusion continued in many circles even after the microscope entered the picture.

D. Germ Theory

After numerous tantalizing suggestions that living organisms could be responsible for disease, the germ theory became firmly established during the last quarter of the nineteenth century. Following in the footsteps of some of the lesser lights of the seventeenth century, scholars so ridiculed by Astruc, disease investigators became more accepting of the possibility that disease could "[depend] upon little living things." By the middle of the nineteenth century John Snow, in his classic studies on the epidemiology of cholera, concluded that this disease was caused by a specific poison, that the poison particles were dispersed in the water with sewage, and caused cholera by multiplying in the next victim after ingestion in contaminated water. By these hypotheses and the development of microscopic and cultural techniques by Louis Pasteur, Robert Koch, and others, the Germ Theory of Disease became the major paradigm in the medical world and in the thinking of the general population. Few people would have any problem with Ogden Nash:

> A mighty creature is the germ
> Though smaller than a pachyderm.
> His customary dwelling place
> Is deep within the human race
> His childish pride he often pleases
> By giving people strange diseases.
> Do you, my poppet, feel infirm?
> You probably contain a germ.

So we arrived at the point, only a century ago, where much of the sickness and disease in plants, animals, and humans could be attributed to various infectious organisms or "germs": bacteria, viruses, fungi, and parasites. Just as "natural selection," at this same time, seemed to be answering questions regarding the origin of species, so "germs" of various types were answering questions regarding the origin of disease.

E. Too Many Germs and Other Problems

But following the establishment of a theory there is often the tendency to claim more than the theory justifies. At the time of Pasteur and Koch, whose work was mainly with bacteria, there appeared claims for the presumed discovery of the bacteria that caused various diseases. Most of these discoveries — such as those for cholera, typhoid fever, tuberculosis, and leprosy — were correct. Others, however, were wrong. Thus *Haemophilus influenzae* was proclaimed as the cause of influenza, a disease later shown to be caused by a virus. Likewise *Bacillus malariae* was championed as the cause of malaria until it was clearly demonstrated that this affliction was a mosquito borne disease caused by several species of protozoans of the genus *Plasmodium*. Furthermore, we accept the fact that medical investigators have identified numerous diseases that are not caused by infectious organisms: diseases that may result from hereditary defects, from poor nutrition, from environmental factors, etc.

Following the establishment of a theory there is often the tendency to claim more than the theory justifies.

In this process we often find that the rationalistic theories of the ancients were not 100% wrong. Thus, while we accept the reality of a diversity of very

different diseases and different causes, we have also come to appreciate the intricate balances (homeostasis) that are involved in normal biological processes and that diseases — infectious or noninfectious — are usually associated with an upset in these balances. But, of course, there are more than a mere four humors to balance!

"Disease is the result of a combination of geographical circumstances which bring together the disease agent, vector, intermediate host, reservoir, and man at the most auspicious time."

In addition to disease production by environmental factors such as asbestos, benzene, tobacco, and lead we have come to appreciate that a complex network of the components of the environment plays a significant role in the occurrence and the course of infectious, "germ" related diseases. G. Melvyn Howe summarizes this interplay of a variety of factors:

> One of the intriguing features of the microorganisms which attack man is their natural history and the ways in which they, the disease agents, are transmitted from person to person. It is here that relationships between disease agents, the diseases they cause, and the physical and human environment are particularly evident ... Whether it be causative organism (virus, bacterium, spirochaete, rickettsia), intermediate host or vector, each element in the disease complex has its own specific environmental requirements. Each element, including man himself, is inescapably ... bound up with the geographical environment. *Disease in any given loc-ality is the result of a combination of geographical circumstances which bring together the disease agent, vector, intermediate host, reservoir, and man at the most auspicious time.* Knowledge of these relationships and of each element in the complex is a prerequisite to a true understanding of infectious disease, its distribution and control.[5] (Italics mine.)

And the *human* component was emphasized by Henry Sigerist:

> Religion, philosophy, education, social and economic conditions — whatever determines a man's attitude towards life — will also exert great influence on his individual disposition to diseases and the importance of these cultural factors is still more evident when we consider the environmental causes of disease.[6]

So, in considering disease from a rationalistic perspective we now recognize a variety of specific diseases, interrelated to normal biochemical balances, and influenced by a variety of environmental factors. We've also come to appreciate the role of the emotional state in the ability of an individual to respond to infectious agents. We now must deal with a "germ theory of disease" that has many more factors — at both the individual and the community levels — than just a germ and a person made sick and a simple "bug/drug" association for prevention or cure.

The Origin of Species

As with the determination of the cause of disease, explanations of the nature and origin of the diversity of plants and animals have also involved numerous theological and rationalistic hypotheses. Ancient theorists associated the living world with a bewildering array of fertility gods, often related to specific animal species such as bulls, cats, crocodiles, etc. Some of these views obviously were related to the polytheism that dominated ancient religions; others tended toward the pantheism we associate today with eastern religions and New Age theorizing. In the historical development of modern, rationalistic views there were several concepts that played roles which are significant in understanding some of the evolution/creation controversy.

A. Spontaneous Generation

From the ancient Greeks to the nineteenth century it was commonly assumed that various living organisms developed spontaneously from specific environmental situations. Thus crocodiles developed from the mud of the Nile River, birds appeared suddenly from swamps and marshes, frogs from mud, maggots from flesh, and mice from various types of filth. The experiments of Francisco Redi in the seventeenth century proved that maggots were the larval stages of flies that laid their eggs on flesh. Spontaneous generation almost disappeared as a viable rationalistic option until the development of the microscope led to revival of this type of thinking for at least the tiny forms of life. But then the work of Pasteur and others convincingly disproved this explanation of the origins of even microscopic living things.

B. Fixity of Species

With the advent of global exploration, the collecting of large numbers of specimens lead to

Living things were sorted and assigned to groups in systems that resembled the sorting of mail at the post office...

attempts to systematically catalog the vast array of plants and animals. Living things were sorted and assigned to groups in systems that resembled the sorting of mail at the post office or as we might classify motor vehicles into a hierarchy of concept-related categories. In the eighteenth century the Swedish botanist Carolus Linnaeus formalized classification, especially in his 1758 publication *Systema Naturae*. From this work developed not only the highly useful binomial system of nomenclature, but also the hypothesis that each species has remained very much as when originally created. Hence we get two related terms: "fixity of species" and "special creation." (It is important to remember regarding the latter concept that "special" does not refer to divine purpose but rather to the creation of particular "species.") Such a concept, supported by Linnaeus and others, appealed to many Christians, and the "species" of science became equated with the "kinds" of Genesis. However, anyone with any experience with the taxonomic process quickly realizes that "species" is a manmade category of convenience: biologists are still arguing over the definition of "species" (some of the dogmatic statements to the contrary in popular literature notwithstanding.)

C. Catastrophism

Concurrent with the attempts, on the basis of the developing species concept and the description of hierarchical schemes for establishing inter-species relationships, was the accumulation of a fossil record and indication of large time spans. The occurrence of a vast array of fossil plants and animals stimulated discussion of these time relationships. How and when did these fossils get in the rocks and how are they to be related to the living world of today? One view of this phenomenon that gained popularity among both scientists and theologians was that of catastrophes. Some sought explanation in a single catastrophe, usually based on the biblical flood. Others saw the fossil record as indicating a series of catastrophes with subsequent re-creations. Still others de-emphasized the importance of "catastrophes" and, especially after Darwin, focussed on a gradualism through long periods of time. In recent years, some paleontologists have, by the hypotheses of "punctuated equilibria," modified steady gradualism with interspersed periods of relatively rapid change. Furthermore, meteoric impacts have been blamed for the catastrophic demise of the dinosaurs.

D. Natural Selection

Amidst the various attempts to explain species diversity on the basis of spontaneous generation, fixity of species, and catastrophism, there were numerous suggestions that somehow life forms as we know them today may have at least some ancestral relationships. Species within a given genus, or genera within a family, may have had common ancestors and at least some of these ancestors could be represented in the fossil record. Such ideas had been postulated by some of the ancient philosophers. Jean Baptiste Lamarck, early in the nineteenth century, suggested that individually acquired characteristics could be passed on and developed further in succeeding generations. However, none of these mechanisms appeared viable as a basic theory to explain species diversity. There was no substantial evidence for the inheritance of these acquired characteristics.

Then in 1859 appeared Charles Darwin's *On the Origin of Species by Means of Natural Selection*. This mechanism for an "evolution" quickly became accepted as the major explanation of species diversity and interrelationships. As with many dramatic and sweeping theories, controversy soon erupted. However, as documented by David Livingstone[7] and James Moore[8] this was not simply a conflict between scientists and theologians, as it is so often erroneously portrayed. Some of Darwin's most vigorous opponents were scientists such as Louis Agassiz; some of his supporters were conservative, Calvinist theologians such as Benjamin Warfield and James Orr.

Some of Darwin's most vigorous opponents were scientists such as Louis Agassiz; some of his supporters were conservative, Calvinist theologians such as Benjamin Warfield and James Orr.

But what is this "natural selection"? First we need to be aware of what it is *not*. Some evolutionists and some anti-evolutionists imply that *natural* selection is opposed to *supernatural* selection or special creation. However, if one even skims Darwin's vol-

ume, it is obvious that natural selection is primarily in contrast to *artificial* selection, a process much used in Darwin's time (and before) for the selective breeding of plants and animals. Such a process has been developing even further in recent years through genetic engineering.

...In Darwin's volume, natural selection is primarily in contrast to* artificial *selection, a process much used in Darwin's time (and before) for the selective breeding of plants and animals.

Darwinian "natural selection" is based on several basic principles that are of a relatively noncontroversial nature. It is the extrapolation to a sweeping general evolutionary theory that becomes more questionable.

1. High Reproductive Rates

While it may be an encouragement to recognize that insignificant people or ideas can accomplish much, the observation that "mighty oaks from little acorns grow" has limitations. Anyone who has an oak tree in their backyard realizes that if all of the acorns produced were to survive, the earth would be completely buried in oak trees in a short time. A single female mackerel produces 400,000 to 500,000 eggs each year; an Atlantic cod can develop 9 million eggs; and a freshwater carp almost 2 million. The human intestinal roundworm (*Ascaris*) releases up to 200,000 eggs per day and, on the basis of its longevity, a single female can produce 73 million eggs during its life span.

2. Limiting factors

Although the earth experiences occasional episodes of overpopulation, such as hordes of locusts or gypsy moths, plants and animals usually exhibit relatively stable population levels. The numbers of individuals are controlled by a variety of factors: limited food supplies, predators, and parasites. So, in these situations of high productivity, only a small percentage of eggs or seeds reach reproductive maturity. Even in species with more modest reproductive potential a majority of offspring do not survive.

3. Genetic Diversity

Except for identical twins and clones, no two individuals are exactly alike in their inherited characteristics. While many hereditary features, especially new ones (mutations), are harmful — and hence lower chances of survival under normal circumstances — others can be helpful if changes occur in the physical or biological environment. Any feature that would enhance disease resistance, the ability to flee or hide from predators, or make use of another food supply would enhance the chances of survival of a given population.

The interplay of overproduction, genetic diversity, and the various limiting factors became the basis of Darwin's proposal for the "origin of species by natural selection."

E. Too Much Natural Selection

Like the Germ Theory of Disease, "natural selection" tended to become the ultimate answer to questions concerning species diversity and phylogenetic relationships. Natural selection, together with the fossil record, was soon developed, by Darwin and others, into the general theory of evolution. Such a concept was readily accepted by an increasingly rationalistic society as an explanation which made divine control or origin unnecessary. There was some scientific opposition to Darwin's ideas of evolution by natural selection on the basis of Darwin's erroneous ideas regarding the mechanisms of heredity. Several scientific and theological writers used this faulty understanding of genetics in their attempts to discredit natural selection in particular and evolution in general. There was some theological opposition on the basis of literal interpretations of Genesis and a fear that "natural" was eliminating "supernatural." However, natural selection soon received recognition as the major, if not only, method of all of evolution.

Like the Germ Theory of Disease, "natural selection" tended to become the ultimate answer to questions concerning species diversity and phylogenetic relationships.

Furthermore, the emphasis on limiting factors and species survival led to concepts such as "the survival

of the fittest," which for many portrayed only "nature, red in tooth and claw." Totalitarian political philosophies along with an extreme free enterprise capitalism led to "Social Darwinism." Such nonscientific, philosophic speculation and theorizing became the basis of the evolutionism that dominates current attitudes towards the natural world. "Nature" and "Evolution" are obviously the gods of many of the otherwise educational, awesome, and spectacular TV programs (and of their narrators) that describe what for Christians must be thought of as God's creative and sustaining handiwork. This same "Nature" is even the god of some of our TV meteorologists!

Concluding Comments

Where does God and Scripture fit into all this rationalistic theorizing and theological interpretation? Christians have taken various positions on natural selection and on broader evolutionary theory. Some have denied both: some have accepted theistic neo-Darwinism: many have taken numerous other positions from among those outlined by David Wilcox[9] and Craig Nelson.[10] On the other hand, we have too often allowed our over-rigid commitment to one interpretation of Scripture to be the means of evaluating the current fad theory in science. Such either/or approaches and stiff-necked rigidity hinder us from moving toward both scientific and theological truth.

Any biologist who has had hands-on experience with the identification and classification of "species" knows that the criteria for defining "species," "genus," "family," etc. vary with the experts and change from year to year. For example, the major group of parasitic worms which I have studied since graduate student days is the Acanthocephala, or spiny headed worms. During the lifetime of my major professor their status changed from genus to family to class to phylum. The major reason for such tentativeness is that "species" or any other category of living things exhibit remarkable diversity and explanations of such diversity are often difficult.[11]

On the basis of laboratory and field studies, natural selection can be accepted as a major factor in plant and animal diversity. Microevolution or special evolution should be no problem to any Christian, even those committed to recent creationism. Further changes that appear to require long periods of time (macroevolution or general evolution) may also take place, at least in part, through natural selection. But these interrelationships are impossible to firm up with certainty and the suggested pathways are constantly changing. Other still unknown mechanisms, some perhaps no longer operating, may also have been involved. As Christians, while it is still basic that *God did it*, we can still speculate on *how* he has done it as we study what he is doing now. To accept natural selection does not deny God. To insist on God as the explanation for only the unknown is an unbiblical God-of-the-gaps deism. To ignore God in natural processes (natural selection or infectious disease) is also unbiblical.

To accept natural selection does not deny God. To insist on God as the explanation for only the unknown is an unbiblical God-of-the-gaps deism. To ignore God in natural processes (natural selection or infectious disease) is also unbiblical.

In the Germ Theory of Disease I have not found much Christian opposition to these naturalistic explanations of how living organisms get sick. In accounts of community response to serious epidemics there has been some tension between the emphasis on practical procedures, such as sanitary improvements or quarantines, and spiritual activities such as fasting and prayer. Some of this tension has not always been accompanied by Christian love and compassion and has certainly been as negative a witness as some of the heated, emotional evolution/creation debates. For example, an editorial in the *Western Sunday School Messenger* during the cholera epidemic of 1832 stated:

> Drunkards and filthy wicked people of all descriptions are swept away in heaps, as if the Holy God could no longer bear their wickedness, just as we sweep away a mass of filth when it has become so corrupt we cannot bear it. The cholera is not caused by intemperance and filth, in themselves, but it is a scourge, a rod in the hand of God.[12]

And another writer thanked God that the cholera remained, "almost exclusively confined to the lower classes of intemperate dissolute and filthy people huddled together like swine in their polluted habitations."[13] It is sad that we have heard similar cruel and self-righteous comments from some Christians in regard to AIDS victims, all of whom are *not* homosexuals or drug addicts. And even when they

are, Christian compassion may lead some of them to repentance and salvation.

But Christians have often been in the forefront of care and compassion for the sick, even in disastrous, personally dangerous epidemic situations. William McNeill could write:

> One advantage Christians had over their pagan contemporaries was that care of the sick, even in time of pestilence, was for them a recognized religious duty. When all normal services break down, quite elementary nursing will greatly reduce mortality... The effect of disastrous epidemic, therefore, was to strengthen Christian churches at a time when most other institutions were being discredited. Christian writers were well aware of the source of strength and sometimes boasted of the way in which Christians offered each other mutual help in time of pestilence whereas pagans fled from the sick and heartlessly abandoned them.[14]

In addition to these social/theological implications of disease, there have been some theoretical theological implications of germ theory. While not so prominent in scientific/theological controversies as evolution and creation, numerous speakers and writers on disease have, in this author's experience, often implied that it is either God *or* germs. Just as natural selection and genetics have given us rationalistic explanations of the origin of species that make theological interpretations unnecessary, so our understanding of germs (bacteria, viruses, etc.) often remove God from individual sickness and from epidemics. As one anonymous writer put it: "In the nineteenth century man lost his fear of God and acquired a fear of microbes." Howard Haggard expressed similar conclusions when he wrote:

> In the nineteenth century a search that had been going on for more than one hundred and fifty centuries ended. The spirits which primitive man had thought responsible for pestilential disease were finally seen and identified as bacteria.[15]

In contrast to Christian suspicion of rationalistic, nontheistic descriptions of the origin of species, it seems that perhaps we all too often treat individual sickness and even epidemics on a purely rationalistic, even nontheistic basis. We talk only in terms of immunization procedures, antibiotics and the latest chemotherapy. We need to avoid the harsh condemnation of the sick as quoted above or as spoken by Job's unhelpful "friends." We need to reaffirm that our Creator and Sustainer controls the disease processes, whether personal or community. Perhaps the AIDS epidemic and its obvious dependence on human sin will help us to remember the role of Almighty God in the processes of speciation and mutations, whether in the "origin of species" — or in the origin of epidemics. Our God, who controls the heavens, the winds, and the seas, is certainly in control of climate changes (even man-induced!) *and* species variation. Our God, who inflicts war, famine, and pestilence on sinful humans, certainly controls the occurrence and behavior of bacteria, amebae, worms, and viruses. For both Natural Selection and Germ Theory we need to humbly remember God's sovereign rule as well as the limitations of human theories. ✣

NOTES

1 Duffy, John. 1966, *Sword of Pestilence: The New Orleans Yellow Fever Epidemic of 1853*, Baton Rouge, Louisiana State University Press, p. 153.
2 Lucretius. *On the Nature of Things*, Book VI, Section 8 "Plague and Disease."
3 Duffy, John. *op cit*. Also Rosenberg, Charles. 1962, *The Cholera Years: The United States in 1832, 1849 and 1866*, Chicago, University of Chicago Press.
4 Haggard, Howard. 1929, *Devils, Drugs, and Doctors*, Cardinal Giant paperback edition (1959), p. 258.
5 Howe, G Melvyn. 1977, *A World Geography of Human Diseases*, New York, Academic Press.
6 Sigerist, Henry E. 1943, *Civilization and Disease*, Chicago, University of Chicago Press, p. 3.
7 Livingstone, David. 1987, *Darwin's Forgotten Defenders*, Grand Rapids, Eerdmans.
8 Moore, James R. 1979, *The Post Darwinian Controversies*, Cambridge, Cambridge University Press.
9 Wilcox, David. 1986, "A Taxonomy of Creation", *Journal of the American Scientific Affiliation* 38:4, pp. 244-250.
10 Nelson, Craig. 1986, "Creation, Evolution, or Both", in: Hanson, Robert (ed), *Science and Creation*, New York, Macmillan.
11 Bullock, Wilbur L. 1969, "Morphological Features as Tools and as Pitfalls in Acanthocephalan Systematics", in Schmidt, Gerald D. (ed), *Problems in Systematics of Parasites*, pp. 9-45.
12 Rosenberg, Charles. *op cit*, p. 44.
13 Rosenberg, Charles. *op cit*, p. 42.
14 McNeill, William. 1976, *Plagues and People*, New York, Anchor Press/Doubleday, p. 121.
15 Haggard, Howard. 1959, *op cit*, p. 373.

