JOURNAL OF THE
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Evangelical Perspectives on Science and the Christian Faith

Expanded Oxford issue . . .

Scientific and Theological Descriptions

Legend of the Shrinking Sun

Interpreting Genesis One

Spirituality and Science

Summing Up

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

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Putting Things in Perspective

As we announced in June, this is the second of two expanded issues of the *Journal*. Now for September all of the major papers and one communication were originally given at the 1985 Oxford meeting with our friends of the Research Scientists Christian Fellowship. More of these papers will appear in December.

Dick Bube analyzes five approaches to the relationship between science and theology: theology-first, science-first, conflict, compartmentalization, and complementarity (science and theology say different things about the same things). He concludes that only complementarity allows for significant integration of the two sources of knowledge. I have recently been reading Andrew White's *A History of the Warfare of Science with Theology in Christendom* with its emphasis on conflict and science-first. In the light of that, Dick's approach is a welcome breath of fresh air.

Howard Van Till, author of the recently released *The Fourth Day* (Eerdmans, 1986), discusses in detail the controversy surrounding "creation-science" and its all too ready acceptance of a rapidly shrinking sun as evidence of a young earth. The more recent discovery of an 80-year oscillation should be a warning that too hasty commitment to a claim of science which appears to prove our pet theory damages "the credibility of the Christian witness to a scientifically knowledgeable world." I am reminded of the astute observation of Harold Nebelsick in our June 1986 *Journal*: "Since science is on the move, should theology marry it today, theology might well be widowed tomorrow."

Charles Hummel, author of *The Galileo Connection* (IVP, 1986), gives us a key chapter from that significant book. In this paper Charlie emphasizes that biblical interpretation "must deal with three elements: historical context, literary genre and textual content." His emphasis on the importance of all three elements is in healthy contrast to the tendency of many Christians to manipulate textual content and/or science to devise simple theories. All too often we tend to assume that God gave His written word with only the twentieth century western world in mind. How can we, who believe that God's grace is for *all* peoples, be so arrogantly provincial?

On a very different subject, David Moberg discusses the problems and the promise of scientific studies of spiritual phenomena. To those of us who sometimes feel uncomfortable with investigators' biases, reductionism, and abuse in the "hard sciences," it may be a bit disconcerting to read about things like "Spiritual Distress Scale" and "Religious Life Scales." However, such scales are being formulated by sociologists, and they need to be carefully evaluated by Christian social scientists.

Our last major Oxford paper in this issue is Donald MacKay's excellent *Summing Up*. I trust that this overview of the Oxford Conference will be meaningful to our readers who were unable to attend. Donald gives the real flavor of the meetings as he summarizes the major problem areas that were confronted, and he does this in his own inimitable way. "We are . . . not lap dogs, but sheep dogs. We are not pampered pets . . . we are commissioned agents." All Christians need to appreciate the "Comaraderie of Christian Fellowship" and to remember continually that "it is not an optional duty to help one another to be good, careful, fair, and honest thinkers in the sight of the God who is always over us, with us, in us, and who is disgraced if we are sloppy in our logical standards."

Among the Communications in this issue are Jack Haas's timely discussion of "Integrity in Science." We, both as Christians and as scientists, need to be careful that we are honest in our teaching, our research, and our writing. Raymond Frey reminds us that much of the disagreement and confusion in the creation/evolution debate is because of the inability and the unwillingness to accurately define our terms. Bruce Nilson discusses some of the basic differences between Christianity and humanism in science and in western thought. We continue our historical series by Raymond Seeger with a look at the life and religious inclinations of John Dalton.

WLB

The Relationship between Scientific and Theological Descriptions

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There are five fundamental patterns for relating scientific and theological descriptions. The first two approaches are based on the assumption that there is only one primary method of description and that other descriptions must be derived from it. (1) In the theology-first *approach a scientific description derived from a theological source takes precedence over a scientific description derived from scientific investigations. (2) In the symmetric* science-first *approach, theological descriptions must be derived from scientific descriptions in order to be relevant and meaningful.*

The other three approaches are based on the assumption that both scientific and theological descriptions can be constructed from activities within the two disciplines. (3) Scientific descriptions and theological descriptions give the same kind of information about the same kinds of categories. This leads to a conflict *approach in which apparent disagreement between the two descriptions must be settled by determining which is right and which is wrong. (4) Scientific descriptions and theological descriptions give different kinds of information about different kinds of categories. This* compartmentalization *approach allows no interaction between the two types of description. (5) Scientific descriptions and theological descriptions give different kinds of information about the same kinds of categories. This* complementarity *approach allows one to integrate insights from the different scientific and theological disciplines.*

When applied to the observed hierarchical structure of the scientific description of the universe, theology-first leads to a God-of-the-Gaps, science-first leads to a scientific pseudo-theology, conflict leads to a rejection of either scientific or theological descriptions, compartmentalization allows both types of descriptions to exist but removes their fundamental meaning and significance, and only complementarity provides a framework within which one can arrive at an integration of scientific and theological inputs to describe God's activity in creating and sustaining the universe.

The relationship between scientific and theological descriptions is one of the fundamental questions that must be faced in dealing with the interaction between science and theology, as is the possibility of their integration into a unified perspective. Do scientific descriptions tell us the way things are—whereas theological descriptions are only a subjective expression of personal preferences? What do we say about the Bible? Do our interpretations of the Bible provide us with scientific descriptions as well as theological ones?

How can we know "the truth?" Do theological interpretations give us the ultimate truth, while scientific descriptions provide only some incidental and relatively unimportant details? Or are scientific descriptions the only way human beings have to find out the truth about the world in which we live?[1]

A recognition of five basic patterns of relating scientific and theological descriptions is helpful in evaluating questions that fall in this area. The assessment following from this is that both scientific and theological descriptions are significant *and* incomplete, that we need both of them, and that their integration is what we should seek.

The Five Patterns of Interpretation

There are five patterns for the interpretation of scientific and theological descriptions. We first enumerate and define these patterns, and then in subsequent sections indicate more completely their characteristics. Finally we apply these patterns to the interpretation of the hierarchical structure of the scientific description of the universe in order to see the consequences of their application to a specific question.

Paper presented at the conference "Christian Faith and Science in Society," a Joint Meeting of the American Scientific Affiliation, Canadian Scientific and Christian Affiliation and the Research Scientists' Christian Fellowship, held July 26-29, 1985, at St. Catherine's College in Oxford, England.

The first two approaches are based on the assumption that there is only one primary method of description and that other descriptions must be derived from it.

(1) The *theology-first* approach. It is assumed that descriptions of any nature, whether scientific or theological, are derived first of all from an interpretation of the Bible. This involves the assumption that descriptions derived from theological sources are both relevant and sufficient to define related scientific descriptions, and that a scientific description derived from a theological approach takes precedence over a scientific description derived from scientific investigation.

(2) The *science-first* approach. This approach is symmetric to the theology-first approach: it is assumed that scientific descriptions derived from scientific investigation are the primary representations of reality, and that therefore theological descriptions must be derived from scientific descriptions in order to be relevant and meaningful.

The other three approaches are based on the assumption that both scientific and theological descriptions can be constructed essentially independently from activities within the two disciplines.

(3) The *conflict* approach. It is assumed that scientific descriptions and theological descriptions say the same kinds of things about the same things, i.e., that they provide the same kind of information about the same events or phenomena. If this is the case, then if the two descriptions are not essentially identical, one must be correct and one must be in error. The only course of action is to determine which to accept and which to reject.

(4) The *compartmentalization* approach. It is assumed that scientific descriptions and theological descriptions say different kinds of things about dif-

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ferent things, i.e., that they provide information of such different types that they cannot be integrated. Conflict is avoided by compartmentalization, but relevance to the real world tends to be negated for at least one of the descriptions for at least some of the time. In practice the individual is most likely to slip into a theology-first or a science-first position, rejecting the relevance of the other approach for daily living.

(5) The ***complementarity*** **approach.** It is assumed that scientific descriptions and theological descriptions say different kinds of things about the same things, i.e., that both descriptions deal with the same reality but provide insights into its nature from different areas of experience. The task that follows from an acceptance of the complementarity approach is the integration of scientific and theological descriptions to gain a more complete and faithful understanding of reality than can be provided by either one of these descriptions by itself.

Theology-First

It is evident that a perspective that places theological descriptions above scientific descriptions on every level must be rather disengaged from the modern spirit that tends, if anything, to over-evaluate science. It is probably true, therefore, that this position is seldom found in its pure state except in rather isolated, highly conservative Christian communities, and that in practice it tends to shift quickly toward the conflict perspective. Elements of its emphases are found, however, in the approach of defenders of absolute biblical inerrancy[2,3] who contend that whenever the Bible appears to speak on a subject with scientific content, it presents a true scientific description, capable of being compared with the scientific descriptions of modern science. In several crucial areas, therefore, it is assumed that authentic scientific descriptions (e.g., particularly in cosmogony) are given, and that scientific information is provided concerning such topics as the age of the earth, the origin of life, and the origin of human life.

The shortcomings of this approach need not be belabored here. It reflects in general a modern attempt to answer claims that Christian theism is not scientifically defensible in today's world by claiming scientific support for the inspiration and authority of the Bible. Such an approach runs the danger on the one hand of ascribing far too much significance to science, and far too little significance to the actual nature and purpose of the biblical literature, particularly that found in the early chapters of Genesis.[4,5]

Science-First

The other extreme approach of science-first arises from the conviction that modern scientific understanding makes impossible any traditional interpretation of the biblical record. This conviction then leads to one of two possibilities: (a) "scientific theology" in which traditional theological categories are reinterpreted in terms of modern scientific categories, or (b) "new age theology" in which philosophical speculations based loosely on modern science are used to generate a theological system that usually closely resembles that of Eastern monism.[6,7]

The theology-first *perspective reflects in general a modern attempt to answer claims that Christian theism is not scientifically defensible in today's world by claiming scientific support for the inspiration and authority of the Bible.*

"Scientific theology" is based on the presupposition that the modern scientific mind cannot accept truth under the categories set forth in the biblical record, that religious beliefs are wholly human products, and that the only way to preserve the essence of religious truth is to recast it into other more acceptable categories. The general result is usually an eclectic universalistic religion in which God has been replaced by nature, the kingdom of God by the natural system, the supernatural by anything not covered by common sense, truth by science, evil by the non-viable, and salvation by human survival.[8] Faith in the future depends on the hope that increasing knowledge will lead human beings to do what they ought to do to save themselves, i.e., to assure the survival of the human race. Unfortunately, the God who calls, empowers, forgives, loves and acts is no longer there.

"New age theology" moves beyond the objective universe of science and into a mysticism often supposedly based on the modern understanding derived from quantum mechanics. In its various manifestations it presents itself as a grand harmonization of science and religion, a final unification of the whole person. The various forms that this approach takes are too numerous to even elaborate on here,[7] but it is reasonably accurate to note that all of the forms find their most complete agreement with Eastern monism. Three specific critiques of this general approach are offered by Sire[9]: (a) it shares with naturalism and pantheistic monism the concept of a closed universe in which the

Self is all and ethical issues are largely irrelevant, (b) it reverses the historic Christian desacralization of nature by investing inanimate nature with spiritual qualities, and (c) it has no inner test for truth and leads to the ultimate relativism in which every system is equally valid.

A particular emphasis of this "new age theology" is on the importance of modern quantum mechanics as the source for philosophical and religious speculation.[10,11] The interpretation of the process of measurement in quantum mechanics, and the realization through the Heisenberg Uncertainty Principle that it is often not possible to separate the observer from the observed in any classical sense, are frequently taken as the sure scientific foundation for the assertion that there is no reality except that which we ourselves create. Sometimes wholly fantastic world views are spun out of this basic material, leading to claims of a new humanity, a new psychology, a universal mind, and a new religious consciousness.[12] It is essential here as elsewhere to discriminate plainly between what a particular scientific perspective *requires* us to believe and all of the presupposition-based interpretations, speculations and extrapolations that others may claim to be derived from science. In this case it appears that only a special identification of the mathematical structure of quantum mechanics with the nature of "the way things are" enables authors to derive such mystic conclusions, and that in fact there is nothing in quantum mechanics itself that demands or even actively supports such philosophical and religious speculations.[13–15]

Conflict

Historically the conflict perspective has been the popular conception of the interaction between science and theology. It has been fed by both Christians and non-Christians alike, who have agreed in principle when they should have disagreed. It is enshrined in the famous book by A. D. White, *A History of the Warfare of Science with Theology in Christendom.*[16]

Leaning on the theology-first perspective, naive Christians suppose that they already have the scientific answer to many important questions, and furthermore they believe that it is necessary *not* to have a scientific description of these events if one is to attribute the activity to God. They are supported by naive non-Christians leaning on the science-first perspective, who suppose that science provides the answers to most important questions, and believe that the existence of a scientific description of an event invalidates its consideration as God's creative activity. Paradoxically both Christians and non-Christians agree that one cannot have simultaneously meaningful scientific and theological descriptions! This agreement becomes evident as the possibility of scientific descriptions of previously undescribable events increases. The naive Christians reject the scientific descriptions because if they were accepted, they would do away with the evidence of God in their eyes. The naive non-Christians reject God because the scientific descriptions give a situation where there is "no need" for God. By insisting that either the scientific description or the theological description must be the only correct one, Christians and non-Christians reinforce their conflict mentality.

It is essential . . . to discriminate plainly between what a particular scientific perspective requires *us to believe and all of the presupposition-based interpretations, speculations and extrapolations that others may claim to be derived from science.*

Compartmentalization

What the conflict perspective has done historically, the compartmentalization perspective does every day in ordinary life. Men and women who have both a scientific commitment and a Christian commitment all too often think scientifically six days a week, and then think theologically on the seventh, with little attempt to resolve apparent interactions between them. During the week we can act as if the world were five billion years old, but on Sunday we can also act as if the world were 10,000 years old. We do not need to let these two apparently contradictory statements interact with one another at all, but simply hold them without inner thought as two quite different and non-interacting pieces of information.

It is easy to shift toward a theology-first or a science-first position in a practical sense. Scientifically inclined non-Christians regard theological descriptions as so much irrelevant speculation; indeed, many Christians seem to ignore them a large part of the time. Conversely, theologically inclined Christians regard scientific descriptions with suspicion, as inputs from an alien and unfriendly culture: one may have to live with these descriptions in the nitty gritty details of life, but it is certain that they contain no information of ultimate significance, and thus can easily be ignored. Again

Christians and non-Christians parodoxically agree: only one perspective is practically valid and significant. Not only can the other be safely neglected, or at least locked away in its own airtight compartment to be brought out only when appropriate, but it is safer and far simpler to neglect it.

Complementarity

Finally we come to the perspective of complementarity, the holding of both types of descriptions together, while recognizing their differences and yet appreciating their similarities, with the effort to integrate them into one whole picture that does justice to them both as different insights into the nature of reality.[17-19] The practice of an effective complementarity demands that the insights being integrated come from authentic science on the one hand (and the conviction that such a thing as "authentic science" is a relevant concept), and from authentic theology on the other hand (with the corresponding conviction that such a thing as "authentic theology" is a relevant concept). Strict efforts must be maintained to eliminate inputs from various kinds of counterfeit science and theology (pseudo-science and pseudo-theology).[20]

Men and women who have both a scientific commitment and a Christian commitment all too often think scientifically six days a week, and then think theologically on the seventh . . .

Why is it necessary to use such a complementarity approach? There are two basic reasons derived from the very nature of communication: (a) the limitations imposed on us when we try to describe something that is unknown in terms of what is known, the only choice available to us; and (b) the use of descriptions drawn from different areas of experience to describe the same event or phenomenon.

It is essential to realize that whenever we attempt to characterize something unknown that is not part of our regular experience, we have no choice available to us except to describe the unknown in terms of what is known to us. Since this description can never be complete, our descriptions in either science or theology cannot be *completely* accurate. In both science and theology we are involved with the expression of what things *are like*, employing similes, metaphors, analogies, models, pictures, and the like.[21-23]

Scientific descriptions commonly consist of *models* of the world being observed and described. These models do not describe the world completely or fully accurately (they certainly do not in any sense fully *explain* the world), but we believe (as a matter of personal scientific faith) that the better the model is, i.e., the more it corresponds to our perceptions of the world and allows us to predict new perceptions that can be tested, the more completely it images for us what reality *is like* (never necessarily what reality *is*). Such models are always changing as we gain new information and as we formulate new pictures and ways of looking at things more in agreement with our new information. This is the reason that it makes no sense to speak about God revealing to us the "true scientific model" in the Scriptures; the very nature of communication and revelation makes such a communication impossible.

This condition is not unique to scientific descriptions. Theological descriptions also make use of models (or metaphors) to reveal to us what God is like and what His relationship to the world is like. God Himself is pictured for us in the Scriptures under the models of Father, King, Husband, Bridegroom or even Hen. This means, for example, that there are attributes of fatherhood that accurately depict some of the qualities of the character of God; it certainly in no sense implies that God is wholly like a human father or that our human concept of fatherhood is adequate to describe the actual characteristics of God. Similarly the central biblical doctrine of the atonement is presented to us under various different models: healing, wholeness, redemption, reconciliation, sacrifice, legal substitution, and victory. No one of these models does full justice to the ultimate mystery of the atonement; yet we have a more complete description of God's activity in this event if we include the insights of all of these models than if we include the insights of only one or two.

Thus we often find it both expedient and necessary to use more than one metaphor to give a number of possible different perspectives on the unknown, providing a more complete representation than any single metaphor alone. As in the old story of the blind men describing an elephant, we know more completely what an elephant *is like* if we know that it is like a tree (its leg), a rope (its tail), a sail (its ear), a wall (its side), and a hose (its trunk), than if we had only one or two of these metaphors at our disposal (yet it is clear that we are a long way from knowing by this process what an elephant actually *is*). Such helpful and necessary multiple metaphors can properly be considered to be complementary to one another.

Particular models or metaphors give particular insights, but they each of necessity convey only partial and incomplete insights into the nature of reality. When we therefore use more than one model for more complete description, it is common to use scientific metaphors to describe scientific issues, and to use theological metaphors to describe theological issues. For example in science we find the complementary descriptions of an electron as a particle or as a wave are used depending on the type of experiment we perform to measure it. In theology we find the complementary descriptions of God/human relationships as Divine Sovereignty and human responsibility, again dependent on the type of perspective we are adopting. In all such cases it is critical that the right question be asked in order to get a meaningful ("the right") answer. To ask "Where is the electron when we are measuring its wave length?" is not a meaningful question; it violates the nature of the complementary metaphors being used. Similarly, the answer to "On whom does my salvation ultimately depend?" is "On God," but the answer to "Does my salvation depend on my choice to commit myself to Jesus Christ?" is "Yes."

Sometimes complementary descriptions are drawn from different realms of discourse and experience and are applied to the same event. This can happen within different levels of scientific investigation, as for example, with descriptions drawn from both chemistry and psychology to describe psychological aspects of whole human beings, or it can happen with both a scientific description (of one type or another) and a theological description being given for the same kind of event or phenomenon. Healing from disease can be appropriately described both in terms of antibiotic defense against infection and as the healing activity of God. To eliminate one description or the other decreases our understanding of the whole process; both are needed. The coming of rain can be appropriately described both in terms of hot and cold air masses and as the activity of God to provide support for the growth of crops. Although we do not yet have all the information necessary, it is likely that the origin of life can be appropriately described in terms of physical, chemical and biological processes, and in terms of the creative activity of God bringing something new into being. To be able to give a description in the scientific categories

by no means makes unnecessary, invalid, or meaningless a complementary description of the same event in theological categories. The opposite is also true; having a theological description does not rule out the significance of a scientific description of the same event or phenomenon. Ethical issues concerned with the beginning and ending of life must be informed by information drawn from the biological and psychological scientific areas *and* from insights provided by biblical perspectives on the value of human personhood.

The Scientific Structure of the World

Reflections on the scientific description of the structure of the world have led many thinkers[24-26] to conclude from different orientations that this structure can most adequately be conceived of as a hierarchically arranged system composed of interrelated parts and wholes.[27-30]

This structure can be described in an order corresponding approximately to increasing complexity of interaction as consisting of the following representative "levels": energy, elementary particles, atoms, molecules, inorganic matter, organic matter, living cells, plants, animals, human beings and human society. Corresponding to these various levels are the specific sciences: physics, chemistry, biology, physiology, botany, zoology, anthropology, psychology, and sociology. There are three main qualitative breakthroughs in this hierarchy; they occur at (a) the transition from non-matter to matter, (b) the transition from non-living to living, and (c) the transition from non-human to human. Among the material-based levels (i.e., excepting "energy") an apparent parts/whole relationship exists; e.g., a cell is the whole for an electron that is a part, or a cell is a part of an animal that is the whole. This same relationship could be alternatively pictured as a subsystem/system relationship. Reflection on the structure indicates that wholes have properties that are not manifested by the parts (there are systems properties not exhibited by the subsystems).

As is the case with all scientific "facts," the "fact" of the structure does not provide its own interpretation. Nor does the structure itself indicate the origin of the novelty manifested by the new properties of the wholes. The interpretation of this hierarchical structure depends critically on which of the five patterns of science/theology interaction is chosen to guide the interpretation. To conclude this paper we consider briefly the results of such interpretations.

The Theology-First Interpretation

Starting from the correct biblical premise that all novelty in the world must result from the free creative activity of God, the theology-first approach is led by its own presuppositions to argue that the origins of this novelty must be instantaneous, supernatural acts, incapable of being scientifically describable as process. The more dramatic and qualitative the degree of novelty involved, the more impelled is the theology-first approach to insist on a supernatural "intervention" of God and to deny the possibility of any "natural" (usually seen in this approach as implying "not related to God's activity") scientifically describable process. Therefore, particularly with respect to the origin of life and the origin of human life, the theology-first approach finds it essential to maintain that these were discontinuous, instantaneous, supernatural acts of God, impossible of description in scientific terms by their very nature. These "gaps" in the continuity of the hierarchical structure become, in fact, the test points for evidence for the existence and activity of God. In a somewhat paradoxical way, the present absence of a scientific description for these events becomes the scientific evidence for the existence of God!

Inevitably, therefore, a theology-first commitment leads to acceptance of a "God-of-the-Gaps" approach.[31] It is the gaps exposing current human ignorance in the hierarchical structure that are seized on as being the most significant. In extreme cases these are viewed as the only genuine instances of God's direct activity except for the initial *creatio ex nihilo*, a sharp distinction being drawn between the supernatural acts of God and the natural phenomena of the world (often almost regarded as the workings of a classical machine independent of God's continuing activity). Any proposed scientific descriptions of these major qualitative changes are regarded as being the result of anti-religious motivation and as constituting bad science that should be contested by theology-first proponents. Thus, again paradoxically, theology-first proponents find themselves heavily engaged in the scientific effort to demonstrate that science is unreliable.

The Science-First Interpretation

In our earlier discussion of the science-first approach, we indicated two major schools: "scientific theology" and "new age theology." It is not surprising that each of these schools adopts a somewhat different attitude toward the hierarchical structure of the world. It is a little surprising, however, that they adopt almost exactly inverse positions.

"Scientific theology" tends toward the approach of reductionism, which is the reason that within the terminology of this system "God" can become "nature," the "kingdom of God" can become the "natural system," *et cetera*. Reductionism advocates the position that the whole is no more than the sum of its parts. If

the parts are completely understood, then the whole is completely understood. The properties of the whole that seem to transcend the properties of the parts do not really do so, but merely seem that way to us because of their complexity. All phenomena, whether conventionally described in terms of biology, psychology, sociology or theology, find their only true and complete description in the physical and chemical description of the behavior of matter. Theology must be reduced to anthropology, psychology to biology, and biology to physics and chemistry. Only physics and chemistry are "real;" all other terms and concepts are only "shadow" constructions to cover ignorance.

The reductionist approach, therefore, regards the hierarchical structure as a convenient way of describing what today lies beyond our ability to describe in a more fundamental and significant way. Not only do the supposed gaps in the structure, discussed above as being central to the theology-first perspective, play no appreciable interpretive role, but they are not recognized as existing as *gaps* at all! The occurrence of novelty in the hierarchical structure of the world is demystified completely: it is the necessary consequences of the laws of nature operating sometimes within the context of chance.

The "new age theology" that is also based on the science-first approach takes an inverse approach. If reductionism claims that the properties of the whole are only illusory because they are not explicit in the parts, the "preductionism" (a word I believe I have coined for this context) of the "new age theology" claims that the properties of the whole are authentic *because* they are indeed implicit in the parts themselves. Qualities of "being alive" or "being conscious" should be considered as being intrinsically present in the atoms themselves since it is unthinkable that any properties should arise in the whole that are not at least implicitly present in the parts. In a statement that must be a hallmark of its genre, it is claimed that we can recognize the fundamental basis for fear (or hate) in the electron itself (since electrons obey Fermi-Dirac statistics that allow only one electron per state), and the fundamental basis for love in the photon itself (since photons obey Bose-Einstein statistics that allow more than one photon per state).[12]

Preductionists tend to emphasize the single organic unity of the universe so that necessary distinctions between properties of different configurations of matter tend to become blurred. It is common to be told that we are all part of one another; it is only a small step from a mystical interpretation of such a statement to the affirmation that we are all part of God, or that we are all in some sense God. The recognition of the hierarchical structure leads to the hypothesis that we are parts of God, and that God is simply the larger whole that embraces an organic universe. It might be claimed that if reductionism deals with novelty by demystifying it completely, preductionism deals with novelty by mystifying it completely. The two forms of the science-first perspective do agree on the absence or the insignificance of any gaps in the hierarchical structure, and it is this agreement that identifies them as stemming from the same sources, however different their appearance.

To be able to give a description in the scientific categories by no means makes unnecessary, invalid, or meaningless a complementary description of the same event in theological categories.

The Conflict Interpretation

The conflict approach looks at the hierarchical description of the structure of the world and concludes that there must be only one correct and proper type of interpretation. Since it is assumed that both scientific and theological descriptions tell us the same kinds of things about the same things, and since it is evident what kinds of things a scientific description tells us (mechanisms), it follows that we must demand that the theological descriptions also provide us with information about scientific mechanisms derived from theological interpretation, and on the other hand information about the same scientific mechanisms derived from scientific investigation itself. If they do not agree, it follows that one must be right and one must be wrong; one must be chosen and one must be rejected. Choice between them becomes the critical element of interpretation.

It is for this reason that the critical element of the conflict interpretation in the subject of creation, for example, is that one must choose between creation and evolution, between theistic action and atheistic meaninglessness. Either the world was created in six twenty-four hour days no longer than about ten thousand years ago ("as Genesis plainly says"), or the world was not created at all and there is no God. If we choose to maintain as an item of faith that there is a God and that He did create, then it follows that the vast edifice of science, involving for example dating based on radioac-

tivity, geological and paleontological methods (all of which appear to agree in indicating that the world is some five billion years old), must all be discounted and discredited with every means at our disposal. If, on the other hand, familiarity with scientific investigations and the apparent integrity of the methods used lead us to choose a scientific description of earthly origins, then it follows just as surely that the vast system of biblical doctrine, involving the doctrines of creation, redemption, justification, sanctification and glorification, must all be discounted and discredited with every means at our disposal.

The complementarity perspective is demanded by the requirements imposed when we attempt to describe the unknown in terms of the known, and when we try to apply descriptions from different realms of experience to the same event or phenomenon.

According to the conflict interpretation we must choose between seeing the hierarchical structure of the world as scientifically described as providing us with authentic insights into the structure of the world, or seeing this structure as rather incidental, our understanding instead being dominated by the necessity to superpose upon this structure (or at least to harmonize with this structure) our theological descriptions concerning the structure of the world. Novelty comes about *either* because of the creative activity of God exercised in supernatural acts of "intervention," *or* because of "natural processes" operating continuously in space and time through processes that can be scientifically described. It certainly cannot be both, and we must choose which to accept.

The Compartmentalization Interpretation

In the compartmentalization approach it is quite possible to hold both scientific and theological interpretations of the hierarchical structure of the world, for example, but no interaction is allowed between them, even if to all intents and purposes they appear to conflict. Whenever a person separates the various concerns of life into such different non-interacting compartments, the almost inevitable consequence is that both types of description lose at least some of their life-shaping significance. When interpretations really *matter*, it is not possible to keep them so separate that interaction and conflict are impossible.

Because of this inherent instability in the compartmentalization approach, it frequently develops that one of the descriptions comes to take on primary practical significance, with the consequence that the other description is retained only as a useful fiction or as a cultural attachment. In many other cases the attempt to resolve the issue by schizophrenic reaction to scientific and theological descriptions leads to the situation where neither description is accorded much value, and personal commitment to a particular perspective no longer has the motivation that is required. In such a situation both authentic science and authentic theology are the weaker.

The Complementarity Interpretation

In terms of the complementarity approach, an event in the life of a human being, for example, can be described on many different levels—in fact, on all of them: the physical, chemical, biological, anthropological, psychological, sociological and theological. To suppose that a description on one level is adequate for a *complete* description is to misunderstand the nature of the situation. We do not expect these different descriptions to give the same information, nor do we expect them to contradict one another. Rather we must integrate them to get as complete a picture of the human person as possible.

The hierarchical structure of the world is therefore interpreted to represent the different levels on which meaningful descriptions can be given. Scientific descriptions suggesting known or possible mechanisms or processes by which the hierarchical structure may have originated or may be understood today are applicable to all the levels of this structure and are not *a priori* excluded from any level or transition between levels. Similarly theological descriptions concerning the structure of the world and its relationship to God are not restricted to some particular gaps in human knowledge, but are relevant to the whole hierarchical structure, revealing it to be our present understanding of the nature of God's activity in that portion of reality susceptible to scientific description. To be able to give a description in the scientific categories by no means makes unnecessary, invalid, or meaningless a complementary description of the same event in theological categories. The opposite is also true; having a theological description does not rule out the significance of a scientific description of the same event or phenomenon.

The complementarity approach also gives particular insight into the question of the origin of novelty as this

is posed by the hierarchical structure. In general the whole is more than the sum of its parts. The whole has properties that are not exhibited by the parts. These properties are not necessarily *added* to the parts, but may often (if not always) arise from the specific pattern of interaction in which the parts are dynamically arranged. Thus the complementarity approach leads to the concept of the hierarchical emergence of new properties, in which the unique properties of more complex organizations of matter are real (as opposed to reductionism), but are not present in the parts making up the whole (as opposed to preductionism). Rather these new properties emerge as a characteristic of the whole (a systems property) when the structure of the interactions making up the whole is suitable to sustain them. The unique properties of the whole are not present even implicitly in the parts, but emerge when the parts participate in a particular, suitable pattern of interaction. It is the pattern of interaction that is responsible for the real properties of the whole, a pattern that is not demanded by the properties of the parts but shapes and focuses their interaction in the same way that boundary conditions shape and focus the solutions of a differential equation.

Where do these boundary conditions come from? From within the confines of the scientific perspective, we are often led to reply that they occur "by chance." But we should not suppose that this is an anti-religious or non-teleological assertion. From the perspective of scientific description, the appearance of novelty requires the presence of a scientific chance description (rather than a scientific deterministic description in which there is no room for novelty). But it is precisely at this point that the complementary theological description of novelty arising from God's free activity makes its most significant contribution.

Summary

After the overview provided above we may summarize some basic conclusions. The complementarity approach appears to be the most suitable for preserving the integrity of both authentic scientific and authentic theological descriptions of the world, and to provide the framework within which their integration can be worked out.

The complementarity perspective is demanded by the requirements imposed when we attempt to describe the unknown in terms of the known, and when we try to apply descriptions from different realms of experience to the same event or phenomenon.

A complementarity perspective is illustrated by the set of hierarchical scientific descriptions that we can apply to describe the scientific structure of the universe, and is consistent with adding also those insights available to us through revelation in a theological description.

A complementarity perspective allows us to integrate the development of novelty through what we describe scientifically as hierarchical emergence of new properties with what we describe theologically as the continuous free activity of God.

