PERSPECTIVES on Science and Christian Faith

JOURNAL OF THE AMERICAN SCIENTIFIC AFFILIATION

In this issue . . .

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

VOLUME 41, NUMBER 4

DECEMBER 1989

MEMBER epa EVANGELICAL PRESS ASSOCIATION

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

MANUSCRIPT GUIDELINES

1. All manuscripts except Book Reviews should be addressed to Editor, *Perspectives,* 13 Thompson Lane, Durham, NH 03824.
2. Authors of *Papers* and *Communications* must submit an original and two copies of their papers for review purposes.
3. Regular Papers should be accompanied by an *Abstract* of not more than 100 words.
4. All manuscripts should be typed double-spaced on good quality 8½ × 11 paper.
5. References should be collected at the end.
6. Figures or diagrams should be clear, black and white, line ink drawings or glossy photographs suitable for direct reproduction. Captions should be provided separately.

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

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

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

LETTERS to the Editor concerning contents of *Perspectives* may be published unless marked not for publication.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

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

Putting Things in Perspective

In developing Christian perspectives on scientific problems one of our major tasks is to realize that different conclusions are often the result of the diverse backgrounds and experiences we each bring to an issue. In addition, nearly all of the phenomena we consider have different "levels of explanation." In our lead article in this issue, Marvin McDonald gives us the first of a two-part series examining "hierarchy theory." He examines the implications of these concepts for the relationships of scientific and theological consideration of evolutionary biology, molecular biology, and epistemology.

In addition to awareness of basic philosophical concepts in the relationship of science and Christian faith we are often faced with everyday problems and frustrations of formulating and presenting our science/faith views in the workplace. Richard Bube gives us a blow-by-blow account of his problems with a university bureaucracy. His experience with a change of administration, which resulted in the threatened elimination of a twenty year-old seminar on science and religion, is all too typical of the biases that face us today in these days of supposed "academic freedom." We can have free exhange of ideas so long as we do not emphasize biblical Christianity!

In the bioethical realm, Armand Nicholi discusses the importance of the world view of the investigator and the clinician. He emphasizes that it does make a difference whether our view of our fellow human beings is based on an atheistic view of life and the world around us or whether we think of ourselves and our fellow human beings as created in the image of God.

With increasing concern about crime in our society and what we should do about it there are many proposals for dealing with the problem, and most of these center on the punishment and/or rehabilitation of the criminal. Jack Balswick gives us a Christian sociologist's perspective on how we can apply biblical principles to punishment—principles that incorporate both motive and act with both justice and mercy. In addition, there is need for concern with public safety, deterrence, restitution to the victim, and restoration of the criminal.

One of the major challenges to those who are investigating the origin of life is to define the real essence of "life." David Wilcox examines this question in the light of recent studies on DNA coding. He suggests that "the real essence of life is the information or patterns which, although carried on DNA, are not determined by it."

In the Communications section, Richard Bube discusses "determinism" and "chaos" in the light of a recent publication in *Science* magazine. Denis Burkitt emphasizes the modifications that occur in both scientific observations and hypotheses and in biblical interpretation, and urges us to continually integrate our scientific and Christian thinking.

* * * * *

One final note... Having edited our journal for six years, I reached the conclusion that it was time for a change. As was announced at our annual meeting in Marion, Indiana last August, John W. Haas, Jr. of the Chemistry Department of Gordon College, has agreed to serve as editor. Jack brings to the journal his years of experience as one of our reviewers, as well as his knowledge of the philosophy and history of science. I trust that we will all give him support and encouragement as he seeks to make *Perspectives on Science and Christian Faith* a publication which honestly seeks to relate and explain science and evangelical Christianity to both the scientific and the theological communities.

I thank the members of the Editorial Board and our Consulting Editors as well as other reviewers for their time and their efforts to help make our papers readable, accurate, and of maximum significance. These people are to be commended for their part in making our journal a truly "peer-reviewed publication," a status that I could honestly affirm in answers to letters associated with the promotion and tenure process for several of our authors. I especially thank Ruth Herr, Ann Woodworth, and Nancy Hanger for their often tedious, time-consuming and valuable services as Managing editors. These women have been largely responsible for all of the practical details involved in publishing *Perspectives on Science and Christian Faith* ✤

WLB

Exploring "Levels of Explanation" Concepts Part I: Interactions Between Ontic and Epistemic Levels

MARVIN J. MCDONALD

Psychology Department
The King's College
Edmonton, Alberta, Canada

This paper invites scholars interested in science-religion relationships to examine the notion of "levels of explanation" in more depth than is usual. Interactions among epistemological and ontological aspects of levels have been explored in writings about "hierarchy theory." Examples of expanded levels ideas are considered in three areas: evolutionary biology, molecular biology, and epistemology. These examples suggest that connections between ontological and epistemological levels are important to explore when the scope of a scientific theory is broad enough to be reflexive, when one looks closely at a boundary between levels, or when one considers connections between scientific and religious knowledge.

In recent years the pages of this journal have carried several discussions highlighting some key concepts for understanding science-religion dialogue, including reflexivity, complementarity, and levels of explanation (e.g., Cramer, 1985; Haas, 1983; Van Leeuwen, 1983). While these concepts are closely interrelated, emphasizing one of them for discussion is much more manageable than trying to sort them all out at once. My aim in this paper is to support this clarification process by looking further at the notion of "levels of explanation." In particular, I examine literature from an interdisciplinary area of study sometimes referred to as "hierarchy theory" because it is one valuable resource for clarification.[1]

Levels of explanation and related notions often hold pivotal positions in discussions of religion and science relationships, particularly among scholars seeking to demonstrate the compatibility of the two domains (e.g., Barbour, 1966; Bube, 1971; Capra, 1982; MacKay, 1979; Peacocke, 1986; Polkinghorne, 1986). Despite the popularity of levels notions in the exploration of science-religion interfaces, there are many unanswered questions regarding the viability of current formulations (e.g., Cramer, 1985; cf. Orlebeke, 1977). In fact, there also are unresolved questions in the broader literature on "hierarchy theory," so the open-endedness of levels notions in religion-science discussions is not surprising (Pattee, 1973; cf. Grene, 1972; Salthe, 1985). Moreover, since concepts of a hierarchy of levels have a wide-ranging history in both Western and Eastern intellectual traditions (e.g., Capra, 1982; Leake, 1969), it is probably unrealistic to expect coherent, consistent use of these ideas across diverse areas of study. In this paper, I explore a selected set of questions in hierarchy theory to highlight potential directions for fruitful development of hierarchy models. A next step, applying these issues to science-religion dialogues, is the task of a companion paper.

Background Terminology

Given the diversity and poorly coordinated nature of literature on hierarchy theory and levels of explanation, terminology is an important preliminary consideration. Although the term "hierarchy" is often used to describe authority relations in institutions or relations among taxa in classification systems, the focus for this paper is the use of "hierarchy" to describe an ordered sequence of levels more generally. Different kinds of hierarchies can be distinguished from the outset.[2] Levels of "explanation," "analysis," "abstraction," or "description" emphasize hierarchical strucuture as reflected in knowledge systems. Epistemic concerns (i.e., concerns about the nature of knowledge) are frequently emphasized by "levels of explanation" terminology. Sometimes levels of explanation are expressed as a form of the traditional "hierarchy of disciplines" which features physics at the base, biology in the middle, and social science toward the top (cf. Beckner, 1974). By contrast, one can distinguish levels of "being," "reality," or "organization" as designations for basic ontic (reality) structures, usually emphasizing nested composition patterns of elementary entities or "things." The "levels of organization" frequently used as a framework for biology curricula is a classic illustration of compositional levels: cell, organism, population, etc. Each level of the hierarchy is defined by things which are composed of entities from the level below: for example, organisms are made up of cells. Finally, one can also identify levels of "activity" or "modal aspects" which reflect functions or processes instead of the entities in compositional hierarchies (e.g., Barbour, 1966; Hart, 1984). For example, some authors argue that mind-brain questions reflect different modes of functioning (physiochemical and cognitive) of a single entity (a person) rather than reflecting different entities (brains and minds).[3] It is helpful to note that both compositional and functional hierarchies describe reality (ontic patterns), though functions and entities are not usually considered the same kind of reality. Differentiation among hierarchies can easily be continued beyond these types, but for the present purposes distinguishing epistemic, compositional, and functional hierarchies of levels will suffice.

A central reason for clarifying and elaborating our understanding of hierarchies of levels is to contribute to dialogue between religion and science. Eventually, this aim will require developing insights from hierarchy theory beyond current consensus in the field. As a beginning, however, it is important to learn what we can from what is currently being developed. My strategy for getting started is to focus on interconnections between epistemic and ontic hierarchies, and to illustrate what happens when one does this. Admittedly, the material is at times abstract, but then hierarchy theory is similar to the interdisciplinary nature of religion-science dialogue in that it requires most of us to be out of our depth most of the time. In reading philosophers of science and scientists working on theory construction, I find their work intertwines to a large degree with this area, so no attempt is made to systematically separate various disciplinary strands in the following discussion. My hope is that the continuity of topic justifies any blurring of disciplinary boundaries.

To focus the discussion of interconnections between ontic and epistemic hierarchies, I will make brief excursions into theoretical biology and philosophy of science. In the recent history of science, biology has provided the richest context for development of hierarchy theory. In particular, biological ecology,[4] molecular biology, and evolutionary theory have used levels concepts in systematic theorizing. It comes as no surprise, then, that two of the three selections overviewed in this article focus on biological topics. First, selected issues in evolutionary biology provide an illustration of the breadth of scope possible within hierarchical models. A second point focuses on molecular biology as a

Marvin McDonald received his training from St. John's University, Collegeville (B.A.) and Purdue University (M.S., Ph.D.) in psychology and quantitative methods. His areas of special interest include theory construction, community psychology, and Personal Construct Theory. He worked in the University of Wisconsin system before moving to The King's College to help establish a psychology program.

case where hierarchy considerations arise at a boundary between levels. Finally, a view of epistemology is discussed to raise issues surrounding connections of hierarchical models with social and spiritual reality. Many aspects of the positions presented here are controversial and nothing is without challenge, especially within the disciplines of the authors. Nevertheless, the work considered below may be able to aid attempts to elaborate our understanding of ontic and epistemic levels.