Communication

The Many Faces of "Tribalism"

RICHARD H. BUBE

Dept. of Materials Science & Engineering
Stanford University
Stanford, CA 94305

The contents of this Communication do not claim to constitute some unheard of novelty in thinking about human interactions. Rather, this piece tries to call attention to a characteristic of human interactions that is well known, but is so structured and so ingrained in our cultural attitudes that, although it constitutes a major antithesis to Christian living, still Christians often continue to live as though it did not exist. Not only does it challenge Christian living in every day life, but it challenges the basic Christian conviction that all human beings share in a unity based on the Christian doctrines of Creation and Redemption.

Human society is saturated with conscious and unconscious attitudes that seek to represent the local group to which one belongs ("I and mine") as being superior in all matters, both practical and moral, to any other local group ("you and yours"). This superiority rests primarily on the recognition that others are different from me: "to differ from me is to be inferior to me." Although there may be some debate about the choice of a name for this attitude, I will follow common practice and refer to it as "tribalism." An alternative label that fits some of the cases might also be "ethnocentrism."

What makes this situation so complex is that in each case there is a right and proper understanding of loyalty to one's own group that takes precedence, at least in some ways, over loyalty to another group. There is, however, also an improper exaltation of one's own group at the expense of any other group, which constitutes what we here call tribalism. Such attitudes of tribalism form a complex hierarchy that dominates much, if not all, of life. They can be viewed as an extended manifestation of original sin and as a dominant cultural antithesis to Christianity. It is all the more inappropriate, therefore, when we as Christians appear to wholeheartedly support some, if not all, aspects of such tribalism.

In this Communication I give fourteen examples of human living with these two types of attitudes clearly defined.

1. *Self.* Each human being is born with an instinct for self-survival that is a proper aspect of our biological structure, and with the need for self-esteem that is a proper aspect of our personal identity. The Christian position takes for granted that it is right for us to love ourselves, and this self-love is taken in the second Great Commandment as the example for our love for others. The worth of the individual is confirmed by the great expression of God's love for us.

Tribalism, however, is not content with this expression of the worth of self, but seeks to establish *my* worth at the expense of the worth of all other selves. The individual acquires significance in his or her own eyes primarily because others are deprived of their rightful significance. The attitude is that, "I am worth something because I am better than others."

2. *Family.* Families are precious units of society and we are perhaps in danger today of not fully realizing and implementing the important role that the nuclear family plays in the raising of children and the support of one another. It is right and proper that members of a nuclear family should, at least usually, see their primary responsibility directed toward the welfare and needs of the members of their family.

Tribalism, however, is quick to appear in the form of rivalry and animosity between families. Other families differ from mine, and therefore they are inferior; they lack the morality and fundamental goodness that characterizes my family. My family is to be exalted; other families are to be denigrated.

3. *Extended Family.* We have to a considerable extent lost the benefits of an extended family, one

in which several generations and many relatives live in reasonably close proximity and share the happy as well as the sad times of life together.

But an extended family can also be the cultural basis for tribalism. Family feuds range from those that are oriented to name-calling and social insults, to those that develop into deep-seated hatred. Every occasion for the development of such extended family feuds is seized upon; no slight, no injury, no insult, real or imagined, is too small to be neglected in building up the superiority of one's own extended family.

4. *Tribe.* In many societies, the extended family is identified with a particular tribe. For the reasons given above, loyalty and participation in the life of a particular tribe with its cultural and social traditions is a proper and enriching experience.

But some of the worst feuds that exist in the world today occur between members of different tribes, in societies where loyalties have not extended appreciably beyond the level of tribe. Members of other tribes are hated both because of their differences and because of real or imagined injuries caused in the past. These injuries can never be forgotten. The honor of one's own tribe—the superior, righteous, honorable tribe—must at all costs be maintained and affronts to it must be avenged. Since the characteristics of my tribe are the standard for beauty, dignity, value and worth, any tribe with different characteristics (all other tribes) can only be denounced as ugly and worthless.

Indeed, this may be a more general condition than we are usually willing to admit. A tragic resurgence of tribalism is occurring as the restraining checks of totalitarian government break down. We need only look at Lebanon, the Middle East, South Africa, the Soviet Union, or many places in Asia and around the world.

5. *Race.* Again it is right and proper to trace one's "roots" as these may include racial, cultural and traditional backgrounds. But unfortunately racial characteristics are one of the most prevalent and tragic sources of often violent tribalism. Perhaps one practical reason for this is that one's race can usually be determined immediately simply by visual contact, and because skin color and facial characteristics form such an obvious source of difference between people. If one member of another race engages in undesirable behavior, it is easy to automatically assign the guilt for that behavior to every member of that racial group.

6. *Religion.* Different peoples in the world may well have legitimate and historically describable reasons for seeing God differently. As Christians we believe that insight into the nature of God and His purposes are revealed most clearly in Jesus Christ, whose life and death are furthermore an historical outworking of that purpose. In general it would appear that there is a place for people with a common religious commitment and heritage to relate together to help support and transmit that heritage.

But the all too frequent outgrowth of the separation of people into different religions (and "no religion" is one of these) is that each group tends to regard its own view as conveying an intrinsic superiority to those who hold it over all others. Religious tribalism can, as we know, lead to some of the most violent conflicts between peoples, each determined to uphold their own religion at the expense of all others (or at least to use that as a rallying call).

7. *Church.* What is right and proper about religions in general, as well as what the temptations of tribalism are, apply to individual Christian churches as well. The existence of separate Christian churches is a consequence of a whole stream of historical and cultural factors, which have nothing to do in many cases with the profession of the Christian position.

In view of the central Christian position on the unity of all believers in Christ, however, it is impossible to defend the rampant tribalism that characterizes so much of Christian history. One's own church is upheld as the only true Church, and members of all other Christian churches are viewed with an attitude of suspicion suitable for apostates or heretics, but not for brothers and sisters in Christ. Historically, the use of force or violence against them has often been justified as necessary to lead them to see the error of their ways.

8. *Neighborhood, City, or State.* Love of one's own politically or geographically defined regions, as well as of the people and places related to them, is a natural and healthy response. But absolutization of that love so that all other people and places must be regarded as inferior is another form of tribalism in action. In the United States, in particular, neighborhoods, cities and states do not demand high degrees of allegiance, bound together as they are at the national level. But the situation can change rather drastically if a particular neighborhood, city or state is identified with some other human activities, as described in the next sections, that give the context of tribalism specific significance.

9. *Ethnic Background.* It is right and good for people to remember the customs and culture of the people from whom they are descended, and it is healthy to share these ethnic delights cross-culturally so that people preserve their own ethnic specialties, while enjoying those of other ethnic backgrounds.

But since ethnic background includes preferences in clothes, social mores, language, food, art, and music, it is a great temptation to regard one's own ethnic preferences as the ideal, against which all other ethnic preferences should be measured and found wanting. All too often the desire to preserve the purity of one's own roots leads to the assignment of inferior status to the roots of others.

10. *Nation.* Patriotism, i.e., love for one's own country, is both good and desirable. As long as the members of a nation believe that theirs is "the best nation on earth," no harm results if they are thankful and determined to work hard to preserve the quality of life there while being also mindful of the needs and aspirations of other people in the world.

But the indiscriminate effort to advance the cause of one's own nation "right or wrong" is the kind of supreme claim of nationalistic tribalism that clashes head-on with the Christian view of all human beings as created in the image of God. When a people believe that because their nation *is* the best on earth, all other nations are inferior and less righteous, and when they believe that *therefore* any actions taken toward the rest of the world to preserve and expand the culture, the standard of living, or the political goals of that nation are totally justified as a sacred duty, tribalism in its most terrible forms is experienced. When national tribalism becomes coupled with racist tribalism and ethnic tribalism, we find that violence, war, and the destruction of human values is the inevitable consequence.

11. *Sports.* Participation in sports can be a very positive and healthy activity, and the enjoyment of sports by the spectator can be equally enjoyable and relaxing. Various qualities of character can be learned by doing one's best in a sports situation. Competition by itself can be a stimulant for improvement in performance.

But as a matter of fact, the practice of sports is one of the types of human activity that often evokes the spirit of tribalism, especially professional sports or sports for financial gain. How else can one explain the intense intercity rivalries that spring up and persist after a particular World Series or Super Bowl competition between their teams? And how else can one explain the frequent boiling over of team spirit among the sports fans and violence between those who are supporting opposing teams? One can tell whether or not sports is leading to tribalism by observing the relationship between the participants, and by seeing whether the winner is viewed as intrinsically superior and the loser as intrinsically inferior. One can judge the degree of tribalism in sports by how much a participant will be willing to do, how much of his ethical convictions he will be willing to overlook, and how totally devoted he is to winning.

As it is introduced to young people, built up in public relations, sold by coaches, and experienced by many people today, sports is a means of vicariously exalting oneself over others. "We are Number One" is the omnipresent cry at a championship game. At its worst, sports can prepare the way for the acceptance of tribalism in other aspects of life.

12. *Pursuit of "Excellence."* The universal pursuit of excellence (often known as "success") can be interpreted in two quite different ways. One sees "excellence" as being better than anyone else; it is the precursor to tribalism in interpersonal relationships. The other interpretation sees "excellence" as indicating the highest quality when judged by an appropriate standard; it is the Christian guideline rightly applied to all aspects of a person's life using the standard given by God.

13. *Education.* Competition between students, faculty, departments, and universities is often coupled with the desire to "be Number One," thus introducing into the educational area the mentality of the sports contest. When this is the driving force for increased excellence, as defined above, in all aspects of education, such competition has a positive result. But when the competition assumes the characteristics of tribalism, then once again the consequences are negative.

14. *Business.* Competition is the strength of American business, but it can also be the cause of forsaking a Christian lifestyle. When any activity is viewed exclusively as "us vs. them," "the good guys vs. the bad guys," it is all too easy to encounter the economic form of nationalism: "my company right or wrong," which leads to business tribalism. The psychological approach of many company managements does not differ appreciably from that of many sport coaches.

When we work constantly in a spirit of competition to advance and promote "our company," and play constantly in a spirit of competition to advance and promote "our team," is there any wonder that

these two mutually reinforce one another, and we become ready prey for a variety of other forms of tribalism in the rest of our lives? Is there any wonder that when we constantly use terms of warfare to describe business and sports activities — "fighting for the home team," "battling for the lead," "make a killing" — it is easy for us to slip out of the mode of considering these expressions as harmless metaphors into a real warfare mentality toward other people, the prime requisite of which is to regard them as inferior, more evil than we are, and deserving of destruction?

Summary

In the attitude of tribalism we regard ourselves as being superior to those who differ from us. They look differently from us, they speak differently from us, their roots do not come from the same place that our roots come from, they are not in our family, part of our tribe, a member of our race, a citizen of our nation, a member of our team, a part of our company, or a student or faculty at our university. They are different and therefore they are inferior to us—physically, mentally, and morally.

I have tried to show how universal this spirit of tribalism is, how it appears at every level of human society in a different but related guise, how it permeates our daily work as well as our daily play. We need to watch ourselves as we face the various issues in life and become aware of how often tribalism exerts its claims upon us.

May we see tribalism as the great antithesis of the Christian commitment, and discriminate carefully between loyalties that are proper and self-exaltation at the expense of others. May we recognize its forms as they impact our lives, and call upon the guidance of the Holy Spirit to enable us not to become entangled. ✣

The more important fundamental laws and facts of physical science
have all been discovered,
and these are now so firmly established that the possibility of their ever being supplanted
in consequence of new discoveries is exceedingly remote ...
Our future discoveries
must be looked for in the sixth place of decimals.

Albert Abraham Michelson, 1894

Essay Review

An I *Behind the Eye*: Donald MacKay's Gifford Lectures

W. R. THORSON

Department of Chemistry
University of Alberta
Edmonton, Canada T6G 2G2

Behind the Eye, *by Donald M. MacKay; edited by Valerie MacKay (based on the 1986 Gifford Lectures). Basil Blackwell Ltd., Oxford, UK; Cambridge, MA (1991). [288 pages; hardcover, $24.95.]*

Behind the Eye is based on Donald M. MacKay's Gifford Lectures, given October-November 1986 at Glasgow under the title "Under our own microscope: What brain science has to say about human nature." Donald MacKay died in February 1987: the book, taken from transcripts of the Gifford Lectures and augmented in a few places with other relevant material from the author, was edited posthumously at his request by his wife and frequent co-worker, Valerie MacKay. (Explanatory comments by the editor to clarify points in the text appear occasionally and are set off in italics.) While the enormous difficulties of posthumous publication have left occasional traces, in the end they are minor, and in such places careful reading nearly always makes the meaning plain.

As its title suggests, the theme of the book is the brain, its nature and relation to the functioning individual (seen primarily through extensive work done on the visual cortex and its relation to brain organization) — and the implications of such understanding for our view of human nature, the meaning of freedom and moral responsibility, the knowledge of God, and Christian belief in particular. Donald MacKay was a careful experimental worker in brain neurophysiology, physical psychology and theoretical problems of information processing and systems control related to the brain and observable conscious phenomena; his meticulously logical thinking is evident throughout this book. MacKay distinguishes scrupulously between the sort of understanding we can have of brain function as external observers of neurophysiological data ("the brain story") and the sort of understanding we have as possessors of minds and conscious experience ("the I-story") and he makes it clear that he believes firmly in the legitimacy and reality of both. Having begun with the recognition of the two distinct vantage points for our understanding, the exposition moves from a neurophysiological standpoint toward a presentation of many aspects of the experienced phenomenon of vision, illustrated by examples in the psychology of visual perception. Many of these are presented in Figures as visual experiments for the reader. Starting with a broad sketch of what is known about the connection between conscious mental activity and physiological observations (in the chapter entitled "Reading the Mind"), MacKay moves to a discussion of the fascinating higher level cerebral organization problems posed by the work of Sperry and others with persons in which the right/left brain connections have been impaired or severed (chapter: "The Divided Brain").

The author next moves toward the general philosophical questions raised by what we now know about the mind and its brain — concerns quite appropriate to the Gifford Lectures on "Natural Theology." He opens this broader discussion by considering the popular analogy of the brain to a computing machine, and examining both the analogy's perceived strengths and weaknesses from the vantage point of his own wide experience as a brain scientist. MacKay's early background as an expert in electronic analog computers, information

A biographical sketch of Donald M. MacKay may be found on page 55 of this issue.

processing mechanisms and their logic gives him some sympathy with this analogy, but he makes clear it is a critical one: indeed, as a foreword "about the author" states, his perception of differences rather than similarities between brain and computer initially stimulated his professional interest in neurophysiology.

In the final four chapters of the book, MacKay turns to the questions of freedom and responsibility in conscious, willing agents; the speculative problem of the nature and origin of thought and imagination; reflections on tacit vs. explicit knowledge and their possible bearing on the legitimacy of spiritual experience; and finally an open, personal account of his own thinking as to the meaning of being *embodied*, and its relation to the questions of life, death and a life hereafter. Those familiar with Donald MacKay's writings on topics bearing on science and Christian faith, or who heard him express these views in person, will recognize the familiar arguments which, even allowing a *materialist and physically determinist* account of the brain as scientific, set out the *principle of logical indeterminacy*, and then insist *on the logical as well as existential legitimacy of moral agency and responsibility*. These topics form the focus of the chapter "My Fault or My Brain's."

The chapter "Where Do Ideas Come From" introduces a later aspect of MacKay's thinking, emphasizing the fact that there is little positive evidence for a determinist view of the brain, and moving instead toward an emphasis on the role of "randomness" in brain processes and its possible relation to imagination and creative mental activity. In the chapter "Knowing More Than We Can Tell" he develops a view of tacit knowledge which he feels is compatible with current approaches to scientific understanding of the brain as a system with massively parallel connective architecture — and recognizes also the possibility that coherence in such processes lies at the base of our awareness of larger contexts of meaning, including the possibility of spiritual awareness. While he makes his own distinctive interpretation of these concepts, an appreciation of their relevance to a scientific understanding of conscious phenomena is a more recent development in MacKay's writing on philosophical themes.

In each of these last four chapters he moves toward a warmly personal apologetic for faith in a personal God revealed in Jesus Christ. As the author himself notes, the terms of the Gifford Lectures rule out reference to "miraculous revelation" as a source of theological truth, so MacKay's presentation of Christian convictions is put rather as a consistent and credible hypothesis to be examined seriously in the light of what has already been presented — and he does a splendid job of it. Knowing (as MacKay must have) that his own death was not far off gives a particular value and depth for any serious reader of the final chapter, "And in the End?"

While this reviewer has never fully shared MacKay's views on some of these philosophical matters (differing at least tentatively, if not absolutely on such issues as the legitimacy of the grounds he tries to provide for spiritual meaning and responsibility, or the elements of a somewhat positivist outlook in his philosophy of science), it must be stated most emphatically that in this book these views get a superb presentation in context — the context of the actual scientific knowledge with which Donald MacKay dealt continually and creatively as a brain scientist. Too often his philosophical views have been dealt with as mental abstractions by theologians or apologists, treated without any understanding of the milieu in which they were held, and then dismissed just as superficially or unfairly. It may be possible to get away with this if one sees them presented in isolation — for example, in short works like *The Clockwork Image* or his essays in *Christianity in a Mechanistic Universe*. As they are presented in *Behind the Eye*, however, one can begin to see the issues and problems with which MacKay was concerned, and can then recognize more fully the depth and content which must be addressed in stating a different view of things. (I do not pretend to be able to do this adequately!)

Secondly, this book, like the collection *The Open Mind and Other Essays* by MacKay (published in 1988 by InterVarsity Fellowship (UK)), shows the development of some new directions in MacKay's thinking about the complex phenomena of consciousness and the brain's physical processes, and a parallel understanding that some new categories of argument and scientific meaning are probably needed to discuss the problems involved. The principle of logical indeterminacy is only a first step of this kind. These shifts of emphasis were almost certainly provoked by the enormous escalation of knowledge about, or relevant to, the brain, and vision in particular, which has occurred since 1980, and to which MacKay himself made important contributions. He was always alert to the changing climate of scientific thinking and its implications for corresponding changes in a philosophical apologetic. *Behind the Eye* reflects these shifts in emphasis in MacKay's apologetics and should commend the book especially to those only familiar with his earlier writings. Overall, the short preface to the present work conveys a biblical wisdom and understanding of our condition as persons with minds and brains which sets

a tone maintained throughout the whole, culminating in his closing words in the final chapter — and which faithfully reflects Donald MacKay as the person many of us were privileged to know.

I should like now to make some broader comments on the value of this work as a contribution to understanding the problems of the brain and the associated metascientific and philosophical questions.