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The Legend of the Shrinking Sun

A Case Study Comparing Professional Science and "Creation-Science" in Action

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In recent years, advocates of the young earth hypothesis have assembled numerous lists of "scientific evidences" for their recent creation scenario. In this paper we critically evaluate the scientific adequacy of one such evidential claim of "creation-science," viz., that the sun's diameter has been shrinking in such a manner as to preclude the credibility of the standard multibillion-year chronology for terrestrial history. Within the professional scientific community, a preliminary report which suggested a long-term and rapid shrinkage of the sun presented a puzzle for solar astronomers. Consequently, additional studies were made and the credibility of the original data was re-evaluated. The result is that secular shrinkage has not *been substantiated, but an 80-year oscillatory behavior was discovered. Within the "creation-science" community, however, the response to the original report has been remarkably different. The suggestion of rapid long-term shrinkage was uncritically accepted, the evidence and conclusions drawn from subsequent studies were generally dismissed, and extrapolations of the presumed rapid solar shrinkage have been performed without restraint. Isolated from the corrective of continuing professional investigation and evaluation, the "creation-science" community continues to employ this unwarranted extrapolation of a discredited report as a "scientific evidence" for a young earth. The credibility of the Christian witness to a scientifically knowledgeable world is thereby clouded.*

Lists and Letters

Advocates of the young earth hypothesis frequently publish extensive lists of "scientific evidences" which, they claim, provide observational support for their recent creation scenario.[1] A typical entry on such a list presents the results of some empirical investigation, often drawn from the professional scientific literature, and interprets the data in such a way as to reach the conclusion that the universe cannot be billions of years old. And if, as the "evidence" purports to demonstrate,

cosmic history does not span the lengthy time period incorporated into the standard evolutionary scenario, then, according to the young earth proponents, the universe must have been recently created in a mature and fully functioning form by divine fiat.

Although those of us who are trained in the natural sciences may scoff at these lists as having little scientific merit, we must be aware of their persuasive impact on the Christian community and of their negative effect on the Christian witness to a scientifically knowledgeable world. Christians who are not specialists in one of the sciences can easily be misled by claims presented as "scientific evidences" for a recent creation. Numerous intelligent Christians have already been persuaded by these lists that a recent creation scenario is supported by a wealth of empirical evidence. However, if the Christian message of redemption becomes associated with a picture of cosmic history that is convincingly contradicted by the results of honest and competent scientific investigation, the Christian witness may be seriously weakened. It is imperative, therefore, that we carefully evaluate the scientific adequacy of the youthful universe "evidences," and that we communicate this evaluation to the Christian community of which we are members.

In this paper we focus on a typical example of an appeal to empirical support for the young universe hypothesis. I have chosen an example from astronomy—the phenomenon of variations in the diameter of the sun. My choice is not entirely arbitrary. This example is the first item on a brief list which was recently published as a letter to the editor of the *The Banner*, the weekly publication of the Christian Reformed Church (the denomination of which I am a member). The writer of this letter introduced himself as "an engineer from MIT and a student of the scientific creation account given in Genesis 1" who wished to inform the editor of "recent findings that point to a very young earth."[2] The first of these "findings" concerns the shrinking sun phenomenon: "The sun has been observed to shrink in size at the rate of five feet per hour. At this rate the sun would have been so large 20 million years ago that it would have touched the earth."

Reports concerning the possibility of a rapidly shrinking sun have had an interesting history. The initial report of evidence for rapid shrinkage can be found in the professional scientific literature. However, as the ensuing discussion will demonstrate, that report failed to survive the critical evaluation of the scientific community. Subsequent investigations have revealed a history of variations in solar diameter quite different from the steady five feet per hour shrinkage cited above. The literature of professional solar astronomy documents this corrective evaluation with characteristic thoroughness. In the literature of the young earth advocates, however, the shrinking sun report has had a remarkably different history. While professional science continued to plod laboriously along the path of information gathering, data analysis, and theory evaluation, the "creation-science" community accepted the initial report with little critical review and employed extrapolations of solar shrinkage to argue against the conventional multibillion-year solar chronology. What began as an interesting puzzle in the arena of solar astronomy has been transformed into a "proof" for recent creation. The story of the shrinking sun has become one of the legends that comprise the folk-science of recent creationism.

Solar Shrinkage: The Investigation of a Puzzle

In June, 1979, a paper entitled "Secular Decrease in the Solar Diameter, 1836–1953" was presented at a meeting of the American Astronomical Society.[3] In this report, John Eddy, a respected solar astronomer, and his colleague Aram Boornazian presented an analysis of solar meridian transit data from the Royal Greenwich

An abbreviated version of this paper was presented at the ASA/RSCF conference at Oxford, England in July, 1985.

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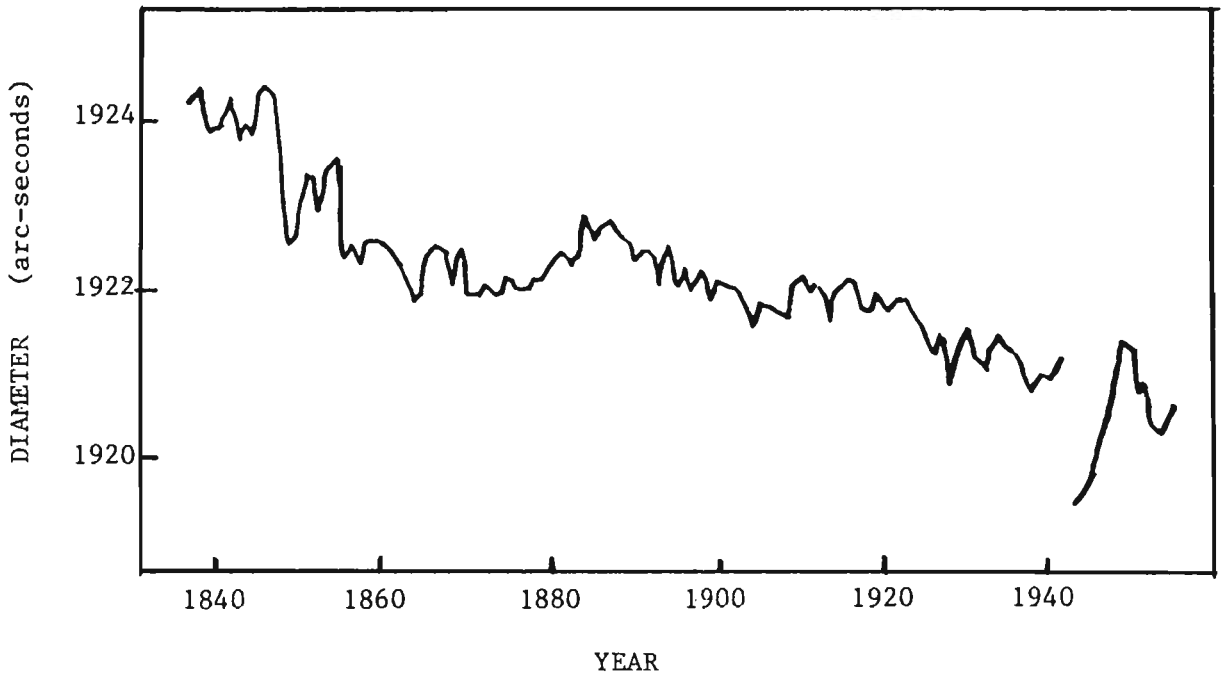

Figure 1. The horizontal (east-west) diameter of the sun from 1836 to 1953 as determined by Eddy and Boornazian from the Royal Greenwich Observatory data. (This figure is adapted from the diagram published in *Physics Today*, ref. 4.)

Observatory which suggested that during the specified time period the sun's angular diameter had been contracting at a rate of more than two arc seconds per century, equivalent to a linear shrinkage rate of five feet per hour. Figure 1 shows how the Greenwich data encourage such a conclusion. Furthermore, the case for solar shrinkage over an extended time period appeared to be strengthened by an appeal to a 1567 report of a solar eclipse which suggested that the eclipse was annular rather than total.[4] If the sun had been the same size then as now, a total eclipse should have been observed.

Eddy and Boornazian's report generated considerable interest because it presented the astronomical community with a puzzle: if the sun has behaved in the manner suggested by that report, then the sun has been far more variable than paleoclimatic evidence and conventional solar models have led us to believe. It was the combination of extended duration and high rate of variation in the sun's diameter that was puzzling. Rapid changes of short duration can be understood in terms of numerous transient and oscillatory phenomena. Relatively slow change, either contraction or expansion, extending over a period of hundreds or even thousands of years could also be the consequence of oscillatory or temporary changes in the behavior of the solar interior.[5] But a truly secular shrinkage, that is, a steady decrease in size over an indefinitely long period of time, would be at odds with contemporary models of solar behavior and inconsistent with geological evidence.

Prior to the discovery of the process of thermonuclear fusion, gradual gravitational contraction (commonly called "Helmholtz contraction") appeared to be the most likely candidate for the energy generating process in stars, including the sun. Since the 1930's, however, astrophysicists have become convinced that the thermonuclear fusion process is responsible for maintaining stellar luminosity. According to contemporary stellar models, the physical conditions that prevail within the core of a star make the fusion process unavoidable. As a consequence of changes brought about by thermonuclear fusion, a slow secular increase in stellar size is predicted—far too slow to observe with present instrumentation, but a secular *increase* nonetheless.

In the context of this prediction, Eddy and Boornazian's suggestion of a rapid secular *decrease* in solar diameter was especially intriguing. Even the *rate* of decrease was difficult to understand. Because a shrinkage rate of five feet per hour is hundreds of times greater than Helmholtz contraction could sustain, Eddy proposed that only the outermost, low density

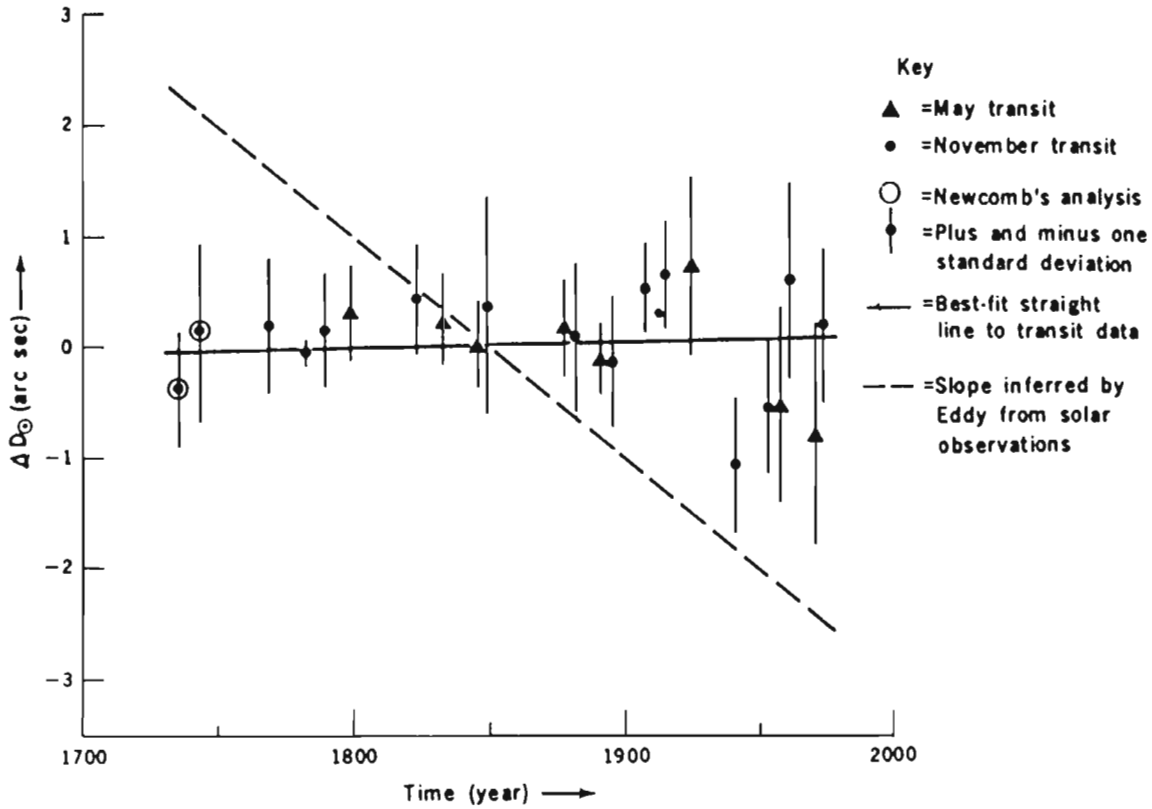

Figure 2. The diameter of the sun from 1723 to 1973 as computed by Irwin Shapiro from Mercury transit data. The dashed line represents the Eddy and Boornazian rapid shrinkage rate. (Diagram taken from ref. 7)

portion of the sun was involved in contraction. In this way the rate of gravitational energy conversion into heat could still be lower than the sun's luminosity value. Even with this interpretation, however, Eddy and Boornazian's report was provocative and it stimulated a heightened interest in both the rate and duration of variations in the sun's size.

The rate of solar shrinkage suggested by Eddy and Boornazian was disputed from the outset. In the same month that Eddy and Boornazian's preliminary report was presented, S. Sofia, J. O'Keefe, J. R. Lesh and A. S. Endal published an article in *Science* which expressed the judgment that, on the basis of available data (mostly from meridian transit observations), the sun's angular diameter did not diminish by more than 0.5 arc second between 1850 and 1937.[6] This value was less than one-fourth the rate proposed by Eddy and Boornazian.

In addition to the timing of solar meridian transits, other observations can be employed to determine the sun's diameter. In 1980, Irwin Shapiro published his analysis of the transits of Mercury in front of the sun from 1736 to 1973.[7] Shapiro concluded that no significant change in the sun's diameter could be detected, and that the maximum shrinkage rate allowed by the data was 0.3 arc second per century, about one-seventh of the Eddy and Boornazian value. Figure 2 illustrates how the Mercury transit data contradict the Eddy and Boornazian proposal. Similarly, D. W. Dunham *et alia* analyzed solar eclipse data and concluded that between 1715 and 1979 the sun's diameter may have decreased, but only by 0.7 arc second, equivalent to a rate of about 0.25 arc second per century.[8]

The discrepancy between these results and the report by Eddy and Boornazian called for a second look at the solar meridian transit data. John H. Parkinson, Leslie V. Morrison and F. Richard Stephenson performed such a re-evaluation and concluded that the trends in the Greenwich data reported by Eddy and Boornazian "are the result of instrumental and observational defects rather than real changes."[9] In their judgment, based on the combined data sets of the Mercury transit and total solar eclipse observations, *no* secular change over the past 250 years was detectable, but a cyclic change with an 80-year periodicity was indicated. In an extensive article published in the *Astrophysical Journal*, R. L.

Gilliland confirmed the presence of a 76-year periodic variation in the sun's diameter, but suggested that the data do allow for a very small long term shrinkage at the rate of 0.1 arc second per century during the past 265 years.[10]

During the past two years, additional papers have been published which reinforce the conclusion that secular changes in solar diameter cannot be confirmed by available data, but numerous oscillatory phenomena have been verified. Parkinson, for example, in a 1983 paper, states that solar eclipse and Mercury transit measurements "confirm that there is no evidence for any secular changes in the solar diameter, with a reduced upper limit. However, there is increased support for an (approximately) 80-year cyclic variation."[11] And, according to Sofia *et alia*, "Solar radius changes are not secular (monotonic and uniform)."[12] In 1984, Claus Frohlich and John Eddy reported the results of recent measurements of solar diameter.[13] Of particular relevance to the present discussion is the result that during the period from 1967–80 the sun exhibited an *increase* in diameter at the mean rate of 0.03 arc second per year, equivalent to a linear rate of eight feet per hour. Since 1980 the solar diameter has remained nearly constant, with a weak suggestion of decreasing. This behavior is remarkably consistent with the 76-year periodic behavior found by Parkinson and Gilliland, for which a broad maximum would be expected in the mid-1980's.

What began as an interesting puzzle in the arena of solar astronomy has been transformed into a "proof" for recent creation.

Where did Eddy and Boornazian go wrong? It appears that the Greenwich data contain some systematic errors which limit their reliability. As noted by Parkinson *et alia* (see ref. 9), there were significant changes in both the methodology and the instrumentation employed in obtaining the Greenwich data. A number of discontinuities in the data can be correlated with these changes. Such phenomena, along with significant variations in both the skill of observers and the quality of observing conditions, place severe limitations on the reliability of some of the Greenwich data and on the credibility of the Eddy and Boornazian proposal concerning rapid solar shrinkage. The data on which Eddy and Boornazian based their conclusions are plagued with subtle flaws.

Reflections on the Professional Approach

This brief sketch of the past six years of investigation regarding solar size variations has concentrated on observational matters; we have not dealt extensively with theories concerning the physical processes which might generate these variations. Furthermore, we have been most concerned with secular or long term variations, and have chosen not to discuss a number of short term oscillations and fluctuations. In spite of these limitations, however, what we have considered here does provide us with an illustrative case study of the way in which professional natural science is performed. Let us highlight some of the characteristic features of this episode.

The question of solar size variations is interesting mostly for its relevance to other phenomena. The temporal development of the sun's radius is an integral part of any theoretical model for solar behavior. Episodes of gravitational contraction, for instance, might be relevant to the resolution of the neutrino puzzle. And scientists who are interested in the history of the terrestrial climate are concerned to investigate the relationship of variations in solar radius to variations in the rate at which earth receives solar energy.

Eddy and Boornazian chose to look for variations in solar diameter by investigating historical records of solar meridian transits. Their preliminary results suggested a long term contraction at a surprisingly high rate. Though they did not consider their results ready for formal publication, Eddy and Boornazian decided to present their puzzle in a brief talk at a meeting of the American Astronomical Society. In this way the professional scientific community could join them in a critical evaluation of the data and their interpretation.

Where did Eddy and Boornazian go wrong? It appears that the Greenwich data contain some systematic errors which limit their reliability.

The response of the scientific community was precisely as one should expect. Various investigators began to consider other relevant phenomena which might shed light on the puzzle. Data from solar eclipse observations and transits of Mercury, for example, were employed to generate independent computations of variations in solar diameter. The reliability of the meridian transit data was carefully scrutinized. And

the results of these several investigations were published for further community evaluation.

By now the puzzle has largely been solved. The possibility of long term rapid shrinkage is *not* supported by the data. On the question of secular contraction or expansion at a very slow rate, the data are inconclusive. The limited precision of the data and the limited duration of the historical record preclude the employment of these data as the basis for any conjecture concerning the sun's size before about 1700. Any extrapolation of transit or eclipse data beyond three or four centuries is entirely unwarranted. Geological evidence for terrestrial climate variations provides a far more reliable indicator of solar dimensions prior to 1700. All of the variation in solar diameter that is revealed by the transit and eclipse data can be identified with oscillatory and transient effects. The 80-year oscillation confirmed by this data had been anticipated on the basis of clues drawn from sunspot cycles. While the investigations discussed in this paper have not resolved the neutrino puzzle, neither do they offer any substantial encouragement for doubting that thermonuclear fusion is responsible for energy production in the sun. In fact, paleoclimatic evidence clearly discourages such a conjecture. And because of the strong influence of solar history on terrestrial history, conjectures concerning the history of solar behavior should never be made in isolation from a consideration of the physical record of terrestrial history.

From Puzzle to Proof: The Creation of a Legend

The puzzling report that there was evidence to suggest a rapid shrinkage of the sun over several centuries was quickly adapted by the "creation-science" community for use as a "scientific evidence," or "proof," for a very young earth. Without the extended duration of cosmic history, the concept of cosmic evolution would appear to be untenable. And, according to the proponents of "creation science," if evolution over a multibillion-year period did not take place, then creation (restricted to acts of inception) must have occurred during a very busy week about 10,000 years ago. Let us explore for a time how the shrinking sun report has been employed to function as an "evidence" in support of the young earth hypothesis.

The basic framework is set in place by Russell Akridge. The Institute for Creation Research publishes a monthly series of brief, popular level "vital articles on science/creation" under the heading of *Impact*. The April 1980 issue, entitled "The Sun is Shrinking," is written by Akridge, a physicist at Oral Roberts University. Two elements characterize his approach: (1) an unquestioning acceptance of the solar shrinkage rate proposed by Eddy and Boornazian in 1979, and (2) an unrestrained extrapolation of that behavior into the indefinite past. Employing this approach, Akridge calculates that 100,000 years ago the sun would have been twice its present size, and that 20 million years ago it would have been as large as earth's orbit, thereby precluding a multibillion-year duration for cosmic history and discrediting all concepts of evolution.

To speak of the Eddy and Boornazian result (published only as an abstract) as if it had convincingly established the occurrence of long term solar shrinkage constitutes a failure to exercise appropriate restraint in employing the results of a single investigation.

According to Akridge, not only does the shrinking sun phenomenon cast doubt on the standard chronology for terrestrial history, but it also has the potential for destroying the credibility of conventional astrophysical models for stellar behavior, ultimately dismantling the very concept of stellar evolution. By assuming that gravitational contraction has now been amply demonstrated, Akridge concludes that the identification of thermonuclear fusion as the solar energy source is seriously threatened. In his words:

> The discovery that the sun is shrinking may prove to be the downfall of the accepted theory of solar evolution. . . . The entire theoretical description of the evolution of the universe may be at stake. . . . The changes detected in the sun call into question the accepted thermonuclear fusion energy source for the sun. This, in turn, questions the entire theoretical structure upon which the evolutionary theory of astrophysics is built.[14]

These are bold claims, asserting the imminent collapse of a major portion of the contemporary paradigm of astrophysics. The credibility of a scientific claim, however, is established not by its boldness, but by its adequacy to account for physical phenomena in an accurate, coherent and fruitful manner. How well do Akridge's claims hold up under the ordinary tests for scientific adequacy?

In order to support his assertions, Akridge must establish at least these two points: (1) that solar contraction over a period of a century or more is convincingly demonstrated by the empirical evidence; (2) that

a contraction in the sun's diameter, if observed during a period of a few centuries, may be extrapolated indefinitely into the past. On the first point, Akridge is already on shaky ground. Recall that the 1979 paper published by Sofia *et alia* placed a much lower limit on

In their judgment, . . . no *secular change over the past 250 years was detectable, but a cyclic change with an 80-year periodicity was indicated.*

the rate of any possible shrinkage. Furthermore, the results of investigation concerning related phenomena, such as Mercury transits or solar eclipse observations, had not yet been published. Thus, to speak of the Eddy and Boornazian result (published only as an abstract) as if it had convincingly established the occurrence of long-term solar shrinkage constitutes a failure to exercise appropriate restraint in employing the results of a single investigation. Though it may not have been apparent to his untrained readers, Akridge's uncritical acceptance of a single report—a report greeted with skepticism by the relevant professional community, a preliminary report not yet tested by comparison with other relevant studies—represents a serious failure to perform with integrity the critical evaluation expected of professional scientists.

The second failure is considerably more obvious. Not only does Akridge unquestioningly accept the Eddy and Boornazian preliminary result as if it had firmly established solar shrinkage, he extrapolates that behavior indefinitely into the remote past. Assuming, without sufficient warrant, a constant shrinkage rate, Akridge leads the reader to believe that, had the sun existed 20 million years ago, it would necessarily have been as large as earth's orbit. In performing such an extended extrapolation, Akridge has chosen to ignore the possibility of numerous transient and oscillatory phenomena with characteristic time periods as long as thousands of years. As we indicated earlier in this discussion, any extrapolation of solar diameter variations beyond a few centuries would be entirely unwarranted, thereby representing unacceptable scientific practice. To base, as does Akridge, a bold and substantial claim on such an unwarranted extrapolation represents a serious failure to follow the fundamental principles for competent scientific investigation. And not only does Akridge presume the validity of this extrapolation, he even argues that to assume a constant shrinkage rate over extended time periods is a *conservative* assumption.

In spite of these and other shortcomings, however, the shrinking sun report, presented in the manner established by Akridge, continues to be employed as a "scientific evidence" for a young earth. In a 1982 article in *Christianity Today*, Thomas Barnes, then Dean of the Graduate School at the Institute for Creation Research, presents a list of six "evidences" for a recent creation.[15] Barnes concludes his list with an appeal to the shrinking sun report. Though this was written three years after the Eddy and Boornazian report, Barnes gives no evidence of having taken into account the several professional publications which had cast serious doubt on the reality of secular solar shrinkage. Instead, Barnes simply repeats the Akridge analysis. In a handbook written to accompany the *Origins* film series, distributed by Films For Christ, we also find the shrinking sun cited as evidence for a young earth.[16] The brief discussion follows the Akridge approach very closely; it even borrows from the *Impact* article a diagram which shows the earth skimming the surface of a bloated sun, presumably 20 million years ago.

Having lost contact with the results of continuing investigation and evaluation by the professional scientific community, the employment of the shrinking sun as an "evidence" for recent creation ceased to be authentically scientific. Instead, it took on the status of a legendary tale, recited to provide its hearers with the comforting reassurance that their recent creation scenario was supported by empirical evidence.

Functioning to provide young earth advocates with reassurance for their particular picture of God's creative activity, lists of "scientific evidences" serve as specimens of a creationist folk-science.[17] One of the most lengthy of these lists can be found in the June, July, and August, 1984, issues of the *Bible-Science Newsletter*. Under the heading of "The Scientific Case for Creation," we find a list of 116 categories of evidence prepared by Dr. Walter T. Brown, Jr., a mechanical engineer. Number 85 on this list is the shrinking sun phenomenon. Brown's analysis is essentially the same as Akridge's. He treats secular contraction as if convincingly established and extrapolates that behavior indefinitely, on which basis he concludes that "had the sun existed a million years ago, it would have been so large that it would have heated the earth so much that life could not have survived."[18]

Henry Morris, President of the Institute for Creation Research, does no better than Akridge, Barnes or Brown. In his 1984 treatise on *The Biblical Basis for Modern Science*, Morris presents his vision of biblical insights into a broad spectrum of natural sciences. In a brief discussion on solar energy generation, Morris wishes to argue that gravitational collapse, not thermo-

nuclear fusion, is responsible for solar luminosity. The shrinking sun report is employed to bolster that argument:

> As a matter of fact, careful measurements in recent years have supported the collapse theory by showing that the sun's diameter does, indeed, appear to be shrinking. But this in turn would mean that the sun could not possibly be billions of years old![19]

This statement, made five years after Eddy and Boornazian's preliminary report, demonstrates no attempt to incorporate the results of the numerous, relevant investigations performed and reported during that five year interval. Instead, Henry Morris, clearly the most influential person in the "creation-science" movement, propagates the same misrepresentation of solar behavior initiated by Akridge's 1980 *Impact* article.

The Shrinking Sun in the *Creation Research Society Quarterly*

Thus far, the "creation-science" literature cited has been popular-level material intended for a general audience. Is it possible that the more technical literature of the recent creationist community does a better job of displaying a respect for the professional standards of competence and integrity held by the scientific community? As a general rule it does not, though there are exceptions.

As representative of literature that we might expect to demonstrate a higher level of methodological competence and professional integrity, the *Creation Research Society Quarterly* provides us with several papers on the topic of the shrinking sun report. In a series of two articles, published in June and December of 1980, Hilton Hinderliter presents his analysis of this phenomenon.[20, 21] Although these articles are anecdotal in style, very different from professional journal literature, we will assume that they were intended to be read as authentic specimens of "creation-science," that is, informative analytical reports written by scientifically trained persons. (Dr. Hinderliter is an Assistant Professor of Physics at the New Kensington campus of Pennsylvania State University.) The scientific adequacy of the analysis, however, differs little from the popular material reviewed above.

Like Akridge, Hinderliter uncritically accepts the rapid shrinkage rate first reported by Eddy and Boornazian; he even praises the reliability of the historical data used by Eddy and the thoroughness of his data analysis. On the other hand, the judgment expressed by Eddy and many others[22] that the suspected variation was most likely a cyclic phenomenon was summarily dismissed as no more than the product of an unwarranted belief in what Hinderliter calls the "billion year myth." We find in this discussion no evidence of any careful evaluation of the merits of several suggested mechanisms that could introduce periodic variations in solar size.[23] Instead, the suggestion of periodic behavior is rejected as merely a product of an evolutionistic bias. Similarly, Hinderliter's ready acceptance of the conclusion drawn from one analysis of meridian transit data alone fails to recognize the relevance of data drawn from other phenomena, such as solar eclipse records, Mercury transit observations, and the paleoclimatic record. None of these data are critically evaluated by Hinderliter; they are simply ignored or rejected as unworthy of consideration.

Hanson's incandescence model with its isothermal sun is in contradiction not only to "evolutionary astrophysics;" it also stands in contradiction to a basic thermodynamic principle taught in most first-year general physics courses! Heat does not flow through an ordinary medium unless there is a temperature gradient.

In his discussion of gravitational contraction as a possible source of solar energy, Hinderliter claims that this mechanism had been rejected by the scientific community "solely on the basis of a supposed age of the earth in billions of years;"[24] and that, furthermore, "the compelling force for the acceptance of vast ages was merely a faith in evolutionism, which itself has no evidential leg to stand on."[25] In summary, he concludes that ". . . evolutionism demanded a vast age for the sun, which in turn caused gravitational contraction to be ruled out as a major source of the sun's energy."[26]

A careful review of the relevant history, however, yields a significantly different conclusion. Because both geological and radiometric evidence indicated a terrestrial age of billions of years, the gravitational collapse lifetime for the sun—a few tens of millions of years—presented a real puzzle. When the process of thermonuclear fusion first became known, it was indeed greeted as a *candidate* for solar energy generation. But the transformation from candidate to accepted phenomenon could take place only with the development of a model for the sun which complied with all of the known patterns for material behavior, and which

would make fusion inevitable. Such has been the case.[27]

Nonetheless, by assuming that the meridian transit data has convincingly established a secular gravitational contraction of the sun, and appealing to the lower than expected solar neutrino flux as supporting evidence, Hinderliter concludes that the thermonuclear fusion model for solar energy production has been thoroughly discredited. In a manner very much like that of Russell Akridge, Hinderliter asserts that from his analysis of the shrinking sun report, "it is clear that we have witnessed a *major scientific defeat for evolutionism.*"[28]

While the papers by Hinderliter may fail to display the appropriate level of critical evaluation of the relevant phenomena, data and theoretical models, another paper, "The Sun's Luminosity and Age," written by James Hanson, suffers from even greater shortcomings. Hanson strongly favors a shrinking sun, such as was reported by Eddy and Boornazian. The first reason cited by Hanson for this opinion is the following: "It is anti-evolutionary and compatible with the creationist view of a recently created, not evolved, sun."[29] He cites papers by Shapiro, Sofia, and others,[30] but fails to deal substantively with their content. Their objections to Eddy and Boornazian's conclusions are dismissed as the product of evolutionistic bias.

In advising his readers to suspend judgment on his earlier conclusions, Steidl is displaying the kind of professional integrity that is expected within the scientific community.

But the most bewildering component of Hanson's paper is his proposal of an "incandescence theory" for solar luminosity. He proposes that the sun was created 6000 years ago with a *uniform* temperature, and that it has been *uniformly* cooling off since that time. Solar luminosity, according to Hanson's model, derives simply from the thermal energy stored in the recently created sun. After performing some calculations which purport to show that the decrease in solar temperature during the past 6000 years would be acceptably small, Hanson says:

> Note that by this analysis we may infer that if the sun or a star were created isothermal it would stay nearly that way, which is, also, in direct contradiction to evolutionary astrophysics.[31]

Within the statement just quoted, we encounter at least three serious problems with Hanson's approach. First, the idea that the sun would, if created isothermal, remain isothermal cannot be *inferred* from Hanson's model; rather, it is no more than the *unwarranted assumption* on which the model is built. Second, Hanson offers no demonstration that an isothermal solar model which complies with all relevant physical laws (concerning gravity, hydrostatic equilibrium, equation of state, etc.) can be constructed. In fact, the necessity of such a demonstration is not even recognized. Third, and especially devastating, Hanson's incandescence model with its isothermal sun is in contradiction not only to "evolutionary astrophysics;" it also stands in contradiction to a basic thermodynamic principle taught in most first-year general physics courses! Heat does not flow through an ordinary medium unless there is a temperature gradient. Hanson's isothermal sun would demand an infinite thermal conductivity (or some other means of unimpeded heat transfer) in order to remain at a uniform temperature while radiating energy from its surface. Contemporary models for the solar interior, on the other hand, indicate that a central temperature of greater than 10,000,000 K is required to maintain an adequate heat flow from the core to the solar surface. The incandescence model proposed in Hanson's paper is wholly unrealistic.

Elsewhere in the paper, Hanson expresses a certain fondness for reviving theories from the past. In his closing statements Hanson favorably associates his incandescence model with pre-Copernican astronomy.

> The incandescence theory would probably have been the explanation in pre-Copernican times. This is another example of the frequent superiority of pre-Copernican astronomy over the present Copernican-evolutionary views.[32]

Enough said. Let the reader judge the merits of that sentiment.