Foundations of Evolutionary Theory[5]

One set of ontic-epistemic interactions among hierarchies arises from acknowledging the reflexivity of an observer generating a theory about an ontic hierarchy in which the observer "fits." For example, a biologist studying evolution can develop a hierarchical model in which humans (including theoretical biologists) fit at an organism level. The broad scope of evolutionary theory requires reflexive theory because the theory addresses realities (e.g., process rates and levels of organization—see below) which are part of the context for theory building by humans. Note that this self-reference involves both descriptive levels of theory construction and the compositional levels of organization. So reflexivity implies interconnections among ontic and epistemic hierarchies. Stanley Salthe explores several issues dealing with self-reference and hierarchy as background for his proposal of a framework for evolutionary biology.[6] To illustrate perspectives offered by hierarchy theory, I will discuss two topics addressed by Salthe: (a) differences in average rate of processes between levels, and (b) the interdependence of research interests and levels of organization.

Differences in the average rates of key processes are often observed in entities at different levels.[7] This pattern has consequences for an observer situated at a given level. Considering processes of growth and decay, for example, the lifespan of organisms is often in a range from one to a few generations, while the "lifespan" or duration of biological populations extends over many generations. More generally, from the perspective of an observer's level, processes at a preceding, micro, or "lower" level (e.g., an atom level preceding a cell level) are "seen" as constants. That is, micro-level processes generate constraints reflecting the cumulation of multiple cycles because the rates of preceding level processes are much faster than processes at a given level of observation. For example, the temperature of objects is not directly perceived by humans as vibratory patterns of atomic structure, but as a molar, semistable characteristic. Interestingly, interactions of an observer's level with subsequent, macro, or "higher" levels are also often perceived as constant constraints, in this case because the process rate is so slow relative to the rates of observation processes. Consider our perceptions of glacial activity; we cannot directly perceive glacial motion.[8]

Since observers are "embedded" in a specific level and average process rates differ between levels, one can see why entities at different levels (e.g., atoms and ecosystems) can be difficult to perceive when compared to observations of entities at the observer's level. For micro-levels, the "thing-ness" of small entities is lost in the fabric of events because micro-processes cumulate to act as constraints at the observer's level. For macro-levels, entity activities are seen as constant patterns of constraint characterizing the environment because the rates of change are slow relative to observation level processes. Since the co-occurrence of multiple processes is a major principle for identification of entities, rate differentials render the identification of entities at other levels more difficult by inhibiting the perception of processes. Using the terms presented above, descriptive levels (for identification of entities and processes) are intertwined with levels of organization (as reflected in the average rates of processes) in a manner which shows up particularly in instances of cross-level observation.[9]

Whatever the source of the change in perspective, a new entity inhabits discussion which cannot be simply set along side of familiar things.

A closer look at how explanatory and compositional levels intertwine here requires an examination of dynamics in hierarchical systems in which an observer is embedded. An illustration may help clarify what Salthe is suggesting. Consider the process of an observer overcoming the difficulties of perceiving some target entity which is at a level other than the observer's: say, an ecosystem. This learning process can be broken down into phases for the sake of discussion (without implying any rigid categories or temporal ordering). At first, the observer does not distinguish a target ecosystem from among the variety of environmental features and the fabric of events shaping the world. In this first phase, the observer and target interact in such a way that the target is not clearly perceived as an

entity. A forest or riverbank is seen as a place, an undifferentiated aspect of the environment. This "observation" process reflects the average rate of processes characterizing both the observer level and the target level. One might well see "seasons" in the forest and adjust actions like tapping the maples for sap only in the spring. But one might not, for example, notice the patterns which distinguish seasons in the forest from the seasons of the prairie or mountain top. They are just different places, not systems which actively shape the weather and climate.

In a second phase, some change in the observation and perception processes results in a new identification of coherence. Perhaps stories across generations about a place, a given forest, start to come together in such a way as to encourage seeing the forest as a "living thing." Or perhaps a field biologist identifies patterns across a number of contemporary ponds which fit historic data for a given pond, suggesting that ponds have "lifespans," that they emerge, "grow, develop, and die." Whatever the source of the change in perspective, a new entity inhabits discussion which cannot be simply set along side of familiar things. A bear and a riverbank are simply not the same kind of things. One develops a new level of explanation—or fits this new entity somewhere in one's already well developed descriptive hierarchy.

A third phase emerges when the modified levels of explanation function as a framework for action in addition to providing a perceptual frame. Perhaps the observer develops a new observation technology to take into account the new understanding of phenomena related to the target. Clearly one can identify rates of certain target processes without necessarily employing a sophisticated epistemic hierarchy as a framework. Knowing that spring is the best time to tap maples for sap does not require a modern ecosystems theory. Nevertheless, coordinating actions across mutiple domains or tracing complex interactions across wide systems often improve with the insights gained from more elaborate models (including hierarchy structures). The helpfulness of ecosystems concepts in tracing the deaths of maples in Quebec to acid rain serves as a case in point.

Finally, a fourth phase involves the impact of changed observer actions on physical reality. If a soil scientist advises a farmer, the resulting agricultural technology, embodying relevant levels of description, may significantly impact the interaction of the farmer with the ecosystems related to the farm. Or a scientist developing observational technology for marine ecosystems based on novel concepts may change the interactions of the observer with the target, an ontic outcome of epistemic processes. Fourth phase activity thus reflects an ontic change in the interlevel interaction between the observer and the target. If farmer-field ecosystem interaction changes as a result of the introduction of new herbicides or fertilizers, the ecosystem may simply adjust to the new relationship or it may change drastically if important stability mechanisms are disrupted. The main point here is that changes in levels of description may lead to ontic changes, perhaps even in levels of organization if an ecosystem transforms radically.[10] Any change might, in turn, bring us back to Phase One if relevant entities are not perceived. Hierarchy models can help understand such processes as part of the dynamics of hierarchical systems.

To summarize the illustration, the transition from first to second phase described above reflects a familiar process to working scientists and "scientific realists." The intertwining of composition levels and description levels involves ontic patterns shaping epistemic patterns through observation. More simply, we "learn something about the world through observing." The later transition from phase three to phase four may be less intuitively familiar, however, in that we find our understanding actually forming reality.[11] An observer's levels of explanation become a framework for action which results in ontic consequences, possibly shaping levels of organization.

I have described this point in some detail because it serves to illustrate reciprocal interactions between epistemic and ontic levels, a point easily passed over in summary. My emphasis is on the necessity of distinguishing between levels of explanation and levels of organization in order to formulate claims like Salthe's. To the degree that Salthe's assertions (or disagreements with him) make use of epistemic-ontic relations among levels, my aim of illustrating the value of the distinction between different kinds of hierarchies is supported.

Changes in levels of description may lead to ontic changes, perhaps even in levels of organization if an ecosystem transforms radically.

Observer-embeddedness in nature implies that the guiding interests of observation interact with the different kinds of entities to generate different levels of organization, each reflecting the same hierarchy of nature.

At this point in the discussion, one might be tempted to simply identify levels of explanation directly with corresponding levels of organization, given their reciprocal interdependence. But a second aspect of Salthe's consideration of observer reflexivity suggests that any such correspondence cannot be simple. Consider his example of a geologist and biologist formulating the levels of organization in nature (especially pp. 168f). One easily finds a correspondence between their hierarchies at the molecular level even though the molecules involved are quite different. When one examines the levels above that, however, the phenomena are not comparable. Icicles and turbulence patterns are composed of molecules, as are organisms, but even though we are studying the "same" level of nature in an important sense, we find they are not the same "level of organization."[12] The problem shows up when one starts to connect geological and biological levels of organization. They should reflect the same ontic levels because nature is unitary, not divided up into separate geological and biological worlds. But if we collapse the hierarchies by saying that icicles and organisms are on the same level, we run into problems. Since both hierarchies are compositional, we say that biological populations are made of organisms. If icicles are at the same level as organisms in the same compositional hierarchy, however, then icicles are also components of biological populations.[13] For Salthe, this kind of confusion is an error of logical type, an indication of absurdity in the same way that asking about the mass of one's emotions is absurd.

So what are we left with? Biologists and geologists have a few lower levels which correspond, but we cannot collapse levels of organization studied in the two disciplines into a single, linearly ordered hierarchy of nature, because we generate logical absurdities by doing so. This does not imply, in Salthe's view, that there are multiple natural worlds which cannot be combined. He asserts clearly his assumption of a unitary hierarchy of nature behind all the studies of various sciences. For Salthe, what this inability to combine different formulations of the same ontic hierarchy means is that "[l]evels of organization can be seen to be the consequence of the observer's being embedded in "the hierarchy of nature (p. 167). That is, the compositional hierarchies of biologists and geologists, each reflecting the single hierarchy of nature from a disciplinary perspective, do not coincide completely because different kinds of entities (rocks and organisms) exist in nature and researchers' interests address this complexity. Observer-embeddedness in nature implies that the guiding interests of observation interact with the different kinds of entities to generate different levels of organization, each reflecting the same hierarchy of nature. In short, the patterns of reality (levels of organization) not only reflect the unity of nature's hierarchy but *also* the characteristics of observers (researcher interests, in this instance) interacting with the larger ontic context.

Nothing in this discussion of genetic codes indicates a total uniqueness of the questions about function and description.

To summarize, Salthe argues that observer-embeddedness in nature's hierarchy yields an interdependence between epistemic and ontic hierarchies for cross-level observation. Difficulties arise in the identification of entities at lower and higher levels partly because of average rate differences in key processes at each level. Likewise, one encounters logical difficulties in combining compositional hierarchies from different sciences even though they reflect the same hierarchy of creation. Independent of one's final evaluation of Salthe's proposals as evolutionary biology, his work on hierarchy theory addresses complications following the acknowledgment of an observer's place in a hierarchy. His views illustrate the value of distinguishing compositional, functional, and epistemic levels. Such distinctions become necessary for Salthe when formulating foundations for evolutionary theory because the scope of the theory is all life on earth, yielding self-reference. Evidently, the complexity which attends reflexivity can be managed to some degree with the tools of hierarchy theory.