Someone has made the waggish observation "by their *Lives of Jesus* you will know them" — meaning that in reading a modern account of the life of Jesus we may learn more about the author's perspective on the world than we do about the person of Christ. This is a true statement for many such biographies and studies. Somewhat analogously, one may suggest that as we get deeper into the study of the Creator's handiwork, especially the study of our own nature and identity, there is again a similar tendency to tell more about our world view than we do about the thing we study. It is precisely on this account that this reviewer found reading *Behind the Eye* a most worthwhile and intellectually helpful experience. Within the past year I have also read a number of other works dealing at least peripherally with many of these same issues: Hans Moravec's *Mind Children*;[1] Roger Penrose's *The Emperor's New Mind*;[2] neurophysiologist Oliver Sachs' *The Man Who Mistook His Wife for a Hat*;[3] a variety of short speculative articles by contemporaries working on problems of artificial intelligence and its possible bearing on biological systems (too numerous and transient to cite here); and finally a most worthwhile technical review article by experimental psychologist Bela Julesz on "Early Vision and Focal Attention"[4] published in the July 1991 issue of *Reviews of Modern Physics*. This last is especially valuable for a wide citation of very recent work on vision, though mostly with the particular biases and concerns its author frankly acknowledges. Other readers will have their own background of recent reading on these subjects, especially with the tremendous spate of interest these days in "neural networks" and parallel organization as a basis for computer simulation of brain function or biological development and organization.

My eclectic citation is deliberate, because it portrays the confused state of modern thinking about the issues. Moravec's work in particular conveys the mirror image of his own heart rather than a faithful presentation of where we actually stand with "artificial intelligence", and for me at least is a chilling reminder that many of the clever people in modern laboratories are devoid of any true wisdom. (Penrose reviewed Moravec's book for the *New York Review of Books* last February, and his comments, which do not arise directly from any acknowledged spiritual base but simply from a more profound respect for the contingency of creation, make very good reading — he can see that Moravec's emperor has no clothes). On the other hand, Moravec's book raises interesting issues arising from the increasing complexity and speed of computing machines, and is worth reading for that reason.

In MacKay's book one finds a *balanced* appreciation — ready to use what is valid in the analogy with computers of any kind, but thoroughly honest and scrupulous about the problems involved. The development of parallel computing machines and neural networks has mostly occurred in the past decade, just at the end of MacKay's career; he obviously took note of these developments and their implications. One feels that if he were still alive, he would be in the thick of things developing today, but with the same critical judgment — a judgment sadly lacking in wide sectors of the AI community.

Mathematician and cosmologist Roger Penrose's *Emperor's New Mind* is fascinating reading, since it elegantly conveys the author's tacit understanding that the depth and complexity of an intelligible creation seem to have a correspondent puzzle in the depth and complexity of our own minds and their brains. Penrose devotes some space in his book to what is known about the neurophysiology and function of the brain, and one immediately recognizes in his response to those facts the harmony and compatibility with the views expressed in MacKay's more directly professional exposition. Both men are clearly dealing with a common appreciation of reality, even though their detailed concerns and beliefs about it may differ.

I mention Oliver Sachs' book, which gives fascinating accounts of clinical experience with higher-level neuro-physiological brain disorders or anomalies, not only because it is exceptionally well written but because it illustrates (on the "I-story" side, as MacKay would call it) some of the mysterious problems we are still very far from grasping at all in brain function — and is another powerful antidote to closed thinking about analogies with computers. In MacKay's accounts of interviews with some of Sperry's subjects there is an appreciation of the ultimate integrity of personhood similar to that which Sachs conveys more poetically, and again it shows the strong sense of balance in *Behind the Eye*.

Lastly, I cite Julesz' 1991 review article because it shows how very rapidly progress is being made on some aspects of the problem of vision, while

other apparently simple puzzles remain largely unsolved. Since I am not a professional in the field but only an interested layman, I have made no attempt to decide whether or not Julesz has given an accurate picture of what he calls "early vision" and focal attention; however, I found his article has the same cautious attitude about interpretation of physiological structure and its relation to psychological observations as is evident in MacKay's book, and therefore feel that readers who are stimulated by MacKay's presentation, and wish to pursue current developments in the problem of vision and brain function, will value the Julesz article as at least a good starting point for further study.

For me, the least convincing section in *Behind the Eye* was the chapter "Where do Ideas Come From?" In it MacKay appeals (somewhat speculatively, as he admits) to the notion that creative mental processes *might be* (from the viewpoint of physiology) the result of brain processes which are in some sense "random", though he is careful to point out that this "randomness" may or may not be fundamentally indeterminate at a physical level — we simply do not know. In this argument MacKay follows much of contemporary scientific fashion on the subject, and again he is thoroughly consistent here with his lifelong attitude toward scientific truth: if this is a valid scientific description of the origin of ideas, he is willing to embrace it. He also follows the fashionable line of thought in suggesting as well that this view is compatible with accounting for evolution as the combination of chance variation with natural selection. Just as in his earlier arguments about mechanistic determinism and the authenticity of personal existence, however, we should understand that this adoption of a tentative interpretation does not necessarily mean he is committed to this particular conclusion, and I believe a careful reading of his comments in the concluding chapter makes this plain.

However, most people who have disagreed with MacKay about such questions have done so in part because they felt no need to make such sweeping concessions to current scientific fashion; there are always other, more fundamental issues which may be ignored by doing so. For example, take the view expressed in this chapter that the phenomena of mind are fundamentally understandable on the scientific side as "random" in some vital respects. No matter how ably MacKay may then defend the moral authenticity of a creation with "random" as well as "determinate" or "orderly" elements put there at the sovereign will of the Author, such a view *does* impact our understanding of what science is about, and, in fact, assumes that we already have a sound notion of the presuppositions of science as an enterprise. It would follow from this general approach that the assertion of a *different meaning* to the events in question is forever separated cleanly from the problem of their *scientific* intelligibility, and this continues what many have critically called his "dualism." Yet MacKay himself recognized elsewhere in the book that the strictures of an earlier extreme and positivist behaviorism (which refused to accept the psychophysical phenomenon of vision as legitimate scientific data) actually hindered the discovery of important truths about the way the brain really works. Why, then, should we be too eager to accept the current dogmas of a scientific mentality which seeks to reduce all the world's phenomena to the laws of physics (and at the same time increasingly lacks an adequate respect for contingency as an overriding fact of creation)?

I am unconvinced of even the scientific merit of such a reductionist position. There are a great many significant and objective phenomena in the world, and if it is the goal of science to offer valid explanation for many of them, I see no essential need for a dogmatic belief that all of these things need even be scientifically intelligible as the result of "chance" plus physics. Such belief is essential to modern Darwinist religion, but I see no reason why it need be true (it has certainly not been established): I remain an agnostic on the matter. It seems to me that a real belief in the contingency of the created order, to which Donald MacKay ultimately subscribed, would allow us to remain open to the possibility that (for example) there may be perfectly valid scientific laws which account for the unfolding of life on this planet and which have no necessary connection to physics as such, even though they are compatible with it.

To deny that possibility at the outset may indeed be unhelpful, particularly when so much fruitful work on living things and their function today assumes operationally that they function and develop according to discoverable and orderly "programs." Our business now is a lower order one: it is to find out how the programs actually work — what their logical structure is. Only afterward are we going to be even in a beginning position to show how they might have come into being. I stress that this does *not* deny the possibility that everything is derived from the physics via the sort of "randomness" to which MacKay and others ascribe such creative potential; it's just that I see no reason to believe dogmatically that this is necessarily so in advance of a

real understanding. The fact is that we still know precious little about living things.

After this choice, the discussion of tacit knowledge given in the chapter "Knowing More Than We Can Tell" is, to a considerable extent, constrained by the author's assumptions. As a notorious fan of the ideas of the late Michael Polanyi, this reviewer is forced to disqualify himself from extended commentary — except to state that it is my opinion that MacKay misunderstood what Polanyi really meant at certain points (notably, the comments at the top of page 239 strongly suggest such a misreading to me.) On the other hand, whether or not one thinks that MacKay really "gets some of the steam pressure out of the idea," what I found most interesting in the chapter is the extent to which MacKay acknowledges the reality of the tacit as valid knowledge, indeed perhaps the only sort of knowledge we can have of some realities. He gives his own distinctive argument for the reasons why tacit knowledge is an important conception: he emphasizes the connection to parallelism in the organization of brain responses to a set of inputs, and the ability of such a system to recognize coherent patterns while ignoring irrelevant discordances. Indeed, he even goes on to suggest that awareness of spiritual realities must be more like tacit than like logically explicit knowledge. This line of development seems to be a more recent element in MacKay's philosophical thinking about scientific understanding, and will be welcome to many readers.

Throughout his book, MacKay emphasizes a distinction to be made between the notion of the brain's perceptual activity as entailing a *representation* of the external world mapped somewhere within, and the notion (which he prefers) of a conditional readiness to respond to the external world. At the most fundamental level, he makes his point: it is not the case (and cannot be, for reasons of informational economy and efficiency) that representation is the goal of brain processing of retinal signals. The same conclusion is evident in reading Julesz, and of course its justification lies in recognizing the role of extensive parallel connectivity in the brain's processes and the associated psychobiological phenomena.

I sense, however, that this persistent emphasis in the exposition may be intended by MacKay to convey some still deeper points about functioning living creatures, and the phenomena of conscious minds in particular. For example, MacKay returns to this point in the chapter on brains and machines; since computers also must be designed in terms of such conditional readiness to respond, he seems to argue that there may never be a *scientifically* intelligible basis for belief in the authenticity of mind and consciousness. Readers of the book will appreciate that while MacKay is not quite saying this, such perspectives may be another reason why he preferred his very particular kind of "dualism" to any attempt to bring "the I-story" and "the brain story" together illogically or prematurely. After two or more critical readings of many sections in *Behind the Eye*, I remain unsure what the author is really getting at in this general theme, and still more unwilling to accept some of the philosophical conclusions which he may feel it warrants. I expect to continue reading the book with this and related critical questions in mind.

I am convinced, however, that anyone who wishes to argue against what they consider to be an unacceptable dualism in MacKay's philosophical apologetic must ultimately understand and deal with the unresolved nexus in this conception and its centrality to his argument; any critique of MacKay's views cannot do less and be either fair or adequate. That undertaking will be no mean task. While I am inclined to feel that such a critique can be made in the long run, nobody should suppose that it can be a valid one without taking a thorough look at the intellectual and scientific questions which moved Donald MacKay to take the positions he did. Donald has given me and others the privilege of continuing the argument with him for some time to come as we read and think through *Behind the Eye*.

I confess that I did not always *enjoy* reading this book. I have the same reaction to some writers on physics or mathematics — a feeling that I am being argued into some wild conclusion or other against my better judgment. It tends to make me uneasy and put me on my guard, since I am by nature an intuitive, fuzzy sort of thinker. Nevertheless, MacKay's is an argument with warm-hearted integrity throughout, and as a scientist I have learned the benefit of sharpening wits with very different minds.

MacKay's *style* may not please one's esthetic taste, either; as his wife comments in her editorial note, he "always chose his words with precision." This shows his profound respect for the objectivity of scientific knowledge and a wish to convey neither less nor more than the sober truth as he understood it.[5] Some of us like a more heady style which stimulates the imagination, dangerous as we know it may be; but in the end we also need precision of thought and statement. Readers therefore should know that they are in for a serious challenge in this book; the pleasures it affords will be more like nutmeats than nectar.

Finally, I did not find that all the figures and examples of visual phenomena worked well. I could not, try as I would, experience some of the effects described, either because the procedure was not fully prescribed, or because at my age there is a focal length problem and difficulties result in achieving binocular vision or stereopsis for close objects without artificial aids. However, I had as much or more trouble with some of the figures and experiments in the article by Julesz from *Reviews of Modern Physics*. I conclude that there may be a general tendency of people in this field to be so familiar with the visual effects they describe that they neglect to tell those of us who have never experienced them the elementary points of technique involved — something like the amazing omissions by authors of computer manuals, though not so devastating in their results. More extended instructions in Figure captions for viewing what is meant to be viewed would greatly help the understanding. ✣

REFERENCES

[1] Hans Moravec, *Mind Children: The Future of Robot and Human Intelligence*. Harvard University Press, Cambridge, MA (1988).

[2] Roger Penrose, *The Emperor's New Mind: Concerning Computers, Minds and the Laws of Physics*. Oxford University Press, Oxford, UK (1989).

[3] Oliver Sachs, *The Man Who Mistook His Wife for a Hat, and Other Clinical Tales*. Originally published by Summit Books, Simon & Schuster (1970); published in paperback edition by Harper, New York, NY (1987).

[4] Bela Julesz, "Early Vision and Focal Attention," *Reviews of Modern Physics* 63, 735-772 (July 1991).

[5] MacKay could certainly write in a more pleasing style when he thought it appropriate — as is shown by a number of very relaxed and enjoyable essays in *The Open Mind and Other Essays* (Valerie MacKay, Ed.), InterVarsity Press, 38 De Montfort Street, Leicester, UK (1988).

Donald MacCrimmon MacKay (1922-1987): A View From the Other Side of the Atlantic

J. W. HAAS, JR.

Gordon College
Wenham, MA 01984

To a Scotsman the name MacKay brings to mind ancient battles defending a people against incursion from the south. To the American Scientific Affiliation (ASA) and scientist-Christians around the world, the name reminds us of one with a razor-sharp intellect who had both a passion for science and the Christian faith.

No evangelical in the post World War II period has influenced the discussion of science and Christianity in the English speaking world as much as this spare Scotsman from Lybster, Scotland. Donald M. MacKay first came to these shores in 1951 as a Rockefeller Fellow, visiting research departments in neurophysiology and related fields. He was to return often over the next three decades both in the practice of his profession and as an apologist for Christianity.

MacKay was born August 9, 1922, the son of Dr. Henry MacKay and Janet MacKay in a small town on the North Sea in the northern edge of Scotland. He attended nearby Whych High School and gained a B.Sc. at St. Andrews University in 1943. Upon graduation he joined a radar research group under the British Admiralty, serving until 1946. He then began a graduate program in physics at the University of London, gaining a Ph.D. in 1951. During that period and up until 1960 he held various academic posts at King's College. He then moved to a newly established research chair as Granada Research Professor of Communication at the University of Keele in Staffordshire, England to begin an interdisciplinary Department of Communication and Neuroscience. This visionary program sought to draw from the disciplines of physiology, experimental psychology, physics and computer science to elucidate the organization of the brain focusing on the information-processing mechanisms of vision, hearing and touch. He retired from this post in 1982, but actively continued research as emeritus professor in conjunction with his wife Valerie until his death in 1987.

Donald married Valerie Wood (one of his physics students) July 16, 1955. She continues to reside at the family home in Keele and (at last word) is still involved in research. Their five grown children, Robert (teaching mathematics at Warwick University), Eleanor, Janet, Margaret, and David (mathematics) are scattered about the world.

MacKay has noted that the roots of his professional direction came from his World War II radar research.

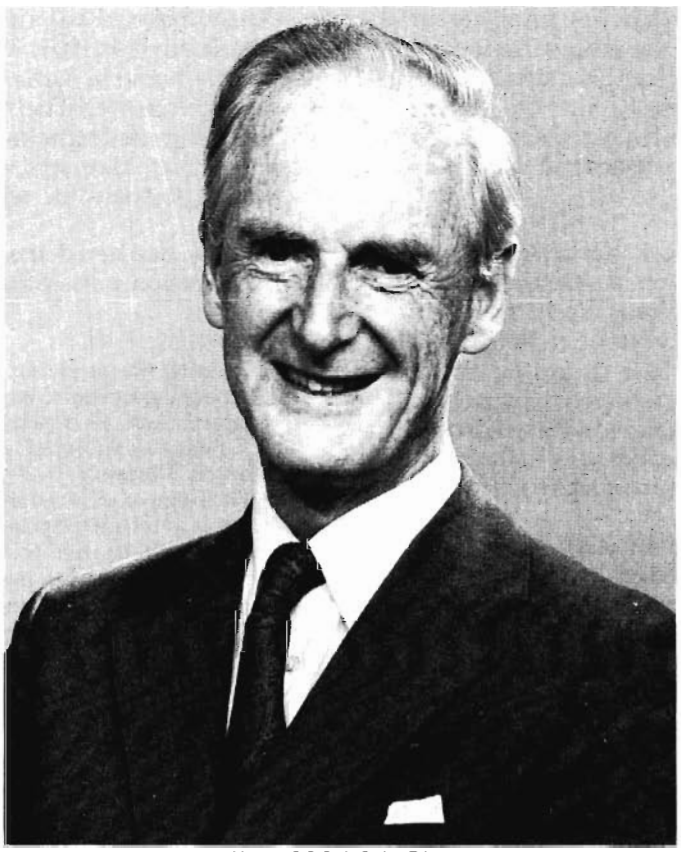
> ...during the war I had worked on the theory of automated electronic computing and on the theory of information, all of which are highly relevant to such things as automatic pilots and automatic gun direction. I found myself grappling with problems in the design of artificial sense organs for naval gun-directors and with the principles on which electronic circuits could be used to simulate situations in the external world so as to provide goal-directed guidance for ships, aircraft, missiles and the like.
>
> Later in the 1940s, when I was doing my Ph.D. work, there was much talk of the brain as a computer and of the early digital computers that were just making the headlines as "electronic brains." As an analogue computer man I felt strongly convinced that the brain, whatever it was, was not a digital computer. I didn't think it was an analogue computer either in the conventional sense.
>
> But this naturally rubbed under my skin the question: well, if it is not either of these, what kind of system is it? Is there any way of following through the kind of analysis that is appropriate to their artificial automata so as to understand better the kind of system the human brain is? That was the beginning of my slippery slope into brain research.[1]

MacKay's research program was thus established, and he would spend his life in brain research using

An Essay Review of Donald M. MacKay's Behind the Eye *may be found on page 49 of this issue.*

computer methods to gain insight into the mechanism of the brain and as a metaphor in looking at larger issues such as the brain/mind problem, free-will and determinism, and the role of God in nature. Even though bound up with the details of running a first rate research program, Donald felt drawn to examine the implications of his work for Christian thought and witness, writing and lecturing on a wide range of topics over the course of his career.

MacKay had the opportunity to participate in the Ratio Club founded at National Hospital in London in July 1949. A group of "Young Turks" (those of Professorial rank were excluded) from various disciplines met informally once a month over dinner to discuss cybernetics. Alan Turing attended the meetings and found them "good entertainment." He became entertainer with his talk "Educating a Digital Computer" in the December 1950 meeting. Turing would note the presence of "the philosophical physicist, D. MacKay ... also very interested in machine intelligence."[2] The group would die a natural death in the middle 1950s as they had less to say to each other.



Donald M. MacKay

Another formative influence on MacKay's thinking in this period came through an opportunity to meet Dutch historian of science Reijer Hooykaas. English evangelical Martyn Lloyd-Jones had heard Hooykaas in the Netherlands and invited him to London in 1948 to talk to the annual conference of the Research Scientists Christian Fellowship (RSCF, now Christians in Science). That meeting was an important step forward in the thinking of many of those present, including MacKay. Although Hooykaas held views on the subject which had resulted in a great deal of controversy with the Dooyeweerd school of thought, Lloyd-Jones felt that he had much to offer. MacKay was impressed with his thinking and later visited the Hooykaas family in Zeist. The two families became close friends over the next decades, and Hooykaas visited the MacKays at Keele and made the long trek to Northern Scotland to visit the MacKay family home. He would later dedicate his *Religion and the Rise of Modern Science* (1972) to Donald's mother, Janet MacKay.[3]

Hooykaas made a great impression on MacKay with his concern that science be "free," eschewing the notion of, say, a "Christian chemistry," which was associated with Dutch thinkers Abraham Kuyper and Herman Dooyeweerd.

MacKay credited Hooykaas as having "taught [him] to recognize the liberating implications of biblical faith [as distinct from rationalistic biblicism] for the freedom of science and for properly critical thinking."[4] MacKay often referred to Hooykaas' *Christian Faith & the Freedom of Science* (1957)[5] as advancing what *he* would claim. He would later author a paper entitled "Value Free Knowledge" which supported this view.[6]

Hooykaas' trenchant statements on "Mosaic science" and analysis of the post-reformation views on science and the Bible in *Christian Faith & The Freedom of Science* often paralleled the points that Bernard Ramm stressed to an American audience with his *The Christian View of Science and Scripture* (1954).[7]

MacKay became a leading thinker in the RSCF, whose conference he attended every year and at which he often spoke. He was also widely used as a lecturer on apologetics questions in British universities.