An article of considerably higher quality, "Solar Neutrinos and a Young Sun," by Paul Steidl, can be found in the June 1980 issue of the *Quarterly*. Compared with the material written by Akridge, Hinderliter, or Hanson, Steidl's paper demonstrates a far greater knowledge of astrophysics and a creditable awareness of relevant data and phenomena. The chief topic of the paper is the solar neutrino puzzle. Contemporary solar models predict the types and rates of thermonuclear fusion reactions that would occur in the sun, provided that our understanding of the relevant physical conditions and processes is adequate. During the past several years, measurements have been performed to determine the rate at which neutrinos, a byproduct of these fusion reactions, are being received on earth. The puzzling result is that the measured rate is only one-third of the expected rate.

Steidl's solution to this puzzle is to propose that no fusion whatsoever is occurring in the sun and that solar luminosity is derived solely from gravitational contraction, thereby discrediting any multibillion-year chronology for solar system history. In Steidl's words, "Thus the near absence of solar neutrinos alone is enough to indicate that the sun is considerably younger than usually assumed. . . . The sun is surely younger than its accepted (uniformitarian) age."[33]

In my judgment, however, Steidl paid far too little attention to a vast array of empirical and theoretical considerations which have led the professional scientific community to the well founded *conclusion* (not assumption) that the solar system formed about 4.6 billion years ago. I suspect that it was Steidl's commitment to a recent creation scenario, rather than a critical evaluation of the data, which played the decisive role in leading him to his conclusion. Yet Steidl himself accuses the entire professional scientific community of a bias in favor of an ancient, evolved sun. "It [fusion] has become accepted dogma simply because it is the only conceivable process which could provide energy for the billions of years which stars are believed to have existed."[34]

Steidl offers a brief discussion of the solar shrinkage phenomenon as reported by Eddy and Boornazian. For Steidl this report is taken as confirmation that fusion is not occurring in the sun and that solar luminosity is powered by Helmholtz contraction. Regarding Eddy and Boornazian's own judgment that the solar shrinkage they reported was part of a cyclic phenomenon, Steidl says, "Of course they do not allow the possibility that it has been going on for more than a few hundred years, since this would totally dethrone stellar evolution."[35] By suppressing arguments based on the coherence of numerous empirical and theoretical considerations which have led scientists to their conclusions concerning an old and fusion powered sun, claiming instead that these concepts are based *solely* on some form of evolutionistic bias, Steidl is joining in the approach followed by Akridge, Hinderliter and Hanson.

But our review of Steidl's work can end on a much more positive note. In a brief letter published in the March 1981 *Quarterly*, Steidl alerts his readers to two significant developments.[36] First, the possibility of a non-zero rest mass for the neutrino would reduce the expected neutrino detection rate by a factor of three, consonant with the observed value. Steidl aptly concludes: "Perhaps the sun is burning hydrogen after all." (Note: In this context, "burning hydrogen" refers to the thermonuclear fusion of hydrogen into helium.) Second, Steidl calls attention to several recently published papers which contest the reality of secular solar shrinkage. In advising his readers to suspend judgment of his earlier conclusions, Steidl is displaying the kind of professional integrity that is expected within the scientific community.

The world to which we direct the Christian message has every right to expect our scholarship, including our natural science, to be characterized by the highest standards of competence and integrity.

Paul Steidl is to be commended for his attempt to alert the readers of the *Quarterly* to the fact that the credibility of earlier reports regarding solar contraction had been greatly diminished by further investigation. Unfortunately, his warnings went unheeded. Long after Steidl's letter appeared in the *Quarterly*, and long after the professional journals had published extensive papers discrediting the initial claim, references to the shrinking sun as a "scientific evidence" for a young earth continued to appear in the creationist literature. The *Impact* article by Akridge, in spite of its grievous shortcomings, had far more influence than Steidl's more critical appraisal.

Does It Really Matter?

As our case study has illustrated, what began as a puzzling report within the professional scientific community was transformed by the "creation-science" community into "scientific evidence" purporting to substantiate the recent creation scenario. We have seen how the shrinking sun report, as propagated through the recent creationist literature, lost contact with the critical evaluation and continuing investigation performed by the community of professional scientists. And, having lost this vital connection, the solar shrinkage report became the "legend of the shrinking sun"—the vehicle of misinformation and unwarranted conclusions.

It is unfortunate that many readers of "creation-science" literature have been misinformed concerning such matters as the sun's history. To be misinformed, even by well meaning fellow Christians, is a regrettable experience.

Of far greater concern to me, however, is the negative effect that these episodes of misinformation may

have on the Christian witness to a scientifically knowledgeable world. The world to which we direct the Christian message has every right to expect our scholarship, including our natural science, to be characterized by the highest standards of competence and integrity. If we publicly fail to maintain those standards, how can that world gain confidence in the message we proclaim? If we disseminate misinformation in the name of Christian scholarship, who will listen to our preaching of the gospel?

More than fifteen centuries ago St. Augustine expressed this same concern in his commentary on Genesis:

> Usually, even a non-Christian knows something about the earth, the heavens, and other elements of this world, about the motion and orbit of the stars and even their size . . . and this knowledge he holds to as being certain from reason and experience. Now, it is a disgraceful and dangerous thing for an infidel to hear a Christian, presumably giving the meaning of Holy Scripture, talking nonsense on these topics; and we should take all means to prevent such an embarrasing situation, in which people show up vast ignorance in a Christian and laugh it to scorn. . . . If they find a Christian mistaken in a field which they themselves know well and hear him maintaining his foolish opinions about our books, how are they going to believe those books in matters concerning the resurrection of the dead, the hope of eternal life, and the kingdom of heaven . . . ?[37]

May we be any less concerned than Augustine?

NOTES

1. See, for example, the following:
   a) Thomas G. Barnes, "Evidence Points to a Recent Creation," *Christianity Today*, October 8, 1982, pp. 34–36.
   b) Henry M. Morris and Gary E. Parker, *What Is Creation Science?*, (San Diego: Creation-Life Publishers, 1982), pp. 254–257.
   c) Walter T. Brown, Jr., "The Scientific Case for Creation: 116 Categories of Evidence," *Bible-Science Newsletter*, June, July, August, 1984.
2. *The Banner*, January 28, 1985, p. 4.
3. J. A. Eddy and A. A. Boornazian, "Secular Decrease in the Solar Diameter, 1836–1953," *Bull. Am. Astron. Soc. 11*, 437 (1979). Note: This is only an abstract. The full text was never published.
4. G. B. Lubkin, "Analyses of Historical Data Suggest Sun Is Shrinking," *Physics Today 32* (No. 9), 17 (1979). The reference to the 1567 solar eclipse does not appear in the abstract (ref. 3), but can be found in this news report regarding Eddy and Boornazian's presentation.
5. See the comments by Martin Schwarzschild reported in ref. 4. For an extensive review article which discusses these matters, see Gordon Newkirk, Jr., "Variations in Solar Luminosity," *Annual Review of Astronomy and Astrophysics*, Vol. 21, 1983, pp. 429–67.
6. S. Sofia, J. O'Keefe, J. R. Lesh, and A. S. Endal, "Solar Constant: Constraints on Possible Variations Derived from Solar Diameter Measurements," *Science 204*, 1306 (1979).
7. Irwin I. Shapiro, "Is the Sun Shrinking?", *Science 208*, 51 (1980).
8. D. W. Dunham, S. Sofia, A. D. Fiala, D. Herald, and P. M. Muller, "Observations of a Probable Change in the Solar Radius Between 1715 and 1979," *Science 210*, 1243 (1980).
9. J. H. Parkinson, L. V. Morrison, and F. R. Stephenson, "The Constancy of the Solar Diameter over the Past 250 Years," *Nature 288*, 548 (1980).
10. R. L. Gilliland, "Solar Radius Variations over the Past 264 Years," *Astrophys. J. 248*, 1144 (1981).
11. J. H. Parkinson, "New Measurements of the Solar Diameter," *Nature 304*, 518 (1983).
12. S. Sofia, D. W. Dunham, J. B. Dunham, and A. D. Fiala, "Solar Radius Change between 1925 and 1979," *Nature 304*, 522 (1983).
13. C. Frohlich and J. A. Eddy, "Observed Relation between Solar Luminosity and Radius," (Paper presented at an international conference sponsored by the Committee on Space Research, July, 1984, in Graz, Austria).
14. Russell Akridge, "The Sun is Shrinking," *Impact* No. 82, Institute for Creation Research, April, 1980, pp. iii, iv.
15. See Thomas G. Barnes, "Evidence Points to a Recent Creation," *Christianity Today*, October 8, 1982, pp. 34–36.
16. See *ORIGINS Film Series Handbook* (Phoenix, AZ: Films for Christ Association, 1983), pp. 11–12.
17. We are using the term 'folk-science' in a manner similar to that of Jerome R. Ravetz in *Scientific Knowledge and Its Social Problems* (New York: Oxford University Press, 1971), especially pp. 386–397. Ravetz defines folk-science as that "part of a general world-view, or ideology, which is given special articulation so that it may provide comfort and reassurance in the face of the crucial uncertainties of the world of experience" (p. 386).
   In order to give due recognition to an important symmetry, we should note that just as scientific creationism functions as the folk-science of contemporary Christian fundamentalism, so also naturalistic evolutionism functions as the folk-science of modern Western naturalism. In each case, selected results of scientific investigation are interpreted in such a way that they may be employed to bolster a creedal tenet of a world view, or ideology.
18. Walter T. Brown, Jr., "The Scientific Case for Creation," *Bible-Science Newsletter*, July, 1984, p. 14.
19. Henry M. Morris, *The Biblical Basis of Modern Science* (Grand Rapids: Baker Book House, 1984), p. 164.
20. Hilton Hinderliter, "The Shrinking Sun: A Creationist's Prediction, Its Verification, and the Resulting Implications for Theories of Origins," *Creation Research Society Quarterly 17*, 57 (1980).
21. Hilton Hinderliter, "The Inconsistent Sun: How Has It Been Behaving, and What Might It Do Next?" *Creation Research Society Quarterly 17*, 143 (1980).
22. See ref. 4.
23. See ref. 5.
24. Hinderliter, ref. 20, p. 57.
25. Hinderliter, ref. 20, p. 59.
26. Hinderliter, ref. 20, p. 59.
27. See Chapter IV, "Stellar Evolution and Nucleosynthesis," in *A Source Book in Astronomy and Astrophysics, 1900–1975*, edited by Kenneth R. Lang and Owen Gingerich (Cambridge, MA: Harvard University Press, 1979). This collection of original papers and editorial commentary provides an excellent overview of this important episode in the history of astrophysics.
28. Hinderliter, ref. 20, p. 59.
29. James Hanson, "The Sun's Luminosity and Age," *Creation Research Society Quarterly 18*, 27 (1981).
30. See ref. 6, 7.
31. Hanson, p. 29.
32. Hanson, p. 29.
33. Paul M. Steidl, "Solar Neutrinos and a Young Sun," *Creation Research Society Quarterly 17*, 63 (1980).
34. Steidl, p. 60.
35. Steidl, p. 64.
36. Paul M. Steidl, "Recent Developments About Solar Neutrinos" (Letter), *Creation Research Society Quarterly 17*, 233 (1981).
37. Augustine, *The Literal Meaning of Genesis*, translated and annotated by John Hammond Taylor, S. J., 2 vols. (Ancient Christian Writers, Nos. 41, 42), (New York: Newman Press, 1982), vol. I, pp. 42–43.

Interpreting Genesis One*†

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Like other parts of Scripture, Genesis 1 must be interpreted in terms of its historical and literary context. This creation account was given to the Israelites in the wilderness, after the exodus from Egypt but before the conquest of Canaan. What the message ***meant then*** *to the original hearers must govern the application of what it* ***means now*** *to us today. The historico-artistic interpretation of Genesis 1 does justice to its literary structure and to the general biblical perspective on natural events.*

From time immemorial people have speculated about how the world began. Many fascinating myths and legends date from the dawn of civilization in the Middle East. Reflecting polytheistic religion, they feature violent struggles by a variety of deities for supremacy over the world.

For example, Sumerian tablets around 2500 B.C. present a pantheon of four prominent gods, among them Enki who leads a host of the gods against Nammu, the primeval sea. In one Egyptian myth the sun god Re emerges from the deep to create all other things. The best known of the creation myths is the Babylonian national epic *Enuma Elish*, which was composed primarily to glorify the god Marduk and the city of Babylon. Amid such a mythological environment Israel fled from Egypt, wandered in the wilderness and took possession of Canaan.

The biblical creation accounts in Genesis have some similarities with those of Israel's pagan neighbors as well as several radical differences. The relative importance of those elements has been a focal point of theological controversy for more than a century. Some issues have been resolved, but considerable confusion persists over the nature and purpose of Genesis 1.

Genesis is a book of beginnings: the origin of the universe, birth of the human race and founding of the Hebrew family. Yet the book is more than an account of origins. It provides a foundation for many themes prominent throughout the Old and New Testaments. Here one learns about God, humanity and nature in their mutual relationships. The Creator and Controller of the universe reveals himself as the Lord and Judge of history, which has both a purpose and goal. Such great doctrines as creation, sin and salvation trace their beginnings to this remarkable book. Concepts of covenant, grace, election and redemption permeate God's saving activity to overcome the consequences of evil and sin. It should not surprise us that Genesis, more than any other part of the Bible, has been a scene of historical, literary, theological and scientific battles. Some of those battles have made their way out of church and seminary into the schools and courts.

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†*This article is taken from chapter 10, "Genesis One: Origin of the Universe," of the book* The Galileo Connection, *recently released by InterVarsity Press (Downers Grove, Ill.: 1986, 296 pp., paper, $8.95).*

Much of the controversy arises from a misunderstanding of what the Genesis account of creation intends to teach. What message was it meant to convey to ancient Israelites in their struggle against the pagan mythologies of the surrounding countries? How does that meaning apply in a post-Christian culture whose gods and values infiltrate even the church?

Approach to Genesis

An interpretation of Genesis 1 must deal with three elements: historical context, literary genre and textual content. Many commentaries skip lightly over the first two in an eagerness to grasp the meaning for today. As a result their interpretations at critical points would hardly have been intelligible to ancient Israel, much less equip God's people to resist the influence of pagan mythologies. Therefore, we will adhere to the following principle: What the author *meant then* determines what the message *means now*.

Historical Context

What was the situation of the Israelites who received the message of Genesis, especially their cultural and religious environment? The answer to that question depends to a large extent on certain assumptions about the authorship and date of the document. Two main approaches have dominated the interpretation of Genesis during the last century.

One position rejects the Mosaic authorship and early date of the Pentateuch along with its divine inspiration and trustworthiness. The *developmental* view of the nineteenth century treated those five books as the culmination of a long process of social growth. It assumed that, culturally and religiously, humankind has moved through evolving states from savagery to civilization. But, as new data provided by archeology tended to discredit that view, the *comparative religion* model became increasingly popular. It holds Genesis 1–11 to be a Jewish borrowing and adaptation of the religions of neighboring nations. Both views consider the Pentatauch to be writing of unknown authors or redactors (editors) long after Moses, probably late in the period of the Hebrew monarchy.

A contrasting position holds that Moses wrote most of the Pentateuch (though he may have used earlier sources) and that some editing took place after his death. The *historical-cultural* model used in this paper assumes that the Genesis creation narratives were given to the Israelites in the wilderness, after the exodus from Egypt but before the conquest of Canaan. This view considers the Pentateuch to be a revelation from God, through his prophet Moses, to Israel en route to the Promised Land. An understanding of the historical context and primary purpose of that revelation lays the foundation for our interpretation.

For more than four hundred years the Hebrews had languished in Egypt far from the land promised to Abraham. Those centuries took a spiritual as well as physical toll. The people had no Scriptures, only a few oral traditions of the patriarchs. Devotion to the God of their forefather Joseph had largely been supplanted by worship of the gods of other nations. The incident of the golden calf suggests that fertility cults may have been part of Hebrew religious life in Egypt (Ex. 32:1–6). Even though they were miraculously delivered from slavery and led toward Canaan, many of the people may have had a minimal understanding of the God of Abraham, Isaac and Jacob.

When the wanderers arrived at Horeb, their world view and lifestyle differed little from that of the surrounding nations. Their culture was essentially pagan. Now God was calling them to keep his covenant, to become "a kingdom of priests and a holy nation" (Ex. 19:6). Although the people responded, their yes was just the beginning of a long, painful process by which God would create a new culture.

Although trained by God in Pharoah's house and then in the hills forty years, Moses faced a formidable

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task. His people needed a radically different theology for a knowledge of God and his purposes; a new cosmogony to restructure their attitudes toward the created order; a new religious institution to guide their worship; a new anthropology to understand the human condition; and a different lifestyle for moral and ethical living. The five books of Moses were designed to make the Hebrews a people of God through a divinely instituted culture.

The location of God's people at that point is significant. In each pagan nation the gods, of which there were hundreds, permeated and dominated every aspect of life. A people and their gods formed an organic whole with their land. Religion existed for the welfare of society, not primarily for the individual. Religious change was not possible; it occurred only when one nation conquered another. Even then the defeated gods were usually absorbed into the victorious pantheon. In Egypt, for example, only Egyptian gods were worshiped. Hence Moses had initially asked Pharaoh to permit the Hebrews to go three days' journey into the wilderness to worship their God; there the Egyptian gods had no power and need not be feared. Now God had created for the Hebrews a religious crisis that opened them to the new order he desired to institute. The events of Sinai could never have taken place in Goshen.

Although Israel had left Egypt behind, they still retained its world view. Paganism is more than polytheism; it is a way of looking at the whole of life. So a complete break with Israel's past required the strong antipagan teaching provided in the Pentateuch, beginning with Genesis.

Literary Genre

What kind of literature are we dealing with? Is it prose or poetry, history or parable? Only after that question is answered can the appropriate interpretive guidelines be applied.

The style of Genesis 1 is remarkable for its simplicity, its economy of language. Yet to ask whether it is prose or poetry is a serious oversimplification. Although we do not find here the synonymous parallelism and rhythms of Hebrew poetry, the passage has a number of alliterations. The prominence of repetition and of its corollary, silence, brings the writing close to poetry; its movement toward a climax places it in the order of prose. Sometimes called a "hymn," it appears to be a unique blend of prose and poetry.[1]

Although it has no trace of rhetoric, the passage does use figurative language for describing God's activity: anthropomorphisms which represent God as if he were a human being—speaking and seeing, working and resting. Yet a conclusion that Genesis 1 is semipoetic and has figurative language by no means determines the main question—the connection of the narrative with actual events.

Once for all we need to get rid of the deep-seated feeling that figurative speech is inferior to literal language, as if it were somewhat less worthy of God.

Once for all we need to get rid of the deep-seated feeling that figurative speech is inferior to literal language, as if it were somewhat less worthy of God. The Hebrew language is rich in figures of speech. Scripture abounds with symbols and metaphors which the Holy Spirit has used to convey powerfully and clearly the message he intended. What would be left of Psalm 23, for example, if it were stripped of its figurative language? Further, we must give up the false antithesis that prose is fact while poetry is fiction (prose = literal = fact, and poetry = figurative = fiction). Indeed, prose writing often has figures of speech and can recount a legend or parable as well as history; by the same token, poetry may have little if any figurative language and narrate actual events. The prophets, for example, recalled past facts and predicted future events with a welter of symbols and images as well as literal description. (See Ezekiel 16 and 22 for two versions of the same events.) Jesus summarized centuries of Hebrew history in his parable of the wicked tenants (Mt. 21:33–41). Good biblical interpretation recognizes and appreciates this marvelous and effective variety of literary expression.

Genesis 1 appears to be a narrative of past events, an account of God's creative words and acts. Its figurative language is largely limited to anthropomorphisms. (For a highly imaginative and figurative account of creation, read Job 38:4–11.) The text does not have the earmarks of a parable, a short allegorical story designed to teach a truth or moral lesson. That genre generally deals with human events and often starts with a formula like "There was a man who had two sons" in Jesus' parable of the prodigal son (Lk. 15:11–31). Genesis 1 is "historical" in the sense of relating events that actually occurred. Modern historians distinguish between "history," which began with the invention of writing or the advent of city life, and "prehistory."[2]

According to that definition, the events in Genesis 1 are prehistorical. Nevertheless the writing can be called historical narrative, or primeval history, to distinguish it from legend or myth, in which ideas are simply expressed in the form of a story.

Our interpretation of a passage should also be guided by its structure. Narrators have the freedom to tell a story in their own way, including its perspective, purpose, development and relevant content. The importance of this principle comes to focus in the Genesis 1 treatment of time. The dominating concepts and concerns of our century are dramatically different from those of ancient Israel. For example, our scientific approach to the natural world seeks to quantify and measure, calculate and theorize, about the mechanism of those events. For us time is as important a dimension as space, so we automatically tend to assume that a historical account must present a strict chronological sequence. But the biblical writers are not bound by such concerns and constrictions. Even within an overall chronological development they have freedom to cluster certain events by topic. For example, Matthew's Gospel has alternating sections of narrative and teaching grouped according to subject matter, a sort of literary club sandwich. Since Matthew did not intend to provide a strict chronological sequence for the events in Jesus' ministry, to search for it there would be futile.

By the same token our approach to Genesis 1 should not assume that the events are necessarily in strict chronological order. An examination of the phrases used by the author reveals his emphasis on the creative word: "And God said" appears eight times, in each case to begin a four-line poem (figure 1).[3] These poems form the basic structure of the narrative. (The third and seventh poems do not have the final line, "And there was evening, and there was morning," since they are combined with the fourth and eighth creative words, respectively, to link with the third and sixth days.) Although the eight poems vary in length and minor details, they have the same basic format.

It also becomes evident that the *eight words* are linked with the *six days* in an overall symmetrical structure (figure 2). The second half of the week (fourth to sixth days) parallels the first half. Augustine noted this literary framework early in the church's history. He believed that everything had been created at once and that the structure of the days is intended to teach the "order" in creation. Two centuries ago J. G. von Herder recognized the powerful symmetry between the two triads of days. The two have been contrasted in several ways: creation of *spaces* and then their *inhabitants forming* of the world followed by its *filling*.[4] Such a sequence is indicated by the conclusion

Word	Day	Poem	Verse
1	1	(a) And God said, "Let . . ."	3
		(b) and there was . . .	
		(c) God saw that . . . was good.	4
		(d) And there was evening, and there was morning—the first day.	5
2	2	(a) And God said, "Let . . ."	6
		(b) And it was so.	7
		(c)	
		(d) And there was evening, and there was morning—the second day.	8
3	3	(a) And God said, "Let . . ."	9
		(b) And it was so.	
		(c) And God saw that it was good.	10
		(d)	
4		(a) Then God said, "Let . . ."	11
		(b) And it was so.	
		(c) And God saw that it was good.	12
		(d) And there was evening, and there was morning—the third day.	13
5	4	(a) Then God said, "Let . . ."	14
		(b) And it was so.	15
		(c) And God saw that it was good.	18
		(d) And there was evening, and there was morning—the fourth day.	19
6	5	(a) Then God said, "Let . . ."	20
		(b)	
		(c) And God saw that it was good.	21
		(d) And there was evening, and there was morning—the fifth day.	23
7	6	(a) Then God said, "Let . . ."	24
		(b) And it was so.	
		(c) And God saw that it was good.	25
		(d)	
8		(a) Then God said, "Let . . ."	26
		(b) And it was so.	30
		(c) God saw . . . it was very good.	31
		(d) And there was evening, and there was morning—the sixth day.	

Figure 1. Eight Poems of Genesis 1

Creative Words	Day	Elements	Creative Words	Day	Elements
1 (verse 3)	1	light	5 (verse 14)	4	luminaries
2 (verse 6)	2	firmament	6 (verse 20)	5	birds
3 verse (9)	3	seas	7 verse 24)	6	fishes
4 (verse 11)		land & vegetation	8 (verse 26)		animals & humankind

Figure 2. Literary Structure of Genesis 1

of the narrative in Genesis 2:1 (RSV): "Thus the *heavens and the earth* were completed [days 1–3] and *all the host of them* [the crowds of living organisms, days 4–6]."

The writer's use of the significant numbers 3, 7 and *10* also highlights the careful construction of the creation account. It starts with three problem elements (formless earth, darkness and watery deep) which are dealt with in two sets of three days; the verb "create" is used at three points in the narrative, the third time thrice. Both the completion formula, "and it was so," and the divine approval, "God saw that it was good," appear seven times. The phrase "God said," the verb "make" and the formula "according to its/their kind" appear ten times.

In both its overall structure and use of numbers the writer paid as much attention to the form as to the content of the narrative, a fact which suggests mature meditation. The *historico-artistic* interpretation of Genesis 1 does justice to its literary craftsmanship, the general biblical perspective on natural events and the view of creation expressed by other writers in both Old and New Testaments.

Interpretation of Genesis 1

The third step, after determining the historical context and literary genre, is to discover what this account of creation means to the first readers. Although a thorough exegesis cannot be done in a few pages, we can note the narrative's development and the meaning of several key words.

In the beginning God created the heavens and the earth. (v. 1)

God is not only the subject of the first sentence, he is central to the entire narrative. It mentions him thirty-four times. The phrase "God created" can also be translated "When God began to create," but the latter translation is linguistically cumbersome; it also seems to connote a dualism incompatible with the rest of the chapter.[5]

The meaning of the word "create" (*bara*) in this context is determined in the light of its meanings elsewhere in the Old Testament. Its subject is always God; its object may be things (Is. 40:26) or situations (Is. 45:7–8). The specific context determines whether the creation is an initial bringing into existence (Is. 48:3, 7) or a process leading to completion (Gen. 2:1–4; Is. 65:18).

The Bible's opening statement may be taken as either the beginning of God's creative activity or a summary of the account that follows. Either way, the "beginning" includes not only the material universe but also time itself. Since all of our thought and action occurs within a time scale of past/present/future, we find it difficult if not impossible to conceive of timelessness. Yet as Augustine observed many centuries ago, God created not *in* time but *with* time.[6]

Now the earth was formless and empty, darkness was over the surface of the deep. (v. 2)

The writer expands on his initial statement, making the earth his vantage point (compare Ps. 115:16). He uses two rhyming words, *tohu* and *bohu*,[7] to describe a somber scene: a trackless waste, formless and empty in the utter darkness. Those two words signifying a lack of *form* and *content* provide a key to the chapter's literary structure.

And God said, "Let there be light," and there was light. . . . And there was evening, and there was morning—the first day. (vv. 3–5)

Here is the first of eight creative commands distributed over six days. A major focus of the narrative is the word of God: God "speaks" and it is done. The Hebrew *amar* has a variety of meanings.[8] Its use in Genesis 1 emphasizes God's creative command, his pledge to sustain the creation and his revelation as the Creator (this theme is echoed in Psalm 148:5 and Hebrews 11:3). The words leave no room for the divine emanation and struggle so prominent in pagan religions. Nevertheless there has been too much emphasis on God's creating simply by command. Only verses 3 and 9 report creation by word alone; the other six occurrences include both a word and an act of some kind, indicated by verbs such as *make*, *separate* and *set*.

For us time is as important a dimension as space, so we automatically tend to assume that a historical account must present a strict chronological sequence. But the biblical writers are not bound by such concerns and constrictions.

The creation of light marks the first step from primeval formlessness to order. "God saw that the light was good" (v. 4). There is no hint of ethical dualism, good and evil coexisting from eternity. To some of the pagans day and night were warring powers. Not so here. The Creator assigns to everything its value (4a), place (4b) and meaning (5a).

And God said, "Let there be an expanse between the waters to separate water from water." . . . And there was evening, and there was morning—the second day. (vv. 6–8)

An expanse or firmament separates the waters below (the seas and underground springs) from those above in the clouds which provide rain. Unlike the first day, the creative command here is followed by an action: "So God *made* the expanse and separated the water under the expanse from the water above it. And it was so" (v. 7). That combination of word and act also occurs on the fourth day: "God *made* two great lights . . . *made* the stars . . . *set* them in the expanse of the sky" (vv. 16–17); and on the fifth day, "God *created* the great creatures of the sea . . . "(v. 21). The wording for the sixth day is unusual in that God commands himself, so to speak, and then does it: "Then God said, 'Let us make man' . . . So God created man . . . "(vv. 26–27). This variety of wording for the eight creative events/processes should caution against an attempt to formulate one basic procedure or mechanism for the creation.

There has been too much emphasis on God's creating simply by command. Only verses 3 and 9 report creation by word alone . . .

And God said, "Let the water under the sky be gathered to one place, and let dry ground appear." And it was so. (vv. 9–10)

Then God said, "Let the land produce vegetation: seed-bearing plants and trees." . . . And it was so . . . And there was evening, and there was morning—the third day. (vv. 11–13)

Two events are linked to the third day. In the first, a creative command continues to give form to the world through differentiation, the land from the sea. In the second, a procreative action of the land, empowered by God, brings forth vegetation in an orderly fashion "according to their various kinds." That phrase, also used for the reproduction of animals (v. 24), would be especially meaningful to the Hebrews, since pagan mythologies featured grotesque human-beast hybrids. (The concept *fixity of species*, often read into this phrase, would have been unintelligible to the original hearers.) Here God commands *the earth* to produce something, and it does so.

The emphasis has begun to shift from *form* toward *fulness*, which becomes prominent in the remaining creative words. Originally formless and empty, the earth is now structured (through the division of light from darkness, upper from lower waters, dry land from the seas) and clothed with green, ready for its inhabitants. What God has formed he now fills. The second half of the week generally parallels the events of the first.

And God said, "Let there be lights in the expanse of the sky to separate the day from the night." . . . God made two great lights . . . to govern the day and . . . the night . . . And there was evening, and there was morning—the fourth day. (vv. 14–19)

The expanse of the sky is now filled with the stars, sun and moon "to give light on the earth." (*Our* problem of how the earth could be lighted [v. 4] before the sun appeared comes when *we* require the narrative to be a strict chronological account.) It is significant that the sun and moon are not mentioned by name—because those common Semitic terms were also the names of deities. This description may be seen as a protest against every kind of astral worship, so prevalent in the surrounding nations.[9] Here the heavenly bodies do not reign as gods but serve as signs (see Ps. 121:6). They "govern" (vv. 16, 18) only as bearers of light, not as wielders of power. These few sentences undercut a superstition as old as Egypt and as modern as today's newspaper horoscope.

And God said, "Let the water teem with living creatures, and let birds fly above the earth across the expanse of the sky." . . . And there was evening, and there was morning—the fifth day. (vv. 20–23)

The sea and sky are now filled with their inhabitants. The word for birds literally means "flying things" and includes insects (compare Deut 14:19–20). The special reference to great creatures (*tanninim*, "sea monsters") also serves a polemic purpose. To the Canaanites the word was an ominous term for the powers of chaos confronting the god Baal in the beginning. In the Old Testament the word appears without any mythological overtones; it is simply a generic term for a large water animal.

And God said, "Let the land produce living creatures according to their kinds." . . . And it was so. God made the wild animals according to their kinds. (vv. 24–25)

Then God said, "Let us make man in our image, in our likeness." . . . So God created man in his own image, . . . male and female he created them . . . . God saw all that he had made and it was

very good. And there was evening, and there was morning—the sixth day. (vv. 26–31)

The seventh and eighth creative acts are linked to the sixth day. The former populates the land with three representative groups of animals: "livestock, creatures that move along the ground, and wild animals." The creative action here parallels that in verse 20–23, but is unique in one respect: God commands the earth to do something, yet he himself makes it. Here as elsewhere in the Bible, what we call "natural" reproduction and God's creative activity are two sides of the same coin.

The eighth act produces man and woman both *in* nature and *over* it. They share the sixth day with other land creatures, and also God's blessing to be fruitful and increase; yet their superiority is evident in the words *Let us make* (instead of "Let the land produce") and in the mandate to "fill the earth and subdue it." Human uniqueness lies in the relationship to God: "Let us make man in our image"—that of a rational, morally responsible and social being. The words *male and female* at this juncture have profound implications. To define humanity as bisexual makes the partners complementary and anticipates the New Testament teaching of their equality ("There is neither Jew nor Greek, slave nor free, male nor female, for you are all one in Christ Jesus"—Gal. 3:28).