Molecular Biology and Genetic Coding

Another important context for exploring relations between epistemic and ontic hierarchies has received

considerable attention: molecular biology and study of the "genetic code" (e.g., Pattee, 1971, 1973, 1979). The amount of attention paid to this area generates the advantage of widespread familiarity with major results, but the attention does not necessarily entail an appreciation of foundational issues in the field. Along with other scholars, Pattee (1979) has been attempting to stimulate the molecular biology community to greater concern for fundamental elements of their work. Specifically, the empirical successes of molecular biology have, according to Pattee, failed to stimulate a resolution of certain conceptual debates in the literature which were present prior to elucidation of mechanisms. Instead, interest seems to have waned and attention is now focused on the "business as usual" of building on key discoveries while some conceptual complexities lie unexplored. For this paper, the issue of interest is that Pattee employs hierarchical models to address the conceptual problems to which he points.

Pattee suggests that we first of all need to generalize the notions of language and description in order to examine interconnections between ontic levels and descriptive levels in molecular biology. After discussing the relation between the chemistry of DNA and life, he states in summary:

> Life is distinguished from inanimate matter by the co-ordination of its constraints. The fundamental function of this co-ordination is to allow alternative descriptions to be translated into alternative actions. The basic example of this function is the co-ordinated set of macromolecules which executes the genetic coding. It is useful to think of such co-ordinated constraints as generalized language structures that classify the detailed dynamical processes at one level of organization according to their importance for function at a higher level. In this sense, co-ordinated constraints, language structures, alternative descriptions and hierarchical controls are inseparably related concepts. (1971, p. 171)

Since the sequences of bases are physico-chemically "indeterminate," DNA strands and associated macromolecules bear information ("alternative descriptions"), thus permitting genetic patterns to serve as constraints (designs) for cellular functioning.[14] The distinction here between physico-chemical processes and information is central to his claim. As Pattee states, "the relation between the structural [in my terms, compositional] and descriptive levels is the central problem that must be solved to have a theory of hierarchical control" (1973, p. 136, emphasis deleted).

Summarizing Pattee's views in the vocabulary employed here, the topic of interest is the interface between molecular and cellular levels of a biological composition hierarchy. Conceptualizing genetic codes and information as "generalized language structures" or descriptions ties in epistemic hierarchies at this same boundary between levels. That is, he presents biological information as one level of an epistemic (informational) hierarchy.[15] In my elaboration of Pattee's discussion, hereditary mechanisms are examples of compositional and epistemic hierarchies entwining at an interlevel interface. So his critique of molecular biology clearly distinguishes ontic and informational levels while confronting basic conceptual issues. Without presenting a full analysis of genetic codes, one can see that Pattee's foundational questions in molecular biology are more easily formulated once one has distinguished ontic and epistemic levels. Clarifying, extending, or critiquing Pattee's analysis requires even further elaboration of levels notions.

The purpose of hierarchical models is to disclose some of the intricate pattern of epistemic-ontic interaction in a "participative ontology."

One can extract several lessons from Pattee's discussion of molecular genetics.[16] First, the empirical grounding of the area helps focus important questions, but data alone do not resolve questions about hierarchical interrelations. Pattee's concern about scientists focusing on mechanisms to the exclusion of conceptual fundamentals makes this point. Although empirical and philosophical questions are intimately intertwined in this context, it does not seem that we have a case of "naturalization" of fundamental issues in genetics, popularized statements to the contrary notwithstanding.[17] Thus, simply going back to the lab will not make these questions go away. Second, I suggest that formulations of these issues via hierarchical models is more fruitful than attempts to avoid levels concepts. By restricting attention to "information," for example, instead of dealing with Pattee's notion of "generalized language structure" or informational levels, one might claim that hierarchy is irrelevant to genetic codes or biological information. However, such a move merely buries the same issues in the definition of "information." We can still ask about the relationships between genetic and linguistic information, for example, by suggesting that sorting out that relationship is important for adequate definitions. As a final lesson, I suggest that nothing in this discussion of genetic codes indicates a total uniqueness of the questions about function and description.

One might anticipate that elaborations of hierarchical models in molecular genetics could be generalized in some form to apply to other domains of inquiry. For example, there may be fruitful parallels between the interlevel interface of genetic codes and traditional condundrums surrounding mind-brain or individual-society relations.[18] In short, Pattee's work illustrates contributions of hierarchy models at a specific interlevel interface.

Philosophy of Science & Epistemology

Salthe and Pattee's work on hierarchy theory addresses epistemology as necessary for advancing our understanding of levels. Arbib and Hesse (1986), on the other hand, find levels notions necessary for their project of developing an epistemology. Their contributions to the present exploration of ontic-epistemic relations in hierarchy theory center on questions about the ontic status of epistemic hierarchies. Also, they deal explicitly with knowledge of spiritual domains. So a brief excursion into their work can illustrate another way hierarchy theory might benefit dialogue between scientists and religionists.

Their project extends schema theory from roots in cognitive science and Piaget to the development of an epistemology which can address both scientific and religious knowledge.[19] Moreover, in their elaboration of schema theory Arbib and Hesse maintain a consistent awareness of hierarchical patterns (although they do not present a systematic hierarchy theory).

> We need a multilevel description of the human being. Schema theory, as it develops, is to provide an ever more appropriate mental vocabulary, while neural processes provide the mechanism for schema storage and dynamics. This is both more and less than reductionism. In some sense, everything in human behavior or society is mediated by neural firing and other physicochemical processes. And yet, there is no useful sense in which our analysis of human beings can be conducted exclusively at that level. We have many different levels of description, including neural, mental, and social, and we find ways of illuminating any particular level of discourse by placing it within a higher level context and by seeking lower level mechanisms. In this way, we see how to think coherently of the neural and the social levels as placing constraints on the schema level of analysis without claiming that any level is the one true level at which we should conduct all discussion. (pp. 14f)

Although their phrasing in this passage might lend itself to an interpretation restricted to epistemic levels, Arbib and Hesse are clear that patterns of reality are also at stake: "we in fact advocate a permissiveness with respect to ontology: there are all manner of levels of reality."[20]

Within the background of these general comments, Arbib and Hesse address the ontic status of epistemic hierarchies: In what sense is language or scientific theory real? They start by accepting spatio-temporal reality as unproblematic in that members of our culture readily acknowledge that the physical world is "real." On the other hand, the reality status of values, rational truths, symbol systems, ideologies, and God is questioned (pp. 2–5; cf., pp. 58–62, 84). (Interestingly in this context, questions regarding the ontic status of logic are explicitly avoided, pp. 59f.) Nevertheless, in their view knowledge systems are real at least in the sense that our theories, for example, impact physical reality through human action. For these authors, the clearest case of this process is technology: scientific knowledge clearly impacts the physical world through application in technology, and knowledge has to be real in some sense to influence spatio-temporal reality.[21] In short, the interaction of epistemic levels with physical reality (via technology) demonstrates something of the ontic status of epistemic phenomena (e.g., scientific theory).

For the present discussion, my main interest is their broader principles for studying the ways in which knowledge systems are "real." First, they assert that hierarchical patterns of description are necessary to elaborate an epistemology adequate to deal with both scientific and religious knowledge. Then, while assuming unspecified hierarchical patterns of reality, they also note that (a) language, scientific knowledge, and other knowledge systems (which have hierarchic form themselves) are real in a different manner than is physical reality, but that (b) knowledge systems can change physical reality (with technology being the main example of how this happens). Thus, a major principle in Arbib and Hesse's approach is that when epistemic systems impact physical reality, the impact gives us important clues about the ontic status (type of reality) of the epistemic systems.[22]

When examining the reality of spiritual knowledge systems, we can look, in various senses, to the consequences of spiritual knowledge for spiritual (and physical and social and cognitive) reality.

Arbib and Hesse's argument presents a clear analogy to Pattee's claim that the functional consequences of genetic information in the physical system of a cell reflect the impact of a "generalized language structure." In both cases, information (in genes or theory) strongly influences physical reality (via organism functioning or human technology) through known mechanisms (cellular decoding systems and technology). Similarly, Salthe's views on observer reflexivity portray observation processes as inextricably intertwined with levels of organization, observer actions, and observer interests. These facets of observer epistemology actually shape reality. In this sense, descriptive levels are not simply shortcomings of human capacity which limit the extent of human knowledge.[23] Despite widely diverse foci of discussion, these authors all suggest a "participative ontology" of some kind where epistemic issues are intimately intertwined with ontic processes. In this kind of "constructivist" view, reality independent of an observer is, in principle, not identical to reality including observers.[24] The purpose of hierarchical models in this context is to disclose some of the intricate patterns of epistemic-ontic interaction in a "participative ontology." Once again, whether or not we want to accept a constructivist viewpoint, I want to point out the value of levels notions in explicating what the concepts mean. In fact, it seems to me that hierarchical models are necessary either to support or to refute constructivist theories like those examined here.

One aspect of Arbib and Hesse's work covers topics not addressed by the authors focusing on biological topics: the interconnections of social and spiritual realities with a hierarchy of nature. The full range of biological, mental, and social levels are considered minimal context for an epistemic framework adequate for addressing spiritual reality. How, then, can we apply their principle for the "reality" of epistemic systems noted above? When examining the reality of spiritual knowledge systems, we can look, in various senses, to the consequences of spiritual knowledge for spiritual (and physical and social and cognitive) reality.[22] Consider also how the broad scope of their model raises questions about reflexive features of Arbib and Hesse's program (paralleling Salthe's model of observation). Once one addresses spiritual activity in addition to cognitive and social activity, the question comes up regarding the relations of spiritual knowledge to the scholarly enterprise. Unless one posits a complete autonomy of scholarship from spirituality, another loop of self-reference arises when considering an epistemology of spiritual reality.[25] In light of these points and those in previous paragraphs, it seems clear to me that Arbib and Hesse's levels conceptualizations will continue to distinguish and interrelate epistemic and ontic hierarchies (as well as challenging us with important issues). Once again, the distinctions highlighted here can prove beneficial for topics related to science-religion dialogue.

In our age of technological science, we are well accustomed to a variety of tools which extend the ranges of our senses....there is no debate about the "reality" of invisible wavelengths of electromagnetic radiation.

In short, Arbib and Hesse do not present a systematic hierarchy theory, but their theory of knowledge does depend explicitly on levels ideas to conceptually ground their approach. This epistemology project stimulates important questions by going beyond scientific knowledge to include other forms of social and religious knowledge. Overall, careful examination of Arbib and Hesse's work hints at an intricate interweaving of hierarchy notions with the complexities of an epistemology of spiritual and scientific realities.