On To America

Donald (the name he preferred over Don) was often drawn to these shores through his involvement with the Neuroscience Research Program of MIT headed by Francis O. Schmidt. Schmidt pioneered

a trans-disciplinary approach to the study of the brain and behavior which would break down traditional disciplinary barriers existing in the sciences. Schmidt developed novel ways to bring together leaders in the field for cross-discipline tutoring, lectures on emerging topics, and for brainstorming sessions which led to a worldwide network which would promote the field.

Schmidt recalls in his autobiography:

> At Stated Meetings the air was usually charged with intellectual excitement. This was the atmosphere in which much "inter thinking" occurred. There was much highly informed input from experts in different fields, which catalyzed the synthesis of new concepts. This was the very essence of the NRP concept and the reason why so many world-class scientists were willing to travel long distances and devote much of their time to attendance at Stated Meetings and at two- to four-week long Intensive Study Programs.[8]

Donald was elected as an Associate in the middle 1960s and was deeply involved over the next two decades. He was the host and organizer of what were called "Whither" meetings at Keele in the middle 1960s and in London in 1970.[9] Schmidt recalls the many contributions of MacKay to the various meetings and conferences and the high regard in which he was held by his fellow participants.

Schmidt recalls Donald's willingness to communicate his thoughts on religious matters in after--dinner informal talks, gaining the respect of his colleagues, even though they may not have agreed with him. Schmidt would pick up MacKay at his hotel on occasion to attend his Congregational Church in Weston and then bring him home for dinner and conversation on theological and other matters.

MacKay and American Evangelicals

Americans first became acquainted with MacKay through a Conference on Science and Christian Faith held in Oxford, England July 17-26, 1965 involving 37 scientists from 12 nations.[10] Curiously, the five reports on the meeting by ASA participants in the March, 1966 *Journal of the ASA* barely referred to MacKay. Instead, the account of the meeting by (then) Australian psychologist Malcolm Jeeves in his book, *The Scientific Enterprise and Christian Faith* (1969), provided the first full statement of MacKay's ideas broadly available in America.[11]

MacKay was to receive many invitations to speak on science/religion topics to student groups in secular settings and Christian colleges and seminaries. He participated in many ASA/CSCF functions over the years and was the plenary speaker for the 1976 ASA Annual Meeting at Wheaton College and the ASA/RSCF Conference at Oxford in 1985. The ASA awarded him an honorary membership in 1977 in recognition of his achievements. MacKay became an evangelical folk hero for his performance in a debate on behaviorism with B. F. Skinner on Wm. Buckley's PBS *Firing Line* program, October 17, 1971. His *Clockwork Image* (1974), *Science, Chance and Providence* (1978), *Brains, Machines & Persons* (1980), and *Science and the Quest For Meaning* (1982) provided expositions of his ideas on a popular level. His *Behind the Eye* (1991) stems from his Gifford Lectures at the University of Glasgow, October 27-November 11, 1986, given under the title "Under our own microscope: What brain science has to say about human nature."

The Canadian complement of ASA also benefited from MacKay's transatlantic travels to former colonies. Dan Morrison remembers a late 1970s meeting of the Canadian Scientific and Christian Fellowship at his farm with MacKay as featured speaker.

> It was a picnic and people came with their lunches, children, dogs and so on. It was a really lovely fall day and we were in the process of harvesting barley. Don began his lecture on the lawn, with people sitting in the shade of the trees, but very suddenly clouds came over and it began to rain. Fortunately, we have a very large barn with a very extensive loft, or mow, with what is called a double driveway. We simply picked our chairs up and scurried to the barn where some sat on bales and others on the chairs that they brought, and Don continued his lecture. He remarked that it was the first time that he had given a lecture in a barn.[12]

Morrison recounts an earlier visit with his wife to the MacKay home in England.

> He took us to the University to show us some of his laboratory equipment and to explain a bit more about his work. One of the areas he was studying had to do with the brain's reaction to sound and for that he had a soundproof chamber. He asked me in the presence of my wife, if I had ever experienced a perfect quiet. I responded that had not been the case since I was married! He then invited me to step into the chamber and close the door and, for the first time before or after marriage, I experienced a feeling of absolute quiet.[12]

It would be interesting (but beyond the scope of this essay) to examine the roots of MacKay's think-

ing. Donald was not a lone wolf and hammered his ideas out in discussions with colleagues and friends such as J. B. Lloyd and J. M. Forrester and his wife, Valerie. In *Science, Chance, and Providence*[13] he remarks that he could hardly add to what his old friend Charles Coulson, (1910-1974) had said in his *Christianity in an Age of Science*.[14] Those gracious words do not undercut the fact that MacKay made original contributions to apologetic thought that continue to influence this generation.

Some Personal Reflections

MacKay presented the second in a series of Pascal Lectures on Christianity at the University of Waterloo, Canada in October, 1979. Host John S. North wrote the introduction to *Science and the Quest For Meaning*, the printed version of the lectures. In it he paints this picture.

> I have dined with his family in their home on the outskirts of Keele, joining him, his wife Valerie, and their five children, as they considered the scriptures and prayed for each other at the end of a busy day. I have also watched him, under the stress of travel, lecture in an unfamiliar environment to a large, unfamiliar group, and maintain an attitude both gentle and tenacious in the discussions, however ill-informed or ill-mannered the questioner. These two experiences provided the comforting reassurance that this intellectual is a person of warmth, strength, consistency, and wholeness.[15]

Richard Bube recently summed up his view of MacKay.

> I must confess that his assessment of the interaction between science and Christianity was so compelling for me that I cannot tell whether I ever had a truly creative idea in this area that did not have its root in the ideas expressed in one way or another by MacKay. In person [he] was polite, genteel and friendly; yet at the same time he demanded a degree of logical consistency and precision in analysis and expression that marked his comments and reactions.
>
> With deeply held convictions, MacKay was sometimes outspoken and consistently uncompromising on his perspective of the relationship between authentic science and an unyielding faith in the truth of life in Christ. His determined challenging of the popular notion that a completely deterministic description of the brain would, if possible, do away with the concept of personal responsible choice, received wide publication and equally wide challenges.
>
> His development of the idea of complementary descriptions, each valid in its own domain, and each contributing true insights into the nature of reality, continues to be a source for guidance and inspiration for many, as well as a focus for debate and questioning. As long as he could get people to think faithfully and intelligently about these issues, I think MacKay would be happy.[16]

MacKay demanded much from the listener and was not unwilling to correct those who misunderstood him, or cross swords with those who would criticize his thinking. He was willing to stand with those with whom he agreed and loyally defended his friends.

In his ASA paper summing up the Oxford ASA/RSCF joint meeting in 1985, MacKay interjected a personal observation on the "camaraderie of Christian fellowship." Concerned with the ways that Christian scholars dealt with "possible cracks, chinks and damage in one another's armor," he asked us to "deliberately [seek] to develop less abrasive, more constructive ways of helping one another to get our thinking clear and our arguments solid, by gently shaking them." For MacKay "scrupulous fairness is not an optional extra for the Christian, still less an apologetic liability, however dramatic and rewarding may be the short-term payoffs of unfairness on the part of Christian propagandists." He challenged us "to be good, careful thinkers in the sight of God ... who is disgraced if we are sloppy in our logical standards, whether of biblical inference and interpretation or of scientific inference and interpretation." He called us to follow this course "as the pathway to truly realistic fellowship of the kind that I pray that RSCF [now C*i*S] and ASA will go on providing for generations to come."[17]

Perhaps the most significant measure of one's contribution is found in the extent that one's ideas influence the discussion of one's day and beyond. A reading of broad evangelical works on science/Christianity themes over the last 15 years reveals the many contributions that Donald MacKay has made to our thinking. We may disagree at particular points, but his ideas must be carefully weighed. The more liberal wing of Christendom is less accepting of his thinking, but finds him one evangelical that they must take seriously. At this writing, MacKay's ideas are the subject of vigorous discussion in recent issues of *Zygon*, *Science and Christian Belief*, and *Perspectives on Science and Christian Faith*.

A Final Visit

Donald's last visit to America took place in September 1986. Aware of the gravity of the cancer that he fought so hard he came a last time to fulfill a

few long term speaking commitments and meet some old friends. He was granted an honorary degree by Gordon College on September 19 and gave his final talk to an American audience that evening at Harvard Medical School. ✣

Acknowledgements

This sketch will seem deficient in content for many readers. A combination of Scottish reticence, suspicion of American biographical style and distance have provided severe limitations. Donald was unwilling to open his personal life to the scrutiny of a biographer, asking instead that it be his ideas that we examine. When reminded that he was a model for many in the UK and America he would smile and shake his head. A much more thorough examination of MacKay's life and thought is needed if we are to understand the discussion of science and faith in our generation.

I wish to thank the following for their help in developing this article: Dan Osmond, Oliver Barclay, Reiker Hooykaas, Francis O. Schmidt, and Richard Bube.

A SELECTIVE CHRONOLOGICAL BIBLIOGRAPHY

The Application of Electronic Principles to the Solution of Differential Equations in Physics, Ph.D. Thesis, University of London, 1951.

"Mindlike Behaviour in Artifacts." *British Journal of Philosophy of Science* 2: 105-21 (1951).

"Mentality in Machines." *Proc. Aristot. Soc. Supplement XXVI* (1952) 61-68.

"From Mechanism to Mind." *Transactions of the Victoria Institute* 85 (1953) 17-32.

"Operational Aspects of Some Fundamental Concepts of Communication." *Synthese* 9 (1954) 182-198.

"Man as Observer-Predictor." In *Man in his Relationships*, H. Westman, ed., (London: Routledge & Kegan Paul, 1955) 15-28.

"Towards an Information-Flow Model of Human Behaviour." *British "Journal of Psychology* 47 (1956) 30-43.

"The Epistemological Problem for Automata." In *Automata Studies*, C. E. Shannon and J. McCarthy, eds., (Princeton University Press, 1956) 235-251.

"Complementary Descriptions." *Mind 66* (1957) 390-94.

"On Comparing the Brain with Machines." *The American Scientist* 42 (1957) 261-268.

"Complementarity II." *Aristotelian Society Supplement* 32 (1958) 105-122.

"Perceptual stability of a stroboscopically lit visual field containing self-luminous objects." *Nature* 181 (1958) 507-8.

"Operational aspects of intellect." In *The Mechanization of Thought Processes* (NPL Symp. no 10, 1958), (London: HMSO, 1958) 37-73.

"Information Theory and Human Learning Systems." *Impact of Science on Society* 8 (1960) 86-101.

"On the Logical Indeterminacy of a Free Choice." *Mind* 69 (1960) 31-40.

"Modelling of large-scale nervous activity." In *Models and Analogues for Biology*, J. W. Beament ed. Symposium of the Society of Experimental Biology, 14, (London: Cambridge University Press, 1960) 192-8.

"Information and Learning." In *Learning Automata*, H. Billing ed., (Munich: Oldenbourg, 1961) 40-49.

The Use of Behavioural Language to Refer to Mechanical Processes." *British Journal of Philosophy of Science* 13 (1962) 89-102.

D. M. MacKay and M. E. Fisher, *Analogue Computing at Ultra-High Speed: An Experimental and Theoretical Study*, (London: Chapman & Hall, 1962)

"Theoretical models of space perception." In *Aspects of the Theory of Artificial Intelligence*, C. A. Muses ed., (New York: Plenum Press, 1962).

"Machines and Societies." In *Man and His Future*, G. Wolstenholme ed., (London: Churchill, 1963) 83-103.

"Psychophysics of perceived intensity: a theoretical basis for Fechner's and Steven's laws." *Science* 139 (1963) 1213-16.

"Information and prediction in science." In *Symp. of the Int. Acad. for Phil. of Sci.*, 1962, S. Dockz and P. Brtnays, eds.(New York: Academic Press, 1965) 255-69.

"Man as a mechanism." In *Christianity in a Mechanistic Universe*, D. M. MacKay, ed., (London: InterVarsity Press, 1965).

"From mechanism to mind." In *Brain and Mind* J. R. Smythies, ed., (London: Routledge and Kegan Paul, 1965) pp. 163-200.

"A mind's eye view of the brain." In *Cybernetics of the Nervous System*, N. Wiener and J. P. Schade eds., Progress in Brain Research 17, (New York: Elsevier, 1965) 321-332.

"Visual noise as a tool of research." *Journal of General Psychology* 72 (1965) 181-97.

Cerebral Organization and the Conscious Control of Action." In *Brain and Conscious Experience*, J. C. Eccles, ed., (New York: Springer-Verlag, 1966) 422-455.

Freedom of Action in a Mechanistic Universe, (Cambridge: Cambridge University Press, 1967)

"The mechanism of normative behaviour." In *Communication Theory and Research*, L. Thayer ed., (Springfield, IL: Charles C. Thomas, 1967) 228-45.

Possible information processing functions of inhibitory mechanisms." In *Structure and Functions of Neuronal Mechanisms: Proceedings of the Fourth International Meeting of Neurobiologists*, Stockholm, Sept. 1966 (Oxford and New York: Pergamon, 1968).

"The Sovereignty of God in the Natural World." *Scottish Journal of Theology* 21 (1968) 13-26.

"The importance of landmarks in visual perception." In *Neural Networks* E. R. Caianiello ed., (Berlin: Springer-Verlag, 1968) 59-64.

"What Makes a Contradiction?" *Faith and Thought*, 97 (1968) 7-14.

"Information Technology and the Manipulability of Man." *Encounter*, 5, 1, (1969) 17-25.

"Information, Mechanism & Meaning." In *Selected Papers, Vol. I*, (Cambridge: MIT Press, 1969).

"Digits and analogues." In *Principles and Practice of Bionics*, H. E. von Gierke, W. D. Keidel, and H. L. Oestreicher ed., (London: Technivision, 1970) 457-66.

"Choice in a mechanistic universe." *British Journal of the Philosophy of Science* 22 (1971) 275-285.

"Scientific beliefs about oneself." In *The Proper Study*, G. N. A. Vesey, ed., (London: Macmillan, 1971) 48-63.

"The human touch." In *Pattern Recognition in Biological and Technical Systems*, O. J. Grusser and R. Klinke, eds., (New York: Springer, 1971) 20-30.

"Formal analysis of communicative processes." In *Non-Verbal Communication*, (London: Cambridge University Press, 1972).

"The Logical Indeterminateness of Human Choices." *British Journal of Philosophy of Science*, 24 (1973) 405-408.

Science and Christian Faith Today, (London: Falcon Press, 2nd ed., 1973).

"Neurophysiological aspects of vision." In *From Theoretical Physics to Biology*, (Basil: S. Karger, 1973) 322-27.

"Visual stability and voluntary eye movements." In *The Handbook on Sensory Physiology*, Vol VII/3A., (Berlin: Springer-Verlag, 1973) 307-31.

The Clockwork Image, (Downers Grove IL:InterVarsity Press, 1974).

"Complementarity in Scientific and Theological Thinking." *Zygon* 9 (1974) 225-244.
"The Mechanics of Tacit Knowing." In *I.E.E.E. Transactions on Systems, Man and Cybernetics*, SMC-4, 1974 (no. 1) 94-95.
P. Hammond and D. M. MacKay, Differential responses of cat visual cortical cells to textured stimuli." *Experimental Brain Research*, 22 (1975) 427-30.
D. M. MacKay and V. MacKay, What causes decay of pattern-contingent chromatic after effects?" *Vision Research* 15 (1975) 462-4.
"Human Engineering and the Church." *J. Am. Sci. Affil.* 28 (1976) 62-65.
P. Hammond and D. M. MacKay, "Functional differences between cat visual cortical cells revealed by use of textured stimuli." *Experimental Brain Research*, Suppl. 1, 22 (1976) 397-402.
"The Clockwork Image Controversy." *J. Am. Sci. Affil.* 28 (1976) 125-127.
"Differential responsiveness of simple and complex cortical cells in cat striate cortex to visual texture." *Experimental Brain Research* 30 (1977) 275-96.
"What Determines My Choice?" In *Cerebral Correlates of Conscious Experience*, P. A. Buser and A. Rougeul-Buser eds., (Amsterdam: Elsevier, 1978) 335-46.
Science, Chance and Providence, (Oxford: Oxford University Press, 1978).
"Selves and Brains." *Neuroscience* 3 (1978) 599-606.
"Biblical Perspectives on Human Engineering In Modifying Man: Implications and Ethics, *Craig W. Ellison ed., (University Press of America: Washington, 1978) 67-90.*
Human Science and Human Dignity, (London: Hodder & Stoughton, 1979).
"The mind-body problem, information theory and Christian dogma. Reply to M. Bunge." *Neuroscience* 4 (1979) 453-4.
Brains, Machines and Persons, (Grand Rapids: Eerdmans, 1980)
"Value Free Knowledge." *Faith and Thought* 107 (1980) 202-209.
"Conscious Agency With Unsplit and Split Brains." In *Consciousness and the Physical World*, B. D. Josephson and V. S. Ramachandran eds., (Oxford: Pergamon, 1980) 95-113.
"Neural Basis of Cognitive Experience." In *Handbook of Cognitive Neuroscience*, G. Szekely, F. Labos, and S. Damjanovich eds., (New York: Pergamon: Budapest, 1981) 315-32.
"What kind of neural image?" *Freiburger Universitatsblatter* 74 (1981) 67-72.
Science and the Quest For Meaning, (Grand Rapids MI: Eerdmans, 1982)
D. M MacKay and V. MacKay, "Explicit Dialogue Between the Left and Right Hand Systems of Split Brains." *Nature* 295 (1982) 690-91.
"Ourselves and our brains: duality without Dualism." *Psychendochrinology* 7 (1982) 285-94.
"Anomalous perception of extra foveal motion." *Perception* 11 (1982) pp. 359-60.
"Seeing the Woods and the Trees." In *Thinking: The Expanding Frontier* W. Maxwell ed.,(Philadelphia: Franklin Institute Press, 1983) 5-12.
"On line source density computation with a minimum of electrodes." *Electroencephalography and Clinical Neurophysiology* 56 (1984) 696-8.
"Mind Talk and Brain Talk." **In** *Handbook of Cognitive Neuroscience*," M. S. Grazzanga ed., (New York: Plenum, 1984) 293-317.
"Source-density mapping of human visual receptive fields using scalp electrodes." *Experimental Brain Research* 54 (1984) 579-581.
"The Beginnings of Personal Life." *Journal of the Christian Medical Fellowship* 30:2, April 1984. 9-13.
D. M. MacKay, V. MacKay and M. J. Rulan, "Scalp topography of EPR source-densities during visually guided target practice." *Experimental Brain Research* 64 (1984) 434-50.
"Objectivity in Christian Perspective." *J. Am. Sci. Affil.*, 36 (1984) 235-237.
"The significance of 'feature sensitivity'." In *Models of the Visual Cortex*, D. Rose and V. G. Dobson eds., (New York: John Wiley and Sons, 1985) 47-53.
"Machines, Brains and Persons." *Zygon* 20 (1985) 401-12.
"Christian Priorities in Science." *J. Am. Sci. Affil.* 38 (1986) 67-74.
"Summing Up of ASA/RSCF Conference." *Ibid.* 195-203.
"The Health of the Evangelical Body." *Ibid.* 258-265.
"Seeing with moving eyes." In *The Oxford Companion to the Mind*, R. L. Gregory ed., (Oxford:Oxford University Press, 1987).
The Open Mind and Other Essays (Valerie MacKay, Ed.), InterVarsity Press, 38 De Montfort Street, Leicester, UK (1988).
Behind the Eye, (Oxford: Blackwell, 1991).