The culmination of creation in man and woman who are to rule over the earth and its inhabitants is especially significant to Israel. In pagan mythology the creation of mankind was an afterthought to provide the gods with food and satisfy other physical needs. But in Genesis 1 the situation is reversed. The plants and trees are a divine provision for human need (v. 29). From start to finish the creation narrative challenges and opposes the essential tenets of the pagan religions of Egypt, where the Hebrews stayed so long, and of Canaan, where they would soon be living.

At each stage of creation, six times, God has pronounced his work to be good. "Thus the heavens and the earth were completed in all their vast array" (Gen. 2:1). The creation narrative then concludes with a seventh day.

By the seventh day God had finished the work he had been doing; so on the seventh day he rested from all his work. And God blessed the seventh day and made it holy, because on it he rested from all the work of creating that he had done. (vv. 2:2–3)

The word *rested* means "ceased" (from *sabat*, the root of "sabbath"). It is a rest of achievement or pleasure, not of weariness or inactivity, since God constantly nurtures what he has created. Nature is not self-existent but is constantly upheld by his providential power.

This part of the narrative has an immediate application embodied in the Ten Commandments. The seven-day format is given as a model for Israel's work week and sabbath rest:

> Remember the Sabbath day by keeping it holy. Six days you shall labor and do all your work, but the seventh day is a Sabbath to the Lord your God. . . . For in six days the Lord made the heavens and the earth, the sea, and all that is in them, but he rested on the seventh day. (Ex. 20:8–11)

This is the account of the heavens and the earth when they were created. (v. 2:4a)

The narrative finally ends with a "colophon," a statement that identifies a document's contents, which we generally put at the beginning of a book.

The Creation Days

Much controversy over the interpretation of Genesis 1 focuses on the meaning of the word *day*. Many commentaries wade into that question first and soon bog down in a hermeneutical quagmire. First one's perspective on the chapter should be defined. Since no one is completely objective, it is not a question of *whether* we have an interpretive model but *which one* we are using.

The *comparative religion* approach views Genesis 1 as the work of an unknown author long after Moses, and considers its creation account as being similar to the primitive stories in other Semitic religions. The *concordist* model assumes a harmony between the Genesis 1 and scientific accounts of creation, and seeks to demonstrate the Bible's scientific accuracy. The *historical-cultural* approach views the narrative as given by Moses to Israel in the wilderness, and tries to discover what the message *meant then* without any attempt to harmonize it with either past or present scientific theories.

Throughout the Old Testament the word "day" (*yom*) is used in a variety of ways. Usually meaning a "day" of the week, the word can also mean "time" (Gen. 4:3), a specific "period" or "era" (Is. 2:12; 4:2), or a "season" (Josh. 24:7). We have already noted the literary symmetry of eight creative words linked to six days, which occur in two parallel sets of three. The six days mark the development from a dark, formless, empty and lifeless earth to one that is lighted, shaped and filled with teeming varieties of life, culminating in the creation of man and woman.

The author's purpose—teaching about God and his creation in order to counteract the pagan myths of neighboring countries—has become clear in our exposition of Genesis 1. Israel's God is the all-powerful Creator of heaven and earth. His world is orderly and

consistent. Man and woman are the culmination of creation, made in the image of God, to enjoy and be responsible for their stewardship of the earth.

The literary genre is a semipoetic narrative cast in a historico-artistic framework consisting of two parallel triads. On this interpretation, it is no problem that the creation of the sun, necessary for an earth clothed with vegetation on the third day, should be linked with the fourth day. Instead of turning hermeneutical handsprings to explain that supposed difficulty, we simply note that in view of the author's purpose the question is irrelevant. The account does not follow the chronological sequence assumed by concordist views.[10]

Scholars from the theological left, armed with scissors and paste, have rearranged supposed authors and dates into a variety of configurations. Commentators from the right, scientific texts in hand, have repeatedly adjusted their interpretations to harmonize with the latest theories.

The meaning of the word *day* must be determined (like any other word with several meanings) by the context and usage of the author. A plain reading of the text, with its recurring phrase of evening and morning, indicates a solar day of twenty-four hours. That would have been clear to Moses and his first readers. The context gives no connotation of an era or geological age. Creation is pictured in six familiar periods followed by a seventh for rest, corresponding to the days of the week as Israel knew them. But the question still remains whether the format is figurative or literal, that is, an *analogy* of God's creative activity or a chronological *account* of how many hours He worked.

God is a spirit whom no one can see, whose thoughts and ways are higher than ours. So (apart from the Incarnation) we can know him only through analogy, "a partial similarity between like features of two things, on which a comparison may be based."[11] In the Bible the human person is the central model used to reveal God's relationship and actions in history. God is pictured as seeing, speaking and hearing like a person even though he doesn't have eyes, lips or ears. Those figures of speech (anthropomorphisms) assure us that God is at least personal and can be known in an intimate relationship. (Science also uses analogies; for example, a billiard-ball model in physics helps us understand the behavior of gas molecules which we cannot see.)

The human model appears throughout Genesis 1. The writer also links God's creative activity to six days, marked by evening and morning, and followed by a day of rest. In the light of the other analogies, why should it be considered necessary to take this part of the account literally, as if God actually worked for six days (or epochs) and then rested? Biblical interpretation should not suddenly change hermeneutical horses in the middle of the exegetical stream.

A stringent literalism disregards the analogical medium of revelation about creation, raising meaningless questions about God's working schedule. For example, did he labor around the clock or intermittently on twelve-hour days? If God created light instantaneously, was the first day then mostly one of rest like the seventh? How did the plant and animal reproductive processes he constituted on succeeding days fit so neatly into that schedule?

The fact that the text speaks of twenty-four-hour days does not require that they be considered the actual duration of God's creative activity. Even on a human level, when we report the signficant achievements of someone in a position of power, the length of the working day is generally irrelevant. For example, a historian might write, "President Roosevelt decided to build the atomic bomb and President Truman ordered its use to destroy Hiroshima and Nagasaki to end the war with Japan. Two days radically changed the entire character of modern warfare." The exact details of *how* and *when* the commands were implemented over years or weeks are unimportant to the main concern of *who* and *why*, and what resulted.

Preoccupation with *how long* it took God to create the world, in days or epochs, deflects attention from the main point of Genesis 1. Such "scientific" concerns run interpretation onto a siding, away from the main track of God's revelation. Once we get past arguments over the length of the days, we can see the intended meaning of these days for Israel. First, their significance lies not in *identity*, a one-to-one correlation with God's creative activity, but in an *analogy* that provides a model for human work. The pattern of six plus one, work plus rest on the seventh day, highlights the sabbath. In doing so, it emphasizes the uniqueness of humanity. Made in the image of God, and given rule over the world, man and woman are the crown of creation. They rest from their labor on the sabbath, which is grounded in the creation (Gen. 2:2, Ex 20:11).

A metaphor uses the commonplace (or commonly understood, if you wish) meaning of a word in a figurative manner. When, for example, Jesus calls Herod "that fox" (Lk. 13:32), the word does not refer vaguely to any animal but to that one whose characteristics are well known; yet Jesus doesn't mean that Herod is literally a fox. Likewise, when David in Psalm 23 says, "The Lord is my shepherd," he refers not to just any kind of animal keeper but to one who cares for sheep. *It is the commonplace meaning of fox and shepherd that makes the metaphor understandable.* So the fact that the day in Genesis 1 has its ordinary work-a-day meaning, and does not refer to an epoch of some kind, makes possible the metaphor of God's creative activity as a model for human work of six days followed by sabbath rest.

Linking God's creative activity to days of the week serves as another element in the antipagan polemic. "By stretching the creation events over the course of a series of days the sharpest possible line has been drawn between this account and every form of mythical thinking. It is history that is here reported—once for all and of irrevocable finality in its results."[12] Genesis 1 contrasts sharply with the cyclical, recurring creations described by Israel's pagan neighbors.

Two other interpretations of the days have been advanced. P. J. Wiseman considers them days of revelation with the narrative given over a period of six days, each on its own tablet.[13] He notes a precedent for that literary form in other ancient literature. It has also been suggested that Genesis 1 was used liturgically somewhat like the narratives in other religions.[14] Whatever the merits of those views, they at least use the historical-cultural model to focus on what the narrative could have meant to the first hearers.

The Significance of Genesis 1

During the last century, Genesis 1 has suffered much from Western interpreters. Liberal literary criticism removes the divine authority of its message through Moses; conservative concentration on implications for science misses its intended meaning. Scholars from the theological left, armed with scissors and paste, have rearranged supposed authors and dates into a variety of configurations. Commentators from the right, scientific texts in hand, have repeatedly adjusted their interpretations to harmonize with the latest theories. In the process, the message of Genesis 1 has been so muffled that the average reader wonders what it means and whether it can be trusted. Hence we conclude by summarizing the significance of its account for ancient Israel, biblical theology, modern science and the church's life today.

Israel at Mount Sinai

Genesis 1 achieves a radical and comprehensive affirmation of monotheism versus every kind of false religion (polytheism, idolatry, animism, pantheism and syncretism); superstition (astrology and magic); and philosophy (materialism, ethical dualism, naturalism and nihilism). That is a remarkable achievement for so short an account (about 900 words) written in everyday language and understood by people in a variety of cultures for more than three thousand years. Each day of creation aims at two kinds of gods in the pantheons of the time: gods of light and darkness; sky and sea; earth and vegetation; sun, moon and stars; creatures in sea and air; domestic and wild animals; and finally human rulers. Though no human beings are divine, *all*—from pharaohs to slaves—are made in the image of God and share in the commission to be stewards of the earth.

The pattern of six plus one, work plus rest on the seventh day, highlights the sabbath. In doing so, it emphasizes the uniqueness of humanity.

For Israel those were life-and-death issues of daily existence. God's people do not need to know the *how* of creation; but they desperately need to know the *Creator*. Their God, who has brought them into covenant relationship with himself, is no less than the Creator and Controller of the world. He is not like the many pagan gods who must struggle for a period of time in their creative activity. He is stronger than all the powers that stand between his people and the Promised Land, the only One worthy of their worship and total commitment. Creation is the ground of Israel's hope for preservation as God's chosen people. For them the doctrine of creation is not so much a cosmogony as a confession of faith repeatedly expressed in psalms and prophecies throughout the Old Testament.

Biblical Theology

Both Old and New Testaments connect God's creative power with his redeeming love.

> *Blessed is he whose help is the God of Jacob,*
> *whose hope is in the Lord his God,*
> *the Maker of heaven and earth,*
> *the sea, and everything in them—*
> *the Lord, who remains faithful forever.*
>
> (Ps. 146:5–6)

> In last days he has spoken to us by his Son . . . through whom he made the universe, . . . sustaining all things by his powerful word. After he had provided purification for sins he sat down at the right hand of the Majesty in heaven.
>
> (Heb. 1:2–3)

God the Creator of the universe is the Lord and Judge of history who comes in Jesus Christ to demonstrate his saving love and power. Three great creeds emerging from the church's early theological controversies—the Apostles', Nicene and Chalcedonian—affirm that fundamental connection. It has provided the basis for creativity and meaning in human life, and for Christian confidence in ultimate victory over all forms of evil. Thus creation is also closely connected with *eschatology*, the doctrine of the end-times in which God ultimately vindicates his own creativity.

Eschatology is more than futurology, despite prevalent fascination about time tables of future events. It deals with the fulfillment of what God initiated in creation. God creates through his eternal Word; he also redeems and brings to completion through the incarnation and glorification of the same Word in Jesus of Nazareth. "Creation, as the going forth from God, is simultaneously the first step of the return to God; and the return is the completion of the journey begun in creation. God creates for a purpose which becomes known as the future of the world in the resurrection of Jesus, the Christ."[15] Even though creation has scientific and philosophical implications, its central significance is theological.

The Scientific Enterprise

The positive contribution of biblical teaching about God and the world to the development of modern science has been well documented. Yet a certain kind of modern theology has considered the biblical description of nature a liability, requiring "demythologizing" to make it acceptable to a scientific age. Actually, Genesis 1 prepared the way for our age by its own program of demythologizing. By purging the cosmic order of all gods and goddesses, the Genesis creation account "de-divinized" nature. The universe has no divine regions or beings who need to be feared or placated. Israel's intensely monotheistic faith thoroughly demythologized the natural world, making way for a science that can probe and study every part of the universe without fearing either trespass or retribution.

That does not mean that nature is secular and no longer sacred. It is still God's creation, declared to be good, preserved by his power and intended for his glory. The disappearance of mythical scenes and polytheistic intrigues clears the stage for the great drama of redemption and the new creation in Christ.

Nature is not secular and is no longer sacred. It is still God's creation, declared to be good, preserved by his power and intended for his glory.

The Contemporary Church

Meanwhile, the doctrine of creation has profound implications for contemporary Christian thought and life. Study of Genesis 1 illuminates two major questions that should concern Christians in modern culture. First, what false gods command a following in our society and even in our churches? Although they differ radically from the false deities of ancient Israel's neighbors, their worship can produce similar results. In order to escape the influence of current unbiblical philosophies, religious ideas and superstitions, the message of Genesis 1 is urgently needed.

Second, in a day of increasing environmental concerns, what actions should Christians take as stewards of the earth? Environmental problems have scientific and technological, political and economic, social and legal aspects. Important moral and ethical concerns derive from the biblical doctrines of creation and human responsibility for the earth. Basic to such concerns is our understanding of nature. Most other religions view the world as spiritual in itself or as irrelevant to spiritual concerns. But in the biblical view, the natural world is created, material and significant in God's purposes. From that teaching come basic principles which are belatedly receiving attention from Christian writers.[16] Surely the church needs a solid contemporary theology of creation to help define our human relationship to the natural world.

The doctrine of creation is foundational for God's providential care of his creation, for his redemption of humanity and for his re-creation of a new heaven and earth. Its teaching of God's transcendent sovereignty and power is embodied in a hymn in the last book of the Bible:

> *You are worthy, our Lord and God,*
> *to receive glory and honor and power,*
> *for you created all things,*
> *and by your will they were created*
> *and have their being.*
>
> (Rev. 4:11)

APPENDIX

Before 1750 it was generally held that God created the world in six twenty-four-hour days, although some early church fathers like Augustine viewed them allegorically.[17] Archbishop Ussher around 1650 even calculated the date of creation to be 4004 B.C. But as the science of geology matured in the 1800's, many were shocked to discover that the earth was millions of years old. Since modern science had gained so much prestige, many interpreters strove to retain credibility for the Bible by attempting to demonstrate its scientific accuracy. Therefore, a variety of concordistic (harmonizing) views were proposed to correlate biblical teaching with current scientific theories.

For example, "flood geology" attempted to account for fossil discoveries through the catastrophe of a universal flood.[18] When new geological discoveries questioned that view, it was replaced by the "restitution" or "gap" theory popularized by a Scottish clergyman, Thomas Chalmers, in 1804. According to that view a catastrophe occurred between Genesis 1:1 and 1:2 to allow the necessary time for the geological formations to develop. Eventually it became necessary to assume a series of catastrophies or floods to account for newer scientific findings.

Although such theories accounted for the time that science required, they could not explain the sequence of the geological record. The "day-age" interpretation considered the Genesis days to be metaphorical for geological ages. That view was advocated by influential North American geologists J. W. Dawson and James Dana as well as many theologians. The Genesis days were then correlated, more or less accurately, with the proposed epochs. Another version retained literal twenty-four-hour days of creative activity, but separated them by geological epochs.

The above views, with varying degrees of credibility, have in common three major problems. First, they attempt to find answers to questions the text does not address, about the *how* or the mechanism of natural forces. (To see how inappropriate such an approach is, consider its opposite: suppose one tried to derive information about the meaning and purpose of life from a technical treatise on astronomy in which the author had no intention of revealing his philosophy.) The biblical accounts of creation do not provide scientific data or descriptions. John Calvin emphasized that point: "The Holy Spirit had no intention to teach astronomy. . . . He made use by Moses and the other prophets of the popular language that none might shelter himself under the pretext of obscurity."[19] Adapting Calvin's principle to the present we can affirm, "The Holy Spirit had no intention of teaching geology and biology."

Second, not only do the concordistic views strain Genesis by importing concepts foreign to the text, but any apparent success in harmonizing the message with "modern science" guarantees a failure when current scientific theory is revised or discarded. During the last two centuries, that pattern has been evident in the continual efforts of harmonizers to keep abreast of rapidly changing scientific views. The credibility of the Bible is not enhanced by thrusting it into the scramble of catch-up in a game it was never intended to play. What is the point of trying to correlate the ultimate truths of Scripture with the ever-changing theories of science? No wonder that when those theories go out of date, in the minds of many people the Bible joins them in gathering dust on the shelf.

Third, any extent to which Genesis teaches modern scientific concepts would have made its message unintelligible to its first readers, and to most of the people who have lived during the last three thousand years. Even in our own century, what per cent of the people understand the abstract language of science? And of those who do, how many use it in the communications of daily life with which the biblical writers are primarily concerned?

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Spirituality and Science

The Progress, Problems, and Promise of Scientific Research on Spiritual Well-Being

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Numerous recent developments have attracted attention to "spiritual" phenomena. Yet in the scientific study of religion it is typically neglected, although aspects of it are as amenable to research as many other subjects which are investigated in the human sciences. Growing awareness of the need for such work has led to the development of research instruments, and many relationships have been discovered between spirituality and other variables. Opportunities for further research on the subject are increasing. The biases of investigators, the danger of reductionism, the diversity of ideological orientations, and potential abuses of measurements are among the problems confronted in such work.

Most social and behavioral scientists avoid attention to the spiritual nature of humanity. Some deny that such a dimension exists, assuming the concept is merely a reification. They reduce evidence for it to the level of sociocultural factors and treat it as a dependent variable. Many who believe that it may or does exist are convinced that it cannot be studied scientifically; they feel that the spiritual is ethereal, unobservable, supernatural, and thus ineffable and supra-empirical, transcending the boundaries of scientific methods.

The growing interest in eastern and "new" religions, holistic health, the human potential movement, and numerous occult and pseudo-religious phenomena has attracted attention to various "spiritual" phenomena. The sense of alienation, lack of purpose for life, and related feelings of non-identity often experienced in modern society have stimulated a search for enduring values. These have contributed to the rise of a third group of scientists who have begun to probe the domain of the spiritual, believing that it may be as susceptible to scientific research as many other intangible concepts in their disciplines.

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The Bible uses many words to characterize the human being. The Hebrew *nepes*, usually translated "soul," appears 754 times and *ruah* for spirit 378 times in the Old Testament, while the New Testament refers to the Greek *pneuma* for "spirit" 146 times and psyche for "soul" 11 times (McDonald, 1984). Concepts like "heart," "mind," inner and outer nature, natural man, and spiritual man also relate to the human spirit. Yet there is no metaphysical dichotomy between body and spirit. "By God's inbreathing the man formed from dust became a living soul, a unified being in the interrelation of the terrestrial and the transcendental" (McDonald, 1984:677).

As among the ancient Hebrews, a wholistic emphasis characterizes most Christian thought today. In contrast to Greek dualism separating body from spirit and its trichotomy of body, soul, and spirit, "Present theological and psychological emphasis is almost altogether upon the fundamental wholeness or unity of man's being as against all philosophical attempts to divide it" (Ward, 1984:1112). Yet analytically both distinctive and overlapping concepts of "soul" and "spirit" and their relationships to the body, mind, and God receive attention in theology (Osterhaven, 1984). Similarly, most scientific work artificially breaks down its subject matter into component parts and processes. Within the context of human wholeness, it is appropriate to analyze spirituality by scientific methodology. We already have seen considerable success in moving toward the goal of including spirituality in the human sciences.

Pioneering Progress°

Glock (1962) alleged his five "dimensions of religiosity" cover all manifestations prescribed by all religions of the world, but my check against biblical values revealed that a spiritual component infusing and cutting across all five dimensions is missing. The evidence of this spiritual component is circumstantial, philosophical, and theological, "although it is susceptible to scientific testing" (Moberg, 1967a:29). It rests upon the Bible, ancient traditions, the autonomous nature of people, the analogy to life in which its whole is more than the sum of its parts, the self-consciousness that transcends material matter, the other minds phenomenon, the fact that knowing a person goes far beyond knowing about that person, the probably universal (though often unconscious) desire of people to have an ultimate commitment or focus of loyalty, internal subjective experiences in decision-making, and the "proofs" of theological apologetics for belief in the existence of God. Most of the evidence is not "hard data" directly susceptible to conventional scientific tests, yet the same can be said of numerous other intangible and subjective concepts that are widely used in the human sciences—alienation, anomie, depression, catharsis, empathy, intelligence, loneliness, space, and time, to mention but a few.

The susceptibility of spirituality to scientific investigation is indicated by the fact that many religious groups have tests for the validity of people's relation-

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°*My topic for the International Conference on Science and Christian Faith in Oxford, England, July 17-23, 1965, was "Science and the Spiritual Nature of Man." The other participants made me aware of numerous problems and components of the subject, and two presentations that August compelled me to summarize results of my studies (Moberg, 1967a, 1967b). Those papers still provide a foundation for systematic study of the subject, so I'll summarize a few highlights here. They indicated that everyone has biases, and this is especially true when dealing with topics related to religion. Sociology of religion inevitably gets involved in "science-religion conflicts;" problems related to human spiritual nature are nowhere more obvious than in the study of personal religiosity.*

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ships with God. Self-reports (testimonies, personal documents, questionnaire answers, etc.) of believers are indicators reflecting the subject, even if they cannot constitute conclusive scientific "proof" that people have a spiritual nature. The *verstehende* approach in sociology that emphasizes sympathetic, introspective, and intuitive understanding provides valuable insights about internalized aspects of the personality and the social self. It is related to the biblical concept of "spirit bearing witness with spirit" (Romans 8:16) and of the human spirit's perceiving what is within oneself (I Corinthians 2:11–12).

Sociology of religion inevitably gets involved in "science-religion conflicts"; problems related to human spiritual nature are nowhere more obvious than in the study of personal religiosity.

Every science is time-bound and culture-bound; our perceptivity is limited to the current stage of its sensitizing concepts, research instruments, theoretical orientations, and analytical procedures. We who observe the spiritual nature of humanity with "the eyes of faith" must humbly take care lest we assume that a metaphysical tenet of Christian dogma is scientific fact before it is based upon scientific evidence. At the same time, "non-religious" empiricists should not arbitrarily conclude that there is no such thing as a spiritual component to human nature before crucial tests support their hypothesis. Two kinds of faith are battling each other.

> To assume that there is no God and nothing supernatural is just as much a metaphysical faith as assuming that there is. . . . While it is currently impossible to prove conclusively by science that man's religiosity has a spiritual component, neither can the opponents of this proposition disprove it. . . . the situation pertinent to science and man's spiritual nature is not a battle between "pure science" and "religious bias." Rather it is . . . a case of science plus biases versus science plus different biases. (Moberg, 1967a:32–33)

> It is entirely possible that the spiritual component of religion is transcendental, so far above and beyond objective experience that it cannot be studied scientifically. . . . But even if this is so, the correlates and effects of the man-God relationship may be measurable and hence as proper a subject of scientific study as numerous other phenomena that can be investigated only indirectly. . . . Scientific scepticism and scientific humility are needed on both sides of this subject. To "explain" scientifically is not to "explain away," for the phenomena explained remain (if they were there in the first place) unless they were mere reifications, creations of men's imaginations.
> (Moberg, 1967b:16)

Popular and Professional Developments

Agnostic scholars for at least two centuries have predicted that advancing modernization, scientific research, and education would gradually erode all but vestiges of traditional Christianity. Few in the mid-1960's foresaw the tremendous growth of interest in "spiritual" phenomena that has occurred in the 1970's and 1980's. Popular culture has often focused upon prominent gurus, Eastern religions, occult groups, introspective meditation, witchcraft, astrological horoscopes, human potential movements, holistic health groups, self-actualization, parapsychology, and "new religious movements" that emphasize a non-material spiritual domain. Yet in terms of numbers the converts to evangelical and fundamentalist Christianity far exceed those to the religious and pseudoreligious cults. At least in the U.S. and Canada, groups which have clung to the central traditions of Christian faith have been growing while those which capitulated to agnostic presuppositions of modern scholarship have tended to decline in membership strength (Kelley, 1977; cf. Hoge and Roozen, 1979).

Rising popular interest in spiritual and religious concerns was paralleled by growing attention in many professions that serve human needs. Much pastoral care in the mid-twentieth century had shifted toward increased stress upon material and psychological problems and diminished concern for explicit God-person relationships. Meanwhile, chaplaincy services were established in numerous hospitals, convalescent homes, health services, retirement communities, institutions for the mentally ill, and other locations. Clinical pastoral education programs trained thousands of clergy. As they became team members in the "helping professions," Pruyser (1976) warned them of the danger of trying to be mere mini-psychologists or pseudo-psychiatrists. He emphasized that the clergy ought instead to emphasize their unique role, that of spiritual diagnostician, drawing upon resources of Scripture and faith to make contributions no other profession can make.

In the field of health care, growing recognition of the unity of all components of the total person contributed to the development of multi-professional teams in many hospitals and rehabilitation centers. Physicians remained dominant, but nurses, rehabilitation therapists, psychologists, social workers, and clergy all worked together to establish protocols for patients' therapy. Wholistic Health Care Centers under Granger Westberg's leadership emphasized the importance of preventive as well as curative health care using services of a team including a nurse, psychologist, pastoral counselor, and physician to care for the whole person, not just the body or the mind (Tubesing, 1979; Peterson, 1981).

Reed's (1979) "surgery of the soul" developed into an emphasis upon logo-psychosomatic healing that ministers to the spirit, soul, and body. Christian faith, prayer, and the work of the Holy Spirit are part of its therapeutic process alongside of conventional medical and surgical treatment. The newsletter and annual conferences of the Christian Medical Foundation International he heads are building a network of medical professionals who are ministering explicitly to spiritual as well as physiological and psychiatric needs. The Christian Medical Society also has gained strength and influence.

A notable new ministry to those in trouble is Prison Fellowship, which is ten years old in 1986. By 1984 it had 16,000 inmates participating in discipleship and training programs and nearly 20,000 volunteers in the U.S. plus thousands more in 15 other nations (Colson, 1984). Its services include evangelism and spiritual nurture, one-on-one visitation to prisoners by volunteers, help with employment after release, integration into a Christian community of faith, and family restoration. Thousands of lives have been transformed, disciplinary problems in prisons reduced, and recidivism rates cut sharply among its alumni.

Alcoholics Anonymous emphasizes spiritual concerns in several of its twelve steps to overcoming alcoholism. It appears to have been more effective than other programs which treat that human ailment, but it does not keep records of members. In the religiously pluralistic context of American society, it cannot be explicitly Christian, so concepts like belief in "a Power greater than ourselves" and "God as we understood Him" have numerous interpretations. Indeed, some of its publicity states that "the word 'God' is not necessarily used here in a religious sense. It may be interpreted to mean any power greater than your own" ((Minnesota Council on Alcohol Problems, n.d.:3).

Sensitivity to the autonomy of the person, the pluralism of society, the consequences of religious liberty, and the separation of church and state in America, make it difficult to apply explicitly Christian values in social work even in church-related agencies (Moberg, 1978b). Yet Renetzky's (1979) work has demonstrated how "the Fourth Dimension," a spiritual component added to the biological, psychological, and sociological dimensions, can be used in nonsectarian counseling of people with problems.

The section on spiritual well-being and its book-length "background paper" (Moberg, 1971) at the 1971 White House Conference on Aging pointed to the significance of spiritual needs, goals, and services in the later years of life. They led to creation of the National Interfaith Coalition on Aging (NICA) in 1972, an agency remarkably successful in drawing together Catholics, Jews, and Eastern Orthodox people with Protestant liberals and evangelicals. In its conferences, publications, research, and services to "the religious sector," it has consistently kept spiritual well-being at the forefront, reminding religious groups not to overlook that important human need which other agencies ignore.

A highly significant development of the past decade has been incorporation of "spiritual distress" into the diagnostic classification used in the nursing profession (Kim et al., 1984). This has increased the awareness of nurses that people have spiritual needs, and it has stimulated a growing body of research. Closely related is the work of the Nurses Christian Fellowship, an association providing support for Christians in the profession. Its workshops help nurses to understand the spiritual needs of patients and cultivate resources to meet them. Books sponsored by NCF (e.g., Fish and Shelly, 1978; Shelly et al., 1983) include insights and guidelines useful to persons in any profession oriented toward human needs.

Research Needs

These and many other clinical and service-oriented developments related to spiritual well-being are typically accompanied by strong faith in the effectiveness of the services provided, especially on the part of Christians who offer them. Anecdotes and "case studies" of persons and families whose lives were changed are abundant, especially in church-related ministries. Yet very few of the services and programs have received systematic scrutiny to determine whether or not their claims are "scientifically" justified. Instances of constructive change eclipse other cases in which, conceivably, less good than harm resulted.

Not only is self-justification a prominent human trait, but self-healing tendencies are built into every individual, family, and group, so it is possible that observed healing consequences would have occurred even without the therapy. Evaluation research hence is needed in order to discover the extent to which the services enhance or diminish the spiritual well-being of recipients and participants. Constructively effective activities would then receive increased support and encouragement, while those which are ineffective or have negative results could be eliminated or modified.

Research is a major component of "the language of science." It can attract the attention of even skeptics and agnostics. To be sure, those who are unhappy with findings will identify missing details, alternative explanations, flaws in operational connections between concepts and their alleged measures, and defects in the

validity and reliability of measuring instruments and statistics. Nevertheless, their giving heed contributes to opening up the subject for further investigation.

There is a great need for research on and related to spiritual well-being in the context of both the "pure" and "applied" aspects of numerous academic disciplines (Moberg, 1978a). Among the significant subject areas for such work are the relationships of spiritual well-being with physical and mental wellness, fear of death, life adjustment, quality of life, ability to work with other people, personal morality, social ethics, child rearing, marital success, rehabilitation of criminals and juvenile delinquents, suicide, abortion, occupational success, charitable giving, church participation, volunteer services, voting, and hundreds of other topics.

If one recognizes that . . . pluralism neither denies the reality of the spiritual nor insists that one's favorite measure is the only valid one, the diversity can contribute to enriched insights and expanded perspectives.

In order to do such work, however, careful conceptual study is needed to delimit the components of "spiritual well-being." This in turn will lead to further development of methodological procedures and measuring instruments with which to investigate the subject. Some of the instruments also could be used clinically, enabling professionals to learn quickly the approximate level of spiritual well-being of a client and thus to know whether some deficiency or weakness in that area should be a major focus of therapy. The measures also could be applied before and after professional, clinical, and religious services, programs, and ministries to discover results, and they could be used to measure quality of life in the social indicators movement (Moberg and Brusek, 1978).

Research Instruments

Several instruments already have been developed to measure phenomena related to spiritual well-being. The most widely used of these is the attitude scale developed by psychologists Ellison and Paloutzian (1978). Each item is answered by checking Strongly Agree, Moderately Agree, Agree, Disagree, Moderately Disagree, or Strongly Disagree. Ten of the items comprise a Religious Well-Being Scale on the "vertical dimension" of one's relationship with God (e. g., "I believe that God loves me and cares about me" and "I believe that God is impersonal and not interested in my daily situations"). The other ten, an Existential Well-Being Scale, refer to the "horizontal dimension" of one's sense of life satisfaction (e. g., "I don't know who I am, where I came from, or where I am going" and "I feel that life is a positive experience"). Together the twenty items are a Spiritual Well-Being Scale, not to be confused with spiritual health and spiritual maturity (Paloutzian, 1982). Test-retest reliability, internal consistency, face validity, and correlation with theoretically related scales are all high.

Another psychological instrument is that developed by Farnham (1979). It consists of a series of semantic differential scales based on the teachings of Jesus Christ with comparisons to Maslow's definitions of psychological well-being and the self-actualized person. "Spiritual/psychological well-being is defined as a state of life that is joyful, full, rewarding, interesting, hopeful, friendly, meaningful, free from guilt, free from worry, purposeful, trusting, exciting, enabling, and happy" (p. 2). Each of these concepts is contrasted with an opposite polar adjective to make a seven-point rating scale on which a respondent can indicate which position best represents his or her life at the present time. The technique aims to discover the connotative meanings of each pair of characteristics.

A 22-item Likert-type Spiritual Distress Scale based upon five major areas in which people can experience distress of the spirit (forgiveness, love, hope, trust, meaning and purpose) was constructed by Flesner (1981). Scores on it correlate negatively with those on the Ellison-Paloutzian Spiritual Well-Being Scale and have very high test-retest reliability (pp.58–61).