Summary

I started this paper by pointing out that "levels of explanation" and related ideas play important roles in many discussions of relationships between science and religion. That importance alone justifies attempts to work out more detailed understanding of these notions. By reviewing selections from literature on hierarchy theory and epistemology, I attempted to show that there are available resources available for clarifying levels concepts. One basic contribution was offered in the distinction between epistemic, compositional, and functional levels. Complexities associated with observer reflexivity, interlevel boundaries, and spiritual knowledge were clarified by distinguishing these different kinds of hierarchies. Rather than providing complete resolutions to the complexities encountered, this paper invites scholars interested in science-religion dialogue to continue the elaboration of available hierarchical models. I believe the work required will continue to be rewarded, and that available literature demonstrates the promise of levels notions for further grounding of religion and science dialogue.

The literature on hierarchy theory is certainly not the only resource we can draw upon in expanding our understanding of levels concepts. Additional resources in philosophy and systems theory, for example, are also well worth exploring. This paper does not attempt to review all valuable literature. There is, however, at least one major point which has not received adequate attention. I claim that elaborating our levels concepts will contribute to the dialogue between science and religion. With the introduction provided in this paper, I can turn more directly to the task of further illustrating these contributions in "Levels of Explanation: Part II." ✤

ACKNOWLEDGEMENTS

This paper is a revision of a portion of a paper presented at the 1988 ASA annual convention in Malibu, California. I want to acknowledge the contributions of colleagues to this paper. Vaden House provided critique and conversation which significantly strengthened both my thinking and my writing. I can no longer distinguish at this point between lessons learned in conversation with him from learning gained elsewhere. For repeated encouragement and material support, I thank Harry Cook and also Hank Bestman. Comments by several people at the 1988 conference and by several reviewers were stimulating as well as encouraging.

NOTES

[1]The designation "hierarchy theory" has not acheived consensual acceptance, but it is a convenient designation for a multidisciplinary concerns tied together by questions involving hierarchies of levels (e.g., Pattee, 1973). For definitional issues, see note 2.

There are many other resources besides levels ideas to draw upon in sorting out complex systems. For a popularized overview of various facets of complexity in science, see Davies, 1988.

[2]See, for example, Ayala, 1974; Barbour, 1966; Bunge, 1956; Grene, 1967; Pattee, 1973. No complete definition of levels or hierarchy is attempted because there is no widely accepted formulation to date despite substantive work in the area (e.g., Bunge, 1977). Generally, definitions of levels involve specifying units of analysis which characterize each level and definitions of hierarchies require an ordering among levels. For the present discussion, the common practice of accepting implicit definitions by use of example is adopted rather than the common alternative of stating precise but inadequate working definitions. Substantiating selected definitions is a worthwhile project which is beyond the scope of this paper.

The epistemic-ontic distinction highlighted here does not imply that one can somehow separate or isolate reality from knowing. Rather, one inherently refers to inseparable aspects of complex processes. Likewise, inseparability does not imply that the distinction is meaningless.

[3]See, for example, MacKay, 1982. I am not claiming here that MacKay distinguishes between ontic and epistemic levels. The nature of functions in comparison to entities is the question at issue, and some thinkers want to be able to assert the reality of functions as different from the reality of entities (e.g., Barbour, 1966; Hart, 1984). Making the distinction does not beg the question, but it does aid in formulating both the question and the associated debate.

[4]See, for example, Allen & Starr, 1982; O'Neill, DeAngelis, Waide, & Allen, 1986; and Webster, 1979.

[5]For this paper, I address evolutionary theory *per se* and do not consider evolutionism; i.e., issues following from such theory used as a basis for a myth of origins. Levels notions do not arbitrate directly between viewpoints on creation and evolution. Salthe's work is evolutionary while van der Meer (1989) is developing a hierarchical creationist model. It seems to me that levels notions are fundamental enough to fit with a variety of world views (though not all).

[6]Salthe, 1985. Although Salthe's approach is explicitly non-reductionist in some senses, it is not merely biologists who prefer "reductionist" approaches who might disagree with Salthe's proposals (cf., Williams, 1985). Marjorie Grene (1972), for example, argues for hierarchical models but takes issue with the general form of theoretical synthesis of evolution rooted in the hierarchies of a systems theory. My point in examining Salthe's work is to explore his extension of hierarchy theory to the interactions of epistemic and ontic hierarchies. Debating specific positions on reduction-emergence, evolutionary biology, or the nature of genetic information are related to these aims, but these debates also beyond the scope of this paper.

It is also helpful to point out that Salthe's attempts to deal with reflexivity do not imply a disdain for non-reflexive theorizing (see especially chap. 6). As I read him, he sees his effort as a generalization attempt which addresses a complexity that was ignored for the sake of (necessary) simplification in the early stages of theory construction. In that sense, perhaps, the development of reflexive evolutionary theory can be seen as analogous to mechanics which takes friction into account. For more general background on reflexivity issues, see Bartlett & Suber (1987).

[7]It is helpful to note that rate differentials do not need to be exhaustive for his point to carry weight, they simply need to dominate the major processes of respective levels. See Allen & Starr (1982) for a discussion of similar points in biological ecology theory. In discussing Salthe's views, the distinction between entities and processes need not be strong because he sees the two languages as interchangeable to a large degree.

Discussions of process rates are pursued by Salthe to address the more central notion of transitivity of effects across multiple levels in a hierarchy. His broader concerns, although of interest, are not addressed here due to space limitations.

[8]I emphasize direct perception to make the point about rate differentials, not to deny that technological developments expand the range of human observation. In fact, the technology of observation is of interest in the present context and is mentioned below.

[9]It bears repeating that Salthe's point emphasizes the average rate differential between levels. Thus instances of direct interaction between entities of widely divergent levels and process rates are not counter-instances. The sun interacts directly with many organisms in photosynthesis and sunburn, but we still perceive our star as a constant part of the

environment and its light as a constant flux of energy instead of as a waveform or a stream of particles (despite the theoretical perspectives gained by twentieth-century physics).

Also, there is nothing especially significant solely in the fact that rate differentials render the perception of entities and processes at different levels more difficult. In our age of technological science, we are well accustomed to a variety of tools which extend the ranges of our senses. A simple case is illustrated by the fact that, at this stage of scientific understanding, there is no debate about the "reality" of invisible wavelengths of electromagnetic radiation. Salthe's emphasis on the interaction of epistemic and ontic levels in rate differentials is better illustrated by debates about theoretical notions which are sometimes interpreted instrumentally and sometimes realistically. For example, the kinds of reality represented by species or ecosystems is not currently a matter of consensus among scholars. In debates about whether certain scientific constructs are about "real" objects or processes, reflexive interactions of human observers and other levels involve epistemic hierarchies and compositional hierarchies in mutual influence. In debates of this kind, definitional and methodological issues highlight an interdependence between epistemic and ontic hierarchies. Thus, as I read Salthe, his views amount to claiming that when we debate basic definitions, levels of explanation and levels of organization are equally basic in science.

This point can be illustrated by two questions, the first emphasizing epistemology and the second ontology, but each one depending equally on the other. (1) What perspectives are appropriate to study X (since Xs are this kind of thing)? (2) What kind of thing is X really, given our data and observations of it and related phenomena? In other words, once we are clear on the kind of reality a certain phenomenon reflects, we know best how to study it, and when we are clear on the ways to study a phenomenon, we can best determine what kind of reality the phenomenon reflects. This interdependence is particularly clear when methodological and definitional debates surface.

Just as self-proclaimed reductionists or materialists employ hierarchy theory as effectively as do "emergentists"...so the use of hierarchical models will probably not, in and of itself, prejudge conclusions about other, related questions.

[10]Salthe discusses the emergence of new levels between old ones and higher levels above old ones. Pursuing those concerns would take this discussion too far afield, however interesting and important it is.

[11]See Arbib and Hesse, 1986, on technology as one mechanism for knowledge generating ontic consequences. Their views on this point are briefly noted below.

Most coupling processes do not reflect solely the differential rates of processes, though in Salthe's work rates are emphasized. Coupling and decoupling processes involve many facets. For the present discussion process rates serve well as a feature of activity in our world which concretizes some aspects of interlevel interactions.

[12]In Salthe's terms, these discussions are about a "rank" of nature as a class, and about the relations between levels of generality, functional levels, and cognitive processes like labeling and attention. I have simplified the discussion here because of space constraints. For more detail, see chapter 6 of Salthe in particular.

[13]This specific example can be addressed by changing the structure of hierarchies from simple linear orderings of levels to partial orderings of levels, yielding a "branched" hierarchy with a common trunk and geological and biological "forks" (cf., Salthe chaps. 3 & 6). This form of complexity fits with Salthe's general thesis, but it does not address other cases where there are no levels in common between two related hierarchies. The more complicated examples were not used in this discussion due to space limitations. For more detail on these issues in Salthe, see his discussions of relationships between geneological and ecological hierarchies, especially his chapter 7.

[14]Even more broadly, the set of related notions necessary for coherent and comprehensive study of genetic codes includes information, function, meaning, and structure (cf. Grene, 1967; MacKay, 1969; Pattee, 1979).

[15]In his 1979 paper, Pattee elaborates his views on relations between biological information, structure, and language, specifically arguing for complementary relations reflecting (generalized) measurement processes. The various complementarities are not synthesized into an overarching hierarchy as far as I can tell. He does, however, emphasize the epistemological nature of information-structure complementarity and he does distinguish, in passing, levels of complexity of information (e.g., pp. 218f). While his work in these and other papers provides a large amount of material to help ground and develop hierarchy models, I avoid greater detail here to conserve space. For discussion of the related complex of issues, see Bennett's comment on Pattee's 1979 paper, Pattee, 1978, and MacKay, 1969. Consideration of the relation between information and biological function is a further direction for elaborating here.