NOTES

[1]D. M. MacKay, *Behind the Eye*, (Oxford: Blackwell, 1991) 40.
[2]Andrew Hodge, Alan Turing, *The Enigma*, (New York: Simon and Schuster, 1983) 411.
[3]R. Hooykaas, *Religion and the Rise of Modern Science*, Grand Rapids: Eerdmans, 1972.
[4]D. M. MacKay, *The Clockwork Image*, (Downers Grove: InterVarsity Press, 1974) 10.
[5]R. Hooykaas, *Christian Faith & the Freedom of Science*, (London: Tyndale Press, 1957).
[6]Donald M. MacKay, "Value free knowledge - myth or norm?" *Faith and Thought*, 107 (1980) 202-209.
[7]Bernard Ramm, *The Christian View of Science and Scripture*, (Grand Rapids: Eerdmans, 1954).
[8]Francis O. Schmidt, *The Never-Ceasing Search*, (Philadelphia: American Philosophical Society, 1990) 223-4. Schmidt's biography provides a detailed history of the NRP and of his own perspectives on science and Christianity.
[9]Ibid., p. 242.
[10]James O. Buswell III, David O. Moberg, J. Frank Cassel and Walter R. Hearn, "Reports on the sessions of the international conference on science and Christian faith, Oxford, England July 22, 1966," *J. Am. Sci. Affil.* 18 (1965) 19-28.
[11]Malcolm Jeeves, *The Scientific Enterprise and Christian Faith*, (London: Tyndale Press, 1969).
[12]Personal communication, Dan Morrison to J.W. Haas, Jr.
[13]D. M. MacKay, *Science, Chance and Providence*, (Oxford: Oxford University Press, 1978) 3.
[14]C. A. Coulson, *Science and Christian Belief*, (Chapel Hill: University of North Carolina Press, 1955).
[15]John S. North in D. M. MacKay, *Science and the Quest For Meaning*, (Grand Rapids: Eerdmans, 1982) xi.
[16]Personal communication, Richard Bube to J.W. Haas, Jr.
[17]D. M. MacKay, "Summing Up of the ASA/RSCF Conference," *J. Am. Sci. Affil.* 38 (1986) 195-203.

Book Reviews

HIDDEN THREADS: Social Thought for Christians by Russell Heddendorf. Dallas: Word Publishing (Probe Books), 1990, 277 pages, index. Paperback; $14.99.

The author of this work is past-president of the ASA and professor of sociology at Covenant College. Heddendorf's aim is to share the excitement he feels when he discovers a convergence between "the objective truth God has provided in created social reality," which he claims is discernible through a careful understanding of scripture, and "the subjective interpretation of this reality" offered by social theorists "in their attempts to reconstruct that reality in society" (p. 251). The "hidden threads," then, are conceptual frameworks or interpretative theories which can help to meaningfully tie together and hold in tension the claims of theology with the best insights available from the competing perspectives of social science.

Seven major chapters of this work offer the reader a clear presentation and "Christian critique" of as many social theories: functionalism, conflict theory, social action theory, exchange theory, symbolic interactionism, phenomenology and ethnomethodology, and the sociology of knowledge. Following Thomas Kuhn, Heddendorf treats these interpretative paradigms as determined as much by "shared beliefs" and values ("faith" and ideology) as by objective examination of social structures and functions. Because of the present pluralistic state of social theory the author keeps these perspectives in tension while seeking the valid insights each provides into the complex character of social reality. His historical review and evaluation of these twentieth century positions should be helpful to any reader interested in understanding and working for change in the institutional structures of modern society.

The author is to be admired for being up front with his theological commitment while carrying forward his professional responsibilities as a sociologist. The task is complicated and challenging, as he would be the first to admit. There are "hidden threads" to be drawn from the Bible and from the social sciences, and it is no mean task to see how these both may point to the kind of society God intended. Here are a few hints as to Heddendorf's approach.

1) He suggests that since all humans are part of God's creational reality, the biblical moral principles (rules) have an "innate quality." They are present to the human conscience even though individuals in their sinfulness may reject those moral standards or have a confused understanding of them (pp. 93-4). The resulting institutionalized practices of injustice which constitute present social reality become the focus of study by conflict theory, social action theory and exchange theory (Chapters 6-8), though they themselves can offer no real solution. Heddendorf finds a "more powerful tool" in symbolic interactionism (Chapter 9) — especially when we include the symbols of faith centering in "God in Christ reconciling the world unto himself" and creating a reconciling people at work in society (pp. 184-9).

2) Like the prominent Christian sociologists, Jacques Ellul and Peter Berger (pp. 236-247), Heddendorf encourages his readers to keep two factors in "dialectical tension" (p. 192): (a) the importance of being a dynamic community of people with a history, heritage, commission and hope, and (b) actually reckoning with the social and physical realities, the forces of darkness as well as of light in this present world. For the Christian, this includes taking one's stand both "within" and "outside" the church — the latter to provide a necessary critique of conformity, superficial thinking and divisions in the light of Christ, who is head of the church and the proclaimer of the new Kingdom (pp. 221-2).

This volume not only offers probing *Social Thought for Christians* — it should be read as issuing a renewed call to intelligent and concerned evangelical social action.

Reviewed by William W. Paul, Professor emeritus, Central College, Pella, IA 50219.

THE ORIGIN OF SPECIES REVISITED I by W. R. Bird. New York, NY: Philosophical Library, 1989. 551 pages, subject and author indexes. Hardcover.

Bird is a graduate of Yale Law School and former editor of the *Yale Law Journal*. He has been active with the "scientific creationists" since his major articles on freedom of religion and science instruction in schools were published in the 1978 *Yale Law Journal* and the 1979 *Harvard Journal of Law and Public Policy*.

The Origin of Species Revisited I is the first of a 2-volume work on the conflict between evolution and ("scientific") creation, which Bird includes within the broader Theories of Abrupt Appearance. The book has two prefaces: the first by Gareth Nelson, a leader in Transformed Cladistics, (a nonevolutionary and antievolutionary approach to classification); and the second by Dean H. Kenyon, an evolutionist turned creationist. Extensive (over 2600) references to short quotes and notes make up about 145 pages of end-of-chapter notes.

This book has eight chapters with many clearly defined subsections and frequent summaries. Bird defines the theories of abrupt appearance and evolution, and discusses their religious meanings in part I. Under the broad heading

"Whether the theories of abrupt appearance and evolution are scientific," he then presents the main positive arguments for the theory of abrupt appearance (essentially "creation science") and the major criticisms of evolution concerning the appearance of living organisms (part II), the origin of life (part III), and the origin of the universe (part IV). The last chapter is a summary of the preceding 474 pages.

Bird addresses origins by comparing two families of theories: The Theory of Abrupt Appearance and the Theory of Evolution. The Theory of Abrupt Appearance includes more than "Scientific Creationism," which is found in the subcategory of theories of creation (nomothetic or miraculous. The theory of discontinuity (natural group systematics, typology, etc.), theory of abrupt appearance, theories of panspermia and directed panspermia, and theories of nontheistic forces (vitalism, creative intelligence, great origins thesis, etc.) are also included. His Theory of Evolution includes theories of Darwinian (and neo-Darwinian) evolution, theories on non-Darwinian evolution (saltations, macromutations, structuralism, some transformed cladists, neo-Lamarkian, etc.), and theories of theistic evolution. Origins are discussed on the cosmic, biochemical, and biological levels.

Bird tries to distance himself from some mistakes of previous "Scientific Creationist" writings by stating, "These lines of evidence are affirmative in the sense that, if true, they support the theory of abrupt appearance. They are not negative in the sense of merely identifying weaknesses of evolution," and presenting evidence "...in the words of evolutionists with the data that they recognize, rather than by reliance on any creationist scientists." Asterisks after the names of most evolutionists cited in the text are explained by this footnote at the beginning of each chapter: "Scientists cited in this book, unless otherwise indicated, are not proponents of, and their quoted statements are not intended as endorsements of, either the theory of abrupt appearance or the theory of creation. However, their quoted statements are acknowledging data that some nonevolutionary scientists interpret as supporting the theory of abrupt appearance better than the theory of evolution or as undermining the theory of evolution or significant aspects."

Despite the disclaimers, most of the book is still primarily a discourse on the weakness of neo-Darwinian evolution, and the strengths of the scientific theory of abrupt appearance, Bird's term for "scientific creation" or "creation," which he uses infrequently. A broad background in systematics is recommended for the understanding of the other theories which are given relatively brief mention. Many of the numerous short quotes and citations of references (830 in the 159-page chapter on Biological Evolution (Macroevolution) of Living Organisms) are repeated several times throughout the book. If some of the frequent repetition of the same strengths of abrupt appearance and weaknesses of evolution could be replaced by more discussion of the other theories, which were only briefly mentioned, this would be a fantastic reference book on origins in general.

The Origins of the Species Revisited I has a broader perspective, clearer definitions, and more balance than other "Scientific Creationist" books. It is probably the most extensive source of evolutionist criticism of Darwinian and neo-Darwinian macroevolutionary theory in print. The frequent summaries, systematic organization, and appropriate use of the terms microevolution and macroevolution help clarity and readability.

This book is recommended for scientifically literate persons who want a well documented defense of young-earth creation in more precise language and a broader context than usual for this interpretation of creation.

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

THE CHURCH AND CONTEMPORARY COSMOLOGY by James B. Miller and Kenneth E. McCall (eds.). Pittsburgh, PA: Carnegie Mellon University Press, 1990. 400 pages. Paperback.

In 1983 the General Assembly of the Presbyterian Church, USA, formed the Task Force on Theology and Cosmology. It was charged to develop a process to initiate a study of cosmology in the Bible and in traditional church formulations; changes in cosmology as a result of modern science; the theological significance of contemporary concepts for traditional theological affirmation.

Papers by nineteen scholars were initially presented at a consultation of Presbyterians representing a variety of constituencies: scientists, engineers, other church members, local ministers, theologians, church-related college faculty and campus ministers. After lively and energizing discussion the papers have now been published.

The chapters cover a wide range of relevant issues: ancient Israelite cosmology and the New Testament concept of heaven; modern scientific developments in astronomy, physics, biology and ecology; current interactions between theology and science. The chapters vary widely in length—from 8 to 80 pages with an average of 15 to 20—and in technical detail. Although scholarly, they are intelligible to a reader reasonably well acquainted with the basic issues. Most of the chapters conclude with a brief summary of the main points.

Of special interest to ASA members are the authors who define and interrelate the basic disciplines of science, philosophy and theology. Langdon Gilkey (pp. 149-182) notes that all three are *"hermeneutical"* in the sense that each searches in its own way for the meaning of the experiences in which it originates. They are distinct in that they search significantly different ways and for different sorts or levels of meaning; and they are mutually interdependent and mutually corrective." Gilkey shows that the three differ in the kinds of data appealed to; the kinds

of intelligibility sought; the sorts of authority recognized; and the sorts of symbols found significant and useful.

In a preliminary study of selected modern cosmologies (the writings of Sagan, Dawkins and Pagels, for example), Gilkey notes that they assume a "naive realism," unaware of its philosophical presuppositions and the epistemological problems that hover in the background of their entire work. All these books manifest an "unyielding dogmatism" on basic issues relevant to theology and metaphysics. These scientists, like some theologians, become rigid and dogmatic on subjects outside their field, claiming for their views the authority of science—in fact much more authority than real science ever claims.

Harold Nebelsick (pp. 231-245) offers a fascinating account of the earliest stages of the modern dialogue between theology and natural science. Scientists have belatedly recognized that science does have a history that inevitably influences its present practice. In 1938 two German scientists, Howe and von Weizsacker, were convinced that it was time to start conversations between physicists and theologians. That year the atom was split in a Berlin laboratory; World War II was soon to come. From 1949 to 1963 such conversations took place in Gottingen on an annual basis. Although they were not highly successful, Nebelsick notes several significant concepts. For example, from the outset the group recognized that "analogies between theology and natural science are relational in nature rather than ontological," although the way we know God is related to the way we know the world.

Nebelsick then clearly and concisely points out some procedures of quantum physics that may be applicable to theological thinking. He finally shows how some of the epistemological procedures used in natural science may be applicable to our talk about God. In both science and theology we must recognize "the theory-laden aspect of all factuality and the reality-constrained aspect of all theory." In other words, we do not come into the laboratory or library completely objective, but rather with a theory (hypothesis or doctrine) that determines what we look for and the way we see it. On the other hand, it is not true that any theory will do; theories used to explain reality must fall within the realm of possibility and be tested by interacting with the data.

Ian Barbour's *Consultation Summation* (pp. 297-312) is a response to the addresses and discussion during the consultation rather than a paper prepared in advance. He sets forth four major ways of relating science and religion: *Conflict* (scientific materialism; biblical literalism); *Independence* (contrasting methods; differing languages); *Dialogue* (boundary questions; methodological parallels); *Integration* (doctrinal reformulation; systematic synthesis).

The Dialogue alternative deals with methodology and can be combined with either Independence or Integration. Barbour categorizes the various authors, recognizing that several do not neatly fit into a major category. The chapter concludes with brief comments on three main scientific and theological periods: Medieval, Newtonian and 20th Century. Both models—the four ways and three periods—provide helpful classifications of the plethora of information and issues covered by the consultation.

This book is recommended as a gold mine of information, both technical and popular, for a better understanding of the nature of science and theology and ways in which they are being related today.

Reviewed by Charles E. Hummel, former director of InterVarsity faculty ministries, Grafton, MA 01519.

PSYCHOLOGY FROM A CHRISTIAN PERSPECTIVE by Ronald L. Koteskey. Lanham, Maryland: University Press of America, Inc., 1991. 106 pages, references, index. Paperback; $14.50.

This book was written as a college text by a Professor of Psychology at Asbury College. It is a revision of the first edition published in 1980.

The book attempts to give brief definitions of major psychological terms and concepts, relating them to the Christian faith. In many respects it is more like a dictionary than a text book. The explanations of the various psychological concepts are extremely brief, and thus suffer from oversimplification. The language used in the book is very simple. Those with some knowledge of the field will not find much useful in the text. Students new to the field might find the book useful in introducing the basic ideas of psychology from a Christian perspective.

Reviewed by Richard M. Bowman, Pastor, First Christian Church, 441 No. Church St., Decatur, Il 62522.

COSMIC LIFE-FORCE by Fred Hoyle and Chandra Wickramasinghe. New York, NY: Paragon House, 1990. 151 pages, index. Hardcover; $16.95.

Sir Fred Hoyle, a distinguished astronomer, Fellow of the Royal Society, and Honorary Member of the American Academy of Arts and Sciences, has coauthored a series of books and papers on the theory of cosmic origin of life with Chandra Wickramasinghe, Professor of Applied Mathematics and Astronomy at University College, Cardiff, Wales. This book is their latest. Among the other books in the series are *Lifecloud, Diseases from Space, Living Comets*, and *Evolution from Space*.

Cosmic Life-Force is the "final synthesis" summarizing the authors' general thesis of cosmic life which goes briefly as follows: Living organisms in the form of freeze-dried bacteria and viruses exist in vast quantities everywhere in the universe. These cosmic microorganisms, while residing in comets, arrived and continue to arrive on Earth through cometary injections, and started life on Earth.

The continual arrivals of cosmic bacteria and viruses on Earth also caused biological evolution as well as occasional outbreaks of epidemic diseases such as influenza.

There is no doubt that this cosmic life theory is considered provocative and controversial by many. However, this review is mainly an evaluation of the book as written and is not really a critique of the theory itself.

The authors did a fairly good job in presenting their thesis by citing a combination of direct scientific measurements, indirect observations, circumstantial evidences, inferences, correlations, and speculations. They also provided an extensive bibliography on various topics of their arguments. The book is written at the level of comprehension of high school graduates who have taken courses in biology, chemistry, and physics.

The book consists of 10 short chapters, 13 black-and-white photographs, and 25 line drawings and graphs. Some of the illustrations lack clear explanations. For example, the two pictures that were deciphered from the binary-coded messages written for transmission to prospective extraterrestrial intelligences, are supposed to depict important information about us on Earth. The authors did not bother to relate specifically the drawings in the pictures to that information.

Chapter 8, Fabric of the World, is a brief description of the physical makeup of the universe and a general discussion of cosmology, including, of course, the steady state theory which is a trade mark of Fred Hoyle. A substantial portion of this chapter, especially the part on fundamental particles, bears no direct relation to the cosmic life theory, the main theme of this book. Chapter 9, the Control of Galaxies, reminds me of James E. Lovelock's Gaia hypothesis that the Earth is self-regulated by the living systems thereon. The authors postulated that cosmic bacteria may be controlling our galaxy and even other galactic systems, thus the title of this book. The last chapter, the Concept of a Creator, describes the authors' deliberations leading to their vision of an omniscient cosmic intelligence as the Creator of Life. This chapter should be most interesting to members of the American Scientific Affiliation.

For those who love to hear provocative ideas and investigate controversies (don't we all?), this book should provide plenty of food for thought and material for debates. Please note that some of the arguments in the book may significantly raise your blood pressure.

Reviewed by James Wing, Chemist, 15212 Red Clover Drive, Rockville, MD 20853.

PARADIGMS LOST: Images of Man In The Mirror of Science by John L. Casti. New York: William Morrow and Company, Inc., 1989. 450 pages, index. Hardcover; $22.95.

From time to time many of us ask "Why are we here? How did we come to be?" Author Casti takes the serious questioner into deep paths of thought-provoking reading in this volume. We need not agree with his conclusions, or even his arguments, to benefit from his keen insight into six key problems of human existence as he presents evidences and contentions as "science in a court of law."

Casti begins by phrasing the question "Is there anything special — or unique — about human beings?", exploring answers only in the light of science. His answer to this is a qualified "yes," but it is the exploration of the issues, not the author's conclusions, which he urges upon us.

The book has seven chapters, any of which stands alone as a unit. Chapter 1 is an "instruction manual" on science; the author suggests that the reader begins, however, wherever their interest lies! Each of the "Great Problems" are examined in the form of a jury trial, with presentation of evidence and argumentation, summarization, and a verdict. Casti suggests that anyone who shows no interest in the questions may be seriously uninformed about their nature and beauty. Francis Crick goes further, suggesting that such a person may be "truly uneducated!"

Chapter 2 begins with the first claim to be tested: "Life arose out of natural processes taking place here on earth." Certainly the most controversial of the six questions, the author does an excellent job in presenting the several (more than two!) alternatives. Committed evolutionists as well as their creationist counterparts will appreciate this chapter.

The claim that "Human behavior patterns are dictated primarily by the genes" is explored next. This issue can hit home, as some of us observe the behavior of offspring! How much does a childhood environment (read — a warm, loving home) count in determining adult behavior? Casti finds this problem to be the most perplexing of all those considered and, in announcing his verdict, wonders why so many participants in the struggle cling so strongly to one position to the complete exclusion of the other.

Next is the proposition that "Human language capacity stems from a unique, innate property of the brain." The arguments of Chomsky and Fodor are matched against those of Skinner, Piaget and others who argue strongly that language is just another learning activity, and is not unique.

The fourth claim comes close to this reviewer's professional field. "Digital computers can, in principle, literally think." I had my own ideas (prejudices) on this one and it was refreshing to have them challenged in a professional manner. Casti argues in the "verdict" section that the debate is one between philosophers, masquerading as scientists. Those interested in the AI question may well want to dispute him!