Kauffman's (1979) Religious Life Scale measures "spiritual maturity." Its fourteen items are those that ranked highest on four dimensions of religiosity in a study of 3,591 Mennonites, so it is a composite measure of devotionalism, associationalism (church participation), evangelism (Christian witness), and religious experiences. It stresses the manifest expressions of religion (doing and feeling) rather than beliefs and knowledge.

Survey research in 1978–79 in the U.S.A. and Sweden identified seven indexes of spiritual well-being through factor analysis: Christian Faith, Self-Satisfaction, Personal Piety, Subjective Spiritual Well-Being, Optimism, Religious Cynicism, and Elitism. In addition, items on personal volunteer activities over the preceding twelve months were grouped into three indexes of Political, Charitable, and Religious Social Involvement (Moberg, 1981, 1984). Subsequent

research still in progress indicates that these index scores correlate highly and significantly with scores on the Ellison-Paloutzian and Farnham scales.

At least three other instruments give promise of potential development into research tools. Bowman (1982; 1984) developed an interview schedule to identify measurable change in twelve areas of spiritual and religious awareness among people over age 65. Among 100 persons from five groups in Michigan the highest reported change in awareness was increased "feelings of experiencing God's closeness;" no one reported decreased awareness. Increased awareness also exceeded decreases in "recognition of own vulnerability and possible dependency, illness and death," "peaceful confidence in speaking and hearing statements of belief, doctrine," "grateful memories" (especially important to Jews in her study), and "acceptance of life situations." At the opposite extreme were decreased awareness of psychological aspects of sexuality, of personal efforts to serve community and civic needs, of "joy in simple things," and of "relationship with family, friends, neighbors," in all of which diminished awareness was reported by many more persons than increased awareness. For most people awareness in the areas explored neither increased nor diminished. Significant life experiences often triggered the changes.

The Spiritual Checkup by Castle (1985), a Quaker psychologist, was developed as a tool for self-evaluation of one's "spiritual pulse," preferably with the help of a spiritual guide. Most of its items on beliefs, actions, and personal maturity are in the form of semantic differential scales and closed-end questions readily amenable to quantitative analysis. Castle's discussions of the nature of the human spirit, fruit of the spirit, phases or styles in spiritual life, and methods for looking at one's personal history and for "birthing and orchestrating one's future" can stimulate theoretical, methodological and pragmatic thinking on this subject.

Five leading factors emerged in Marcum's (1979) study of the spiritual well-being of religious women who remained in and those who departed from their communities. They could be used as indexes of a flexible person-centered orientation, working and sharing together, dependence on others, prayer in spiritual life, and quality of religious community life, all of which are related to spirituality.

Research Findings

Using a variety of methodological approaches, researchers have discovered many relationships between spirituality and other variables, including the following:

1. Spiritual well-being is associated significantly and positively with self-esteem, perceived level of social competence, memories of family closeness during childhood, accepting religious commitment as a personal rather than an ethical orientation, intrinsic religiousness, purpose-in-life, positive feelings about life, optimism, and participation in religious activities. It relates negatively to loneliness and valuing individualism, success, and personal freedom (Paloutzian, 1982; Paloutzian and Ellison, 1982; Bauwens, Johnson, and Hudgens, 1984).

Another [danger] is a common tendency in the social and behavioral sciences to think that whenever one has attained a satisfactory "explanation" of a phenomenon, one has explained it away.

2. Among clergymen who had in-patient therapy for alcoholism, "super-saints" with high levels of spirituality were much more likely than "mini-saints" with low levels to have experienced a spiritual awakening during therapy, to have high levels of compassion for others, to believe their quality of ministry had improved since treatment, to hold strong theological beliefs, and to have improved ties to their church and fellow clergy (Fichter, 1979).

3. Roman Catholic sisters who remained in their religious communities, in contrast to nuns who departed, were characterized "by prayer and having one's thinking and meditating directly inspired by Scripture" (Marcum, 1979:274).

4. Secondary analysis of data from a large survey in Taiwan suggests that the social integration of individuals is higher among Protestants and Catholics than among Buddhists, Taoists, and Pai Pai members; it is highest of all among the Christians with high levels of spiritual well-being (Hynson, 1979).

5. Although few Americans can define "spiritual well-being," most have clear beliefs about its characteristics when confronted with explicit questions (Moberg, 1979a).

6. Evangelical Christians (including fundamentalists) in both the United States and Sweden have higher levels of spiritual well-being than other Christians, who

in turn have higher levels than those who profess to be atheists, agnostics, or skeptics (Moberg, 1981, 1983).

7. An inverse relationship between levels of depression and of spiritual well-being was found in research on 435 university students (Fehring, Brennan, and Keller, 1982).

Just as there is evidence that a general sense of well-being results from a different and wider combination of causes than a negative sense of ill-being . . . spiritual wellness may be a broader and more complex concept than spiritual illness.

8. A study of 67 Catholic Sisters aged 70 to 92 years found a relationship between their faith life and how they were aging. The majority of those with integrated personalities expressed a satisfying and deepening relationship with God and frequently described God as having a significant effect on their lives, while the others tended not to say much about spiritual relationships even when asked (Carmichael, 1984).

9. When explicit attention was given to spiritual well-being through the "anchor points" of symbols and rituals from their religious heritage, elderly mentally ill patients in a state hospital who were Jewish and Roman Catholic showed clear improvement in memory, interaction patterns, improved appetite, reduced depression, and fewer somatic complaints. A comparison with other patients who had similar religious preferences, medication, and therapy but were without the religious culture group showed that patients with religious therapy were in the hospital two to three months less, had more contact with reality, and had fewer somatic and depressive elements upon leaving the hospital (Gonzales-Singh, 1977).

10. A growing body of research reports relationships of religion and spiritual nurture to physical and mental health. Most reveal positive relationships between spirituality and other domains of wellness or wholistic well-being (Summerlin, 1980; Sanua, 1969; see also Allen et al., 1980; Malony, 1983; Marty and Vaux, 1982).

Perplexing Problems

Despite significant progress, many difficiulties still confront scientific research related to spirituality. One is the variety of measures used to conceptualize it. Since these apparently are highly and significantly intercorrelated, they presumably reflect aspects of a larger whole, whether that be spiritual or wholistic well-being. This supports my belief that the directly and indirectly observable aspects of spiritual well-being comprise a complex multidimensional phenomenon, not a simple unidimensional variable. Eventually we may have dozens of indexes reflecting various components, for composite overall measures tend to hide whatever differential effect each part may have (Kauffman, 1979:251).

The predilections, interests, and biases of each investigator may result in attention to different components and measures of spiritual well-being, and thus seemingly to different subjects. If one recognizes that such pluralism neither denies the reality of the spiritual nor insists that one's favorite measure is the only valid one, the diversity can contribute to enriched insights and expanded perspectives. It is likely that many of the differing measures of spiritual well-being in effect comprise equivalent or parallel forms of each other. Some possibly reflect a general Christianity factor while the more specific subscales reflect other dimensions of religious phenomena (see Gorsuch, 1984). Yet just as the relationship of religion to other variables is affected by the specific items chosen as its indicators (Kauffman, 1979:251–252), so one's choice of indexes and scales to reflect spirituality may influence what one finds.

Reductionism is another danger in studies of spirituality. One form it takes is to assume that whatever is measured constitutes its very essence, thus confusing the concept with its indicators. Another is a common tendency in the social and behavioral sciences to think that whenever one has attained a satisfactory "explanation" of a phenomenon, one has explained it away. MacKay (1974) has warned against such "nothing buttery" (ontological reductionism). Every explanation is of necessity partial and incomplete; it is given within a frame of reference limited by academic discipline, professional demands, pragmatic needs, value orientations, and other variables. Humility is inherent in good science; it recognizes and reflects the complexity of humanity and the universe. We must beware lest we imply that our approaches to a topic like spirituality exhaust the totality of its richness. (see Moberg, 1985).

The wide diversity of religious and ideological orientations in pluralistic societies makes it difficult to construct measures of spirituality that are consistent

with the values of more than one ideology or religion. Separate indexes may be needed for each major religious faith, although it is possible that a common core of overarching values accepted by all religious groups can provide the basis for a universal instrument.

Humility is inherent in good science; it recognizes and reflects the complexity of humanity and the universe. We must beware lest we imply that our approaches to a topic like spirituality exhaust the totality of its richness.

The identification of much research on spirituality with the health professions poses an added difficulty. There is a tendency to use a medical model for work on spiritual well-being. While this has constructive implications, it can also lead to the belief that "healthy spirituality" is simply the absence of spiritual illness and that treating the latter is merely eliminating undesirable symptoms. Just as there is evidence that a general sense of well-being results from a different and wider combination of causes than a negative sense of ill-being (Headey et al., 1984), spiritual wellness may be a broader and more complex concept than spiritual illness.

Measuring instruments are easily abused. We must avoid the mistake of assuming that a measure of spiritual well-being places every person inerrantly upon a scale from spiritual health to spiritual illness, then of arbitrarily treating that person in therapy or daily life as if the instrument is wiser than a skilled professional helper, providing a complete and accurate assessment of all components of spiritual well-being. Furthermore, is it ethical to compel people with low scores to receive spiritual care? Such folly can easily occur if attention to spiritual concerns increases in society and we develop ever more tools to gauge them. Potential abuse exists in every area of life; to evade it fully is to do nothing worthwhile.

Promising Prospects

There are many signs of increasing interest in spirituality, at least in the United States. A Gallup Poll of the adult population found that 57% were more interested in religious and spiritual matters than five years earlier, 56% were more reliant on God, and 44% claimed their spiritual well-being had improved. Two-fifths claimed to be involved in Bible study groups, religious education, prayer groups, or witnessing. Attendance in church or synagogue in the past seven days held steady at 41% ("Trends," 1983).

Religion has gradually gained prominence in the mass media of the U.S.A. Its impact upon politics, always strong in American history, has gained increasing attention over the past decade. While much of this is not explicitly "spiritual," it may reflect underlying spiritual interests on the part of a substantial proportion of the population.

Acknowledgement of the spiritual nature and needs of people may be gradually gaining ground in sociology (McGehee, 1982; Moberg, 1979b), in medicine (Reed, 1979, Fichter, 1981; Marty and Vaux, 1982), in nursing (Kim et al., 1984; Fish and Shelly, 1978), in social psychology and physics (Schroll, 1984), in naturalistic biology (Hardy, 1979), and in other contexts. As this occurs, the needs and opportunities for research on the subject will expand. We who accept this challenge must exercise appropriate flexibility, humility, interdisciplinary cooperation, and all-around wisdom, thus retaining a wholistic balance in our attitudes, actions, and thoughts about spirituality and science.

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Since the story of Genesis 11 emphasizes the fate of language, which is in very truth the expression of human life, we may be permitted to point out how the same principle is confirmed in this area today. Divorced from any concern for truth, human language disintegrates into the repetition of signals and the yelling of slogans, with each universe of propaganda opposed to its rival and all words emptied of their meaning. Communication is lost and meaning is lost. The punishment for the sin of Babel is not to be underestimated.

Henri Blocker
In the Beginning: The Opening Chapters of Genesis, IVP (1984), p. 207.

Summing Up of ASA / RSCF Conference*†

Oxford University, July 1985

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As we come to the end of this memorable occasion, I think it appropriate to begin by expressing on behalf of us all the debt we feel to Professor Hooykaas, whose presence with us here has been a great joy to us all. It was from him more than anyone else that the fledgling RSCF learned what truly biblical freedom means—neither on the one hand the irresponsibility of the careless and self-centred egotist in science, nor on the other hand the cramped spirit of the slave to a philosophical system. It has been a matter of enduring inspiration to all of us to have had the lead he gave us in those early days and which he renewed by his participation in our first international conference twenty years ago.

Reference has already been made to Malcolm Jeeves's digest[1] of that conference, and one of the immediate effects of this extremely enjoyable and stimulating weekend is that I want to go back and read his report again to see just how the scene has shifted since then.

Realism and Reverence

Thinking over the pattern of the weekend, and trying to take a bird's eye view of what our colleagues, by the grace of God, have been able to set before us, what emerges repeatedly is the theme of Walter Thorson's second keynote speech; the close and natural connection, for the Christian, between realism and reverence.[2] There is, of course, a kind of Uriah Heepish piety, a long faced piety, with which we could easily decorate our scientific work by putting an appropriate text over our door and on the laboratory wall; but that kind of "integration" of our faith and our thought, though it goes some way towards realism, is a long way from the sort of thing that Walter and others have set before us. His point was that when reverent love for God has really saturated our being and permeated all our thinking, then a natural outworking of it in our scientific practice is what he called realism. Now realism is not only a theoretical philosophical position; it has many practical facets. One is, of course, an emphasis on the duty of objectivity, to which I want to

*Paper presented at the conference "Christian Faith and Science in Society," a Joint Meeting of the American Scientific Affiliation, Canadian Scientific and Christian Affiliation and the Research Scientists' Christian Fellowship, held July 26-29, 1985, at St. Catherine's College in Oxford, England.

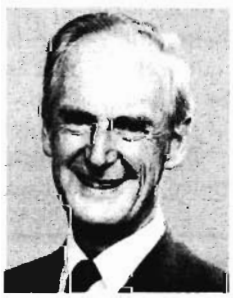
†Professor MacKay's "Summing Up" has also been published in Science and Faith, Newsletter No. 5 of the Research Scientists' Christian Fellowship (RSCF).

return. Another is a readiness to reckon with the fallenness of our world, not merely in the sense that we bite our nails and say, "Gee, if only this wasn't a fallen world we would be able to do this and this;" but in realizing that since our whole natural order, the whole drama in which we find ourselves, is under a curse, we cannot even rely on our intuition to tell us what it ought to be like if it were not fallen. In a fallen world we have again and again to face choices, not between bad and good, but between bad and worse. This, which the Bible makes abundantly clear, affects us as scientists quite as much as our fellows in any other walk of life. Nobody can have more reason to be realistic than the reverent learner of the Creator's lessons, whether revealed in nature or in Scripture.

The Breadth of Our Stewardly Responsibilities

A second key emphasis this weekend has been on the breadth of man's responsibilities as God's steward. I don't think we should allow the frequency with which we are reminded of this precept to cause it to become hackneyed in our thinking. Any number of common misconceptions of "the problems of the scientist" are ruled out once you think of the scientist as essentially a steward. For example, take the question of "scientific freedom." If scientific freedom meant just freedom to speculate, freedom to explore wherever our curiosity took us, and so on, no doubt there are carefully guarded senses in which God's creation of us, and the kind of creation in which He has placed us, give us these freedoms. But of course this view of the scientist fails to put first things first. The Bible portrays each of us as primarily a steward—as one under his master's eye, ready to be asked at any time, "What are you doing, and why?," and "How much are you achieving of the purposes for which I put you here?". Looked at in that light, questions of freedom to speculate and freedom to explore are automatically subject to proper safeguards. What we have to ask is whether as stewards we have any business in the area in question. If we have, then indeed we are free and must not feel cramped even by our theological systems in the scientific explorations we make.

A further effect of the emphasis on man as God's steward, I think, is to prevent us from lapsing into a pietistic passivity. We are, if you will allow the metaphor, not lap dogs, but sheep dogs. We are not pampered pets whose calling is just to look up into our master's eyes and snuffle our contentment. We are commissioned agents. Not that adoring contemplation is out of place; in my native Scotland you will often see a shepherd's collie, back in the croft after a hard day's work on the hills, put his chin between his master's knees and look up into his eyes in silent and blissful adoration. We are meant to worship God in adoring contemplation; but it is only as part of a life of integrated diligence as his commissioned agents. Admiring and thankful contemplation can be part of our worship; but obedient service with diligence and initiative, courageous where need be but always humble, is meant to be the other part. Of course, as we have been reminded by several papers, this includes compassionate service to others, both at the individual and collective levels. Here I believe we found a need for a good deal more constructive theological thinking about the ways in which these two levels should be integrated. In our service to the one God, it is not always easy to relate our attempts to be compassionate to each individual as an individual, and our attempts to show compassion for the "welfare of Israel"—the welfare of the human population as a whole. I stress this because I think it is not trivial. We all know that there was a sense in which the Nazis, for instance, reckoned to be compassionate at a statistical level, but in the process callously trod down the individual and ignored his needs. In our own efforts to be compassionate, the danger is more likely to be the opposite one of subordinating the good of the human community to the interests of the individuals that claim our attention. We need to work this out carefully and prayerfully and biblically, and I believe the help of theologians competent to remind us of the relevant biblical emphases may be essential.



Donald M. MacKay, D.Sc., F. Inst. P., was born in Lybster, Scotland in 1922 and graduated in Natural Philosophy (Physics) at St. Andrews University in 1943. His WWII radar research with the British Admiralty led him to develop a theory of communication, computing, and control which he has employed for 35 years in understanding brain mechanisms for vision, hearing and touch. Following a teaching appointment in Physics at Kings College London he moved to the University of Keele in Staffordshire to found an interdisciplinary department of Communication and Neuroscience. Professor MacKay has been an eloquent spokesman for the Christian faith in Europe and America. His concern for developing a Christian perspective has been articulated in such works as The Clockwork Image; Brains, Machines and Persons; *and* Human Science and Human Dignity.

Science as Obedient Service

Turning then to science itself as a form of obedient service, we have had a good deal of critical thinking (in the proper sense, not sniping, but shaking to test the solidity of our ideas) directed at the classical image of the scientist as a map maker. Map-making is, I still believe, a helpful shorthand term for what the scientist's stewardship is primarily about. But the first point we noted was that the map is not a static map. It is a map, or if you like a codification, based on the discovery of causal relations between events. This is, of course, vital for stewardship. The steward has two different kinds of needs. First, he needs to know the lay of his master's land. He must be able quickly and efficiently to find his way about, and to lay hands on what he needs to perform his duties. For this he needs a map in the conventional sense. But he also needs to understand the "go" of things. If something goes wrong, he can be asked by his master, "But didn't you know enough to expect this? Can you excuse yourself for not foreseeing that consequence of your action?" For this he needs something more in the nature of an explanatory diagram, like a radio circuit or the cutaway schematic of a motor car engine.

What I would stress is that although in all this there is an element of prediction and (at least potential) control, the "stewardly" perspective differs sharply in emphasis from that of a popular tradition in the philosophy of science which makes "prediction" and "domination" the key elements in scientific explanation. It supplies quite a different sort of motivation. To be sure, where our stewardly responsibility requires us to dominate or "tame" nature, our success in doing so provides one (though not the only) test of the adequacy of our explanations. But as Christian stewards we are not primarily out to discover how to get our own way in the natural world, nor how to gratify our individual or collective ego by making successful predictions. Our primary aim is to become sufficiently clued-up with respect to the structure of our Father's world—to learn the "go" of it sufficiently—to be able to operate reliably in it as faithful stewards. No room here for the arrogance that would preen itself on its ever increasing power to dominate, or that would confuse understanding with mere ability to predict. In so far as our science gives us confidence, we trace this back to our personal confidence in the faithfulness of God, who has promised that "while the earth remains" He will maintain a reliable pattern of orderliness in the succession of events.

The Commitment of the Map Maker

The second point about scientific map-making, which Walter Thorson particularly stressed, is that it is not an automatic process proceeding according to a book of rules in an impersonal way: it is a fully human process. It demands personal commitment and it reflects our values and those of the society that ultimately provides the cash for most of it. It is perhaps worth remarking that a good deal of inappropriate mysticism has been spun around the slogan that all human knowledge is personal knowledge, and that all scientific investigation demands commitment. The trouble is that there is a philosophical literature associated with the theme of "commitment" which moves far deeper into the mystical than I believe the scientist is either called upon, or allowed in the course of his normal calling, to go. What I mean is this. Our commitment as scientists is only the kind of commitment that a steward makes in a situation where he is not sure he has got all the facts, but he has enough to be held guilty if he does not use them. His function is in part creative; he is not a detached spectator in the situation, but a participant, a shaper of it. Now commitment in that professional sense, it seems to me, has relatively little in common with, say, the sort of commitment that a husband and wife make to one another: "I plight thee my troth." We should resist the temptation of the mystery-mongers to try to import into the scientific picture as much as possible of the emotive overtones of words like "commitment." Walter certainly did not do that, and I think it is worth noting that he didn't. I suggest that as Christians especially we should be on our guard against attempts to drive us into a mystical fold as scientists, merely on the ground that "all knowledge is personal knowledge" (which is almost tautologous) and that "all investigation demands commitment."

The Bible portrays each of us as primarily a steward—as one under his master's eye, ready to be asked at any time, "What are you doing, and why?," and "How much are you achieving of the purposes for which I put you here?"

On the other hand, we must be realistic as to the extent to which our map-making commits us to value judgments. In my paper[3] I listed a dozen ways in which valuation must come in, explicitly or implicitly, in our choice of things to investigate and in the decisions of society as to what is worth investigating. It is important to bear in mind that although map-making is an act of

obedience to what is given, whether we value it or not, nevertheless the result has value to us, and we cannot pretend that in our work we are as free of moral and ethical implications as, let us say, a designer of crossword puzzles.

How Our Values Affect Our Map-Making

Note that what reflects our values here is not the map, but the map-making process. The contents of the map itself had better be as free as possible from contamination by our particular values if that map is to be useful to those who may not share those values. For Christian propagandists there may be a temptation to try to devise some way of integrating Christian values into our science so that the scientific map would be of more use to the Christian than to the non-Christian; but I see no grounds in Scripture or in anything that was said here for that idea. God sends his rain impartially on the just and on the unjust, and unless we have biblical indications to the contrary we have no reason to suppose that a "Christian science" stimulated by Christian values should be any less useful to a non-Christian than to a Christian.[4] Our values may determine the way our scientific spotlight plays over the terrain we are trying to map, and the wave lengths of the light we use, metaphorically speaking. We all know how different a map of the earth from a satellite looks in infrared and visible and ultraviolet light. Our values in that sense can make quite a big difference to the sort of map that emerges, but they don't in general determine what the landscape is. We cannot remind ourselves too often that reverence here means the kind of realism that respects the objectivity of the way God's world happens to be, the way He has given it to us. It is as impious to imagine that our values have any right to distort the way God's world is and is given to us, as it would be to imagine that our values have a right to distort the way God's revealed Word is and is given to us. We are in fact under judgment by both, we are required to be obedient to both, and we cannot be good stewards unless that is our basic orientation. There is a tendency today which is still surprisingly fashionable (one expects these fads to burn themselves out in a few years, but this one is still around) for Marxist-inspired people and others to argue that we "create our own reality." In relation to the world of nature these tendencies need, I believe, to be explicitly resisted by us as biblical scientists wherever we come across them, as directly contrary to the doctrine of divine creation.

"Reflexivity"—A Special Case

Having said that, let us remind ourselves of something we did not touch on very much here, but which has featured in previous agendas of both our associations. Let us remember that in the special "reflexive" case where the scientific spotlight is turned upon the map-making process itself, and even more so where the scientist turns his lenses and his other instruments upon himself, the map maker, or upon those who are to be influenced by it, then we have good, indeed obvious, logical grounds for expecting anomalies to arise.[5] Where part of what is mapped includes the individual himself with all his values and his value-shaped activities, the content of the map does become to some extent dependent upon values in a unique way. Turning the scientific spotlight on ourselves as cognitive agents introduces an element of what I have called logical relativity. The map of ourselves or our map-users that *we* could validly make will not in every detail be the same as the map that a detached onlooker with a telescope would make of the same situation. The detached onlooker, for example, could have predictive knowledge of our situation that we would even be *mistaken* to believe if we had it, because our believing it would make it out of date.[6] So we must not go overboard in emphasising objectivity and value-free knowledge to such an extent that we forget the limitations that can be set by "reflexivity" to our scientific knowledge of ourselves and our society. In such special cases value-free knowledge becomes something else, and may indeed become impossible.[6,12]

We are . . . not lap dogs, but sheep dogs. We are not pampered pets whose calling is just to look up into our master's eyes and snuffle our contentment. We are commissioned agents.

Areas of Challenge to Christians

(1) The Science of the Human Person

What then are some of the major areas of challenge to Christians in the light of our birds-eye view of the ground we have been covering? The first area that strikes me as important, which indeed was given top priority by several speakers, is the science of the human person. This is explosively developing on several fronts, and at many levels. There is the science of the beginnings of personal life, and the responsibilities that our growing knowledge there places upon us as stewards. We considered the incidence of genetic defects, for example, and our responsibility to ask before God what are legitimate ways of exploring the causes of these

harrowing events. This is one growth area where, as we were told by Elving Anderson and others, we are only at the beginning and need to do more concentrated thinking both as scientists and Christians.

In my own field of neuroscience, we have a whole hierarchy of levels which embraces everything from the biophysics of cell membranes and the like, right up to the general system theory of brain organisation, which, as we were reminded by Malcolm Jeeves and others, thrusts upon us questions of the relationship between the physical and the personal. Man, the spectator of nature, the participant in nature, the manipulator of nature, is also a part of nature. Once again the relativistic logic of situations where the spotlight turns its light upon itself can be expected to introduce unique complications to our analysis of what it means to be persons embodied in a physical world. Here is a further area of strong challenge to Christian thinking, not only in relation to the beginnings and endings of personal life, but also in relation to the biblical doctrine of the Christian hope, the resurrection to eternal life.

Closely related is the science of psychopathology. We have a long way to go in understanding how things can go wrong with the brain, and Christians need to do a lot of consecrated thinking to sort out the biblically proper uses of things like drugs and neural transplants (if that becomes possible) as ways of remedying pathological conditions. Not only have we the problem of understanding the boundary between the "me" and the "not me;" we also must seek spiritual discernment

Responsible stewardship means precisely, and always, "basing our decisions on our present limited knowledge." Humbling though this is, we mustn't be ashamed of it.

between a thankful use of remedies on the one hand, and rebellious discontent with our God-given limitations on the other. Paul's gracious contentment with the unalterable (Phil. 4:11) cannot be made an excuse for complacency in face of what is unsatisfactory and alterable, but the distinction is not always an easy one.[7]

(2) *"Artificial Intelligence"*

Another example from this expanding area of questions relating to our understanding of ourselves comes from the field of computer science and (so-called) "artificial intelligence." In the early days of RSCF back in the forties and early fifties, we had more than one session on this topic, and it was fun even then; but it was very much a matter of responding to speculative claims from philosophers and theologians that "you will never get a machine to do such and such." In principle we were able quite often to see that these claims were baseless,[8] but little in the way of actual hardware to meet such challenges was then on the horizon. Now that we are into the fifth generation of computers which are micro-miniaturised in such a way as to embody within one tiny chip a complete hierarchic computing system, it is no longer derisory to contemplate the design of artificial mechanisms of the same order of complexity as the human brain itself. The complexity of the human brain, even at the level of neurons and their synaptic interconnections, is of course immense—we have in our heads perhaps 10^{14} synapses or more. But given the sort of technology that is now being explored it is not inconceivable that complexities comparable with this might be engineered—not, of course, by taking bits and soldering them together, but by allowing systems to grow under feedback and to selectively mould the pattern of their own connections.[9–11] The implications of this are certainly being widely discussed by some unbelievers who, as usual, hope to find some refuge from God for their unbelief in the alleged "debunking of man" which they would see in such developments.

It is as impious to imagine that our values have any right to distort the way God's world is and is given to us, as it would be to imagine that our values have a right to distort the way God's revealed Word is and is given to us.

(3) *Serving or Manipulating?*

Finally, the whole area of the human sciences raises acutely the question of which Malcolm Jeeves reminded us: When does the attempt to be a servant to our fellow man slide over into an attempt to be his manipulator? I am not going to address that now; but I think it is worth noting that one of the fundamental requirements of manipulation is that the system you are

seeking to manipulate is causally isolated to prevent the kind of feedback that would frustrate the manipulator. To be a manipulator, you must be able to distinguish for purposes of analysis between the thing out there that you are manipulating and you, the manipulator. I have elsewhere[12] suggested the possibility that the line between seeking to help and seeking to manipulate is crossed when our relation with those whom we are trying to help moves over from that of two-way dialogue, where you and he are essentially one system, to that of detached one-way action where dialogue is cut. This, of course, can be legitimate and even essential in special cases, as on the surgeon's operating table where the patient has to be anaesthetised; but we all know in common sense that there is no breach of the essential relationship of dialogue—of mutual accountability—between two human beings trying to help one another in those special cases. In areas like public opinion polling, on the other hand, the situation is very different. The public opinion pollster is in a situation where his science allows him, if he is clever enough, not merely to predict how things would turn out if he kept quiet, but also perhaps to predict how differently things will turn out according to the time at which he chooses to publish his findings, as well as their contents. Here then is an example in which the one-way nature of the scientist's relationship turns what ought to be a service, and is often foolishly imagined to be a service providing the public with objective information, into essentially a manipulative device. It is easy to think of analogous situations at the individual level, not only in psychiatry, where the manipulative element may be professionally recognized, but also in a wide range of counselling, marketing and even preaching activities where the distinction between serving and manipulating may need careful working out.

When short of data it is not a matter of privilege or prejudice, but of obligation to the God of truth, to keep our minds open and our mouths shut.

(4) Needs for Conceptual Clarification

There are no doubt many other areas in your minds where our discussion has brought out a need for future work. Let me just mention a couple of theoretical issues and a couple of practical ones by way of final examples.

First, I see a widespread and dangerous confusion today between questions of the *chronological* origin of the universe and that of its *ontological* origin. The science of chronological origins, which is burgeoning

What I am concerned about is something else—the deliberate selective marshalling of scriptural or other data thought favourable to one theoretical view, and the neglect or disparagement of data adverse to that view, specifically in order to maintain a "clear cut line" in a theoretical controversy.

today with competing models of the beginnings of the universe, big bangs, time reversals and what have you, has no necessary connection whatever with the question of ontological origins: How come there is a universe at all? It is to this question that I believe the Bible offers an answer; and it is a question which I believe requires a lot of hard work to disentangle from the other.[13] As I am sure you know, there are a number of recent books, some of them by unbelievers, or at least people highly sceptical of traditional religion, which encourage the idea that modern cosmology, with its odd singularities ten to the tenth years ago, is making room once again for a belief in a creator-god.[14] Several people in the course of our conference expressed doubts as to whether this was a valid way of relating the two concepts of "origin;" but just how the two relate needs to be clarified by further work.

Secondly, at another philosophical level there is the question of what makes a good explanation. For example, if you read popular physics journals you will find lots of references to things like the "anthropic principle."[15] This is canvassed as a new kind of explanatory answer to ultimate questions. "Why does water have this particular melting point?" or, "Why does a particular constant that determines the structure of the nucleus have this particular value?" Answer, "If these constants didn't have those values you wouldn't be here to ask the question." Now I don't deny that such answers have an attractive "just so" quality; but I don't believe that their logical and epistemic status as a putative *explanation* has been at all adequately worked out. Granted that there is some feeling of satisfaction, a kind of "clunk," as that sort of reply goes home, what kind of intellectual

itch is it scratching? Is it really scratching the kind of itch that irritates the scientist, and if it isn't, is it an answer that is of any special theological interest? These matters, I think, could usefully be on the agenda of a future conference.

Practical Issues

Among practical issues, it will not have escaped your notice that we left virtually untouched the problems of nuclear war on the one side, and of the population explosion on the other. I don't blame us for finding nothing to say about nuclear war. Why should we add one more to the catalogue of depressing truisms? But the population explosion is something else. There are areas of the world today where the population in large groups is doubling every twenty or thirty years while the arable surface of the globe, give or take a factor of two or so, is going to remain fixed. Now you don't need to do much arithmetic to see the awful menace that this situation presents to us, all of us, as stewards of God's earth. Like all God's commands to His stewards, the injunction "Be fruitful and multiply" has an implicit rider—"but *don't overdo it.*" This question—how we can stop overdoing it—is one which was not necessary to discuss here, but which it seems vital that we should address in the immediate future, because at present rates of reproduction there aren't many generations left before it will be too late to avert a total tragedy. One facet of this is worth special mention in view of the concern many of us feel about environmental pollution. Think about most of the problems under this heading that increasingly distress and alarm us: acid rain, airborne lead, smog, river pollution, you name it. Now imagine what they would be like if the overall density of the human population were reduced magically by a factor of one hundred. You can see that most of these pollution problems, given the will, would become virtually negligible. It is basically because we are so knee deep in surplus population in England that we have had to take desperate measures to stop our rivers from poisoning our fish, and so forth. Preachments that blame pollution on our "materialism," greed, selfishness and the like, however salutory and timely, completely miss and obscure this point. If the world were back at the levels of population of a few centuries ago, then even if we made the same demands per capita on our environment we would have nothing like the same crisis. Yet when did you last hear or read a Christian assessment of the *optimum population level* for the earth?