[16]Of course, many important questions are left unmentioned here. Many readers of this journal are probably aware, for example, that sources of information in genetic systems were explored in a recent conference sponsored by ASA's Committee for Integrity in Science Education (see Walter Hearn's description in the August/September 1988 issue of the *Newsletter of the ASA/CSCA*, 30(4), pp. 1–2). Since the papers from this conference are not being circulated pending publication, we will have to wait to benefit from the struggles there for additional detail on relationships between information, function, and biochemistry. For the present discussion, however, it is worth noting that disagreements regarding "physical discontinuity" or "a seamless cause-and-effect continuum" (see Walt Hearn's description) can most likely be argued on both sides with the support of hierarchy theory. Just as self-proclaimed reductionists or materialists employ hierarchy theory as effectively as do "emergentists" (e.g., Bunge, 1977; Campbell, 1974; Glenn, 1988; Wimsatt, 1986), so the use of hierarchical models will probably not, in and of itself, prejudge conclusions about other related questions.

Instead, my expectation is that the continuity-discontinuity disagreement may in fact be made more constructive through clearer formulation of relevant hierarchies. My point about the fertility of hierarchy theory and the importance of informational hierarchies does not presume a resolution to con-

tinuity-discontinuity debates, though implications of my stance may the raise stakes of the discussion through a transformation of the questions. Better understanding of sources of information content in the genetic code cannot but benefit the discussion (by displacing controversy about speculative models, for example), but it will probably not resolve longstanding controversies.

[17]Naturalizing philosophical questions takes place when intellectual debate over questions is replaced by, or made moot by, empirical findings. From a naive point of view, an assumption of exhaustive naturalization of philosophy sometimes seems to be made by those who see philosophy as irrelevant to science.

[18]See Pattee, 1978; cf. Davies, 1988. The central strategy of hierarchy models is twofold: (a) to distinguish phenomena at different levels, and (b) to synthesize a set of such distinctions into a series of levels, a hierarchy. Both of these principles serve the central purpose of levels models: to adequately recognize and understand complexity. So the interest of Pattee and others in relating physical, biological, and social phenomena in hierarchy models clearly reflects their understanding of the cosmos. It is not merely an afterthought of grandiose theorising.

[19]Arbib and Hesse define schema as a " 'unit of representation' of a person's world," including both synchronic and diachronic patterns of change (pp. 13f; cf. p. 61).

[20]Arbib & Hesse, 1986, p. 65. The details of relations between ontic levels and levels of description are purposely not specified in their presentation, however. Arbib & Hesse do describe their stance in general terms as a constructivism or perspectivism, distinguishing their view from "strong versions" of scientific realism (cf. pp. 10 & 182, *passim*). They also indicate that they consider their epistemology is compatible with many, but not all, ontologies. For the sake of clarity, these authors also note that the emphasis on levels originated with Hesse.

[21]The impact of scientific theory on our world via technology is only one form of epistemic influence. To prevent confusion, one would eventually need to distinguish this kind of influence (knowledge of physical reality impacting physical reality through human action) from, for example, self-fulfilling prophecy (social knowledge impacting on social reality; see, e.g., Watzlawick, 1984) or the effects of prayer (human action rooted in spiritual knowledge?) mediated through God's actions (spiritual reality?; see also note 22).

[22]A central point to sort out while exploring the ontic consequences of epistemic processes is the relationships among various levels and domains. For example, consider the "prayer-test controversy" which revolved around whether the prayers of Christians ought to result in empirically demonstrable consequences in physical domains (see Myers, 1978). Before one could test the efficacy of prayer, a well-developed theory (theology) would be required to predict what kinds of effects would be anticipated in various domains and at various levels: physical, biological, psychosocial, spiritual, etc .Likewise, an auxiliary theory of measurement would be necessary to indicate what observation processes would be required. Perhaps the prime question for scientists is whether any scientific approach can mesh with any subset of these questions. In effect, asking such questions is a natural consequence of a unified epistemology able to bridge spiritual and physical reality. Although we may not have, at present, fully formulated responses to these questions, my classroom experience attests to the clear relevance of these issues to the lives of many students (not to mention everybody else)! In my mind, the fruitfulness of Arbib and Hesse's goal is clear. Thus the tools we have available to move toward that goal, such as hierarchy theory, are of value.

[23]One strategy for accounting for empirical levels patterns is an epistemic pluralism (multiple levels of concepts) combined with a unileveled reality which, in a strong form of the thesis, sees levels as distortion due to the limitations of human cognition. This kind of approach can support either an instrumentalism which avoids ontic questions or perhaps a complex view of human fallibility. Although a realist approach certainly would need to develop a theory of error in human knowledge of hierarchies, realists would also require some form of validity in such knowledge. All I want to assert at this point is that I find it highly implausible to attribute all forms of hierarchy in the world to cognitive distortion.

I also assume in this discussion that the ontic impacts of mistaken understanding and valid understanding are distinguishable in some sense. From this point arises my reservations about instrumentalism.

[24]I make no attempt here to distinguish among various schools of thought using the label, nor to differentiate between "constructionism" and "constructivism." Arbib and Hesse use the term for their views and important parallels drawn with the other authors discussed here reflect the same general stance in my view. For overviews of a few forms of constructionism, see Watzlawick, 1984.

[25]I am the first to admit complexities associated with the relations between scholarship and faith. I am not trying to be glib, only to point out important concerns. It does not seem reasonable to anticipate easy answers for or against patterns of spiritual self-reference in scholarship. Arbib and Hesse's position stimulates such discussions as does the work of many other authors (e.g., Wolterstorff, 1984; MacKay, 1979; Mavrodes, 1977; Heie and Wolfe, 1987). My central point at this time is simply that elaboration of our levels notions is important to do justice to this issue, as well as others.

In the examples examined in this paper, obvious connections exist between evolution, molecular biology, and our understandings of creation. Rational and spiritual self-reference emerge behind every corner in such discussions. What Arbib and Hesse's epistemology offers is a framework within which to explore interrelations among specific theories of science and theology. Although the general case may permit the luxury of avoiding some details of levels structures, my clear sense is that elaborate hierarchy models are required for adequately addressing specific questions.

REFERENCES

Allen, T.F.H. & Starr, T.B. (1982). *Hierarchy: Perspectives for Ecological Complexity*. Chicago: University of Chicago Press.

Arbib, M.A. & Hesse, M.B. (1986). *The Construction of Reality*. Cambridge: Cambridge University Press.

Ayala, F.J. (1974). Introduction to F.J. Ayala & T. Dobzhansky (eds.), *Studies in the Philosophy of Biology: Reduction and Related Problems*. Berkeley, CA: University of California Press.

Barbour, I.G. (1966/1971). *Issues in Science and Religion*. New

York: Harper & Row. (originally published in 1966 by Prentice-Hall)

Bartlett, S.J. & Suber, P. (eds.) (1987). *Self-reference: Reflections on Reflexivity*. Dordrecht, Holland: Martinus Nijhoff.

Beckner, M. (1974). Reduction, hierarchies, and organicism. In F.J. Ayala & T. Dobzhansky (eds.), *Studies in the Philosophy of Biology: Reduction and Related Problems*. Berkeley, CA: University of California Press.

Bube, R.H. (1971). *The Human Quest: A New Look at Science and the Christian Faith*. Waco, TX: Word.

Bunge, M. (1956). Do the levels of science reflect the levels of being? In M. Bunge, *Metascientific Queries*. Springfield, IL: Charles C. Thomas.

Bunge, M. (1977). Levels and reduction. *American Journal of Physiology, 233*(3), R75–R82.

Campbell, D.T. (1974). 'Downward causation' in hierarchically organised biological systems. In F.J. Ayala & T. Dobzhansky (eds.), *Studies in the Philosophy of Biology: Reduction and Related Problems*. Berkeley, CA: University of California Press.

Capra, F. (1982). *The Turning Point: Science, Society, and the Rising of Culture*. New York: Simon & Schuster.

Cramer, J.A. (1985). Science, scientism and Christianity: The ideas of D. M. MacKay. *Journal of the American Scientific Affiliation, 37*(3), 142–148.

Davies, P.C.W. (1988). *The Cosmic Blueprint: New Discoveries in Nature's Creative Abilities To Order the Universe*. New York: Simon & Schuster.

Glenn, S.S. (1988). Contingencies and Metacontingencies: Toward a synthesis of behavior analysis and cultural materialism. *The Behaviour Analyst, 11*, 161–180.

Grene, M. (1967/1974). Biology and the problem of levels of reality. In M. Grene, *The Understanding of Nature: Essays in the Philosophy of Biology* (vol. 23 of the Boston Studies in the Philosophy of Science; pp. 35–52). Dordrecht, Holland: D. Reidel. (reprinted from *The New Scholasticism, 41*, 94–123).

Grene, M. (1972/1974). Aristotle and modern biology. In M. Grene, *The Understanding of Nature: Essays in the Philosophy of Biology*.

Haas, J.W., Jr. (1983). Complementarity and Christian thought—An assessment: 2. Logical complementarity. *Journal of the American Scientific Affiliation, 35*, 203–209.

Hart, H. (1984). *Understanding Our World: An Integral Ontology*. Lanham, MD: University Press of America.

Heie, H. & Wolfe, D.L. (eds.) (1987). *The Reality of Christian Learning: Strategies for Faith-Discipline Integration*. Grand Rapids, MI: Eerdmans.

Leake, C.D. (1969). Historical aspects of the concept of organization levels of living material. In L.L. Whyte, A.G. Wilson, & D. Wilson (eds.), *Hierarchical Structures*. New York: American Elsevier.

MacKay, D.M. (1969). *Information, Mechanism and Meaning*. Cambridge, MA: M.I.T. Press.

MacKay, D.M. (1979). *Human Science and Human Dignity*. Downers Grove, IL: InterVarsity Press.

MacKay, D.M. (1982). Ourselves and our brains: Duality without dualism. *Psychoneuroendocrinology, 7*, 285–294.

Mavrodes, G.I. (1977). On Christian scholarship (letter). *The Reformed Journal, 27*(July), 4–5.

Myers, D.G. (1978). *The Human Puzzle: Psychological Research & Christian Belief*. New York: Harper & Row.

O'Neill, R.V., DeAngelis, D.L., Waide, J.B., & Allen, T.F.H. (1986). *A Hierarchical Concept of Ecosystems*. Princeton, NJ: Princeton University Press.

Orlebeke, C.J. (1977). Donald MacKay's philosophy of science. *Christian Scholar's Review, 7*, 51–63.