"There are intelligent beings in our galaxy with whom we can communicate" is the assertion tested in Chapter 6. The Fermi paradox (Fermi, in the summer of 1950, asked the common-sense question "If there are, then where are

they?") began a whole series of experiments which have, so far, found no evidence of intelligence beyond this earth, at least none that is generally accepted. The SETI (Search for Extra Terrestrial Intelligence) projects are described in fascinating layman's terms.

Chapter 7 was the most frustrating, for it was the most profound. The claim is made that "There exists no objective reality independent of an observer." Common sense tells one immediately that this claim is nonsense. Common sense, however, is sometimes wrong. I am still wrestling with this chapter, not because it is hard to read or understand, but because it drives my own thought patterns so far into unfamiliar territory.

In the end, three of the six claims won in Casti's court, one was a draw and two lost. But the cases are ongoing. Those who want to dig deeper will appreciate the 54 pages of footnotes and recommended reading. Alas, one has but a single lifetime! I strongly recommend spending a few hours of your life reading this treasure. Your mind will surely be stretched! You will be the richer for the experience.

Reviewed by John W. Burgeson, Senior Staff, Market Research, IBM Corporation 101 Skyline Rd., Georgetown, Texas 78628.

SEARCHING FOR CERTAINTY: What Scientists Can Know About The Future, by John L. Casti. New York: William Morrow and Company, Inc., 1990. 496 pages, index. Hardcover; $22.95.

Casti, a faculty member at the Technical University of Vienna, Austria, has followed his splendid book, *Paradigms Lost*, with one of equal merit, deserving of serious study. My chief concern in writing this review is that I will not be sufficiently persuasive to induce its readers to share with me the enjoyment of science presented at its best.

Casti begins by discussing the differences between explanation and prediction in science, and in non-science, as he deals with the three C's: Correlations, Causes and Chance. He devotes most of the book, however, to analyses of weather changes, climate predictions, physical changes in living organisms, the stock market, the outbreak of war and, in a brilliant conclusion, the true statements of arithmetic.

For people in a hurry, read just the summary, five short pages. There may be some who will read no more. There may also be some people who can nibble just one peanut at a baseball game!

Casti writes with both clarity and humor. Even the chapter headings ("Proof or Consequences" introduces his chapter on "True" Arithmetic) and section headings ("Looking for a Beta Way" is a topic in the chapter on stock prices) are carefully chosen both to illuminate the topic and to remind the reader that science can be fun!

In discussing the problems, Casti rates "science" in two ways: first, how well the problem can be explained; second, how well future events within it can be predicted. Celestial mechanics is the measure of the others, rating a grade of "A" on both counts. Mathematics, interestingly enough, rates only a "B+" and "B." Quantum mechanics rates "D" in explanation, but "A" in prediction. Evolutionary Biology, as one might expect, moves in the reverse direction, rating "B+" in explanation and "D" in prediction. At the low end of the scale is Economics, rating a flat "D" in both categories. It is part of the uniqueness of this book that the author is able to analyze these matters and show, very convincingly, why these grades are to be expected, what they mean, and what improvements are likely in the future.

Casti observes

> ... that it's in those areas of the natural sciences least susceptible to human influence that we have the best "programs" for prediction and explanation. As we move away from hard physics and astronomy and into the Jello-like realm of biology, our capabilities for prediction and explanation begin to deteriorate. And by the time we reach the almost totally gaseous state of economics and the other social sciences, there's far more "social" than "science" in our capacity to say what's next and why.

As in *Paradigms Lost*, Casti includes a "To Dig Deeper" section to conclude the work. There are 55 pages of notes, indicating that the author has done his homework well!

Reviewed by John W. Burgeson, Senior Staff, Market Research, IBM Corporation 101 Skyline Rd., Georgetown, Texas 78628

SCIENCE MATTERS: Achieving Scientific Literacy by Robert Hazen and James Trefil. New York: Doubleday, 1991. 320 pages, index. Cloth: $19.95.

Science Matters, as its subtitle suggests, is the latest salvo from the scientific community in the war to combat scientific illiteracy. Co-author Trefil, a theoretical physicist by training, has been involved in the informal cultural literacy program for some time, having contributed the science word list and an essay to Hirsh's original *Cultural Literacy* and co-authoring the follow-up "Dictionary of Cultural Literacy." Trefil has also written a number of popularizations of science and is considered to be a master at that craft. He is currently the Clarence Robinson Professor of Physics at George Mason University. Co-author Robert Hazen is Robinson Professor of Earth Science at George Mason University and a research scientist at the Carnegie Institution of Washington's Geophysical Laboratory. He is author of over 150 research articles and several popular books on science.

The goal of *Science Matters* is to provide the reader with "the information you need to become scientifically literate". The authors state that "scientific literacy constitutes the knowledge you need to understand public issues." Thus, the emphasis of the book is not an in-depth or even complete understanding of any scientific concepts, but rather an acquaintance with those aspects of a scientific topic necessary to understand that topic as it is likely to be encountered in the newspaper. The premise of the book is that "The basic ideas underlying all science are simple."

Having assigned themselves the daunting task of providing the reader with the necessary background to understand the full range of scientific ideas that might be encountered in public discourse the authors proceed to distill science into eighteen very straightforward concepts: The universe is regular and predictable; energy is conserved and always goes from more useful to less useful forms; electricity and magnetism are two aspects of the same force; everything is made of atoms; everything comes in discrete units and you can't measure anything without changing it; atoms are bound by electron glue; the way a material behaves depends on how its atoms are arranged; nuclear energy comes from the conversion of mass; everything is really made of quarks and leptons; stars live and die; the universe was born at a specific time in the past, and it has been expanding every since; every observer sees the same laws of nature; the surface of the earth is constantly changing; everything on earth operates in cycles; all living things are made from cells, the chemical factories of life; all life is based on the same genetic code; all forms of life evolved by natural selection; all life is connected.

Expanding each of these ideas in a single chapter, the authors lead the reader to the edge of tomorrow's scientific headlines by explaining why an idea is important and what public issues it addresses. The background to nuclear energy, the greenhouse effect, AIDS, the Search for Extraterrestrial Life (SETI), Genetic Engineering, and many other topics are all treated in enough detail that the reader should feel comfortable reading any discussion of these issues in the popular press.

Like previous attempts to catalog literacy, the authors can be criticized for their particular choice of topics. I might have included more from the life sciences and less from physics, but some degree of subjectivity is certainly inherent in such a project. What is most remarkable about this effort is the extraordinary success that the authors have had in removing technical jargon and details from each of the topics. Without insulting the intelligence of the reader they explain esoterica like relativity, quantum theory, black holes, and genetics. Educators will find the analogies and descriptions very helpful in their attempts to teach related material. And non-scientists concerned about their scientific literacy should find themselves amply rewarded for the effort invested in reading *Science Matters*.

Most of the ideas discussed have little bearing on religious concerns, but the authors do address Creationism briefly in the chapter on evolution, tactfully dismissing it as "a form of religion." This chapter demonstrates the major weakness of the book — its tendency to underemphasize serious difficulties within certain scientific theories. The discussion of "Primordial Soup" and "Fossils and Evolution," for example, fail to mention the extreme challenges that both of those problems pose for modern evolutionary theory.

Reviewed by Karl W. Giberson, Associate Professor of Physics, Eastern Nazarene College, Quincy, MA 02170.

MINDS, BRAINS AND MACHINES by Geoffrey Brown. New York: St. Martin's Press, 1989. xi + 163 pages. Hardcover; $24.95.

The central theme of this book, analyzed in the context of the modern philosophy of mind, is the problem of whether machines can think. The problem is very important in the context of the Christian faith, since a positive answer would require a substantial reevaluation of Christian theology. If machines can think, do they do that in the same way humans do? What would be their spiritual life as compared to that of humans? Could machines be held responsible for their actions, if they think? Such problems would have to be seriously analyzed if machines could be included in the category of rational beings.

The first problem Brown poses is the meaning of thinking: do computers "really think"? But what does it mean to "really think"? It must involve something beyond storing and handling data, which machines can do; a possible candidate is creativity defined as the ability of generating new solutions and acting in an independent way. And machines cannot do that. But is consciousness associated with thinking and intelligence? Yes, the author says, but this also gives rise to the problem of solipsism, and this problem is dealt with from different angles throughout the entire book. Although it seems to be obvious to say who is conscious, it is not trivial to reveal the nature of consciousness.

First, there is a problem of other minds. It may be said after Rorty that the problem of mind is a pseudo-problem, after Dennett that consciousness is a status ascribed to people, not their property, or after Thomas Nagel that it is simply something "that it is like to be a creature." And the latter position seems to the author the most plausible. But it raises a problem of analogy, since subjective facts become a subject of "objective ascription ... only to someone sufficiently similar" (p.33). Brown discusses arguments of Russell and Ayer in favor of argument from analogy and indicates that the solipsist can refute them.

But a problem can be discussed from a different angle: the solipsist has to assume the idea of a private language. Following Wittgenstein, Brown shows that it is highly improbable: the use of language is a collective and social phenomenon. For a solipsist there would be no difference between following a rule and thinking that a rule is followed.

Brown also analyses the mind-body problem. He discusses several positions in this matter, such as dualism, occasionalism, epiphenomenalism, etc., but he himself takes the side of monism. He is aware of the fact that it is a multi-faceted position: it can spring up from rationalism, or materialism. However, a certain version of functionalism, by identifying mental states with functional states, does not decide what is the nature of these states.

Brown advocates a theory that allows rejecting a choice between mind and matter. Such a choice should be secondary and, for instance, Strawson chooses the concept of person as primary introducing the mind-body division only later. But Kant, the author's favorite philosopher, replaces the mind-body pair by a subject-object pair, that is, the division line is of epistemological nature, and not ontological. Thus, "the problem of what is real, what is secondary" is not, in fact avoided, but replaced by the problem what can be known (phenomena) and what cannot (noumena).

Like Piaget, Brown says that "learning depends very much upon doing"; doing implies following rules, following rules implies the concept of correctness. But to possess it one has to be capable of having purposes. The author concludes that it is possible to construct a machine generating its own purposes; but "such artifacts would be hardly anything like the things which pass for 'intelligent machines' at the present time" (p.153).

This conclusion is surprising in the light of his previous discussion: (1) he analyses language as one symptom of consciousness and admits that computers are missing the crucial point, namely meaning; (2) after comparing computers with the brain, Brown concludes that differences between them are much more substantial than similarities; (3) because thinking is thinking about something, and because of the nature of learning, feelings and sensations are necessary for thought, for they form our link with the outside world, and thus, "anything capable of actual thought is at least going to be an organism" (p.135).

Thus, a genuinely thinking artifact can be constructed, in the author's opinion. A philosophical journey he made through a garden of a thousand paths and the paths chosen deliberately led to this conclusion, since some philosophical positions were discarded on the spot as unfashionable and irrelevant. A fashionable way is to be close to a materialist position pretending that this is not quite the case; therefore, a recourse to functionalism. It is, in fact, what Kant himself tried to do: he started with metaphysics and wanted to built a new one, and ended up refuting it, or rather with refuting traditional ontological arguments. The noumenal world remained as an unrefutable foundation; also metaphysics was in the background of his discussion of practical reason, and thus, of ethics.

To sum up, the journey Brown makes is interesting and kept accessible to the uninitiated, but his conclusion is at least unconvincing and, in fact, the reader has a feeling that the author did not even convince himself about the prospect of thinking artifacts. But because the possibility of such a machine is projected very far into the future, the author's conjecture is quite safe.

Reviewed by Adam Drozdek, Professor of Computer Science, Duquesne University, Pittsburgh, PA 15282.

PROJECT EARTH: Preserving The World God Created by William B. Badke. Portland, Oregon: Multnomah Press, 1991. 166 pages, appendix and indexes. Paperback.

Project Earth offers a direct challenge to the conspicuous silence of evangelical Christianity toward the globe's looming environmental problems. This book contests conventional evangelical thinking and practice by linking today's environmental crisis to fundamental tenets of the Christian faith. The challenge might be interpreted as another swipe from theological liberalism except that the author himself carries evangelical credentials. William Badke is associate professor of Bible and theology at Northwest Baptist Theological College and Seminary in Langley, British Columbia, Canada.

The author chides evangelicals for narrowly focusing the central truths of Scripture, and their proclamation, to only the spiritual dimension (i.e., humanity's sinfulness and redemption) with insufficient regard for Scriptural teachings regarding the divine mandate to care for the earth. Evangelicals indifferent to the Earth's plight are guilty, not of the sin of commission (as historian Lynn White suggests), but of omission. With this opening critique, supplemented with a brief non-technical survey of current environmental problems (toxic waste, acid rain, ozone depletion, global warming, loss of rain forests and agricultural land), the book proceeds to its main task of convincing evangelical Christians that caring for the earth is a biblically mandated responsibility.

The book's premise is that creation bears witness to God. Aspects of this premise are used to structure five of the nine chapters. Two chapters succinctly review four ways in which creation's witness is evident: l) nature's testimony to the Creator's glory, 2) God's nuture or providence for all life, 3) penalty (death for all creatures), and 4) precariousness (life's insecurity after the fall). These revelatory and dark witnesses of creation are seemingly in tension, but they are all part of God's plan to call human beings back to himself, the former as blessings accompanying faithfulness and the latter as judgement for not responding to his call. Environmental problems are viewed as a reflection of human rebellion against God.

The next two chapters elaborate on this theme by confronting evangelical arguments which point to God's curse on creation and the apocalyptic vision of a destroyed earth as reasons for not participating in the restoration of an environmentally hurting world. An intervening chapter then poses three options for consideration: indifference, damaging exploitation, and active support. The latter is

obviously the author's option of choice and this leads to a culminating chapter describing the fifth witness: reclamation. The creation bears this witness when Christians, renewed in the image of God, actively proclaim and participate in the earth's healing. In the next chapter, an attempt is made to offer pragmatic suggestions which manifest the witness of reclamation. Most are of the "be informed and get involved" variety, except for the author's suggestion for believers to re-examine their consumptive lifestyles, which is probably the most effective but also the most sacrificial.

The book concludes with 15 Propositions for a Christian Ecology which essentially summarize its theological argument. An appendix lists 39 environmental tips for households and 11 for churches, all familiar to the ardent environmentalist.

This is a short, readable book oriented mainly to evangelical leaders and laypersons unfamiliar with biblical perspectives on the environment. Those familiar with theological discourse on creation will find it rudimentary, although occasional criticism of contemporary Christian writers (e.g., Wesley Granberg-Michaelson) provides alternative viewpoints. Personal anecdotes at chapter introductions illustrate major points but they sometimes fall short in their analogy. Chapter footnotes refer to a mix of academic and popular references.

Project Earth recognizes that the environmental crisis is ultimately reflective of a spiritual problem. It challenges evangelical Christians to search the Scriptures, repent, renew their hearts and minds, and act as the Creator's envoys in reclaiming all creation. It is a welcome addition from the evangelical camp to the meager array of Christian writings on the environment.

Reviewed by Harry Spaling, Land Evaluation Group and Department of Geography, University of Guelph, Guelph, Ontario, Canada N1G 2W1.

SOCIAL PROBLEMS: A Christian Understanding and Response by Jack O. Balswick and J. Kenneth Morland. Grand Rapids, MI: Baker, 1990. 357 pages, index. Paper; $22.95.

Balswick and Morland, both evangelical sociologists, have written a book that attempts to help Christians (many of them frustrated) understand the causes which underlie some current social problems. In addition, they tackle questions regarding how a Christian, using a biblically based framework, should respond to help solve these problems. The extent of the entrenchment of some of the social problems discussed (poverty, discrimination, substance abuse) makes the task of finding causes and determining appropriate responses (Christian or otherwise) is a difficult one. The authors are qualified to take a crack at this task. They have been teaching, writing and actively involved with social issues for a combined total of 65 years.

The book is divided into three parts. Part I gives the reader a brief introduction to sociology, how sociologists come to define what a social problem is, and how a social problem differs from a social issue. Social problems are defined as "any situation which the members of a group consider to be undesirable and which they think should be remedied by cooperative action" (p. 16). Balswick and Morland add that the problems should be identified using both "general American values and Christian ideology" (p. 18). At this point a four-fold sociological analysis is described, which the authors use to discuss eleven different social problems introduced in Part II. This analysis explores the following areas: the nature of the concern (violation of a national value); the dimensions of the problem; explanations of the problem, and proposed solutions. Each analysis ends with suggestions for an appropriate Christian response — exhortations for an individual or the church at large. Part III is comprised of a short chapter on paths to Christian social involvement.

Overall, the book is well organized and well written. Other than occasionally using statistics that are somewhat dated, the research used for indicating the dimensions of each problem was complete and convincing. For the most part, I was pleased with the social problems the authors chose to address: crime and juvenile delinquency, discrimination and prejudice, family instability, alcoholism and problem drinking, drugs, poverty and world hunger. I was surprised to find the inclusion of "redefinition of gender roles" and "alienation and the crises of modernity;" especially because the problems of AIDS, homosexuality, abortion, and mental illness (particularly depression) received merely a passing reference or no mention at all.

One strength of this book is its readability, particularly for the general Christian lay audience who want to learn more about social problems from a sociological perspective (rather than from a psychological perspective.) Another strength lies with the authors' ability to argue that social problems cannot be solved by changing the individual apart from making significant changes within the social structures that helped create the problem in the first place. Although each social problem discussed in Part II is well researched and presented, I felt too many subtopics were introduced. One danger inherent in writing a book which serves as an introduction or overview to a particular area is to include so many secondary themes that the overall product is weakened by the brevity of the coverage. Due to the brief discussion of each subtopic, I thought it was difficult to come to a complete or thorough understanding of any one of them. Once a specific social problem is selected, the chapter subheadings must be judiciously chosen. In this instance too many were superficially covered. For example, the chapter on racial discrimination and prejudice includes a discussion on the "physiological," "psychological," and "sociocultural" approaches to this topic. This is all dealt with in five pages. The book would have been strengthened if a number of subtopics had been removed, providing the space was used to further elaborate on some of the more salient aspects.

Social Problems: A Christian Understanding and Response is a versatile book. ASA members wanting an introduction

to this topic should be pleased. Professors could use it as a supplementary reader in a course on social issues. It could even be used within the church for a topical based Sunday school program.

Reviewed by Bryan C. Auday, Associate Professor of Psychology, Gordon College, Wenham, MA 01984.

THEORY AND PRACTICE IN MEDICAL ETHICS by Glenn C. Graber and David C. Thomasma. New York: Continuum Publishing Co.,1989. 216 pages,index. Cloth; $24.95.

Medical ethics has become a very complicated subject, and probably will increase in complexity in the years ahead. A systematic exposition of ethical theories, the purpose of this book, can also be a complicated undertaking. Graber is Professor of Philosophy at the University of Tennessee, and Clinical Associate in Medical Ethics at the same University's Medical Center. Thomasma is Professor and Chairman of Medical Humanities at Loyola University, Stritch School of Medicine, Chicago. The book was motivated by the authors' teaching to medical and philosophy students on medical ethics.

The presentation follows the form of a more or less formal treatment of ethical issues, without attempting to base the values underlying them within a Christian or theological foundation. There is, therefore, almost no discussion of whether a particular ethical position can be justified or validated by biblical exegesis. Implicit in much of the discussion, and occasionally explicit as well, is the assumption that ethical principles are the product of social consensus.

In successive chapters the authors consider six models of theory-practice relation: the application model, the mediation model, the validation model, the determination model, the origination model, and the virtue model. The strengths and weaknesses of each of these models is discussed, together with illustrations of them in practice. Finally, the book concludes with a proposed treatment of the interaction of theory and practice that avoids the weaknesses and incorporates as many of the strengths as possible.