Once again, I cannot go further into this vital subject. My purpose is only to illustrate the sort of quantitative scientific questions that are crying out for examination by Christians, with a view to getting more of a feel for the dynamics of the task of stewardship. We badly need to enlarge our understanding of the whole social-physical network that God has given to us as the inhabited world, of which He regards us as stewards in His service.

Working on Present Limited Knowledge

This brings me finally to two points that vitally affect our whole posture and orientation, both as individuals, and as members of the Christian fellowship. One I touched on right at the beginning, namely the grievous but inescapable limitations of our present knowledge. I have recently seen somebody attacked in print for (I quote) "falling into the trap of basing his decisions on our present limited knowledge." Now, think about that. What is the alternative? We really must absorb the fact that although in the sight of God we are just so dumb He can hardly bear it, given what He knows to be the facts about the intricate structure of the world in which we are trying our best to behave responsibly—yet He asks us to act as His stewards, on the basis of our current knowledge. We must recognise that it is always going to be like that. Responsible stewardship means precisely, and always, "basing our decisions on our present limited knowledge." Humbling though this is, we mustn't be ashamed of it, because that is certainly part of the giveness of our human condition; not a fault that we should repent of, but a simple given fact within which and in response to which we are meant to live obediently and profitably by the grace of God. There must clearly be some way of being a profitable servant in the biblical sense while living and functioning with limited knowledge and gross ignorance. I suggest therefore that without in the least excusing ourselves for ignorance that we could remedy when we haven't done so, it is important to avoid developing a spuriously guilty conscience, imagining that God would blame us for working as best we can with our present limited knowledge.

The alternative of "taking a view" and creating a following who stridently share it, where the data do not unambiguously require that view or exclude alternatives, has its demagogic attractions. . . . But in the end it is poisonous to the concern for truth.

One corollary is that on the basis of our limited knowledge we should be doubly careful before we ever pronounce something to be impossible. An old harbourside worthy in my fishing home town of Wick was once quoted as saying, in response to a claim that something was impossible, "There is only one thing impossible, Jock, and that's for a chiel [Scot. fellow, lad—*ed.*] to pull his trousers on over his head." Although that may be overly simple (and indeed four-dimensional geometry would put a question mark against it), it may remind us that we should regard the ability to pronounce something impossible, even when we are trying to do so on biblical authority, as something of a luxury, and not part of the normal duty of an obedient steward. When short of data it is not a matter of privilege or prejudice, but of obligation to the God of truth, to keep our minds open and our mouths shut. The alternative of "taking a view" and creating a following who stridently share it, where the data do not unambiguously require that view or exclude alternatives, has its demagogic attractions. Christian bookshops are crowded with examples of this, and thrive on it. But in the end it is poisonous to the concern for truth.

Scrupulous fairness is not an optional extra for the Christian . . . however dramatic and rewarding may be the short-term payoffs of unfairness on the part of Christian propagandists.

Of course where practical politics are concerned, it can be our duty to make up our minds to vote one way or another on issues about which we are agonizingly short of data. Christians individually may then look for the Grace of God to lead them to the right decision for them; but they do not (or should not) expect to find all true fellow believers led to the same practical decision. What I am concerned about is something else—the deliberate selective marshalling of scriptural or other data thought favourable to one theoretical view, and the neglect or disparagement of data adverse to that view, specifically in order to maintain a "clear cut line" in a theoretical controversy. The commonest examples, understandably, are in Church history, where the semi-political nature of the issues has afforded some pragmatic excuse. What is deeply disturbing, to me at least, is to see the readiness with which the same polarizing tactics are adopted on issues (such as the interpretation of Genesis 1–3) where the only *practical* questions at issue are which camp one's readers will join or stay with or leave.

I hope this does not seem an uncharitable diagnosis—I have no wish to be other than clinically accurate and scrupulously fair. The point I am making is a theological one. The God in whose name we dare to speak presumably knows, better than we, the extent to which we are short of conclusive proof for a theoretical position we find attractive. What I am arguing is that for anyone to show unconcern over his shortage of data for some dogmatic pronouncement in the name of God is to *insult* the God of truth. It is no good his arguing that unless he takes a "firm and clear-cut line" there will be no stopping the drift away from the semi-political position he is trying to serve. He can by all means be as firm and clear-cut as he wishes in making any practical recommendations as a leader. What he cannot do without denying his pretentions to love and serve the God of truth is to claim conclusive divine authority for theoretical judgments for which he lacks conclusive data. To keep an open mind is not to keep an empty mind. If pressed for a judgment on a theoretically debatable issue, we are of course entitled to give it to the best of our ability; but once we are alive to the awfulness of presuming to pronounce in the name of God on a theoretical issue where data are short, I would hope that we would see nothing wrong, and indeed much to be commended, in replying, "I simply don't know. God hasn't told me, as far as I can see; so I dare not pretend to give you a clear-cut answer in His name; and to give you one in my own name would in these circumstances seem absurd."

The Camaraderie of Christian Fellowship

Secondly, looking to the future, I wonder whether there is not room and need for serious experimentation in the art of helping one another to shake our theoretical structures and test them for solidity. The obvious example, of course, is the one we have just considered, of the conceptual structures we base on inferences from scripture. One of the really valuable things for me about interactions with RSCF and ASA is the way in which they can help me to look again at some biblical passage or doctrine which I have applied in a particular way, with the question, "But are you sure? Look at it this way: might it not be equally validly read thus?" That kind of process, I think, is a vital part of what is meant by Christian fellowship. Fellowship, or "fellowshiping" as we are now taught to call it, isn't just having a good time together. Christian fellowship is primarily the camaraderie of soldiers back from the trenches, alert to possible cracks, chinks and damage in one another's armour. If one soldier puts his arm round another and says "It looks to me as if you could be vulnerable there," his remark may or may not be a

blow to the other's pride; but that is totally secondary to its comradely intent. Is there any possibility, I wonder, of deliberately seeking to develop less abrasive, more constructive ways of helping one another to get our thinking clear and our arguments solid, by gently shaking them? I mean "gently." Everyone knows the blundering bore who just goes in and knocks his brother's whole argument off the table with ridicule or caricature. That doesn't help anybody. But if you take the biblical attitude to your brother, then he ought to welcome your "safety checks," and you ought to feel an obligation to offer them. Participating in a fellowship like ASA or RSCF ought to be understood as positively inviting efforts to test, from fresh angles, the things we have built so far, to see how solid they are. If we can do this for one another, then I believe we can expect God's blessing as a result. In particular, I hope it can provide a check against what I might call selective indignation. Selective indignation means using the most rigorous logical standards to identify weaknesses in an adversary's position—pointing indignantly to logical gaps, let us say in the theory of biological evolution—but then in our own use of Scripture extrapolating wildly beyond the given data and committing faults of logic which may be much more heinous in the sight of the God of truth than those of the wretch whose little step of inductive inference we are condemning. "Equal weights, and a just balance . . . " 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. It is not an optional duty to help one another to be good, careful, fair and honest thinkers in the sight of the God who is always over us, with us, in us, and who is disgraced if we are sloppy in our logical standards, whether of biblical inference and interpretation or of scientific inference and interpretation. To build up the kind of mutual trust that takes all this for granted is, I believe, the pathway to truly realistic fellowship of the kind that I pray that RSCF and ASA will go on providing for generations to come.

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I'm just coming to understand that in traditional American, Western culture, the posture of servanthood often seems just plain stupid—like you're being taken advantage of, like you really haven't thought things through, like you're not using the strength and resources that you have. In those moments, when you know you look silly, it is important to remember that Jesus was crucified for us in a posture of servanthood, and that we are called to be like him.

Interview with Dr. David Hilfiker, *Christianity Today*, March 7, 1986, p. 28

Communications

INTEGRITY IN SCIENCE—A CHRISTIAN RESPONSE

This generation has seen a remarkable turn toward the human dimension of science. The scientific community and those who chronicle its activities now cloak their ventures with terms such as ethics and morals and human values. In many eyes the acquisition of knowledge is no longer deemed to be the highest purpose available to humanity. Rather, general human welfare, or some other value is viewed as the basic framework from which science and other forms of knowledge can be judged. However laudable this perspective may be, a foundational feature of science seems to almost have been ignored in the rush to apply "values" to the issues of the day. It is the public press and the scientific press (reluctantly at first) which have let the cat out of the bag. It seems that scientific fraud is on the increase. Curiously, the recent public disclosures of gross impropriety come from disciplines closely related to human welfare—the health sciences. However, this may more reflect what sells newspapers or enhances television ratings than an inordinately large number of the dishonest in these areas.

The eighth commandment is foundational for the Christian community and is also basic to the structure of the scientific enterprise. The founding fathers of the Royal Society of London for Improving Natural Knowledge viewed a portion of their task as "strenghten[ing] belief in God's true miracles by exposing fraudulent, enthusiastic, Holy Cheats."[1] Although today's scientists would describe their work somewhat differently, history consistently demonstrates that the "cheat," holy or not, remains as an impediment to scientific understanding and credibility.

William Broad and Nicholas Wade's recent book, *Betrayers of the Truth: Fraud and Deceit in the Halls of Science*, recounts examples of cheating—whether cooking, doctoring, fiddling or fudging—from the time of Hipparchus to the present day.[2] This alleged dishonesty (some cases are in dispute in the historical literature) is found in all areas of the natural and social sciences and ranges from wholesale plagiarism and invention of data to selective use of the literature and the discarding of discordant results. While any evaluation of trends is subjective it appears from the greater number of incidents reported that scientific fraud is on the upswing. Lest we think that the subject is passé, the May 1985 Meeting of the American Association for the Advancement of Science held an extended panel discussion on the issue.[3]

Those who deal with teenagers and undergraduate college students are hardly optimistic about the mores of tomorrow's scientists. Elton Trueblood has suggested that the roots of the problem are found in the current wholesale acceptance of "the belief that there is really no objective moral right and that, consequently, there is no reason for action other than the changing desires of the individual."[4] The problem of dishonesty has been of increasing concern to American educators in the past few years. Two studies carried out during the 1980's showed that 75 and 88 percent of the undergraduates polled reported having cheated in college, figures significantly higher than for earlier polls which indicated that about 50 percent cheated in the 1960's and 25 percent in the 1940's.[5] A UCLA psychologist who surveyed faculty at a major university found that one-third of those who responded had suspected a colleague of falsifying data, "but that only half of this number had ever acted to verify or remedy the deception."[3] The rapidly emerging field of computer science is plagued with the problem due to the relatively independent nature of much of student activity. Table 1 indicates something of the extent of the problem as seen in two recent university surveys.

The tabular data and the personal experiences that each of us can recount serve to remind us that we face a persistent challenge in our scientific work. In this paper we wish to point out some of the sometimes subtle problems faced by the Christian in science and emphasize the importance of one's personal integrity rather than dwell on individual cases from the past.

Christians in science may be forced into compromising situations due to the competitive funding procedures found in industry and the university. The pressure to appear attractive to the source of the money may result in overstatement, withholding of negative data or deliberate lies. The media currently view science (especially medical science) as "hot." Some scientists have exploited this fact by holding press conferences to announce great "break-throughs" in understanding cancer or some new wonder chemical instead of submitting their work to the review process of scientific

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Table 1 *Academic Dishonesty*[5,6]

Type of Cheating	Percent Who Admitted Cheating
Plagiarism	44
Getting an exam from someone who took it earlier	40
Padding a bibliography	35
Working on a assignment with another person when this was not allowed	34
Allowing someone to copy from exam	32
Copying someone else's exam	31
Doing another person's homework	17
Using notes in closed-book exam	12
Taking an exam for another person	2
Turning in a paper purchased from a commercial firm	1
Fabricating or copying another student's lab data	81

journals. Public interest and resultant political support may create a funding bandwagon which may leave much more worthy projects without funding. Christians associated with research groups which practice these behaviors are under pressure to "go along" so that a "greater good" may result.

Broad and Wade note that many instances of fraud go unchallenged for many years in spite of the improbability that the work could be legitimate or even where improprieties are noticed. Often, it is lower level assistants or administrators who finally "blow the whistle." The idea that anything goes as long as no one is hurt seems to prevail.

A recent note in *Chemical and Engineering News* speaks to the "Ethics (Or Lack Thereof) of Refereeing."[7] Among the problems noted were

1) a tendency to rake a competitor or someone considered unworthy over the coals,

2) slowing the review process of a good paper that competes or infringes on one's research area,

3) plagiarizing ideas for one's own work, and

4) pretending expertise.

Christians who referee manuscripts and proposals or act as journal editors must follow a high standard when acting in these areas. Editors should clearly indicate reasons why a given manuscript is unacceptable, a practice that is hardly uniform in Christian or secular circles. Neidhardt has provided thoughtful goals and procedures for the Christian referee.[8]

It would appear to this observer that the development of a proper attitude toward the truth should be an explicit part of the educational process. Curiously, any freshman physics or chemistry lab text spends many pages talking about significant figures and the statistical treatment of data but no one mentions what any freshman knows—that a little fudging of the data can improve any statistics. In designing lab activities one should minimize experiments which repeat work with known answers and maximize the use of unknowns and creative problems. More important than an instructor's injunctions to be honest is the way that his values speak for themselves as he relates to students and colleagues and carries out his scientific work. We should confront students whose work is too exact or done too rapidly. We need to provide an educational climate which allows students to make "mistakes" without fear of irreparable damage to their grade point average. It is frequently noted that the "intensely competitive premedical culture is an eroding factor in the moral fibre of our future physicians."[3]

The scientific community can look with pride at generations of accomplishments gained at the cost of long hours spent in the collection and evaluation of data. This type of work continues to be the basis of true scientific advance. A major strength of the scientific enterprise lies in the public nature of the information. Anyone may repeat the experiments and challenge the data and interpretation. This "self-correcting" aspect can ultimately catch up with fraud. However, in the meantime other workers using this material can waste time and money and be placed in dangerous situations. The apparent increase in adolescent dishonesty suggests that this will be reflected in more extensive scientific fraud in the future. There is no magic potion that changes a dishonest student into an honest scientist. The price paid by those who cheat needs to be high enough to be a more significant deterrent than is presently the case.

One happy recent example of Christian integrity involved a colleague in the Department of History. Near the completion of her doctoral dissertation she accidently found a manuscript in an obscure French library that covered many of the same ideas that she had independently developed. The chances were good that this manuscript would never see the light of day. Yet she took a copy to her advisor and ultimately was required to revise her thesis topic—at a cost of two more years of work. Christian character needs such examples to assist in its development. We must constantly be alert to aspire to the highest standards for our lives and our work. We may not change the overall pattern of scientists' behavior, but we can influence those around us as we follow Christ's command to be "salt" and "light."

Our motivation lies in scripture: "I am the Lord your God; consecrate yourselves and be holy, because I am holy."[9]

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SEMANTIC PROBLEMS IN THE CREATION-EVOLUTION DEBATE

Statement of the Problem

The positions for and against evolution or creationism have been extensively argued for some time now, with no real resolution in sight. Scientists, convinced of what they consider to be creationism's obvious "unscientific" character, have boldly declared the battle to be won, although serious debate as to the precise meaning of the Darwinian synthesis still goes on in some scientific circles.[1] Creationists, for their part, have continued to challenge and debate the fundamental principles of evolutionary biology, by denying the notion that evolution is the only plausible explanation of the origin of life and change in nature.

Neither side seems able to begin a meaningful dialogue with the other, and this is entirely understandable, given the adverse nature of their respective metaphysical positions. Part of the problem, however, seems to stem from nothing more than a simple lack of understanding between the two groups, brought about by the difference in how certain key concepts are defined. When two opposing parties cannot accept a set of basic definitions or concepts on which they both can agree, there is little hope of one side ever accepting (or even understanding) the views of the other. Many of the fundamental disagreements within the creation-evolution debate, when carefully analyzed, appear to be the result of careless or inaccurate use of language. The following examples, drawn from both creationist and evolutionary literature, clearly illustrate that both creationists and evolutionary scientists, confident of the correctness of their respective positions and the error of their opponents' point of view, and eager to convince others of the soundness of their ideas, are often guilty of using ambiguous or incorrect language. Meanings are sometimes obscured (often unconsciously), and precise definitions made elusive, often tending to discredit opposing viewpoints. As with all passionately held beliefs, it is difficult for one to remain totally objective, especially when being confronted with an opposing point of view; yet in order for meaningful dialogue to take place, it is essential that a careful analysis of key concepts and definitions be undertaken. It is only after each side clearly understands the other that fruitful discussion can begin.

Examples From Scientific Literature

Many leading scientists are totally convinced that the mechanism of natural selection as outlined by Darwin, combined with twentieth century discoveries in biochemistry and genetics (referred to as the "synthetic" theory of evolution in scientific circles), gives us the only correct explanation of change in nature. This dogmatic acceptance is of course quite unscientific in character, because every scientific theory, no matter how well it has withstood the test of time, is forever open to revision or even rejection. If one reads the current evolutionary literature, however, this careful, tentative attitude is almost totally absent.

Many of the semantic problems result from the different ways in which the words "fact" and "theory" are defined. According to Stephen Jay Gould, geologist at Harvard and a leading evolutionist, "facts" are the world's data. "Theories" are structures of ideas that explain and interpret facts.[2] Yet scientists often make the mistake, when discussing evolution, of using these two words as they are more commonly employed, rather than in the specialized way in which science uses them to explain the status of an idea. (The *American Heritage Dictionary*, for example, broadly defines a "theory" as "hypothesis or supposition," and a "fact" as "truth" or "reality."). In an article in *Newsweek*, for example, Gould professes that "evolution is a fact, like apples falling out of trees."[3] Dr. Carl Sagan, astronomer at Cornell and one of the more outspoken proponents of the power of the scientific method, affirms that "evolution is a fact amply demonstrated by the fossil record and by contemporary molecular biology."[4] In his popular television series *Cosmos*, seen by millions on public television (and later a best-selling book), he states simply, "Evolution is a fact, not a theory,"[5] Sir Julian Huxley, biologist and grandson of Thomas Huxley, the great biologist of Darwin's day, declared at the 1959 Darwin Centennial celebration at the University of Chicago that " . . . we all accept the fact of evolution. . . . The evolution of life is no longer a theory. It is a fact. It is the basis of all our thinking."[6]

A few scientists have long been aware of this problem and the confusion that often results. Professor Arthur David Ritchie of Cambridge, in his 1923 work entitled *Scientific Method: An Inquiry into the Character and Validity of Natural Laws*, wrote that "of course this (careless) use leads to some abuse in common speech so that 'theory' comes to mean simply what other people believe, 'fact' what I

believe."[7] Philip Kitcher, whose 1982 book *Abusing Science: The Case Against Creationism* contains a devastating attack of the creationist position, nevertheless tries to explain away this apparently deliberate misuse of language in science by declaring that "[scientists'] enthusiastic assertions that evolution is a proven fact can be charitably understood as claims that the (admittedly inconclusive) evidence we have for evolutionary theory is as good as we ever obtain in any field of science."[8]

Examples From Creationist Literature

Pro-creationist literature also contains many ambiguous definitions which are susceptible to multiple interpretations. While scientists sometimes use the words "fact" and "theory" in such a way as to make evolution appear to be a well established reality, creationist writers often apply the word "theory" as it is more commonly used (basically defined as a conjecture or guess) to illustrate that evolution is a questionable doctrine. They also criticize (and quite correctly) scientists' misuse of the word "fact" to denote evolution as a settled scientific issue.[9] Although this criticism is entirely justified, it also serves at the same time to obscure the debate ever further.

For example, Dr. Kelly L. Segraves, director of the Creation-Science Research Center in San Diego, during a March 1981 court trial against the teaching of evolution in California public schools, asked in his complaint that educators "stop teaching evolution as a *fact* in public schools"[10] (emphasis mine). Other writers concentrate on the tentative nature of all scientific suppositions to show that rather than being an asset to further research and new knowledge, this feature of the scientific enterprise is actually a fundamental weakness of the scientific method. Robert E. Kofahl, a leading creationist, writes that "Science cannot discover absolute truth because science is always changing . . . No scientific theory can be 'proved' and the theory of evolution cannot even be tested as can the theories of experimental science."[11] This of course is true, but it is also true of many other well established scientific theories. Even Einstein's Theory of Relativity is not totally *proved* in the sense that a better explanation may someday be found. There are also many theories, such as those in the fields of astronomy and cosmology, that are, of course, totally beyond the realm of direct testing or verification, and some theories, such as Einstein's, may predict phenomena that have yet to be observed. The creationists' tendency to present the tentative nature of science as a liability rather than an asset only serves to further discourage any meaningful discussion.

Conclusion: Toward a More Fruitful Dialogue

It is obvious that the creation-evolution debate is one between two highly different realms of human thought: science and religion. The dispute is the result of two opposing metaphysical positions, each with its own special vocabulary, and each using what at first appear to be identical terms to mean very different things. This unfortunately has led to a misunderstanding of both scientific theory and religious belief. The role of the philosopher in this controversy, therefore, is to apply the tools of logical argumentation and linguistic analysis to carefully sort out the arguments and define the troublesome terms, so that each side can begin to better comprehend the other. When this is done, many of the areas of disagreement can be worked out or eliminated, and both evolutionary scientists and creationists can carry on their work in a spirit of mutual understanding and cooperation. In the final analysis, it will be seen that the correctness of a particular point of view, whether it be that of the scientist or theologian, is only as good as the soundness of the arguments employed.

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HUMANISM TODAY AND ITS INFLUENCE ON SCIENCE AND WESTERN THOUGHT

Humanism as a secular philosophy presents several problems to the scientist who is a Christian. For many, humanism represents a threat to Christianity by promulgating a competing world view with conflicting values. It is acknowledged that humanism appeals to some of the same values as Christianity such as the importance of improving human life and personal dignity. Also, it is recognized that there are varying gradations of humanism that people subscribe to such as religious humanism versus secular humanism. However, it is also true that several major tenets of humanism

represent the antithesis of Judeo-Christian doctrine. Therefore, the Christian ought to be concerned that humanistic thinking today pervades Western thought as never before; some would say that it has become the religion of a secular society. The numerous examples of government reform, advances in the sciences and technology, and artistic expression have served to reinforce the humanist's conviction that people are basically good, self-sufficient, and therefore, given time, capable of solving many of the world's problems.

Before addressing some of the similarities and differences between humanism and Christianity, it is important to give some brief background to the development of humanism. Historically, humanistic thought can be traced back to early philosophers such as Socrates and Protagoras (e.g., "Man is the measure of all things" . . . "the apex of civilization."). Later, during the periods of the Renaissance and Enlightenment, and riding on the crest of new discoveries in the arts and sciences, philosopher-scientists such as Erasmus, Voltaire, and Rousseau began to suggest that humanity could save itself and that "man is perfectible."

Religion, of course, including Christianity, has long been promoted as the means of salvation and way to improve the human condition. Yet, during the Middle Ages the sciences and education began to emerge and develop their own distinct voice and credibility. As the sciences developed, the Christian Church, as a formal institution, reacted by continuing to insist on its own interpretation of the physical and moral realms. The Church maintained these traditional views *even when* they were contradicted by empirical observations. Classical examples of this would be those of Copernicus and Galileo who were forced to recant their views on astronomy because their findings did not fit with the Church's notion that the earth was the unmoved center of the universe.[1] Over time, the Church's dogmatic views on matters of the physical world without empirical evidence contributed to a widening credibility gap. As a result, these sorts of religious bias helped science and education to begin eclipsing the Church as an authority, at least on earthly matters.

As the gap between the church and sciences widened, many scientists gravitated toward a natural, mechanistic view of the observable universe with no room for theistic explanations. By adopting such views, the secular scientist began to conclude—perhaps smugly—that since life events can eventually be explained through natural causes, the Supernatural is invalid. In short, "If we can't see it, it doesn't exist." As one example of this viewpoint, Dr. Edmund R. Leach, Provost of Kings College, Cambridge, once wrote

> Today when the molecular biologists are rapidly unravelling the genetic chemistry of all living things—while the radio astronomers are deciphering the programme of an evolving cosmos—all the marvels of creation are seen to be mechanisms rather than mysteries. Since even the human brain is nothing more than an immensely complicated computer, it is no longer necesssary to invoke metaphysics to explain how it works. In the resulting mechanistic universe all that remains of the divine will is the moral consciousness of man himself.[2]

Put in broad historical form, it seems that many secular humanists today would suggest that science has been able to demystify and explain many of the beliefs that the Church has held sacred and secret. Further, these secularists also would be inclined to interpret Christianity and religion as having been a necessary way to explain purpose and order in the universe until more sophisticated and technical explanations could be offered.

Now, as we stand on the doorstep of the Twenty-First Century and witness rapid advances in the sciences, medicine, and technology, it is tempting to put our whole faith in humanity, not Christianity, and believe that we can save ourselves. As examples of this trend, one can observe the writings and ideas of eminent, contemporary thinkers such as Erich Fromm, Julian Huxley, Jacques Monod, Carl Sagan, and Jonas Salk. They would lead us to believe that through the continual evolutionary and developmental process, "people can know the capacity of their own nature for goodness and productiveness,"[3] and "can discover within themselves their own healing power and instinctive wisdom."[4] Left unchecked, such notions suggest that you alone control your destiny and that you alone possess the capacity to change your life.

Some prominent modern-day thinkers are concerned about the swing of the pendulum toward humanism and away from Judeo-Christian values. For example, Dr. C. Everett Koop, currently Surgeon General of the United States, has written that "humanism has replaced Christianity as the consensus of the West,"[5] and that, as a result, we now live under arbitrary, sociological law where truth is the majority vote or latest opinion from the courts. And, not long ago, Aleksandr Solzhenitsyn, speaking to an audience at Harvard University, had this to say about the present track of Western society:

> Destructive and irresponsible individual freedom has been granted boundless space. Such a tilt of freedom in the direction of evil has come about gradually, but it was evidently born primarily out of a humanistic and benevolent concept according to which there is no evil inherent to human nature; the world belongs to mankind and all the defects of life are caused by wrong social systems which must be corrected.[6]

As previously mentioned, humanism does share some of the same goals and values as Biblical Christianity. For example, improving the quality of human life could be viewed as a general goal that both Christianity and humanism share. Common values shared by Christianity and humanism might include promoting cooperation and peace and encouraging personal fulfillment. These similarities may be one reason for the varying degrees to which Christians subscribe to humanism.

Although similarities do exist, there are also important, fundamental differences between humanism and Christianity. Some of those differences can be outlined by focusing on the philosophy of humanism as embodied in such documents as *Humanist Manifestos I* and *II*. *Humanist Manifesto I* was written in 1933 and signed by thirty-four humanists. *Humanist Manifesto II* was an extension and expansion of the first document, written in 1973 and originally signed by 114 prominent scientists, educators, and theologians from around the world. These documents serve as a reference point for the humanist and delineate the central themes of humanism. Some of the most salient themes of humanism as outlined in these documents include the following:

1) God is either non-existent or impersonal and irrelevant.

2) The universe is viewed as self-existing and not created. Thus the universe and its inhabitants are self-contained. You are on your own. As Carl Sagan has put it, "The Cosmos is all that is or ever will be."[7]

3) People are basically good or, at the least, born neutral in character. There is not malbehavior inherent in human nature.

4) Religions and beliefs in the supernatural are powerless or useless to solve the problems of humans living in the Twentieth Century.

5) Ethics are autonomous and situational. Therefore, an individual's rights and freedom of moral choice are paramount.

Not every humanist necessarily fully subscribes to each of these belief statements. There are humanists who hold various degrees of commitment to humanistic philosophy just as there are Christians who have varying degrees of commitment to Christianity. Moreover, not every person who accepts humanistic philosophy necessarily calls himself or herself a "humanist." For some, it is a passive commitment to a philosophical alternative to religion. Thus, since religion (and God) are irrelevant or nonexistent then humanity becomes paramount and is left to itself. But for others, humanism is an active belief system that must win converts by combatting others, including religious people, who presumably would suppress the importance and potential of humanity.

In order to fully appreciate the tension between Christianity and secular humanism, it should be noted that these humanists maintain a hostile view toward Christianity. To them, Christianity and religion are not neutral forces but rather, agents that are at cross purposes with the progress of humanity. The following quotes from *Humanist Manifestos I* and *II* illustrate this point:

> Humanism asserts that the nature of the universe depicted by *modern science* makes unacceptable any supernatural or cosmic guarantees of human values.[8]

> We find insufficient evidence for belief in the existence of a supernatural; it is either meaningless or irrelevant to the question of the survival of the human race. As nontheists, we begin with humans not God, nature not deity.[9]

> Humanists still believe that traditional theism, especially faith in the prayer-hearing God, assumed to love and care for persons, to hear and understand their prayers, and to be able to do something about them, is an unproved and outmoded faith. Salvationism, based on mere affirmation, still appears as harmful, diverting people with false hopes of heaven hereafter. Reasonable minds look to other means for survival.[10]

These and other doctrines of humanism are viewed as representing the antithesis of Judeo-Christian doctrine which says that there is a living, personal God, that He created the universe and its contents, that human beings must be individually restored from their self-centered and sinful condition, that this restoration necessarily takes place by faith, and that He has prescribed for humanity absolute moral standards by which we ought to live.

To be fair to secular humanism, perhaps we should do more than just say that it is dangerous because it competes with Christianity. As a philosophy, how does it stand on its own? To the casual observer, humanism may appear to be a harmless enough value-base. After all, what is wrong with believing only in oneself or in others? But, a closer examination of secular humanism reveals some fundamental problems and contradictions in logic. For example, because of their belief in respecting individual rights, humanists say that one should not impose values on another; that is, that no one should have the prerogative to establish or suggest universal sanctions or moral codes. Yet to state that no one should impose values on another is to impose a value.

Another problem with humanism is the moral relativity suggested in its code. As an example, humanism proposes "maximum individual autonomy" and personal moral freedom to do as one pleases. Yet, humanism also adds to these statements vague qualifying boundaries such as: "consonant with social responsibility," "being tolerant of others,"[11] "for the common good," and "short of harming others." But *who* decides what is consonant? Or tolerant? Or good? What is "harming others?" Without an absolute standard, as offered by Christianity, to what final Authority does one appeal?

Despite these and other problems with humanistic philosophy, humanism appears to continue flourishing in Western society today while the role of the Christian church wanes. Why is this? Four of the possible reasons for this trend include the following:

1) The Christian Church, in general, has failed to keep pace with the demands of society. Often it has failed to offer workable Biblical solutions to social and personal problems.

2) Many Christians are perceived by others as shallow in character and in intellect. As a result, their faith is viewed as lacking substance and as a narrow interpretation of life events.

3) Many Christians vacillate in their commitment and conviction, thereby obscuring and undermining the integrity of Biblical Christianity.

4) Christianity is often perceived by others as a form of blind faith, without rationale. To them, becoming a Christian would mean compromising logic and commonsense.

The prevalence of humanism today can result in moral dilemmas for the scientist who is a Christian and who is often called upon to make inferences and value judgements from his or her research and case studies. Thus, for example, it is often assumed that the biologist or chemist will discuss how his or her theories and research data support the evolutionary model, the medical scientist is encouraged to apply new medical techniques that will facilitate abortions, and the psychologist must decide whether the client will benefit from self-help therapy only or has a deeper, spiritual problem as well. In each of these situations, the Christian scientist may be inclined to formulate values and strategies that are consistent with his or her professional practices and Christian faith. However, among many scientists today, popular

thought holds that "religion" and science do not mix well and should be kept apart as mutually exclusive world views. Regrettably, many humanists end up encouraging a double standard; that is, you are expected to establish and maintain a "high ethical code," but *not* a code with any religious overtones or reference to a supernatural Being. This bias not only competes with the Christian scientist's view of a world that is explicable in both Biblical and scientific terms, but also threatens to encourage humanism as the philosophy of science.

To help counteract the growth of secular humanism and to defend our own convictions, what can be done? Here are four recommendations:

1) As individuals, we need to ***examine*** humanism as it relates to our respective fields of study and professions. Whether we are geologists, sociologists, or medical doctors, we ought to understand the special problems that humanism presents to us. We should be cognizant of those portions of humanism we find to be parallel as well as of those in conflict with our Christian faith. As a result, we can be clearer on our own position, preserving the integrity of our faith.