Pattee, H.H. (1971/1976). Physical theories of biological coordination. In M. Grene & E. Mendelsohn (eds.), *Topics in the Philosophy of Biology* (vol. 27 of the Boston Studies in the Philosophy of Science, pp. 153–173). Dordrecht, Holland: D. Reidel. (reprinted from *Quarterly Review of Biophysics, 4*, 2–3).

Pattee, H.H. (1973). Postscript: Unsolved problems and potential applications of hierarchy theory. In H.H. Pattee (ed.), *Hierarchy Theory: The Challenge of Complex Systems*. New York: George Braziller.

Pattee, H.H. (1978). The complementarity principle in biological & social structures. *Journal of Social & Biological Structures, 1*, 191-200.

Pattee, H.H. (1979). The complementarity principle and the origin of macromolecular information. *BioSystems, 11*, 217–226.

Peacocke, A. (1986). *God and the New Biology*. San Francisco: Harper & Row.

Polkinghorne, J. (1986). *One World: The Interaction of Science and Theology*. Princeton, NJ: Princeton University Press.

Salthe, S.N. (1985). *Evolving Hierarchical Systems: Their Structure and Representation*. New York: Columbia University Press.

Van der Meer, J. (1989). Hierarchy: Towards a framework for the coherence of faith and science. *Pro Rege, 17*(3/4), 19–33.

Van Leeuwen, M. Stewart (1983). Reflexivity in North American psychology: Historical reflections on one aspect of a changing paradigm. *Journal of the American Scientific Affiliation, 35*, 162–167.

Watzlawick, P. (ed.) (1984). *The Invented Reality*. New York: Norton.

Webster, J.R. (1979). Hierarchical organization of ecosystems. In E. Halfon (ed.), *Theoretical Systems Ecology: Advances and Case Studies*. New York: Academic Press.

Williams, G.C. (1985). A defense of reductionism in evolutionary biology. *Oxford Surveys in Evolutionary Biology, 2*, 1–27.

Wimsatt, W. (1986). Forms of aggregativity. In A. Donagan, A. N. Perovich, Jr., & M.V. Wedin (eds.), *Human Nature and Natural Knowledge: Essays Presented to Marjorie Grene on the Occasion of Her Seventy-fifth Birthday* (vol. 89 of the Boston Studies in the Philosophy of Science; pp. 259–291). Dordrect, Holland: D. Reidel.

Wolterstorff, N. (1984). *Reason Within the Bounds of Religion* (2nd ed.). Grand Rapids, MI: Eerdmans.

ERRATA:

Vol. 41, No. 3, Sept. 1989 *Perspectives*, "Origins & Destiny—Reviews and Responses," "A Review by Clarence Menninga."

Page 168, paragraph 6 read (in part): " ... claiming that spontaneous processes may result in a decrease in the entropy of local systems. If evolutionary development ... " This should have read: " ... claiming that spontaneous evolutionary development of living organisms is impossible; he fails to recognize that spontaneous processes may result in a decrease in the entropy of local systems. If evolutionary development ... "

Our apologies to the author for any grievance this printing error may have caused.

Obtaining Approval for a Seminar on Science and Christianity in a Secular University: A Case Study

RICHARD H. BUBE

Department of Materials Science & Engineering
Stanford University
Stanford, CA 94305

This paper presents a factual case history of what happened at a major university when a new committee became responsible for approving undergraduate seminars. For twenty years, a seminar entitled "Issues in Science and Religion" had been given with general approval and encouragement from the university office responsible. When the administrative responsibility changed, however, the seminar was refused permission in Spring 1988. This case history, presented here without editorializing, describes the events and interactions of that year. It will perhaps give some insight as to the nature of the education process at major secular universities today.

Background

For almost 20 years starting in 1967, I had taught an Undergraduate Seminar on "Issues in Science and Religion," without remuneration, under the auspices of the Undergraduate Special Seminar office. I joined the faculty at Stanford in 1962, have been a Professor of Materials Science and Electrical Engineering since 1964, and served as Chairman of the Department of Materials Science and Engineering from 1975 to 1986.

I think it is not too self-serving to set the record straight by claiming that I had good qualifications to lead such a seminar. I am an internationally known authority in solid state electronics, particularly in photoelectronic properties of materials and devices, have written four books in this field, and have published over 200 research papers. I am also an internationally recognized authority on the interaction between science and Christianity, have written four books in this field as well, and have published over 100 papers. I have spoken at over 60 college and university campuses on science and Christianity since 1962 in this country and abroad, and in this connection have frequently been invited to serve as a Staley Distinguished Christian Scholar Lecturer.

The Undergraduate Seminar had been consistently popular through the years. Each year between 15 and 25 students, usually with some personal involvement in Christianity, chose this seminar and then passed on their enthusiasm to the next generation of Stanford students. The seminar was regularly monitored by representatives of the Undergraduate Seminar Program, and uniformly received their approval. The seminar was an elective, open to students who have the freedom to choose for themselves what seminar they will take, and is not imposed upon any student as a requirement but does offer academic credit. The seminar maintained rigorous academic standards, with varied reading assignments, two written papers in which students were encouraged to carry out a personal integration of science and religion from their own perspective, and assignments for students themselves to lead class discussions.

Because of sabbatical leave and other commitments, the seminar was not taught in 1986 or 1987. By the time that Spring 1988 arrived, the administration of the seminar had passed from the hands of the former Undergraduate Special Seminar committee into the hands of a new Committee (hereafter referred to simply as "the Committee") with new individuals involved. Before Spring quarter 1988 started, the seminar had been canceled.

This paper describes the nature of the interaction from that point through the following year. I offer the facts of the matter with as little editorializing as possible, and without revealing the names of the individuals involved. My only suggestion for readers is that they keep track of the variety of different reasons offered for not permitting the seminar during the course of these negotiations. It is hoped that the story will be informative, entertaining, and possibly a little disturbing.

A Week Before February 17, 1988

The Committee meeting to consider Spring Quarter 1988 seminars was scheduled for February 17, 1988. A week before this, I spoke on the phone with the Director of the Committee (whom I will refer to hereafter simply as "the Director"). During our conversation, she requested me to consider offering the seminar as a Freshman/Sophomore Seminar, a category for which they had special needs. I indicated that I much preferred to have it open to all undergraduates, because the maturity of Juniors and Seniors was an important ingredient.

A preliminary listing of seminars for Spring 1988 included "Issues in Science and Religion," and a special flyer put out to advertise Committee-approved courses referred to this seminar specifically as an example of the breadth that was available through the program.

February 24, 1988

Not having heard anything from the Committee a week after the February 17 meeting, and being bombarded by students coming personally to my office and calling me on the phone to inquire about the seminar, I called the Director on February 24, asked about the seminar, and was put on hold. A minute or two later the Director returned to the phone and apologetically informed me that the Committee had refused to approve the seminar because of "lack of balance."

February 25, 1988

The next afternoon I went to see the Director in her office for a discussion of the reasons for the cancellation. She indicated that she agreed with the decision of the Committee (2 faculty members, 2 students, and the Undergraduate Dean) that the seminar was unsuitable for their program because it openly set forth to discuss the relationship between only the Judeo-Christian tradition and science. She indicated that such a course would be suitable in the Religious Studies curriculum or under the auspices of Memorial Church, but not in the Committee-sponsored program for academic credit. She agreed to accept a letter of rebuttal from me, which was sent the same day.

During the course of the next 10 months, the identity of the 2 faculty members and the 2 students on the Committee was never divulged to me, until I finally did meet with one of the faculty members in December. I was never able to obtain permission to meet with the Committe to discuss the issues. I do not know the identity of the other faculty member or the two students.

In my rebuttal letter of February 25, I argued that the seminar is an attempt to suggest an integration of inputs from a wide range of topics in modern science and the ethical dilemmas posed by modern

Richard H. Bube received the Ph.D. degree in Physics from Princeton University. From 1948-1962 he was on the technical staff of the RCA Laboratories in Princeton, New Jersey, and since 1962 he has been on the faculty of Stanford University as Professor of Materials Science and Electrical Engineering. From 1975-1986 he served as Chairman of the Department of Materials Science and Engineering. Dr. Bube is the author of books both on photoelectronic materials and devices, and on the interaction between science and Christian faith. From 1969-1983 he served as Editor of the Journal of the American Scientific Affiliation. *He has been a speaker on science and Christianity at many college and university campuses.*

science and technology, with inputs from the Judeo-Christian tradition. I questioned the argument that religious perspectives should not be espoused or defended in an academic course, since no course at Stanford or anywhere else could really teach about ethics, values, morals, etc. without "being religious" in some fundamental sense—without some kind of set of values chosen and defended on faith, whether that set of values is derived from a formal religion or from a secular world view.

March 9, 1988

The Director replied to my rebuttal. The Committee had two major disagreements with my letter: they denied (1) that "almost every course at Stanford espouses a religious perspective," and (2) that "it is impossible to teach about ethics, values and morals, without engaging in a religious activity."

She wrote:

> The Committee made a distinction between "espousing" a religious perspective, and critically "examining" religious values, and asserted that only the critical examination of religious perspectives—with the emphasis on the *plurality* of perspectives—was intellectually respectable. Thus your course's espousal and assumption of a shared religious and moral position was viewed as objectionable by the Committee. ... The Committee noted that its own position was supported by the recent Supreme Court decision on secular humanism.

March 14, 1988

I replied by letter to the Director with regrets that the unacceptability of my seminar seemed to be based on a misunderstanding of the seminar itself. The Committee's requirement that "only the critical examination of religious perspectives—with the emphasis on the *plurality* of perspectives—was intellectually respectable," was certainly fulfilled by the seminar.

I wrote:

> We examine the insights obtainable from authentic science on a particular issue, distinguish them from its religious counterpart "scientism," and we examine the insights that have been historically derived, and may be derived today on that same issue from the Judeo-Christian tradition. ... Surely in calling for a *plurality* of perspectives, you cannot imply that "intellectual respectibility" is reserved only for that approach that treats all perspectives as relative and equally viable, or for a situation in which one would attempt to treat *all* possible religious and non-religious positions in one Seminar. How could one lead a Seminar on "Issues in Science and Religion" from a non-religious perspective?