The book is thoroughly scholarly in style. Each chapter ends with the citation of at least 50 references. Appendix A provides an index to almost 300 substantive issues discussed at some point in the book. Appendix B summarizes the strengths and weaknesses of each of the models, as previously discussed in the various chapters themselves. In the body of the book there are about 800 citations from the writings of some 200 ethical analysts, also summarized at the end of the book in an index.

A little feeling for the flavor of the book can be obtained by quoting the authors' summary of their own "Unitary Theory," — proposed after considering the other options.

> Certain conditions (C) are present in this case such that the probability (x) exists that Value (V) A will be judged more important than B by (I) interpreters because the Principle (P) p' will more likely apply to the case than p" (p. 194).

There is much that is helpful in this book in guiding ethical decisions, and anyone seeking to play a major role in this field would do well to be familiar with the various possibilities and emphases that are assumed and put into practice by different ethicists. It emphasizes the intricate feedback interaction between theory and practice in medical ethics. Still, what the book cries out for is an analysis of its contents by a medical ethicist who believes that at some point medical theory and practice should be held up for evaluation in the light of the biblical revelation.

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

MODERN PSYCHOTHERAPIES: A Comprehensive Christian Appraisal by Stanton L. Jones and Richard E. Butman. Downers Grove, IL: InterVarsity Press, 1991. 417 pages. Hardcover.

Jones and Butman say their intended audience is students, pastors, mental-health professionals and informed lay persons. To these I would add "teachers." Effectively integrating the Christian faith with an academic discipline often can add more study hours than most instructors have to give. For the teacher of psychology, Jones and Butman offer a wealth of material. Viewing the field of therapies, they examine, from a Christian perspective, representative therapies from the psychodynamic, cognitive-behavioral, humanistic and family approaches.

Though proffering material for the Christian, the authors seldom refer to the integration of psychology and theology because they say "this implies that the goal is the fusing together of what are and should properly be two distinct conceptual disciplines" (p. 19). They reject any integration that is attempting to create a new academic discipline which might be called "psychotheology" or "theopsychology."

Thus, if one is looking for a scripture verse to substantiate every conclusion or opinion, it will not be found. Scripture, writings of Christian scholars, and biblical principles are the bases of their analysis. Though the book "has been directed at showing the inadequacies in all the approaches" (p. 382), there are contiguous suggestions as to how the Christian faith can interact with secular theories and where, with caution, these theories can be effective resources.

Jones and Butman's summations of the therapies obviously are condensed, which might cause some proponents of a favored therapy to react to areas not fully covered to their liking. The authors' evaluations of each therapy are well defined but not dogmatically asserted.

The first two chapters lay an excellent foundation for understanding the background for the authors' reasoning and their basic philosophies, both theological and psychological. Their approach to each therapy incorporates a descriptive survey followed by models of health, of abnormality, of psychotherapy and of personality. Their "Christian critique" incorporates the same models.

While supporting the eclectic approach, "None of the theories can be rejected out of hand, but none can be wholeheartedly endorsed by the Christian counselor" (p. 380) — they are careful to define eclectic as something more than "anything goes." The final chapter includes what the authors say is "a skeletal and nonexhaustive outline toward a comprehensive Christian counseling approach" (p. 97). Jones and Butman do not believe such an approach exists, but hope to be involved in its development in the future.

Jones and Butman have produced a work useful to Christian and non-Christian. It is comprehensive, scholarly and unapologetically evangelical. The first two chapters and the last two chapters, in my opinion, are worth the price of the book. They should foster considerable thought and comment, and perhaps rebuttal.

Reviewed by Ida Adolphson, John Brown University, Siloam Springs, AR 72761.

MARKET CAPITALISM & CHRISTIANITY by Jim Halteman. Grand Rapids: Baker Book House, 1989. 176 pages. Paperback; $9.95.

This is a thought-provoking little book, certainly the strongest I've read in the genre of "Christianity and Economics." Unlike most such authors, Halteman has no ideological axe to grind and is both cognizant with the formal field of economics and explicit on his theological stance. Indeed, the book's strength is its reflection of the author's personal struggle as a Christian with the functioning of our economy and his role in it.

Halteman's book is really comprised of two loosely integrated pieces. One part seeks to interpret biblical teachings on wealth and possessions in the light of the biblical economic context. The author applies his understanding of these teachings, including in his own choices in areas such as housing. Halteman first argues in effect that much of biblical teaching on "economics" is not relevant today. He interprets the ancient mideast as a static world, so that economic issues devolve into how a fixed pie is to be divided. One family, in other words, can be well-off only if others are commensurately poorer. Those with possessions then face three options: to consume (with income flowing to others), to horde, or to engage in charity. But, Halteman insists, we no longer live in a "premodern" world because there is another alternative: productive investment. In the long run this can do something that charity cannot. (Even with the combined wealth of the U.S., Europe and Japan, charity cannot make more than a small dent in world poverty.) The distinctive biblical injunctions to engage in charity and avoid hoarding are thus no longer apropos.

This argument, however, is at odds with research in development economics and economic history, which stress the importance of accumulated investment — land improvements, inventories, housing — even in "primitive" societies. Indeed, the parable of the talents and of the good steward both revolve around explicit investment,

and the concept of investment was well known in the classical world. (Documents survive outlining the implicit rate of return for investing in an agricultural estate.) Furthermore, the author confuses savings — consuming less today so that we can consume more tomorrow — with investment in productive resources. I believe the biblical injunctions are far more relevant that Halteman admits, and that the moral problem of how much of God's gifts we use for ourselves remains.

How does his analysis affect his own decisions? Here he traces his own personal struggles with this issue, reflecting his Anabaptist focus on community. For him the Church is a discipling body of believers, and this — and ministry to the larger community of non-Christians — is contingent upon effective social ties. Failure to keep up with the Joneses then becomes a source of alienation that sunders the body Christian and prevents effective witness to his peers. I am uncomfortable with this vision of the Church. To my eyes, the poor are always present in the biblical portrayal of both synagogue (temple) and church. (That, surely, was what set the early Church apart from Greco-Roman society!) Indeed, I am struck by how contorted the argument must become to justify our own monocultural suburban (and inner-city and ethnic) churches.

In the end, Halteman is fairly comfortable with his behavior, but I am now increasingly unsettled by my own. (I have architect's drawings in hand, but should I sink a large sum of money into an addition to my house?) Furthermore, he did this gently, by making me reflect in an orderly manner upon my own beliefs and presuppositions. That surely made this a book worth reading for me, and, I suspect, for most of you.

Reviewed by Michael Smitka, Associate Professor of Economics, Washington and Lee University, Lexington, VA 24450.

ARCHAEOLOGY AND THE NEW TESTAMENT by John McRay. Grand Rapids, MI: Baker, 1991. 432 pages. Hardcover.

Christians find archaeology interesting and relevant because it sheds light on the Bible. Archaeology provides information which has the potential to both elucidate the scripture and to support apologetics. This excellent text contributes to this end with its author's lucid writing and wise selection of material. Its 11 chapters are divided into four main parts: the architecture of New Testament times; the building program of Herod the Great; archaeology and the life of Christ; and archaeology and the church. Thus, finds connected with the ministry of Jesus, the travels of Paul, and the circumstances of the seven churches of Asia are all included.

This volume contains 5 tables, 32 illustrations, over 150 photographs, a glossary, extensive endnotes, a bibliography, and 8 maps. This book also has a description of the field of archaeology, including its methods, new technologies, and objectives. Its current and comprehensive archaeological information make this a valuable resource for teachers, pastors, students, and lay persons. Anyone interested in how the results of digging impact the contemporary understanding of the New Testament will find this text invaluable.

McRay, professor of New Testament at Wheaton College Graduate School, has the requisite qualifications to write this book. He has taught archaeology for over 30 years, supervised excavating teams, visited many archaeological sites, and served as consultant and board member to archaeological societies.

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

Letter

Preparing for Socially Comfortable Acceptance of Abortion?

Dr. Ross S. Olson (Letters, September 1991 *Perspectives*) considers that "I am preparing the way for a socially comfortable acceptance of abortion" in my article on "Non-existence" (June 1991 *Perspectives*). His brief comments raise a number of important issues.

The first is the assumption that everyone writing about the beginnings of human existence has "abortion" in mind. What that does is to limit the framework of debate to abortion, and this inevitably ignores other large questions of relevance for Christians.

The second issue is that it is easy to dismiss difficult questions by questioning the motives of an author. I, personally, have no desire to promulgate a socially comfortable acceptance of abortion, any more than I wish to adopt positions that are non-offensive to my secular colleagues (as my secular colleagues could tell you). Questioning the motives of other Christians does not allow us to escape facing the difficult questions. They remain.

A third issue is that of integrity in Christian thinking and living. The fact that some authors raise hard questions and attempt to get others to take them seriously, is not akin to watering down their allegiance to biblical imperatives. I would suggest it may actually be an outworking of this allegiance, reflecting their integrity as God's people.

D. Gareth Jones
Department of Anatomy
University of Otago
PO Box 913
Dunedin, New Zealand

AMERICAN SCIENTIFIC AFFILIATION
1991 Annual Report

REPORT FROM THE PRESIDENT

As I reflect on some 15 years of active involvement with the American Scientific Affiliation, I continue to be amazed at the wide range of stimulating endeavors sponsored by the ASA. I was pleased when I read an article entitled "Science and Religion" (*Current Contents*, June 24, 1991, p.8-13) recently and found that it listed the American Scientific Affiliation as one of the few organizations in the U.S.A. that addresses the interaction between science and religion.

Sincere thanks are due to the ASA staff for their work during the past year. Special thanks is due Frances Polischuk for her management of our financial affairs during a difficult year. I would also like to express appreciation to Karen Brunstrom and Becky Petersen for effective service as our Executive Assistant and Managing Editor, respectively. We are pleased to welcome Carol Aiken and Patsy Ames who assumed these responsibilities late this summer. Many thanks also to editors Jack Haas, Walt Hearn and Richard Ruble who continue to work effectively on our behalf.

Executive Director Bob Herrmann has this year completed ten years of outstanding service to the ASA. It is ironic that he had to miss the 50th Anniversary celebration to recover from a retinal tear.

The long anticipated 50th anniversary celebration at the 1991 Annual Meeting was all that we had hoped for it to be. Jack Haas, our program chair, and the invited speakers did an outstanding job of surveying the past and setting the stage for the "next 50" years.

It was a great honor and an inspiration to have a number of early members of the ASA present at our meeting and it was a privilege to present a gift to Dr. Russell Mixter on behalf of the ASA.

It was a distinct privilege to see two affiliates of the ASA, the Affiliation of Christian Geologists and the Affiliation of Christian Biologists in action at the 1991 Annual Meeting.

These are challenging days for the ASA Executive Council. At the present time we face financial challenges brought on by economic recession. As we anticipate the retirement of several key persons within the next decade, pray with us that God will raise up those who will be able to carry the vision of the ASA into the 21st century.

Gerald Hess
President, Executive Council

REPORT FROM THE EXECUTIVE DIRECTOR

This is the first year that we have published our Annual Report as part of *Perspectives in Science and Christian Faith*, so it is of necessity somewhat abbreviated.

1991, our 50th Anniversary, was celebrated in fine style at the Annual Meeting at Wheaton College in August. I was unable to be there because of medical problems, and I am very grateful for the extra efforts of the Executive Council and the staff. Special thanks is also due Al Smith, our local arrangements chair, and Marilyne Flora, Chicago Section Leader, for providing the facilities necessary for a large and complicated meeting.

As befits our 50th Anniversary, this has been a year for new projects. Walt Hearn began a booklet for graduate students entitled *On Being a Christian in Science*, designed as a response to the new National Academy of Science booklet *On Being a Scientist*. The new ASA booklet will inform Christian young people of the opportunities and responsibilities of a scientific career, affirming the N.A.S. publication but showing how being a Christian provides a higher order of motivation and moral commitment for doing good science. The Stewardship Foundation and the Murdock Trust have supplied grant support for this project.

This year we also began a series of university lectures sponsored by the Templeton Foundation. E. David Cook of Oxford University lectured at the University of Texas and historian of science Owen Gingerich lectured at the University of California at San Diego and at the University of British Columbia. Psychiatrist Armand Nicholi lectured at the University of Miami, and David Allen and I lectured at Georgetown University at the inaugural conference of the new Tournier Institute. Four more lectures will complete the first year of support, the last by Russian quantum physicist Audrej Grib in Rome in March 1992. The Templeton Foundation has given us a second year of support for these university-based lectures, which are intended to emphasize the new openness which should characterize the relationship between science and theology.

A third program which was initiated this year is a new Institute for African Scientific Research and Development. ASA plans to provide training, logistical support and staff on sabbatical leave to the new Nairobi-based organization. At present we are represented by three board members; Ken Dormer, Martin Price and myself. Daystar University College has been very supportive of the new Institute.

1991 was also the occasion of the first resolution ever passed by ASA. The Committee for Integrity in Science Education, chaired by John Wiester, brought a proposal for a resolution entitled "A Voice for Evolution as Science" which states that when evolution is taught in public schools the terms *evolution* and *theory of evolution* should be carefully defined scientifically and the data of evolution

be approached with an effort to distinguish evidence from inference and with due recognition of unsolved problems.

The resolution was approved in an advisory vote by the body of ASA Fellows and given final approval by the Executive Council in December. Press releases were distributed to the media at year's end. This action on the part of the Affiliation derives from the continuing misrepresentations of ASA and our widely disseminated booklet *Teaching Science in a Climate of Controversy* as "anti-scientific." John Wiester and fellow committeeman Walt Hearn have also written numerous letters of clarification. At the same time, several additional favorable reviews of *Teaching Science* have been published, one by Larry Martin in the *Crucible* and another by John Brobeck in the *CMDS Journal*.

Among continuing programs of the Affiliation, the television series, "Space, Time and God" has reached completion of scripts for all six episodes. Writer and anchorman Owen Gingerich and Producer-Director Geoff Haines-Stiles met with the Executive Council in December to discuss funding strategies to raise some two million dollars which will be required for the production of the series for public television.

This year also saw a complete revision of the *Source Book*, due in large part to the efforts of Publications Committee chair Jim Neidhardt and the editorial expertise of Becky Petersen and Robin MacLeod. We plan to go to the printers early in 1992. Another committee, charged with Long Range Planning and chaired by David Swift, is preparing a report for the 1992 meeting in Hawaii.

The Commission program has continued with five commissions reporting activities in publication, recruiting, review of problem areas and public relations. The Biomedical Ethics Commission, newly chaired by Donald Munro, plans a statement concerning the use of animals in research. The Global Resources and Environment Commission, chaired by Fred Van Dyke, continues preparation of a book on Christian perspectives on the environmental crisis which is being reviewed for publication by InterVarsity Press.

The Industrial and Engineering Ethics Commission, chaired by Fred Lehman, has worked on two projects this past year. One, "An Ethic for Christian Servants in the U.S. Marketplace" received strong input from Commission member D.J. Howell before she had to retire because of other commitments. The second project, "Ethics and the Challenger Disaster" is being prepared as a teaching tool for small group discussion with special leadership by Ed Allen.

Finally, the Science Education Commission, chaired by Ken Olson of Greeley, Colorado, met in Wheaton in August and considered various curricula for high school and church school students.

In concluding my report, I wish to invite you all to the 1992 Annual Meeting on the big island of Hawaii. If you are unable to come, we plan our 1993 meeting for the campus of Seattle Pacific University, the 1994 meeting for Bethel College in St. Paul, Minnesota, and the 1995 meeting at Montreat-Anderson College in Montreat, North Carolina.

Robert L. Herrmann
Executive Director, ASA

1991 ASA Approved Budget: Summary Form

Income	
Operating Income:	
Dues	85,000
Subscriptions	40,000
Member Contributions	78,000
Annual Meeting, General Sales, Misc.	81,500
Project Overhead	18,500
Operating Income Total	303,000
Expenses:	
Operating Expense:	
General Office & Salaries	198,857
Budgeted Program Expense	93,300
Total Operating Expense	292,157
Special Projects Income:	
T.V. Series	60,000
Subscription Campaign	15,000
Templeton Lectureship Series	63,500
Book Project: *On Being a Christian in Science*	63,000
African Res. & Devel. Inst.	83,600
Planning Grant: Rel./Science Inst.	24,000
Tacoma Conference	3,500
Total Projects Income	312,600
Special Projects Expense	
T.V. Series	10,000
Subscription Campaign	15,000
Templeton Lectureship Series	55,000
Book Project: *On Being a Christian in Science*	53,000
African Res. & Devel. Inst.	7,000
Planning Grant: Rel./Science Inst.	20,000
Tacoma Conference	3,500
Total Projects Expense	163,500

Frances Polischuk
Financial Manager

AMERICAN SCIENTIFIC AFFILIATION
Financial Statements: December 31, 1990

Independent Auditor's Report

Board of Directors
American Scientific Affiliation

February 13, 1991

We have audited the balance sheet of AMERICAN SCIENTIFIC AFFILIATION (A Non-Profit Organization) as of December 31, 1990, and the related statements of revenues, expenses and changes in fund balance, and cash flows for the year then ended. These financial statements are the responsibility of the Organization's management. Our responsibility is to express an opinion on these financial statements based on our audit.

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

In our opinion, the financial statements referred to above present fairly, in all material respects, the financial position of American Scientific Affiliation as of December 31, 1990, and the results of its operations and its cash flows for the year then ended in conformity with generally accepted accounting principles.

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

Balance Sheet: December 31, 1990

(With Comparative Totals for 1989)

Assets

Current Assets	**1990**	**1989**
Cash	$ 89,587	$91,798
Accounts Receivable	223	764
Investment, at Cost	993	909
Publication Inventories, at Cost	7,573	12,838
Prepaid Expenses		217
Supplies	500	500
Total Current Assets	98,876	107,026
Property and Equipment	13,405	19,161
Other Assets		
Security Deposit - Rent	400	400
Total	$112,681	$126,587

Liabilities and Fund Balance

Liabilities		
Accounts Payable	$ 15,262	$ 8,846
Note Payable - Equipment		573
Taxes Withheld	1,907	1,584
Restricted Deferred Revenue	125,953	121,851
Total Liabilities	143,122	132,854
Fund Balance	(30,441)	(6,267)
Total	$112,681	$126,587

Statement of Revenues, Expenses, and Changes In Fund Balance:Year Ended December 31, 1990

(With Comparative Totals for 1989)

	1990			1989
Revenues	**Unrestricted**	**Restricted**	Total	**Total**
Contributions	$74,230	$41,188	$115,418	$170,391
Dues	80,549		80,549	76,220
Subscriptions	35,386		35,386	16,683
Conferences and Meetings	33,867		33,867	9,901
Sales of Publications	8,468		8,468	11,347
Advertising and Royalties	364		364	614
Overhead Income	24,538		24,538	7,529
Interest Received	5,112		5,112	6,997
Gain (Loss) on Sale of Securities	670		670	(72)
Total	263,184	41,188	304,372	299,610
Expenses				
General Office Expenses	197,838		197,838	175,745
Program Services Expenses	89,520	41,188	130,708	130,351
Total	287,358	41,188	328,546	306,096
Excess (Deficiency) of Revenues over Expenses	(24,174)		(24,174)	(6,486)
Fund Balance, Beginning of Year	(6,267)		(6,267)	219
Fund Balance, End of Year	$(30,441)		$(30,441)	$(6,267)

The accompanying notes are an integral part of these financial statements.