2) Having done this, we need to communicate and ***clarify*** to others our own position. Where do we stand? Are we "Christians," "humanitarians," "humanists" or "Christian humanists?" If we do not communicate clearly to others our position, we may unconsciously distort or confuse their view of Biblical Christianity. Worse yet, if we say *nothing* about our Christian faith, our "good deeds" and ethical conduct may be misconstrued as humanistic and actually reinforce or restore others' "faith in humanity." We need to be visible with respect to our values and a light to the world.

3) As scientists, we need to ***offer*** viable, alternative models to secular humanism that are consistent with science and with our Christian faith. In this manner, we must be sure to use rigorous scientific procedures and methods in our work. By doing so, we may help to increase the credibility of the Christian experience, particularly among colleagues. Secular humanists and other non-believers will observe that one can be faithful to both scientific methods and findings and the Christian faith.

4) We must ***remember*** that the practice of science is very different from the interpretation and application of outcome. Scientists are about the business of researching and testing hypotheses; yet the application of those findings is not a role confined only to the scientist. Although Christian scientists may comprise a minority when compared with the number of other scientists who ascribe to some form of humanism, we are no less qualified to decide what is right or wrong or make quality of life judgements.

In summary, we need to clearly understand the subtle differences between humanism and Biblical Christianity. As Christians, we have a responsibility to counter the perpetuation of secular humanistic philosophy in the sciences. To accomplish this, we need to be prepared to offer viable, alternative models to secular humanism that are consistent with current scientific knowledge and our Christian faith.

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DALTON, NATURAL PHILOSOPHER

John Dalton (1766–1844) was born of simple Quaker folk in Eaglesfield (near Cockermouth). His father Joseph was a weaver of cheap woolen goods; his mother Deborah Greenup had three children that survived, of which John was the youngest. After going to the Pardshaw School, at twelve he was teaching in his own school. Three years later he assisted his cousin George Bewley in the neighboring Kendal school, which he and his brother Jonathan took over in 1785. Meanwhile, he met John Gough, the blind son of a wealthy tradesman, who helped him with Latin and Greek, mathematics and natural philosophy, but, above all, with the use of various measuring instruments. He himself began, at twenty-one, a daily diary of weather observations (thermometer, barometer, hydroscope), which he continued until his death. Dalton was largely self-taught. At twenty-seven he became a teacher of mathematics at the New (Presbyterian) College in Manchester. At the same time he published "Meteorological Essays and Observations." In 1799 he devoted himself wholly to tutoring for Dissenters.

In 1796 Dalton became a life-long member of the Manchester Literary and Philosophical Society (President from 1817 on). He made his first presentation that very year on "Extraordinary Facts Relating to the Vision of Colours" (he had discovered his own color blindness in 1792). His second paper (1799) dealt with meteorology. In 1801 he published a practical "Elements of English Grammer."

Meanwhile, in 1795, having seen some lecture demonstrations, he became interested in the chemistry of gases. His own speculations about Greek atomism led to "A New System of Chemical Philosophy" (1808, 1810). This work,

however, was not generally appreciated until about 1815, and then first by the French Académie des Sciences, which made him a Corresponding Member (a Foreign Associate in 1830). Not until 1822 was he made a Fellow of the Royal Society; the same year he was welcomed with open arms by the scientists in Paris. In 1826, however, the Royal Society did give him a George IV gold medal for his work on atomic theory. In 1832 he was awarded a D.C.L. by Oxford and an L.L.D. by the University of Edinburgh. Other honor societies, namely, Berlin, Moscow and Munich, paid tribute to his investigations. In 1833 the government finally granted him a pension of one hundred and fifty pounds per year (doubled three years later). The following year a bust of Dalton was made for a statue in the main entrance of Manchester Hall and later a bronze replica for the Infirmary Square. At his public funeral there were one hundred carriages and 40,000 spectators. He was buried in Ardwick cemetery.

A Quaker bachelor, Dalton led a quiet life. He was straightforward, devoted to duty, and persevering. There was no pretence to good breeding; at times he was more abrupt and candid in speech than good manners would allow. He had no interest in general reading and even opposed having a library associated with the Manchester Literary and Philosophical Society. He was precise in money matters, had simple tastes and frugal habits. He played bowls once a week and would occasionally joke with friends. He liked to walk in the mountains of his own lake country. He later sent annual allowances to two family members (mentioned also in his will) and gave generously to Friends' causes if warranted.

Dalton's instruments were homemade so that his measurements were never too accurate, although he was a careful experimenter. His demonstration lectures at the Royal Institution (1803, 1810) were not successful. He lectured also at the University of Edinburgh. His main forte, however, was his natural ingenuity. His continuing interest in the atmosphere led in 1803 to his own investigation of the solubility of gases in water, complementing the studies of William Henry (1775–1836). Two years later he showed that each gas in a mixture behaves independently, that is, each with its own (partial) pressure.

Dalton's primary contribution, however, was the resurrection of Democritus's (496–438 B.C.) atomic theory, which assumed matter to be made up of atoms having the same substance, size, form—and possibly weight. He assigned a distinctive weight to each atom. Using Joseph Louis Proust's (1754–1826) law of definite proportions (1799) for any chemical compound, he was able to estimate relative atomic weights on the basis of one for hydrogen. Water, for example, would be 6.66 with 1 part hydrogen and 1 part oxygen (5.66). In this way he was able to produce the first table of approximate "atomic weights." In the case where two elements combine to form more than one compound, he showed that simple ratios of atoms would be involved—a theoretical deduction of the Law of Multiple Proportions, later verified experimentally. Dalton's ideas were not accepted at once by everyone, for instance, Humphry Davy (1778–1829). His own scientific work deteriorated with age.

Dalton had religious convictions; he had reverence for God and respect for the Scriptures. He was not, however, interested in theological controversies. He attended Quaker meetings twice every Sunday, as well as the Quarterly ones. He would not generally accept Sunday invitations for dinner. He did make one liturgical suggestion, the limited use of music on occasion at meetings. He drank water only; he did smoke a pipe.

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This is the nineteenth in a series on profiles of scientists with religious leanings.

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*"Reckless words pierce like a sword.
but the tongue of the wise brings healing."*

Proverbs 12:18

*"A gentle answer turns away wrath,
but a harsh word stirs up anger."*

Proverbs 15:1

*"The tongue that brings healing is a tree of life,
but a deceitful tongue crushes the spirit."*

Proverbs 15:4

*"Like a club or a sword or a sharp arrow is the man
who gives false testimony against his neighbor."*

Proverbs 25:18

*"A man finds joy in giving an apt reply—
and how good is a timely word!"*

Proverbs 15:23

Book Reviews

REALITY AND SCIENTIFIC THEOLOGY by T. F. Torrance, Scottish Academic Press, Edinburgh (1985); in U.S., Longwood Publishing Group, 51 Washington Street, Dover, NH 03820. 212 pages. Cloth; $24.00.

Reality and Scientific Theology is the first volume in a series on Theology and Science at the Frontiers of Knowledge, edited by Professor Torrance. Later volumes in the series are planned, written by scientists and theologians, on the same general subject. The two major themes of this volume are stated in the title: *reality*, and *scientific theology*. This book gathers up the many aspects of theological and philosophical thought which Professor Torrance has devoted to these subjects and brings them together in a concerted statement of what we may call a "proper direction" for Christian theology, both in its temper and in its self-understanding.

There are six long chapters in the book, each dealing with one major aspect of the overall themes. Professor Torrance has given a good summary of the aim of each in the preface to the volume, and again in a more expanded statement at the beginning of each chapter itself. These opening statements are among the most helpful passages in the book.

This reviewer found that the chapters, though necessarily unitary, were generally too long to master in a single sitting; this book needs scholarly hard work to be really understood. I find I have formed a clearer impression of conclusions and main points on a second reading of some sections. Readers should pay attention to any enumerated points or statements in the chapters as these often demarcate most clearly the essential conclusions of what has gone before. This is not a book for the novice; only those who have struggled in a working context with the problems the author discusses, and who have read at least modestly in the topic areas, will appreciate what he is saying at all. Yet for those who will take the trouble, have a concern with and some understanding of the issues raised, this is a thought-provoking and stimulating work. I do not find Professor Torrance's style easy to follow; the stream of his thought is both broad and deep and there is a tendency to tell us more about the full complexity of an issue in a given sentence than we can possibly absorb. Yet (as another reviewer of an earlier Torrance work had said, using the same metaphor) there are pools of limpid clarity and profound depth to which one keeps coming. For me this makes the struggle with the less clear and stylistically turbulent sections of his work worthwhile.

This reviewer is not a professionally trained theologian but a working scientist, though as a Christian concerned with the same theme of *reality*, I have a very great concern with epistemology in both science and theology. It takes awhile for the scientist to appreciate the breadth of a serious theologian's concerns; we are so used to limiting ours.

What is *Reality and Scientific Theology* about? As readers of his earlier works will know, Professor Torrance believes deeply in the legitimacy and very great significance of modern science as the pursuit of truth, the knowledge of an intelligible reality whose creator is God. This realist epistemology and philosophy is especially significant at the present time when modern Western thought is fragmented and in crisis because of a radical dualism concerning truth, reality and our knowledge; when we find existentialism, operationalism, and a whole host of other subtle forms of egocentrism contesting the very existence of objective truth at all, not only in the dominant modern theologies but indeed in all of culture, *including natural science*. Professor Torrance believes, as this reviewer does, that 1) the problems in theology and in culture, including science, are one and the same problem, 2) there are important principles regarding the nature of reality and our relation to it, including the epistemological issues involved in human knowledge of the truth, which can and must be learned from the emergence of modern science as a way of discovering reality, and 3) it is Christian theology's proper direction to develop and apply these same principles to its own task as the "science of God." It is to the development and implications of such a "scientific theology" that this book is devoted. Professor Torrance stands to some extent quite alone in this working vision of the proper goal of theology—misunderstood alike by the essentially non-Christian movements of modern existentialist and liberal theology which deny the objective reality or intelligibility of divine revelation, and by many of the orthodox Christian theological traditionalists who cling to versions of Platonism, rationalism, scholasticism and other accretions to Christian thought acquired in the medieval period as though these rational and logical systems, rather than God in His self-revealing Word, were the basis of the truth.

What has motivated Professor Torrance's thinking about "scientific" theology is the evident authority and truth in the whole way of knowing reality we have learned in the tradition of the physical sciences, a tradition which indeed springs from a fundamentally biblical impulse at the break-up of the medieval period. (This has sometimes made him

sound very unrealistic to those who can see the assertion of human autonomy and pride in the scientific tradition—phrases like "man the priest of creation" tend to make some wonder if the author thought salvation were cultural. Yet one must understand that Torrance is speaking of things as they ought to be—as they could be if men were in the will of God.) But it is to us who believe, and not to mere novelty-seekers, that Torrance really speaks. We who are also in love with the beauty and truth of science as the knowledge of God's created reality are in a position to appreciate the point he is making; we should master the critical ideas emphasized as well. Among my Christian colleagues in science I find a growing awareness that the principles we have learned about knowing truth in nature *do* have a bearing on our attitude to the nature of truth and knowledge in Christian theology. To such people, Torrance's work, studied seriously, can be helpful, for we need to contribute to creative change in the attitudes to theological truth which mark the contemporary Church.

Throughout the book readers will identify the themes which motivate it: that both natural science and theology are disciplines which refer to an *objective* reality beyond ourselves; that these two realities are not unrelated to each other, but have correlatives and consistency arising from the fact that God is the Creator of all things; that as creatures we are necessarily involved in a knowledge which is creaturely and personal (Professor Torrance's sympathy for and understanding of Michael Polanyi's epistemology of personal knowedge is evident in the book); above all that in both science and theology the realities which have their foundation in God *do* have the capacity to shape our understanding and our formalizations if we practice a proper methodology, a biblically based methodology, for discovering and holding truth. This is what Dr. Torrance means by "scientific" theology.

Emphasis is placed by Professor Torrance upon a rigorous intellectual discipline of theology—a discipline like that marking the physical sciences. Leaving aside those for whom such a conception is unacceptable *a priori* (because their view of theology is existentialist), or those who identify that discipline purely in formal, scholastic terms, this emphasis is also difficult for those of us whose concern with theology is not "professional" but deeply personal. Christians who are scientists often tend to the feeling that the sacred is hardly the proper object of mental scrutiny, or at least that the primary emphasis should be placed on personal commitment in piety and practice as the ground of any intellectual formulations we acquire. This instinct at its root is sound, and careful attention to what Professor Torrance is saying will show that he also emphasizes this foundation in the personal for the theologian. However, I think what is back of the often repeated call for rigorous discipline is Professor Torrance's awareness, shared by some of us, that theology—especially conservative, orthodox theology—has had a tendency to remain within its own very isolated confines and to pay little or no attention to developments in thinking outside its own assumptions. This should and must change if we are to offer significant intellectual guidance to a world whose thought is in crisis. Too often the response to culture has been ignorant and philosophically superficial—containing more anathemas than analysis.

Books Received and Available for Review

(Please contact the Book Review Editor if you would like to review one of these books.)

Anderson, R. and Guernsey, D., *On Being Family: A Social Theology of the Family*, Eerdmans

Atkinson, D. *Peace in our Time?*, Eerdmans

Beckwith, R., *The Old Testament Canon of the New Testament Church* (and its background in Early Judaism), Eerdmans

Bergman, L., *Through the Landscape of Faith: Christian Life Maps*, Westminster

Childress, J. and Macquarrie, J. (eds.), *The Westminster Dictionary of Christian Ethics*, Westminster

Christian, S. and Johnson, M., *The Very Private Matter of Anorexia Nervosa*, Zondervan

Dumbrell, W., *Covenant and Creation: A Theology of Old Testament Covenants*, Nelson

Basinger, D. and Basinger, R. (eds.), *Predestination and Free Will: Four Views of Divine Sovereignty and Human Freedom*, IVP

Fugita, N., *A Crack in the Jar: What Ancient Jewish Documents Tell Us About the New Testament*, Paulist

Gaede, S., *Belonging: Our Need for Community in Church and Family*, Zondervan

Grant, R., *Gods and the One God.*, Westminster

Hanigan, J., *As I Have Loved You: The Challenge of Christian Ethics*, Paulist

Kopp, R. and Sorenson, S., *When Someone You Love is Dying*, Zondervan

Jones, R., *The Great Reformation: A Wide-Ranging Survey of the Beginnings of Protestantism*, IVP

Lockerbie, D. B., *The Cosmic Center: The Supremacy of Christ in a Secular Wasteland*, Multnomah

Marshall, P., *Thine is the Kingdom: A Biblical Perspective on the Nature of Government and Politics Today*, Eerdmans

McMullin, E. (ed.), *Evolution and Creation*, Notre Dame Press

Nicholls, B. (ed.), *In Word and Deed: Evangelism and Social Responsibility*, Eerdmans

Pitman, M., *Adam and Evolution*, Rider

Schaeffer, F. (ed.), *Is Capitalism Christian?*, Crossway

Shannon, T., *What Are They Saying About Genetic Engineering*, Paulist

Slocum, R. E., *Ordinary Christians in a High-Tech World*, Word

Sommer, C., *Schools in Crisis: Training for Success or Failure*, Cahill

Stambaugh, J. E. and Balch, D. L., *The New Testament in its Social Environment*, Westminster

Storkey, E., *What's Right with Feminism*, Eerdmans

VanVonderen, J., *Good News for the Chemically Dependent*, Nelson

Professor Torrance's appreciation, as a theologian, of advances in modern physics such as quantum theory or relativity is necessarily not always a highly technical one. I have found it best when reading his work to look *through* this appreciation toward a *focus* on the philosophical or epistemological issue which really concerns him, rather than allowing myself to be distracted by focally attending to occasional imprecisions of his non-technical language. I can only wish I had as good a general grasp of theological history and literature as he does of physics.

The concluding chapter of the book is a revision of an earlier published essay entitled "The Ground and Grammar of Theology." Now called quite appropriately "The Trinitarian Structure of Theology," it sets forth an attempt to

understand the dimensions of the *personal* knowledge we can have of God through His self-revelation in the Persons of the Trinity. I have not read this chapter more than superficially, but it seems to me to be a fitting conclusion to the work, for in it Professor Torrance has given us not only a thoughtful appreciation of the reasons for the intimately personal language of God's word concerning His own self-disclosure, but also a very good example of what is meant by "scientific theology." Christian readers will have no difficulty in recognizing sound Christian doctrine here, presented at a level fully cognizant of modern culture, its misconceptions and its needs.

I do not find *Reality and Scientific Theology* easy to read, but I expect to *be* reading it for a long time to come. Its benefits will come to those willing to give it the effort required.

Reviewed by Walter R. Thorson, Department of Chemistry, University of Alberta, Edmonton, Canada.

THE GALILEO CONNECTION: Resolving Conflicts between Science and the Bible by Charles E. Hummel. InterVarsity Press, Downers Grove, IL (1986). 293 pages. Paper; $8.95.

Over the last twenty years there have been a number of different books treating the topic of the interaction between science and the Christian faith, many with particular reference to the creation versus evolution debate. Some have done this from a primarily philosophical perspective, analyzing the nature of science and considering its interaction with theology. Others have done this from a biblical perspective, inquiring as to how the Bible should be interpreted in order to be consistent with its intrinsic nature and purpose. In this book, Hummel enriches the picture by essentially giving a historical overview of the developments in science and the interaction with theology from Aristotle to Einstein, with particular emphasis on the lives and testimonies of Copernicus, Kepler, Galileo and Newton, with an epilogue on Pascal. Three-fifths of the book is devoted to this historical treatment, followed by equal portions of space devoted to the interpretation of the Bible, particularly the first chapters of Genesis, and to the interactions between science and theology that have given rise to the creation-science controversy of the past few years.

Hummel, who has advanced degrees in both science and biblical literature, has served as president of Barrington College, and is currently director of faculty ministries for Inter-Varsity Christian Fellowship, is admirably prepared for the task he has chosen. Without enumerating all of the points, it is fair to say that Hummel stands squarely in the center of the informed evangelical position that seeks to do justice both to authentic science and to authentic biblical theology. It is a perhaps trivial but unfortunate anachronism that the publisher has chosen the subtitle with the phrase, "conflicts between science and the Bible," in spite of the fact that Hummel argues strongly for the position that both science and theology are human endeavors.

Hummel is consistently faithful in avoiding the semantic pitfalls that so often characterize discussions of this type. He recognizes that one must understand the nature of scientific description, hypothesis, law, and theory, and he avoids the historical mistakes in relating God's activities to the physical universe: "According to the Bible, God does not 'intervene' in a semi-independent order of nature; nor is he a God-of-the-gaps working only in cracks and crevices of the universe." Similarly he recognizes the necessity to observe the intrinsic characteristics of the biblical revelation: "Once for all we need to get rid of the deep-seated feeling that figurative speech is inferior to literal language . . . we must give up the false antithesis that prose is fact while poetry is fiction. . . . The *historical-cultural* approach avoids those problems by explaining the creation days in light of the author's purpose, the literary genre of his message and what it meant to Israel at Mount Sinai."

This book deserves to be read widely. For the non-Christian it will help clear up some of the conceptual and historical caricatures that often obscure this subject, and for the Christian it will provide a balanced view of the nature of scientific and theological inquiry.

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

THE FOURTH DAY: What the Bible and the Heavens Are Telling Us about the Creation by Howard J. Van Till. Wm. B. Eerdmans, Grand Rapids, MI (1986). 280 pages. Paperback.

In 1955, Bernard Ramm's *The Christian View of Science and Scripture* marked the beginning of a modern evaluation of the interaction between science and Christian theology. There were, of course, predecessors such as James Orr, who held with respect both the claims of authentic science and the claims of authentic biblical theolgy, but Ramm's book marks the time when a few evangelical Christians, educated in both modern science and biblical theology, began to formulate the guidelines for their interaction and interpretation in a way that does justice to the integrity and limitations of each. The number of contributors over those thirty years is large, extending alphabetically from Elving Anderson and Ian Barbour to Walter Thorson and Aldert Van der Ziel. In this book Howard Van Till, Professor of Physics and Astronomy at Calvin College, gives us a succinct and clear presentation of this integrated perspective. It is therefore an important book to have available for the next generation of readers. It describes the principal alternative to the competing non-options of "creationism" with its rejection of authentic science, and "naturalism" with its rejection of authentic revelation and theology.

The book is separated into three parts that reflect this spirit of integration. The first five chapters describe the biblical

view, the next four chapters the scientific view, and the final three chapters provide an integration of the two views. The author makes it clear that he is writing for "those who want to take both the Bible and the Creation seriously," and he sets forth his task as integrating "these two views (scriptural exegesis and scientific investigation) into a coherent, unified perspective on the cosmos."

Van Till's treatment of the Bible is motivated by the desire to take it seriously, to respect it for what it is, and to respond to it accordingly. Taking the Bible seriously means for him: "1) affirming its true status, 2) respecting its multifaceted character, 3) promoting its proper function, and 4) engaging in a disciplined study of what it has to say." A key to understanding the Scriptures, according to Van Till, is the recognition of its covenantal structure: not only does it have the status of covenant, it also has the form of covenant. In his exposition of sound hermeneutics, he makes clear the basic importance of the purpose of the biblical revelation. "The task of biblical interpretation is to extract the original meaning, God's message or teaching, from the specific event, account, or story as it has been conveyed to us by a particular literary genre."

Van Till recognizes that asking appropriate questions is one of the necessary steps toward taking the Bible seriously. To the question, "What do we learn about stars from the Bible," he answers that we learn about their status. In fact he argues that the *status* of the material world is the principle question about that material world addressed by the Bible. The answer to the question is that stars are a part of the created world, not gods to be worshipped.

Van Till considers at some length the form and content of biblical references to creation and concludes that "the Creator's work as Governor of his Creation is most frequently portrayed in the form of poetry in which God's actions are presented in highly figurative and anthropomorphic language." He concludes, "The Bible is ascientific; it expresses no interest in either ancient or modern science. It does not speak unscientifically . . . nor does it speak antiscientifically . . . Rather, it speaks nonscientifically, or ascientifically." The purpose of the Bible is to reveal God's activity in originating, preserving or sustaining, governing, and in providential care. It does not provide us with descriptions of physical properties of mechanisms of the created world, with technical information about its behavior, or with a universal history of cosmic chronology outside of human experience.

In the section of the book on the scientific view, Van Till provides a clear summary of the proper domain and limitations of the scientific method, including the restriction of so-called scientific "explanations" to the realm of correlations between properties and behavior. Then he gives considerable insight into the various types of scientific findings and information that have been accumulated in recent years about the behavior and history of stars—more completely, perhaps, than the average non-technical reader will appreciate. Here he discusses such topics as gravitational collapse, thermonuclear fusion, and stellar genesis, development and death. In the final chapter in this section, the author presents the case for stellar evolution, concluding, "Whether we investigate the properties, behavior, and history of stars, of galaxies, of planets, of radiation, of atomic nuclei, or of space itself, we arrive at the same conclusion: cosmic history is evolutionary in character."

In setting forth the framework for his proposed integration, Van Till sets forth four fundamental principles: 1) recognizing the different kinds of questions we ask about the material world; 2) recognizing that the answers to those questions come from two sources, the Bible and the Creation; 3) being careful to address to each source only those questions that are appropriate for it, and 4) respecting the answers provided by each source. His approach is clearly summarized as follows:

> Scriptures present the answers to many important questions about the status, origin, governance, value, and purpose of the universe. Similarly, those of us who want to take the Creation seriously are already aware that honest and competent empirical investigation of the cosmos will provide answers to questions about its physical properties, material behavior, and temporal development. (p. 197)

The tendency for some scientists to obscure the boundaries of the scientific approach and to claim for their own philosophical or religious convictions the authority of authentic science, acts only to confuse the entire dialogue between science and theology.

To achieve his integration Van Till opts for a complementary approach to the insights provided by science and by theology, which he calls "categorical complementarity." When the proper categorical distinctions are observed between scientific and theological descriptions, no contradictions are found.

Van Till devotes a chapter to an analysis of the current forms of the creation/evolution debate, and clearly shows the shortcomings of naturalistic evolution on the one hand, and the pitfalls of special creationism on the other. He concludes that 1) "the concepts of 'creation' and 'evolution' constitute answers to entirely different questions," 2) "the contemporary creation/evolution debate is a tragic blunder," and 3)"the authentic debate is the wholly religious antithesis between atheistic naturalism and biblical theism."

In a final chapter Van Till presents a third option for the interactions that have led to the creation/evolution debate, an option that he labels the "creationomic perspective," summarizing the approaches to integration described earlier, and applying them to several specific issues.

The book is an admirable treatment of all the major science/theology issues involved with the Christian attitude toward creation and evolution. Van Till essentially avoids every pitfall of definition or semantics, and provides for the reader a clear and readily understood summary of the informed evangelical position today: a position dedicated to the upholding of authentic biblical theology and authentic science. The book deserves wide dissemination and attention by both the Christian and the scientific community.

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

CREATION REGAINED: Biblical Basics for a Reformational Worldview by Albert M. Wolters. Eerdman's (1985). 98 pages. Paperback; $7.95.

In the opening chapter Professor Wolters indicates that this book "is simply an appeal to the believer to take the Bible and its teaching seriously for the totality of our civilization *right now* and not to relegate it to some optional area called 'religion.'" He develops his plea largely around two "orders": "structure," which is anchored in creation, and "direction," which designates both the distortion and perversion of creation on the one hand and its restoration and redemption in Christ on the other. His major chapters are, therefore, Creation, Fall, and Redemption. These are followed by a chapter in which, with specific examples, he illustrates how "everywhere the things of our experience begin to reveal themselves as *creaturely*, as under the curse of *sin*, and as longing for *redemption*."

In his consideration of Creation, Wolters emphasizes that the Scriptures do not limit God's creative activity to his direct involvement in the laws of nature, the nonhuman realm, but they also include God's indirect creativity through His norms established for and through mankind. Thus the worlds of art, business, education, and commerce are part of God's creative norms and not merely secular activities. Creation reveals God's power and concern for all that He had made. (However, "as a message of salvation it is useless." Only "the Scriptures are the story of our sin in Adam and God's forgiving grace in Christ.") The earthly creation prior to Genesis 3 is "very good." Following the fall it should be compared to a healthy newborn child who experiences growth and maturation along with sickness (sin). "The ravages of sin do not annihilate the normative creational development of civilization." "God does not make junk and he does not junk what he has made."

In his chapter on the fall the author stresses that Adam and Eve's disobedience was not an isolated act but "an event of catastrophic significance for creation as a whole." A major manifestation of this catastrophic event is in the corruption of all human institutions. Although in his discussion of Romans 8:19-22 he states "that the creation in its entirety is ensnared in the throes of antinormativity and distortion," he bypasses any reference to the views of some Christian scholars that all death and sickness — even in plants and animals — is a result of Adam's sin and, therefore, did not exist before the fall. I wish Wolters would have commented on that viewpoint, although I would assume that with his emphasis on the goodness of God's creation from God's perspective that he would not espouse that view.

In the chapter on Redemption, Wolters vividly describes the ongoing work of Christ and the part that should be played by His people in restoring creation. This is not to be a return to the garden of Eden but all human developments should be reformed toward the kingdom of God. He gives a brief but helpful comparison of this "reformational worldview" with other kingdom views: pietism, the institutional church, dispensationalism, liberal Protestantism, and liberation theology.

Chapter 5 is a guide to "discerning structure and direction" and its practical application in sanctification and progressive renewal—the latter in distinct contrast to revolution. He discusses these processes in regard to societal renewal (government, business, education) and personal renewal (agression, spiritual gifts, sexuality, dance).

This book is a challenging discussion of an important series of issues. Some of the ideas were new to me and I found them to be thought-provoking and helpful. I especially appreciated the thoughts relative to the problem of the apparent coexistence of progress and degeneration in human history:

> Maturation and deterioration can be so intimately intertwined in reality that only scripturally directed sensitivity to the creational norm . . . can hope to discern the difference. Yet it is an absolutely fundamental distinction, and one neglects it only at the peril of falling into either cultural pessimism (which sees only the debilitating effects of sin) or cultural optimism (which sees only the normative development of creational possibilities). (p. 40)

Also noteworthy as a summary of structure and direction are Wolter's statements:

> Everywhere creation calls for the honoring of God's standards.
>
> Everywhere humanity's sinfulness disrupts and deforms.
>
> Everywhere Christ's victory is pregnant with the defeat of sin and the recovery of creation." (p. 60)

I recommend this book to everyone who is seriously concerned with the most important interrelationships outlined in the word of God: Creation, Fall, and Redemption and the implications of those interrelationships for the society in which we live today.

Reviewed by Wilbur L. Bullock, Department of Zoology, University of New Hampshire, Durham, NH.

GALILEO AND HIS SOURCES: The Heritage of the Collegio Romano in Galileo's Science by William A. Wallace. Princeton University Press, Princeton, NJ 08540 (1984). 371 pages.

This is an extraordinarily important and seminal, if demanding, book for understanding in depth the complex relationship of science, philosophy and religion as embodied in Galileo, "the Father of Modern Science" (p. 339). How did Galileo become so? The answer, culled from the evidence assembled in this book, is that he did so by assimilating the scholastic view of *scientia* taught by the contemporary Jesuit professors of philosophy at the Collegio Romano and creatively adapting it to the mathematical-experimental study of local motion.

Part I details the genesis of Galileo's philosophy of knowledge and of nature through textual analysis and comparison. It analyzes and dates two youthful sets of manuscript Latin

notes by Galileo on Logical and Physical Questions (the first composed approximately in 1589 and the second in 1590). It proves that the first was derived from "[Paolo] Valla's course in logic given at the Collegio in 1587–88" (p. 44), while the second was "a cross-section of a body of knowledge that was generally accepted and taught at the Collegio in the last decades of the *cinquecento*." (p. 95).

Part II studies first the ideas about *scientia*, "that is, knowledge that is certain through causes" (p. 99), and the demonstrative methods contained in Galileo's Logical Questions and compares them with those of the Jesuit professors. Then it systematically explores the main "teachings on motion that were being advanced by the [same] Jesuit professors preparatory to evaluating . . . their possible influences on Galileo" (p. 150).

Part III examines all the major writings of Galileo "to document the use he makes of the logical and physical terminology already sketched" (p. 219). Among his youthful works it gives particular attention to a third set of Latin notes by him (dates approximately 1590) where he attempts for the first time to develop a science of motion. By so doing, it proves that "Galileo's earlier treatises on motion were written in continuity with his logical and physical questions" (p. 230). Turning to Galileo's mature writings (i.e., from 1610 on), it examines the development of his philosophical views when he was working to "establish with apodictic certitude the true system of the world" (p. 282) and to "bring his science of motion to its final form" (p. 312).

To exemplify the importance of this book, it sheds impressive light on the existential foundations of science and also clarifies the theological presuppositions and causal character of science itself. To begin with the existential foundations, Galileo repeatedly makes the same unambiguous ontological point in his Logical Questions: science must ultimately rest on effectively existing things known as such (my own translation from the Latin text given in the book):

> At the beginning of the acquisition of a science, the actual existence of a thing was necessary, the reason being that every new cognition originates from the senses which deal only with existence . . . (p. 37)

> Since human sciences concern existing things, one must therefore know about their object whether it is [there], lest they be fictional. (p. 38)

> The question whether [something] is [there] is the first among all, requires the actual existence of a thing; therefore, before [examining] the question of how something is, it is necessary to know whether it is [there]. (p. 38)

> Granted that the sciences manifest only that [some] properties may belong to [some] subjects; nevertheless, since they manifest that they [properties] may belong to real subjects, it is therefore necessary to know in advance about the latter whether they really exist. (p. 39)

> Mathematics prescinds from any [consideration of] existence when it demonstrates properties [of bodies]; nevertheless, it must know in advance the existence of its subjects because, being a human science, it deals with existing things. (p. 40)

Addressing the theological presuppositions of science, Galileo's position is equally unambiguous: science exists because of the hypothesis of God's fidelity to his creation. In Wallace's synthetical formulation:

> Natural science owes the very possibility of its existence to the supposition that God will not miraculously alter the natural order, so that the laws of nature will be continuously operative. (p. 112)

Concerning the causal character of science according to Galileo—versus the empiric-positivistic interpretation—the evidence can be gathered from the long entry on "cause" in the Index. In summary, Wallace puts it well when, contradicting Stillman Drake, he states, "had Galileo rejected causal inquiries, he would have no claim to being the Father of Modern Science" (p. 326, n. 68).