On the same day I wrote a letter to the Dean of the Chapel at Stanford, expressing my concerns to him. I asked, "Can it be that Stanford has come to the point where it is being argued that the opportunity to integrate one's scientific insights with insights from the Judeo-Christian tradition is not an 'intellectualy respectable' activity? That it is permissible to carry out activities that are not 'intellectually respectable' under other auspices at Stanford, but not under the auspices of the Committee?"

The Director apologetically informed me that the Committee had refused to approve the seminar because of "lack of balance."

The Dean replied graciously to my letter, and we did get together a few days later to discuss the issues. I also provided my Chairman the same background of information, and he replied in a sympathetic way.

March 21, 1988

The Director wrote to me to thank me for my recent letter. She proposed a new approach. "In an effort to give the proposal further consideration, I am seeking out someone with well-established academic expertise on science and religion to review your course outline. ... Please know that we are doing our best to give all the issues you raise a fair hearing."

March 29, 1988

I received a phone call from the Director apologizing for the mistake in listing the seminar earlier as one that was being given, indicating that the review would continue, and promising to keep in touch.

April 6, 1988

I wrote a note to the Director thanking her for her note and phone call. I passed on to her suggestions for "someone with well-established academic expertise on science and religion," which had been made to me by a Stanford Professor of Philosophy who gave general support to the seminar.

I also noted that over 40 students had registered for the seminar, and that I had decided, in response

to urgings from different quarters, to give four 2-hour Open Seminars on Tuesday afternoons during the quarter. I invited her to send a representative to evaluate them. None came.

April 11, 1988

I followed up by letter on contacts made by the Professor of Philosophy mentioned above with the Undergraduate Dean, also a Professor of Philosophy. The suggestion had been made to me by the former that the seminar might be approved in future if its reading list reflected a number of pro and con discussion issues involved in the seminar.

The seminar was unsuitable for their program because it openly set forth to discuss the relationship between only the Judeo-Christian tradition and science.

I asked for the opportunity to meet personally with the Undergraduate Dean, and wrote:

> It is not my purpose to give a general treatment of how science and religion in general have and may interact; it is my purpose to give a general treatment of how science and the Judeo-Christian tradition interact. This is in itself an enormous task and far more than can be accomplished within a 10-week Seminar. Other conceivable Seminars might treat "Science and Islam," "Science and Buddhism," "Science and Confucianism," "Science and Existentialism," "Science and Marxism," "Ethical Solutions for Atheists," etc. and each of these would have more than it could handle in a 10-week Seminar.... To require that in the midst of a critical examination of the many issues involved in the interaction between science and Judeo-Christian tradition, one must interject problems raised by those who believe that science has totally invalidated the Judeo-Christian tradition, or by those who believe that the Judeo-Christian tradition totally invalidates tenets of modern science, would do violence to the whole purpose of the Seminar and its learning experience.

April 18, 1988

The Undergraduate Dean graciously replied that, as "an interested layman" with respect to the topics in the seminar, he would prefer to defer our actually getting together until the report had been received from the "objective third party with genuine expertise." He felt that "it is entirely possible that the Committee will reverse itself just on the basis of the outside evaluation, without necessitating a meeting between us. If, on the other hand, the evaluation supports the Committee's original decision, then I will feel more confident defending it to you when we do meet."

April 20, 1988

The Director forwarded to me a review of the seminar from "a scholar in the field." She suggested that the review "provides both an affirmation of the objections raised by our Committee, and a strategy for remedying them. If you are willing to revise your course so as to reflect these changes, I would welcome a new syllabus."

The review read as follows (quoted in its entirety):

> The proposed course is said to focus on the "interaction" of science and religion, but some of the issues discussed are only very peripherally related to science. In fact, the course is not so much about the intersection of science and religion as about a wide range of topics in one or the other area (but not always both). I realize that one of the points of the offering is to break down artificial boundaries between science and religion, but the discussion of divorce, for instance, has little or no relation to what is said about science or scientific method. And this brings me to the major problem. The matters treated are so numerous and so various—from abortion to nuclear energy to free will—that none can be treated in depth. Moreover, though the title is "Issues in Science and Religion,"only the Christian faith is treated at any length, with some reference to Hebrew Scripture. And finally, the fact that the students read only Professor Bube's manuscript (acknowledged to be a "personal integration") means that inevitably a tone of special advocacy prevails.
>
> Now, I do not think it inappropriate for a teacher to indicate what he believes and why, on everything from religious ethics to electrical engineering. (I am a Christian myself.) But it is best to do this in a pluralistic context, where alternate opinions are presented within a diverse reading list. Thus, I would make three recommendations: (1) that Professor Bube narrow the focus of the course to cover a more clearly delimited set of topics, (2) that he alter the reading list to include a mix of religious and secular authors, both scientists and people in the humanities, and (3) that he change the title to "Issues in Christianity and Science," or something similarly indicative of actual content. Were such changes made, I myself would have no hesitation in approving the course for the future.

April 27, 1988

I thought it best at this point to have a personal visit with the Undergraduate Dean.

I pointed out that although I could respond positively to some of the reviewer's suggestions, a number of others indicated that the reviewer really did

not understand the nature of the seminar itself. I argued as follows:

(1) Apparently the reviewer had been provided only with a copy of *Science and the Whole Person: A Personal Integration of Scientific and Biblical Perspectives*, and was under the impression that this collection of papers *was* the seminar. For example, although a discussion of divorce appears in this collection, it has never been discussed in the seminar precisely because it is an issue that does not involve the interaction of science and religion.

"How could one lead a Seminar on 'Issues in Science and Religion' from a non-religious perspective?"

(2) It is not the purpose of the seminar to treat issues "in depth" but to provide the participants with an appreciation for the wide range of issues in which authentic insights from science and from religion can play complementary roles. It is precisely the consideration of a number of such issues that heightens this appreciation.

(3) The seminar has always had an extensive reading list, and it has never been true that participants read only *Science and the Whole Person*. Supplementary reading from the list or any other references desired by the students has always been urged in general and required in connection with the two papers required by the seminar.

(4) One cannot in a quarter's seminar discussion of the major issues in which science and religion interact—already argued by the reviewer to be too numerous—interject serious consideration of a "mix of religious and secular authors, both scientists and people in the humanities" without hopelessly diluting the effectiveness of the seminar.

The Undergraduate Dean was receptive and provided me with advice on how to add information to the seminar syllabus that would be used as the basis for deciding on permission for the future. I believe it is an accurate quote to say that we parted with his remark, "I don't know about the rest of the Committee, but you've convinced me."

April 29, 1988

I sent the Committee a 5-page revised syllabus for the seminar, now retitled, "Interactions Between Modern Science and Christianity." The syllabus starts with a description of the Course Purpose: "This Seminar deals with the interactions between modern science and Christianity. It is assumed that participants are agreed that meaningful insights can be derived from both science and the Judeo-Christian tradition. It addresses areas where these insights come into critical contact, raises questions, encourages discussion, and tries to help participants explore ways of integrating them."

It then summarizes the subject matter to be discussed in each of the ten weeks of the seminar, with about 50 words of detail for each subject. Next comes a full statement of Course Requirements including seminar discussion involvement and subject areas for the two papers. "The only essential requirement for each paper is that it present a discussion with *both scientific and religious inputs*."

Finally, the syllabus presents and describes the contents of 11 books suitable for basic reading in the subject area of the seminar. Included in the list are *The Anthropic Principle* by D. Barrow and F.J. Tipler, who reject any religious foundations to their thinking; *Brave New People* by D.G. Jones, a Professor of Anatomy in New Zealand; *God and Nature: Historical Essays on the Encounter Between Christianity and Science* by D.C. Lindberg, Prof. of the History of Science, and R.L. Numbers, Prof. of the History of Medicine and the History of Science; *God and the New Biology* by A. Peacocke, a physical biochemist, Anglican priest, and Director of the Ian Ramsey Center at Oxford University; *Bioethics* edited by T.A. Shannon, Prof. of Social Ethics; and *Mechanical Man: The Physical Basis of Intelligent Life* by D.E. Wooldridge, a classic expression of the materialistic perspective which finds no place for any traditional religious concepts or for the concept of "God" beyond the sum of all physical mechanisms.

June 8, 1988

No word had been heard from the Committee to date. I telephoned the Director to find out the current status of the seminar. She reported that the Committee found the seminar too broad and recommended leaving out several weeks' topics, and requested the addition of philosophical texts to the reading list, with Stephen Jay Gould's book on evolution as an example. She promised to send me a written report.

October 6, 1988

About four months later I wrote a note to the Director welcoming her back to Autumn Quarter, and reminding her that she had promised to send me in written form the last comments of the Committee with respect to my seminar. I repeated a request often made earlier for an opportunity to meet with the Committee.

October 10, 1988

The Director wrote me with the information promised the previous June. She wrote:

> Several members of the committee were concerned by the "breadth and thinness" of what the course proposed to undertake; they felt it was over-ambitious while not including major works on several of the disputes considered. Thus, the following strategy for revising the course was proposed: it was suggested that you cut the number of topics treated, while adding reading on the remaining subjects.
>
> More specifically, the committee suggested that you cut weeks seven through nine (abortion, euthanasia, and genetic engineering), and expand on the first six weeks and on week ten. They proposed that you explain at the outset your religious point of view on the disputes you will cover. On readings, it was suggested that you include reading from the secular humanist perspective rather than (or in addition to) Wooldridge's *Mechanical Man*, and that you include major writings on creation and evolution such as Stephen Jay Gould's *Panda's Thumb*.

October 12, 1988

I called the Director concerning her letter of October 10, and requested a brief meeting with the Committee. She indicated that she wasn't sure about logistics and promised to get back to me.

November 3, 1988

The Director phoned and I discussed my continuing concerns with: (1) "narrowing the course," in which the very critical areas, where interactions of scientific and Christian inputs were put to the test, had been recommended for deletion, and (2) representing "secular humanism" in the course, which seemed to be an extraneous and diluting complication.

The Director agreed to set up a meeting with Committee members, the Undergraduate Dean, and herself after Thanksgiving.

December 16, 1988

I met in the Undergraduate Dean's office with the Dean, the Director, and one of the faculty members of the Committee, an Assistant Professor of Philosophy.