Statement of Cash Flows
Year Ended December 31, 1990
(With Comparative Totals for 1989)

Cash Flows From Operating Activities	1990	1989
Excess (Deficiency) of Revenues Over Expenses	$(24,174)	$(6,486)
Adjustments to Reconcile Excess (Deficiency) of Revenues Over Expenses to Net Cash Provided by (Used for) Operating Activities:		
Gifts of Stock (Stated at Fair Market Value)	(8,250)	(10,247)
(Gain) Loss on Sale of Stock	(670)	73
Depreciation	6,285	6,203
(Increase) Decrease in Assets:		
Accounts Receivable	541	(21)
Publication Inventory	5,265	(363)
Prepaid Expenses	217	237
Increase (Decrease) in Liabilities:		
Accounts Payable	6,416	1,870
Taxes Withheld	323	(1,172)
Restricted Deferred Revenue	4,102	(44,876)
Net Cash Provided by (Used for) Operating Activities	(9,945)	(54,782)
Cash Flows From Investing Activities		
Purchase of Property and Equipment	(529)	(541)
Sale of Stock	8,836	9,265
Net Cash Provided by (Used for) Investing Activities	8,307	8,724
Cash Flows From Financing Activities		
Reduction of Debt	(573)	(628)
Net Increase (Decrease) In Cash	(2,211)	(46,686)
Cash at Beginning of Year	91,798	138,484
Cash at End of Year	$89,587	$91,798

The accompanying notes are an integral part of these financial statements.

Notes to Financial Statements
December 31, 1990

Note 1 - Summary of Significant Accounting Policies

The financial statements of American Scientific Affiliation have been prepared on the accrual basis. The significant accounting policies followed are described below to enhance the usefulness of the financial statements to the reader.

Fund Accounting

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

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

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

Expendable Restricted Resources

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

Property and Equipment and Depreciation

Property and equipment are stated as follows:

Cost	$44,054
Less: Accumulated Depreciation	30,649
Net Property & Equipment	$13,405

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

Tax Exemption

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

Other Matters

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

Legally enforceable pledges less an allowance for uncollectible amounts are recorded as receivables in the year made. Pledges

for support of current operations are recorded as operating fund support. Pledges for support of future operations and plan acquisitions are recorded as deferred amounts in the respective funds to which they apply.

Note 2 - Cash Flow Information

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

Supplemental Disclosures of Cash Flow Information:
Cash paid during the year for:

	1990
Interest	$-0-

Supplemental Disclosures of Non-Cash Financing Activities:
During the year ended December 31, 1990 American Scientific Affiliation received gifts of stock valued at $8,250.

Note 3 - Summary Description of the Organization

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

Note 4 - Investments

Investments are presented in the financial statements at cost. Market value of investments at December 31, 1990 was $952.

Note 5 - Commitments

The Organization has entered into an agreement totaling approximately $271,000 for the funding of a television series. As of December 31, 1990, $60,000 of the commitment was still outstanding.

Independent Auditor's Report on Additional Information

February 13, 1991

Board of Directors
American Scientific Affiliation

Our report on our audit of the basic financial statements of American Scientific Affiliation for 1990 appears on page 73. We conducted our audit in accordance with generally accepted auditing standards for the purpose of forming an opinion on the basic financial statements taken as a whole. The schedules of functional expenses are presented for purposes of additional analysis and are not a required part of the basic financial statements. Such information has been subjected to the auditing procedures applied in the audit of the basic financial statements and, in our opinion, is fairly stated in all material respects in relation to the basic financial statements taken as whole.

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

General Office Expenses
Year Ended December 31, 1990
(With Comparative Totals for 1989)

	1990			1989
	Unrestricted	Restricted	Total	Total
Public Relations Expense	$ 1,933	$ —	$1,933	$ —
Bad Debts	785	—	785	366
Commissions	2,581	—	2,581	588
Depreciation	6,285	—	6,285	6,203
Employee Benefits	14,700	—	14,700	14,355
Equipment Rental and Maintenance	7,951	—	7,951	6,693
Insurance	481	—	481	481
Interest	—	—	—	237
Office Supplies and Expense	4,059	—	4,059	3,861
Payroll Taxes	10,240	—	10,240	8,888
Payroll Services	533	—	533	479
Postage and Shipping	6,070	—	6,070	4,930
Printing	836	—	836	1,691
Professional Fees	2,150	—	2,150	1,760
Rent	9,900	—	9,900	9,615
Salaries	125,227	—	125,227	112,369
Telephone	3,278	—	3,278	2,445
Utilities	829	—	829	784
Total -	$197,838	$ —	$197,838	$175,745

Program Services Expenses
Years Ended December 31, 1990
(With Comparative Totals for 1989)

	1990			1989
	Unrestricted	Restricted	Total	Total
Annual Meeting Expense	$ 30,828	$ —	$ 30,828	$ 9,468
Editor Stipend and Expense	6,462	—	6,462	6,240
Executive Council	2,241	—	2,241	1,023
Mailing Costs	4,902	—	4,902	4,381
Public Relations	2,389	—	2,389	3,472
Publicity and Advertising	4,582	—	4,582	4,396
Printing	37,116	—	37,116	25,615

Special Projects:				
African Research Development	—	1,000	1,000	—
Field Representative	1,000	—	1,000	1,000
Gene-Splicing Conference	—	—	—	1,000
Geology	—	549	549	—
Middle East Tour	—	1,800	1,800	—
Printing - "TS" Project	—	2,732	2,732	59,942
Subscription Campaign	—	33,908	33,908	12,032
Third World Project	—	—	—	(78)
TV Series	—	1,199	1,199	1,860
Total	$89,520	$41,188	$130,708	$130,351

The accompanying notes are an integral part of these financial statements.

Canadian Scientific and Christian Affiliation Annual Report, 1991

Norman MacLeod of Ryerson Polytechnical Institute, President of CSCA, reports that local sections in Vancouver, Ottawa, Guelph and Toronto continue to be active. The Annual Conference was held at Spring Garden Church in Willowdale, Ontario with the theme, "The Church Prepares Students for College and University." Don Jost, Arthur Lee and Mark Haynes, pastors from three local churches, and John Franklin of Ontario Bible College joined Bob Vander Vennen and Dan Osmond in a program focusing on the preparation of students by church congregations for confronting the naturalistic world view of many colleges and universities.

Perspectives on Science and Christian Faith Report of the Editor, 1991

In this, the second year of my tenure, approximately 60 articles and communications have been received and we have accepted material in hand for the next six issues. The December 1991 and March 1992 issues will offer a representative sampling of " historical" papers offered at the ASA 50th Anniversary Meeting.

There is a continuing vigorous debate over the nature of our Journal. It is clear that one publication cannot meet the needs or desires of everyone. The ASA Editorial Board has discussed this issue at the last two Annual Meetings, and a "mission statement" is being prepared.

Jack Haas
Editor, *Perspectives*

Report of the *Perspectives* Book Review Editor — September 1990 - August 1991

During the past year 115 reviews were published, and the book review backlog which had developed has been eliminated. This was accomplished by soliciting fewer reviews, condensing some reviews, and publishing more reviews. The time from receipt of a book review until it is published has been shortened. More reviews of current books are being published. Fewer older books are being reviewed.

Richard Ruble
Book Review Editor, *Perspectives*

ASA/CSCANewsletter Annual Report, 1991

Six issues of the bimonthly ASA/CSCA Newsletter were produced in the past twelve months. Publishing the Oct/Nov 1991 issue, Number 5 of Volume 33, was one of the first tasks as ASA's new managing editor, Patsy Ames. Publication time, from receipt of the diskette containing the copy to mailing of the Newsletter, has been cut from about four weeks to three, though issues requiring layout of photographs or other illustrations sometimes take longer. The final Dec 91/Jan 92 issue of Volume 33 contains a whole page of photographs from the 1991 Annual Meeting at Wheaton College.

The editor thanks former managing editor Becky Petersen for her excellent work on the Newsletter. He also thanks Affiliation members for keeping him supplied with interesting material, particularly about their own activities.

Walter R. Hearn
Newsletter Editor

SEARCH: SCIENTISTS WHO SERVE GOD Annual Report, 1991

Three issues of SEARCH appeared in 1991 as inserts in *Perspectives on Science and Christian Faith*, as follows:

SEARCH NO. 12	March	John MacIntyre	physicist
SEARCH NO. 13	June	Gordon Mills	biochemist
SEARCH NO. 14	September	Aldert van der Ziel	physicist, electrical engineer

In a cost-cutting move, the Executive Council voted at its August 1991 meeting to drop SEARCH from three consecutive issues of *Perspectives*, starting with the December 1991 issue.

As of November 1991, copy for two more issues of SEARCH has been written and three additional potential subjects have been contacted. No. 14 was the first issue to be published posthumously: Dr. van der Ziel died in January 1991 before that issue of SEARCH was completed.

Walter R. Hearn
SEARCH Editor

Field Representatives Annual Report, 1991

Bill Monsma reports that ASA has been represented at section meetings in the North Central area and at 3M, at the University of Minnesota, and in various church classes on faith and science.

ASA membership has not increased in spite of these efforts, and the Executive Council has reluctantly decided, in view of budget constraints, to terminate our special relationship with Bill for the foreseeable future.

Affiliation of Christian Geologists Annual Report, 1991

The Affiliation of Christian Geologists (ACG) is now in its third year and continues to attract new members. Thanks to John Suppe, our newsletter was published twice during the past year. Ken Van Dellen officially became our treasurer even though he had been performing those duties since ACG's beginnings.

Our business meeting was held in conjunction with the ASA meeting at Wheaton. Approximately 20 geologists were in attendance. ACG also had a place on the formal program at the annual meeting of the Geological Society of America held in San Diego in October.

We plan to gather at the 1992 Cincinnati GSA meeting. We invite suggestions for program ideas and Christian contacts in the Cincinnati area.

We applaud the excellent program activities of the Bakersfield, California chapter of ACG.

Davis A. Young
President, ACG

Affiliation of Christian Biologists Annual Report, 1991

The Affiliation is in its second year and sponsored another full day meeting prior to the Wheaton College Meeting. Twenty-six attended our second annual business meeting where special thanks was given to Russ Camp for his fine work as president during the first year. The new constitution was approved. Re-elected was Anne Whiting, secretary; Marilyn Flora, programs; Mike Sonnenberg, treasurer; and Roman Miller, newsletter editor. Two newsletters are planned for this year. We plan to meet again this summer.

Donald A. Munro
President, ACB

Computer Applications Committee Annual Report, 1991

We are in the process of updating the Journal data base and then will be distributing it early next year. I have generated a list of indexes of many of the most important topics in the Journal and these are suitable for printing. Therefore, we are on our way to generating and printing the Journal by subject index. I will be sending these to headquarters for review by January.

We can always use clerical help in formatting and printing. If anyone would like to help with this, please contact Paul Arveson.

Paul Arveson
Chairman, Computer Applications Committee

"Looking to the Future and Across the Globe"

The

American Scientific Affiliation's

1992 Annual Meeting

in

Kona, Hawaii, July 31 - August 3

U.S. Postal Service
STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION
(Required by 39 U.S.C. 3685)

1A. Title of Publication	1B. PUBLICATION NO.	2. Date of Filing
Perspectives on Science and Christian Faith	2 8 3 - 7 4 0	09-30-91
3. Frequency of Issue: Quarterly	3A. No. of Issues Published Annually: 4	3B. Annual Subscription Price: $25.00

4. Complete Mailing Address of Known Office of Publication (Street, City, County, State and ZIP+4 Code) (Not printers): P. O. Box 668 Ipswich, MA 01938-0668

5. Complete Mailing Address of the Headquarters of General Business Offices of the Publisher (Not printers): P. O. Box 668 Ipswich, MA 01938-0668

6. Full Names and Complete Mailing Address of Publisher, Editor, and Managing Editor (This item MUST NOT be blank)

Publisher (Name and Complete Mailing Address): American Scientific Affiliation P. O. Box 668 Ipswich, MA 01938

Editor (Name and Complete Mailing Address): Dr. J. W. Haas, Jr. American Scientific Affiliation P.O.Box 668 Ipswich, MA 01938

Managing Editor (Name and Complete Mailing Address): Patricia Ames, American Scientific Affiliation P.O.Box 668 Ipswich, MA 01938

7. Owner (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual must be given. If the publication is published by a nonprofit organization, its name and address must be stated.) (Item must be completed.)

Full Name	Complete Mailing Address
American Scientific Affiliation	P.O.Box 668, Ipswich, MA 01938

8. Known Bondholders, Mortgagees, and Other Security Holders Owning or Holding 1 Percent or More of Total Amount of Bonds, Mortgages or Other Securities (If there are none, so state)

Full Name	Complete Mailing Address
None	None

9. For Completion by Nonprofit Organizations Authorized To Mail at Special Rates (DMM Section 423.12 only)
The purpose, function, and nonprofit status of this organization and the exempt status for Federal income tax purposes (Check one)

(1) [X] Has Not Changed During Preceding 12 Months (2) [ ] Has Changed During Preceding 12 Months (If changed, publisher must submit explanation of change with this statement)

10. Extent and Nature of Circulation (See instructions on reverse side)	Average No. Copies Each Issue During Preceding 12 Months	Actual No. Copies of Single Issue Published Nearest to Filing Date
A. Total No. Copies (Net Press Run)	4091	4060
B. Paid and/or Requested Circulation 1. Sales through dealers and carriers, street vendors and counter sales	0	0
2. Mail Subscription (Paid and/or requested)	3530	3548
C. Total Paid and/or Requested Circulation (Sum of 10B1 and 10B2)	3530	3548
D. Free Distribution by Mail, Carrier or Other Means Samples, Complimentary, and Other Free Copies	345	258
E. Total Distribution (Sum of C and D)	3875	3806
F. Copies Not Distributed 1. Office use, left over, unaccounted, spoiled after printing	216	254
2. Return from News Agents	0	0
G. TOTAL (Sum of E, F1 and 2—should equal net press run shown in A)	4091	4060

11. I certify that the statements made by me above are correct and complete. Signature and Title of Editor, Publisher, Business Manager, or Owner: Frances Poloschuk Financial/List Manager

PS Form 3526, Feb. 1989 (See instructions on reverse)

WHAT EXACTLY IS THE AMERICAN SCIENTIFIC AFFILIATION?

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

HOW DO I JOIN THE ASA?

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

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

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

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

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

MEMBERSHIP/FRIEND OF ASA APPLICATION/SUBSCRIPTION FORM

(Subscribers complete items 1-3 only)

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

1) Name (please print) _____ Date _____

2) Home address _____

_____ Zip _____ Phone _____

Office address _____

_____ Zip _____ Phone _____

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

4) Place of birth _____ Date of birth _____

Marital status _____ Sex ____ Citizenship _____

Is spouse a member of ASA? _____ Eligible? _____

5) ACADEMIC PREPARATION

Institution	Degree	Year	Major

Field of study (major concentration) _____

Area of interest (20 character limit) _____

Recent publications _____

Please complete back of this form ☞

WHAT DOES THE ASA BELIEVE?

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

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

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

WHY MUST THERE BE AN ASA?

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

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

Church Affiliation _____

What was your initial contact with the ASA? _____

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

Name _____

Street _____

City _____ State _____ Zip _____

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

STATEMENT OF FAITH

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

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

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

Amount enclosed _____ Category _____

Please mail to: American Scientific Affiliation, P.O. Box 668, Ipswich, MA 01938

OTHER RESOURCES AVAILABLE FROM ASA

"Teaching Science in a Climate of Controversy"is a 48-page booklet that guides science teachers in presenting origins with accuracy and openess. It is available from the Ipswich office for: $6.00/single copy; $5.00/2-9 copies (sent to same address); $4.00/10 or more copies (sent to same address).

Gift subscriptions to *Perspectives on Science & Christian Faith* are also available. Give the gift of challenging reading for $20/year.

Please enter gift subscriptions for:

Name _____

Address _____

City _____ State _____ Zip _____

Name _____

Address _____

City _____ State _____ Zip _____

We believe that honest and open study of God's dual revelation, in nature and in the Bible, must eventually lead to understanding of its inherent harmony.

The ASA is also committed to the equally important task of providing advice and direction to the Church and society in how best to use the results of science and technology while preserving the integrity of God's creation.

AS A MEMBER YOU RECEIVE:

- ASA's bimonthly Newsletter.
- ASA's science journal, *Perspectives on Science & Christian Faith*, the outstanding forum for discussion of key issues at the interface of science and Christian thought.
- Discount on *Contemporary Issues in Science & Christian Faith: An Annotated Bibllgraphy*, the ASA Resource Book — a catalog of science books and tapes on current issues of concern.
- ASA's Membership Directory.
- Opportunities for personal growth and fellowship, through meetings, conferences, field trips, and commissions.
- *Search: Scientists Who Serve God*, an occasional publication relating current trends in science and the people involved in them.

* * * * *

THE CANADIAN SCIENTIFIC & CHRISTIAN AFFILIATION was incorporated in 1973 as a direct affiliate of the ASA, with a distinctly Canadian orientation. For more information contact:

Canadian Scientific Affiliation
P.O. Box 386
Fergus, Ontario N1M 3E2 CANADA

The American Scientific Affiliation

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

Canadian Scientific & Christian Affiliation

A closely affiliated organization, the Canadian Scientific and Christian Affiliation, was formed in 1973 with a distinctively Canadian orientation. The CSCA and the ASA share publications (*Perspectives on Science & Christian Faith* and the *ASA/CSCA Newsletter*). The CSCA subscribes to the same statement of faith as the ASA, and has the same general structure; however, it has its own governing body with a separate annual meeting in Canada.

LOCAL SECTIONS

of the ASA and the CSCA have been organized to hold meetings and provide an interchange of ideas at the regional level. Membership application forms, publications, and other information may be obtained by writing to: American Scientific Affiliation, P.O. Box 668, Ipswich, MA 01938, USA or Canadian Scientific & Christian Affiliation, P.O. Box 386, Fergus, ONT N1M 3E2, CANADA.

Central California	Chicago-Wheaton	Delaware Valley	Eastern Tennessee	Guelph, ONT
Indiana-Ohio	New England	NY-New Jersey	North Central	Oregon-Washington
Ottawa, ONT	Rocky Mountain	St. Louis	San Diego	San Francisco Bay
South Central	So. California	Southwest	Toronto, ONT	Vancouver, BC
Virginia-Kentucky	D.C.-Baltimore	Western Michigan	Western New York	

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);
Vol. 39-41	(1987-1989),	Perspectives	42,	65-72	(1990).

A keyword-based on-line **subject index** is available on 5 1/4" computer disks for most IBM compatible computers with a hard disk or two floppy disk drives. It includes all software and instructions, and can be ordered from the ASA Ipswich office for $20.

Articles appearing in *Perspectives on Science and Christian Faith* are abstracted and indexed in the CHRISTIAN PERIODICAL INDEX; RELIGION INDEX ONE: PERIODICALS; RELIGIOUS & THEOLOGICAL ABSTRACTS, and GUIDE TO SOCIAL SCIENCE AND RELIGION IN PERIODICAL LITERATURE. Book Reviews are indexed in INDEX TO BOOK REVIEWS IN RELIGION. Present and past issues of *Perspectives* are available in microfilm form at a nominal cost. For information write: University Microfilm Inc., 300 North Zeeb Rd., Ann Arbor, MI 48106.

ARTICLES

COMMUNICATION

ESSAY REVIEW & BIOGRAPHICAL SKETCH

BOOK REVIEWS

"Upholding the Universe by His Word of Power" Hebrews 1:3

VOLUME 44 NUMBER 1 **MARCH 1992**