The seminal nature of this book is particularly clear from its last section where Wallace gives "a provisional reconstruction" of what he rightly calls "the novelty of Galileo's contribution" (pp. 338–347). This contribution, which made Galileo the scientist par excellence, was "the reduction of complex natural phenomena to obvious or certifiable principles through the use of quantitative techniques" (p. 339). The greatness of this achievement stands out when one recalls the contemporary philosophical consensus that judged the human study of nature to be inherently limited to "saving the appearances" of phenomena (p. 340) without ever knowing whether the explanation one gave of such phenomena was objectively real or not—thereby making the very notion of natural science a logical impossibility. How did Galileo overcome this obstacle? Excerpting from Wallace's rather involved presentation, we can say that his starting point was the "causal maxims" he had derived from his Jesuit philosophical mentors, namely,

> That every effect has one, true, primary and necessary cause . . . that there must be a fixed and constant connection between cause and effect, with the result that any alteration in the one will be traceable to a fixed and constant alteration in the other . . . recognition that similar effects have similar causes. (p. 344)

On this basis, Galileo's originality as the founder of science can be essentially reduced to two chief activities:

> The first . . . a modeling technique to isolate the primary and intrinsic cause of a particular phenomenon. The second . . . supplies a quantitative surrogate for extrinsic causes when these prove refractory to experimental direction. (pp. 343–44)

In other words, by keeping in mind the entire evidence of this book, we can say that Galileo single-handedly originated the approach of scientific discovery by doing two things. In the first place, he boldly thought away from moving bodies all nonessential factors (such as size, resistance of the air, etc.) and thus, by representing them as geometrical entities, he tentatively described their motion by means of precise mathematical formulas. In the second place, he ingeniously devised and performed experiments where he effectively eliminated the influence of such nonessential factors so that, by proving the validity of his formulas, he also by implication proved the objectivity of the explanation he had given of the phenomena themselves.

In brief, this book is seminal because, by providing dramatically new and deep data, it compels the reflective reader to rethink in depth the whole relationship of science, philosophy and religion: Wallace himself closes with some "residual problems" (pp. 347–49). The appended select bibliography will help to that end.

From the above, this book is a clear must for academic libraries and also—despite its relatively high price ($42.50)—is to be strongly recommended to serious individual scholars.

Reviewed by Enrico Cantore, Director of World Institute for Scientific Humanism, Fordham University, New York, New York 10023.

THE MEDIATION OF CHRIST by Thomas F. Torrance. Eerdmans, Grand Rapids, MI (1983). 108 pages. Paper; $6.95.

With this concise book, the distinguished interpreter of Karl Barth to the English-speaking peoples of the world, the Edinburgh theologian and professor Thomas F. Torrance, now retired, presents us with an understanding of a scientific character that plagues Western Civilization. The opening sentence of the book is worth quoting:

> From time to time there have arisen in the course of human culture ways of thinking in which aspects of reality that are naturally integrated have been torn apart from each other, with damaging effect in different areas of knowledge.

The author then proceeds to explicate those fundamentals with which he thinks we must come to grips if we are going to create that kind of foundation for our thought capable of ordering and structuring the Church's obedience to God so that the wholeness of life in the world is respected. He insists this cannot be achieved by preconceived notions about God or the world. We must have that kind of theology which is capable of questioning all of our suppositions about the nature of the creation and the Creator. Just as Einstein led the scientific culture out of its dualist prejudices about space and time, matter and energy, the Church must witness a reformation truly able to transcend the analytical modes of thought in which she has become trapped and to create a transformation of mind able to express the profound healing and restoration of being for which the world cries out.

This means a deeply integrated way of thinking and being needs to be developed which refuses to cut off the living Christ from the Church, and the Scriptures and their God from the creation and its creatures. Towards this goal, Torrance has attempted to give to everyone concerned with the Word of God in this world a broad outline entailing those orders by which the mediation of revelation and reconciliation in the Person of Jesus Christ may be apprehended today. To supply this, claims the author, a deeper understanding of the relation between the Church and the history of the Jews must be grasped and its impact upon human thought and culture appreciated appropriately. He writes as follows:

> I believe that the inextricable interrelation between God's self-revelation in Jesus and his self-revelation through Israel, and thus the permanent authoritative patterns of understanding which God has forged for us in Israel, require to be reassessed and appreciated by us today in a much deeper way than ever before. (p. 28)

This kind of relational depth to our thinking is a necessity if we are to work out in our modern situations the imperatives of the Redeemer and the Creator of our world. This means we must apprehend anew the meaning of the work and person of Jesus Christ and we must be able as never before to stand under the real significance of His grace and truth, the way He has chosen to bring the light and the life of God to us. Old habits of mind, like those which have conceived of the universe in analytical modes of logically closed systems, must concede the way for new abilities to conceive in depth the realities of our being alive in the world. This newness is a unique necessity if we are to hear and to follow the Word of God in the Creation of God. Torrance understands this as shaking the very foundations of human thought and knowledge. We are experiencing today an earthquake which is necessary to free us from outmoded methodological efforts to know for what we have been made and to give us a fresh outlook upon the kind of future we shall surely see. This means not only painful changes, but deep and profound healing for us all.

For all of us who have experienced, on one level of being or another, the kind of needs that arise in the midst of such quakes, this book will be welcome, not only for its survival techniques, but for its touch with that kind of beauty that is able to move us where we have been most ignored. This little book affirms at last, in the faith of Christ, that there is a response to God by one who has known and overcome the ultimate disaster and evil, a passion by which we have been called to participate in the unspeakable love and joy God has for all those things that He has made.

Reviewed by John McKenna, Fuller Theological Seminary, Pasadena, California.

TRANSFORMATION AND CONVERGENCE IN THE FRAME OF KNOWLEDGE by Thomas F. Torrance. Eerdmans, Grand Rapids, MI (1984). 355 pages. Cloth; $24.95.

The distinguished interpreter of Karl Barth and Edinburgh theologian can be and has been accused of a convolution of style which makes unnecessarily difficult an understanding of the substance of his arguments. Even the title of this collection might put off some people. But we should be reminded that it is with a will that we come to grasp the depths of reality, as Einstein learned when he thought together the compelling nature of light in the world with its matter and energy; and it is with a will that we should attempt to apprehend the content of essays such as these. We live with the orderly structures of a free universe as creatures capable of penetrating into the true nature of the way we have been

made to be and unless we will to freely believe that we can overcome our ignorance in order to meaningfully serve the purpose of our existence upon the planet, we will not to understand. These assertions are fundamental to Torrance's arguments; the difficulties they imply, as he shows over and over again throughout these essays, have not enjoyed an easy time of it in the history of the development of thought. No matter how convoluted they might appear, regardless of how difficult they might seem, I have found my efforts to understand them deeply rewarding. Being put off by appearances is not the scientific method and certainly we will not explore the relations between science and theology except with a will that has been humbled by the complexities of our world and the mysterious wonder by which we actually grasp its simplicity.

It is not possible, in a review such as this, to touch upon each of the essays in this collection. Torrance has in his preface given the main thrust of their contents. They are, he says, essays devoted to helping us overcome the dualist assumptions and presuppositions and conceptions which are intrinsic in so much of Western thought about God and the world. We are in the midst of experiencing the shaking of such foundations, where a transformation of epistemological theory has occurred, and we find true knowledge of the actual relations in the way the world is pointing us beyond ourselves to the light and the love of God Himself. I would simply like to concentrate my attention upon one of the essays which has been especially helpful to me.

Chapter two is entitled "The Integration of Form in Natural and in Theological Science." In it, Torrance shows how categories of thought introduced into Christian theology through the use of Aristotelian science developed in such a manner as to create a profound dichotomy between empirical experience and sensible knowledge, and intelligible and theoretical experience and knowledge. In this split, at the heart of the way we conceive ourselves to be in this world, and the way we know things outside of ourselves, we discover the source of the abstract ways of thinking and the subjectivities which can conceive unreal relations between human consciousness and what actually is. Along with the development of such unreal relations came both the inertial views inherent in Newtonian mechanics and the split between natural theology and revealed theology in Catholic and Protestant dogma. However, since the work of James Clerk Maxwell and Albert Einstein, this split has been overcome and we have had demonstrated to us the epistemological unity intrinsic to a proper relation between theory and experience. This has meant the affirmation of the wholeness of being and the value of the free use of imagination and intuition under the discipline of the compelling nature of reality as we seek to understand what we believe—that the rationality of the world is real. Torrance argues that this split has been indicated by the dichotomies which have tormented the isolation of the arts and humanities from the scientific culture of our society. The transformations and the convergences into a unitary outlook to which Torrance would point us mean the healing and the restoring of relations which have escaped our attention and suffered in the dichotomies which have paralyzed our ability to integrate the diversities of our civilization.

Fundamental to this development is the way the classical Greek Fathers of the Church sought to overcome the epistemological dualisms of the pagan cultures and to root the Gospel in the realities of the Creation. In their belief in the one triune God revealed by the Creator and Redeemer of the world, Jesus Christ, the Fathers posited for confession the hypostatic union of the Word of God and the flesh of man. They committed themselves to unifying through thought the doctrines of creation and incarnation. This meant that Greek views of space and time and matter and energy were attacked, as the cosmos was revealed to be a contingent and uniquely free created reality whose rationality was profoundly dependent upon the rationality of God Himself. That is to say, the nature of God and the nature of the world were ultimately bound up with the nature of Christ. It was in the Word of God come as man into the world that one was to find the rational source of the cosmos. In this way, the Fathers struggled to establish an integrative mode of thinking, capable at once of apprehending both the form and substance of the world and the nature of God, that was truly appropriate to what actually was the case. We should see in this, claims Torrance, how the Judeo-Christian tradition is in fact the real basis from which a true scientific culture can be nourished. It is therefore in the relationship between theology and science that we can expect to find our deliverance from the disintegration in modern culture and the restoration of our experience from the alienated passions which mark our tormented society.

Is this too convoluted for our attention? Is it too difficult? Or is it essential for our development and our grasp of the future? For those of us who have suffered in the fragmented character of our torn society, it is essential that we try. Personal life and the march of civilization, if they remain at odds with one another, will cause such violent confrontations between peoples and archaic ways of thinking that all of us will feel the effects. We who have been lifted up out of our alienation from God must insist that the personal level of reality be respected anew, and that its integration and commitment be shaped by the real love of Almighty God. Is this not possible? Then, it seems, the world itself is not possible.

Torrance ends this collection of essays with a discussion of immortality and the light of God, in which the light of the world is employed to reflect on a created level the faithfulness and the constancy of the passion of God for the Creation. Beyond his immutability and his impassibility is his wonderful ability to care for us in such a way that we are made to understand that our nature is bound up with His passion. Under the compelling truth of the Word of God, we can learn what is truly human and we can become what we ought to become and we can reflect the reality that God is light. Forever will come in this way to us, and in no other. This constitutes good reason, I think, to accept the challenge and to attempt to understand. I do not believe the one who does so will be disappointed.

Reviewed by John McKenna, 455 Ford Place #3, Pasadena, CA 91101.

EVERYMAN REVIVED: The Common Sense of Michael Polanyi by Drusilla Scott. The Book Guild of Lewes, 25 High Street, Lewes, Sussex, England (1985). ISBN #0-86322-077-5. L9.25 (UK).

The ideas of Michael Polanyi about a "philosophy of personal knowledge" are *not* just another option in the vast array of inadequate philosophies of science; they are a radical critique of those philosophies, aimed at restoring a sane and balanced understanding of our knowledge as person. More important, Polanyi's critique is *not* a denial of objectivity as is often superficially stated. On the contrary it is a constructive achievement: Polanyi shows us that knowledge which is personal can indeed be objective, because it involves responsible commitment to a reality which exists independent of our knowledge of it—in which alone that objectivity can be properly grounded. Anyone who thinks about it will realize that this conclusion reopens in its widest terms the question of religious meaning in human life, and that in particular it is compatible with the affirmations of biblical religion concerning faith and a true knowledge of God. Scientific knowledge then can take its proper place as a valid but limited way of knowing reality within a many levelled structure of knowledge held by persons in a free society. Such a healing of the philosophical schizophrenia of the modern Western mind was Polanyi's concern from the outset.

As a Christian and a physical scientist concerned with making whole sense of my knowledge both of scientific truth and of the God revealed in Jesus Christ, I have striven for some years to show students in seminars on philosophy of science and religion why Polanyi's thought is so very critical to our time. For myself and others who are able to read Polanyi's work *Personal Knowledge* because we share as *scientists* his experience of how science really works, this has not usually been a difficult task. As Drusilla Scott has so aptly described it in the Preface to *Everyman Revived*, we were able to "walk joyously into Polanyi's philosophy as into a long-lost home." But for those who did not belong to the scientific subculture, there has always been a difficulty, arising partly from commitments to rigid frameworks of presupposition about philosophy or theology, and partly from lack of experience with scientific truth in any significant way; this made it very difficult for them to believe that Polanyi's thinking could possibly have the radical and essential importance which in fact it does have for our time.

Drusilla Scott's brilliantly written book has changed all this. I expect that from now on it will be possible for me to make very clear indeed just why Polanyi's thinking is important, and to do so for that very important majority of people who are *not* scientists or philosophy students, but "everyman" and "everywoman" in the sense of her book's title. Lady Scott brings to her work not the experience of the scientist proper, but a full appreciation of Polanyi's thought and its relation to almost all the major idols of contemporary philosophy and culture—imposing figures such as Russell, Popper, Quine, Ayer, Kuhn in the philosophy of science—and an exceptional gift for making clear how and why Polanyi's work shows their whole approach is lacking or distorted or wrong in relation to the truth about persons and knowing. In the Preface, she modestly says that her immediate lack of technical knowledge as a scientist "may be an advantage of a sort, if I can show that without much science it is possible to get an idea of what Polanyi is after and how it could change our outlook." In my opinion she has succeeded splendidly in this task.

I am currently reading Drusilla Scott's book for the third time and enjoying her clarifying insights into the significance of Polanyi's thought for topic areas about which I as a physical scientist have known very little. I had reached certain conclusions on my own account about certain problems in philosophy, politics and culture; it has been very good to see them even more clearly set out by Lady Scott's beautifully lucid writing. Moreover, *Everyman Revived* is enjoyable just for its superb style, in some ways as much poetry as prose. I have seldom enjoyed anything so much as her wickedly effective satire of the analytic philosophers through telling epigrams and illustrative stories. The best of it is that her satire is *truthful* and *accurate*.

For readers of this *Journal, Everyman Revived* will have two additional merits:

1) Though we are scientists, not many of us have thought or read widely about serious philosophy; many either are afraid of the philosophers or ignore them as irrelevant. Unfortunately neither attitude is justified. Drusilla Scott's book will bring those readers who find themselves in such states of mind to a sensible and useful appraisal of the importance of philosophy as well as its errors.
2) The author is keenly interested in the relevance of these matters to Christian belief, which she shares with us. She believes as I do that a consistent understanding of knowledge as personal brings us back to biblical faith in its fullest sense, faith in a God who is the source of all reality.

This book will stand high on my assigned reading list for all future study programs on epistemology and philosophy.

Reviewed by Walter R. Thorson, Professor of Chemistry, University of Alberta; Adjunct Professor, Philosophy of Science, Regent College, Vancouver, B.C.

METAPHOR AND RELIGIOUS LANGUAGE by Janet Martin Soskice. Oxford University Press (1985). 191 pages.

One may wonder why a review of a book on this subject should be submitted to the *Journal of the American Scientific Affiliation*. Beyond the book's being helpful to Christians in their apologetic to sceptics is the fact that Dr. Soskice enters the territory of religious language by comparing the use of model and metaphor in science with their use in the Christian religion.

After several chapters dealing with classical and modern philosophic accounts of metaphor and its relation to other tropes, such as simile and parable, the author gives a penetrating analysis of metaphor and model in science, leading to a devastating critique of philosophic emotivism and the logical positivism that stands behind it. She makes a strong case for a

type of realism that considers talk about God to be *reality-depicting*.

> We may justly claim to speak of God without claiming to define him, and to do so by means of metaphor. Realism accomodates figurative speech which is reality depicting without claiming to be directly descriptive. (p148)

This is possible only when there is 1) experience (the Christian, just as the scientist, *does* experience something), 2) a community of peers that provides a context for the experience, and 3) an interpretive tradition. Each of these is indispensibly present in both science and religion. Both of these traditions thus grow in knowledge because, while getting at conceptualizations that convey truth, they both admit the possibility of error. For example, mystics may be in whole or part mistaken about their encounter with God, as may scientists about their convictions about black holes. In this way the author links the epistemic destiny of scientific talk (which positivists idolize) and god-talk (which they dismiss as nonsense).

"Christianity is indeed a religion of the book . . . whose sacred texts are chronicles of experience, armouries of metaphor, and purveyors of an interpretive tradition" (p 160). Dr. Soskice adds provocatively to our understanding of the relation of language to our search for insight into two of God's "texts": the physical universe and the biblical corpus. Thus she helps us to know more about Him who is truth itself.

We who follow science while holding to the faith will glean much from this book, which is not only thorough in scholarship but crisply elegant in style.

Dr. Soskice is tutor in philosophy at Ripon College, Oxford University, located in Cuddesdon, England.

Reviewed by Dr. James Walter Gustafson, Professor of Philosophy, Northern Essex Community College, Haverhill, MA 01830

THE CHRISTIAN STORY by Gabriel Fackre, rev. ed. William B. Eerdmans (1984). 319 pages.

Gabriel Fackre, Professor of Theology at Andover Newton Theological Seminary, has revised and updated his 1978 book of the same title. He presents an introduction to systematic theology in narrative form as a biography of God. He adopts the narrative form in order to show the drama and dynamism of what God is doing in the world. *The Christian Story* has a plot, with beginning and end. It deals with concrete history in which real struggles take place, and in which the final victory will be achieved by active and painful involvement.

The Introduction, fifty-five pages in length, lays a foundation for the rest of the book. In it narrative theology is defined and described. The story line which Fackre adopts is set forth in outline form, which will later give the chapter headings for the rest of the book—Creation, Fall, Covenant, Jesus Christ, Church, Salvation and Consummation. To these he adds a Prologue and an Epilogue, both of which deal with God.

Also in the Introduction, he deals with questions of truth and authority, and establishes a motif/metaphor for his presentation of the Christian story in our generation. He regards the Bible as authoritative, insisting that the story told therein must be empirically true in order to be valid as a statement of faith. "*The Christian Story* is not just a statement of who we are, but an affirmation about the way things really are. It makes truth claims" (p. 40). He does not, however, see the Bible as inerrant, and cites the stoning of blasphemers, and the reference to sheol as our destiny after death, as examples of "earthiness" in the Bible, elements which "cannot be accepted" (p. 46). On the whole, however, he seems to take the Scriptures at face value, as truthful and authoritative.

The motif/metaphor utilized is of vision. This is done in part because it is a way of "translating" the ancient story in our context, where visual images are very important. So Creation is an expression of God's vision, Jesus Christ is the true visionary, and eschatology is the fulfillment of God's vision. The content of this vision, in the world marred by sin and evil, is liberation and reconciliation, a restoration and consummation of God's vision in every area of life.

There is a satisfying unity and balance in Fackre's work. In the Introduction and Prologue he establishes certain themes, which are played out in subsequent chapters in such a way that there is a sense of new discovery while building on points previously established. Since he is drawing on the Christian community to tell the "Story," Fackre often quotes other writers from various periods of church history. He maintains a popular style, with limited documentation. Though his treatment of the issues raised is serious, he avoids technical and complicated argumentation.

In addition to the balance in the design of his book, and in his style of writing, Fackre achieves a balanced position theologically. He steers a middle course between extremes in almost all the questions he discusses. So the main value of this book does not lie in discovering new truth, but in its restatement, in current idiom, of the truth recognized by Christians in successive generations. It can serve as a helpful model for those interested in relating the Gospel cross-culturally, as well as for those seeking fresh ways to present the Gospel within their own culture.

Fackre considers this as an introductory volume, which he intends to follow up with a series related to the chapter titles. Since this book reveals his skill in telling the Christian Story in a clear and gripping way, I look forward to the further volumes.

Reviewed by Joseph M. Martin, Missions Professor, Edward Lane Bible Institute, Patrocinio, MG, Brazil.

IDOLS OF OUR TIME by Bob Goudzwaard. InterVarsity Press, Downers Grove, IL 60515. 115 pages. Paper; $4.95.

Not long ago I became convicted of the truth of the statement that ideology is always the enemy of truth. This little book by Bob Goudzwaard, former member of the Dutch parliament and Professor of Economics at the Free University

in Amsterdam, has been translated from the original 1981 Dutch version; it is pure dynamite in exposing the skeletons of our popular ideologies. If the Christian Church understood what Goudzwaard has to say, took it seriously, and put it into practice, the consequence would be an explosion in the Christian community that would spill over and enrich all the rest of the world. It is remarkable that Goudzwaard has in so few words and pages given the subject a clarity that can have no authentic response except reformation and incarnation.

In eight brief chapters Goudzwaard exposes the illusions under which Western society, and in large measure Western Christianity, has been living. We have made *gods*, he argues, of economic growth, technological development, the advance of the applied sciences and the expansion of the state, only to find that these *gods*, have betrayed us. As a consequence we reap the results of idolatry, the inevitable correlate of ideology. And yet he does not suppose that somehow *the enemy* is identical with these tangible concerns; he is quick to point out that "The *real* enemy lies within *ourselves*."

He focusses on four main ideologies that serve as substitutes for biblical religion. These are the ideologies of revolution, nation, material prosperity and guaranteed security. Having erected these idols for our own worship, we find instead that we are the servants of these idols, with fear as the inevitable consequence. His dissection of the nature of an ideology is crisp and telling, focussed on the realization that an ideology takes root whenever the end becomes more important than the means, so that any means may be considered legitimate in the pursuit of the end. His fierce antagonism to such idolatries arises because he meets "an imitation Christianity in a genuine, full-fledged ideology."

Goudzwaard uses the communist ideology to illustrate the ideology of revolution (although he does not overlook other forms such as the Palestine Liberation Organization or any other groups that may arise in the presence of oppression and violence in our society). He uses the nationalist ideology of South Africa to illustrate the ideology of nation, but is equally sensitive to the possibility that even North America could fall victim to such an ideology in the defense of authority. He uses the shortcomings of the Welfare State to pinpoint his critique of the ideology of material prosperity; it is a situation where we face crisis ahead.

> If we embrace all forms of technological and economic progress and at the same time curtail foreign aid, remove all environmental restrictions, submit to the blackmail of the oil-producing countries and accept weapons from wherever they come—all for the sake of maintaining and expanding our economic achievements—then the prosperity ideology will certainly become full-fledged and absolute. (p. 58, 59)

Finally he turns his attention to the ideology of guaranteed security in a world constantly building armaments in order to assure this security. The whole story of the waging of war has undergone such radical changes that today even Christians are likely to feel that "Biblical norms are very nice, but they must not hinder the progress toward prosperity and peace." The blind continuing arms race is unmistakable evidence of a complete security ideology. Goudzwaard's response is as simple as it is profound: "Either we give biblical norms priority and relativize our goals or we give our goals priority and relativize biblical norms."

Ideologies are all the more sinister since one or more often act in concert to accentuate and accelerate one another. Furthermore, Christians often express hesitation or reluctance about such ideologies, but in the practical matters of everyday life, we all too often give them our total support.

In spite of this bitterly realistic analysis of our situation, Goudzwaard disclaims the role of prophet of doom. Instead his final chapter is entitled, "Hope Awakens Life." Such hope is possible for the author and for us only because of Jesus Christ: "the only escape possible is *in and through the cross* of our suffering and prevailing Messiah." In order to provide a first step for the Christian out of this ideological morass, Goudzwaard offers the simple choice of *enough* rather than the continuing choice of "more and more": enough weapons; enough consumption; an end to our preoccupied dedication to our ideologies of nation, security and prosperity that so dominate the Western world.

Could any other future choice do more for the healing of the world than such choices advocated, acted out and demonstrated by Christians serving their risen and victorious Lord? "Defenseless and on display, the Messiah defeated them and triumphed over them publicly." Either this is the central message of the Christian Gospel and it provides the basis and the guide for our hope, or the Christian message is a fraud, a pious construction doomed to serve other ideologies.

Don't read this book unless you are prepared to take a new and radical look at your Christian life. Don't pass this book along to others unless you expect some startling reactions and changes. Don't dig into this book and begin to take its message seriously unless you want to stand your own Christian life on its head, inject new life and vitality into the life of your church, and come to understand what it means to serve the suffering but victorious Lord.

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

THE STRESS MYTH: Why the Pressures of Life Don't Have to Get You Down by Richard E. Ecker. Downers Grove, Illinois: Inter-Varsity Press (1985). 131 pages. $4.95.

As a chemistry teacher, wife, and mother-of-four, I was eager to read this book, in order to learn how stress could be mythical. Essentially, Ecker's approach in this delightfully concise book is to consider stress not as an action from the

world but as a reaction within one's own body, not as an external cause but as an internal, personalized effect.

By employing a physiological definition of stress, which includes such quantifiable criteria as increased arterial pressure and increased muscle glycolysis, Ecker maintains that a stress myth exists because the true, physiological definition of stress has been lost in an abundance of alternative definitions. With the underlying premise of stress internalization, Ecker leads the reader from a stress profile (I scored as an "active," moderately-high-stress personality) to a consideration of stress as a modifiable response, one in which self-image as the image of God plays a prominent role in establishing a "stability structure" for each individual. Ecker recommends a lifelong process of stress-prevention, using his twelve "Ecker's Laws" and six consecutive stress-prevention steps, with the entire process being considered not primarily a matter of behavior, but a matter of faith. As examples of his theory put into practice, Ecker offers chapters on handling stress in marriage, parenting, and the workplace.

Rejecting the conclusions of the eminent stress researcher, Hans Selye (because Selye's work was done with rats—"Just because people frequently behave like rats, doesn't mean they have no other options."), Ecker insists on each individual's personal responsibility for his own stress. I am not totally convinced; I suspect that the full picture of human stress lies somewhere between the polar conclusions of Selye and Ecker. My other minor problem with the book was that the appendix on diet and stress needs to be reworked to include the recent, relevant glycemic-index research on carbohydrates.

However, Ecker's major contribution—to remind us of our own roles in personal stress-prevention—is an encouraging word for a tense, angry, hair-trigger society: to the extent that stress is self-perceived and self-promoted, to that extent it can also be self-controlled, even prevented.

Reviewed by Irmgard K. Howard, Associate Professor of Chemistry, Houghton College, Houghton, New York.

Letters

Reflections from Murphy

I am a new member of ASA and was very much impressed with the first issue received of the *Journal*. I especially enjoyed reading Dr. George Murphy's "Theological Argument for Evolution." Since I am neither a physicist (chemical engineer) nor a theologian (accepted Christ finally at age 42), I am not very well qualified to comment on the article. However, a thought occurred to me regarding the "backward in time" explanation of death and suffering before the "Fall." Dr. Murphy touches upon it when he says that Christ at the center of history gives meaning to all history.

Since God is not limited by the time dimension of our universe, He logically can see all of history from beginning to end and, while He gives us free choice, He must know what choices we will make. This would require that God know the practically infinite number of possible paths of history which depend upon the choices He allows us freely to make; no problem for our infinite Maker. This is a little hard for me to understand fully but it does help me to see that Christ on the cross died for my specific sins, which I had not committed yet, but which He had already known that I would commit.

The same type of reasoning can be applied to the suffering prior to the fall. Just as Christ redeemed those in both the past and the future, Adam condemned those in both the past and the future.

It seems unfortunate that Christians must spend so much time on this Creation/Evolution issue, which diverts our energies from Christ's work for us. On the other hand, maybe it is necessary for the understanding of the Body to work through it. I am grateful for the clear insight of Dr. Murphy in helping this process to progress.

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Presuppositional Problems with Murphy

When Greek thinkers broke away from the religious mythologies of their day seeking a more earthly (natural) explanation for reality, they obviously believed they could come up with a definitive answer. Yet, some 2,500 years later we are still vigorously debating the nature of the "real."

There have always been proponents who staunchly proclaimed their belief system the "only definitive" answer to questions of reality. Certitude (a feeling of absolute sureness, as Webster defines it) is an interesting concept but if history teaches us anything it is that absolute sureness fits better with dogmatists than with seekers after the truth. This is not to say that we throw our hands up in despair of ever knowing truth; it is to say that certitude is an elusive category and causes many problems when we hang our cosmologies upon it. Any statement of certitude needs much collaborative evidence before we place our hats of trust upon it. I can trust that tonight at 7:57 p.m. the sun will set (or more correctly the earth will rotate in such a way that darkness will replace the light), and that at 5:57 a.m. tomorrow the light will return. And, that this pattern of light and dark will happen routinely without fail, at least until God ends time as we know it or the universe collapses upon itself, whichever comes first. How can I state this with assurance? For forty-one years I've been a witness to it and since the dawn of human history others have been witnesses.

On the other hand, when there is no wealth of collaborative evidence, when the evidence for a belief is at best circumstantial and can be rationally interpreted in different and contrary ways, to claim certitude for any such position is an illusion of its claimant.

In my reading of the literature of macroevolution and special creation in exploring the genesis of life, certitude for either position is presumptuous. Both systems offer reasonable answers, though

neither can prove beyond a faith assumption the basic tenets of their belief.

To wed theology, as Mr. Murphy has done in his article "Theological Arguments for Evolution" (Vol. 38, no. 1) to a fallible and questionable belief system is both disastrous to theology and to science. Charles Hummel's book *The Galileo Connection* is a good primer for those who would enter the dangerous grounds of such a merger.

George Murphy's article is a good example of the problems of such a merger. It is also a good example of the problem of certitude for a belief system that has epistemological problems and of trying to cover over those problems with the blessings of theology. When Murphy uses scripture to validate macroevolution he perverts scripture by making it say something it does not.

Murphy exposes his problem area when he says, "We must realize that arguments and proofs are always contingent upon certain presuppositions . . . ," for it is his presuppositions that get him into trouble. His conclusion that "evolution appears to provide the theologically superior understanding of creation" and that "only evolution fulfills the joint requirements that Christ be the Redeemer of the *world* . . . and that salvation come *via* the Incarnation," is based upon his presuppositional error on redemption. In his argument of II(3) he confuses the redemption of humanity with the redemption of the cosmos. Man and nature did not sin together, but man's sin brought turmoil to nature around him so that what God had created perfect became imperfect only because of man's action of sin. Nature was not given a free choice, only humanity; but nature did directly suffer the consequences of Adam and Eve's sin. It was not to the tree, or the birds, or the rapidly moving stream that God said, "Let us make . . . in our image." It was only humanity he so identified, and it was only humanity wherein he took the further step in creation by breathing into it His breath of life. Nature will be redeemed (made whole) but only because, again, of what happens to humanity—his redemption through the incarnation, death and resurrection of the new Adam. The Word did not become flesh so that nature could be restored in fellowship with the Father but so man could be so restored. And having restored man, God will restore what he created for man, namely, nature around him. That is the theology of redemption and to make it anything else is to force it through leaps of logic to say what you want it to say, not what it says about itself.

Another presuppositional problem arises when he links these two statements: "For the biblical picture is precisely that God brings life out of death, being out of chaos, and hope in hopeless situations," and "The idea that life arises and develops through competition and extinction is part of the same picture." Now I can say that a lemon is sweet like a peach because both grow on trees but that is as much a construction of my mind as the above statements. There is no necessary nor compelling nor attractive reason to link the statements as Murphy has. He simply wants theology to support his position on evolution and so he will build his house upon any foundation, but that foundation does not support the design of his house.

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Correction

JASA, Vol. 38, No. 2, June 1986, "Theological Clues from the Scientific World," p. 113, first column, last line:

". . . General Theory, the principles of energy and gravity . . ." should be changed to read ". . . General Theory, the principles of inertia and gravity . . ."

A new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die and a new generation grows up that is familiar with it.

Max Planck, 1948.
Scientific Autobiography, quoted by Raymond Seeger in *JASA*, December 1985.

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. The *Journal ASA* 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.

Statement of faith: (1) *The Holy Scriptures are the inspired Word of God, the only unerring guide of faith and conduct.* (2) *Jesus Christ is the Son of God and through His Atonement is the one and only Mediator between God and man.* (3) *God is the Creator of the physical universe. Certain laws are discernible in the manner in which God upholds the universe. The scientific approach is capable of giving reliable information about the natural world.*

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