Comments and recommendations made during the meeting were: (1) the seminar covers too many topics and too few perspectives; (2) Week 3, "The Relationship Between Scientific and Theological Descriptions" and Week 6, "Human Responsibility: Chance, Freedom and Free Will," should be dropped as specific week themes; (3) a discussion of ethical guidelines to be provided by the Assistant Professor of Philosophy and an article recommended by the Undergraduate Dean were to be included; (4) inputs were to be sent to me by the Assistant Professor of Philosophy for the reading list; (5) all this was to be completed by January.

The Committee found the seminar too broad and recommended leaving out several week's topics, and requested the addition of philosophical texts to the reading list, with Stephen Jay Gould's book on evolution as an example.

February 1, 1989

I called the Director to remind her that I hadn't received any inputs from the last meeting in writing. She apologized and said that she had forgotten.

February 7, 1989

The Director phoned me to give me four book titles to add to the list. I asked if I was supposed to read all of these and incorporate them into the course; apparently I was. When I indicated that this didn't seem all that reasonable, I received noncommittal agreement. There was a February 17, 1989 deadline for the revised syllabus.

February 10, 1989

I sent in the revised copy of the syllabus. I added another paragraph to the Course Purpose that read: "It is not expected that one two-hour period will be sufficient for the thorough discussion of any of these topics. Rather the purpose of the Seminar is to lay the foundation for future perspectives and investigations by the student. It is also true that

many themes will reappear several times throughout the course of the Seminar."

I replaced the former Week 3 ("The Relationship between Scientific and Theological Descriptions") with the title, "Philosophical Attitudes Toward Science and Theology: How They Relate and Interact."

I moved in a new title for Week 4, "Determinism, Chance and Chaos," and dropped the former Week 6 ("Human Responsibility, Chance, Freedom and Free Will").

The rest of the class schedule remained unchanged.

"... the purpose of the Seminar is to lay the foundation for future perspectives and investigations by the student."

I added the four recommended books to the reading list: R. Harre, *Philosophies of Science* (1972), T. Kuhn, *The Structure of Scientific Revolutions, 2nd ed.* (1970), W.H. Newton-Smith, *The Rationality of Science* (1981), and B. Williams, *An Introduction to Ethics* (1972).

During the Week of February 20, 1989

I received a call from the Director to let me know that the seminar had been approved for Spring Quarter 1989. I told her that the seminar would be given Tuesdays 4-6 pm, with the first meeting in room 550A. She thanked me for my patience throughout all of the preceding negotiations.

March 14, 1989

I received official notification from the Committee that the seminar had been approved as FSS 015.

I learned for the first time that it had been approved as a Freshperson/Sophomore Seminar, not as an Undergraduate Seminar, bringing full circle our discussion initiated the previous February 14, 1988. The reason was that they wished to have the FSS taught by regular faculty and so assigned one to me (the other one was "Towards the Development of an Artificial Person"). It appears that most, if not all, of the other seminars were taught by non-faculty.

Ten other Undergraduate Special Seminars were offered: "American Violence: The Gun Connection"; "The Contemporary Alternative Press"; "Hindu Mythology"; "Informatics and Third World Development"; "Medical Models: Wellness and Healing in Cultural Perspective"; "Principles and Practice in the American Conservative Movement"; "Puerto Rico: An American Experiment in Colonialism"; "The South African Image in the United States"; "Voices from the Grassroots: Social Movements in India"; and "Women's Literature of the Holocaust."

The information sent to me from the Committee contained a few inappropriate items. It listed the wrong room on campus for the first meeting. It requested my Social Security Number, my resume, and my address since "these are not on file." And it also informed me that I "will receive a temporary teaching appointment as Preceptor," and that I am "expected to be in contact with [my] faculty sponsor and to let them know how [my] course is proceeding."

April 4, 1989

The first meeting of the seminar was held on Tuesday, April 4, 1989. The information sent to me from the Committee indicated that 12 students had been allowed to sign up as participants in the seminar, with another 6 students placed on a waiting list. Over 20 students came for the first meeting, and I indicated that all interested would be welcome.

Conclusion

That's about the whole story. You, the reader, must decide what, if anything, can be learned from it. ✤

PUBLICATIONS OF
COUNCIL OF SOCIETIES
FOR THE STUDY OF RELIGION

MERCER UNIVERSITY • MACON, GEORGIA 31207 • (912) 741-2376

The Council of Societies for the Study of Religion is a federation of professional organizations that promotes the academic study of religion. Delegates from the member societies meet annually to review the work of the Council's various committees and to plan its publication program.

Religious Studies Review

Including major reviews, shorter notes, a recap of dissertations in progress and completed, ***RSR*** is ***the*** single source for bibliographical updates in the broad field of religious studies. "The ***RSR*** is noteworthy for its mix of searching essays, critical reviews, and informative notices. Indispensible for those keeping on top of scholarship in the field of religion."
—John F. Wilson, Princeton University

ISSN 0319-485X **$30.00 per year to individuals**

Directory of Departments and Programs

Now in its sixth edition (1989) this handy tool lists more than 400 departments and programs of religious studies in North America with a complete profile including enrollments, degrees offered, faculty and a brief description of the department. The names and addresses of more than 1,500 schools, colleges, universities and seminaries are included as well as several indexes including a faculty index.

ISBN 0-932180-10-8, paper; 11-6, cloth **$20.95, paper; $24.95, cloth**

Bulletin of the CSSR

Publication of the *Bulletin* was resumed in February 1988 (volume 17). The "new" *Bulletin* appears four times a year: February, April, September and November. Its purpose is to serve as a clearinghouse for information about specific activities in the field of religious studies, especially as this information relates to and grows out of the work of the constituent societies. The *Bulletin* includes news from the various societies of the CSSR (and others who care to submit), general announcements, information on grants, fellowships, etc., program announcements, calendars of events, and directories of officers, both regional and national, of the CSSR constituent societies.

ISSN 0002-7170 **$18.00 per year to individuals**

Directory of Faculty

This newest CSSR publication includes complete biographical information on more than 3,200 individuals (representing more than 450 institutions) who teach in the area of religious studies in North America. It is designed to be a companion volume to the Directory of Departments (mentioned above).

ISBN 0-932180-12-4, cloth **$45.00**

ORDER FORM

_____ Religious Studies Review

_____ Directory of Departments and Programs

_____ Bulletin of the CSSR

_____ Directory of Faculty

Name _____

Address _____

City _____ State _____ Zip _____

MAKE CHECKS PAYABLE TO CSSR

How Does the World View of the Scientist & the Clinician Influence Their Work?

ARMAND M. NICHOLI, JR., M.D.

Harvard Medical School
Harvard University
Cambridge, MA

This paper, originally given as an address at the Imago Dei symposium cojointily sponsored by the American Scientific Affiliation & the Christian Medical and Dental Society, explores the role of the scientist/clincian in relation to his personal world view. Does the world view of the scientist affect his results? This paper examines the influence of the investigator on his scientific observations and of the clincian on his work with his patients. Seeing the patient as an object created in the image of God influences the tone and attitude of a physician towards his patient.

Behavioral sciences comprise those disciplines that study man's development, interpersonal relationships, values, activities, experiences, institutions, etc. These sciences include ethology, sociology, cultural anthropology, psychiatry, and many other fields. My remarks will focus on the field of psychiatry. Psychiatry is that branch of medicine that deals with the diagnosis, origin, treatment and prevention of the disorders of the mind. The human mind and that part of the body most directly related to it, the human brain, comprises the primary domain of psychiatry. I limit my remarks to psychiatry not only because it is my field and the only one I could discuss with any semblance of intelligence, but also because it's a medical specialty, and has specific relevance to our theme of "relating man in the image of God to the health sciences." Our theme also mentions "clinical implications," and I would like to focus specifically on clinical psychiatry, that is, that branch of psychiatry involved in the observation and treatment of patients.

If we begin with the proposition that man is created in the very image of God, we have taken a step toward embracing a world view based on the Old and New Testament documents. This world view, of course, suggests certain basic presuppositions; presuppositions about God's existence, about the origin and nature of the universe, about the nature of man, about meaning and purpose of life on this planet, and about ultimate destiny.

On the other hand, does the world view, the *Weltanschauung*, embraced by the scientist have any serious impact on his work? Does the world view of the clinician influence significantly his or her role both as investigator conducting research or as physician and therapist treating patients?

As modern research increases our understanding of the mind and of the brain, the question of the interrelationship of the mind and brain arises again and again. The mind-brain or mind-body problem dates back at least to the Ancient Greeks, to Democritus, Plato, and Aristotle. We cannot take time to focus on this problem in detail—except to ask the question of whether current research in psychiatry takes us any closer to resolving this problem. A popular notion prevails that modern research has now demonstrated that all disorders of the mind can be traced to biological abnormalities

This paper was presented as an address at the *Imago Dei* Symposium, cojointly sponsored by the ASA and CMDS at Gordon College, Wenham, MA, June 4, 1988.

and therefore has taken us a large step toward focusing entirely on the brain, of considering the brain not merely the biological substrate of the mind, but the actual mind itself.

Research on Mind & Brain

New knowledge in psychiatry comes from a variety of sources including the following.

(1) Recent clinical and laboratory research and new technology that facilitates this research such as the vastly improved brain scanning methods of computed tomography (CT), positron emission tomography (PET), and magnetic resource imaging (MRI); from the advances in molecular biology prompting the search for a specific gene in the transmission of schizophrenia and other of the major psychiatric disorders; computer brain electrical activity mapping (BEAM), and new biomedical techniques for assessing enzymes, metabolites and neurotransmitters in human tissues.

(2) The emergence of diseases such as Acquired Immune Deficiency Syndrome, or AIDS, whose first and sometimes only manifestation may be severe psychiatric symptoms.

(3) The increased incidence of disorders such as bulimia, and the recent intensive investigation of others such as Alzheimer's Disease and obsessive compulsive disorder.

(4) Environmental and cultural changes that result from or contribute to psychiatric disorder such as the current changes in family structure, the rapid rise in psychoactive drug use, and the epidemic in adolescent suicide.

Progress in psychiatry continues in many directions. More rigorously controlled studies have replaced the relatively unsophisticated research of the past. Investigations have focused on establishing the neurological substrates of psychiatric disorders; that is, on ascertaining the specific parts of the brain associated with disturbed thinking, feeling, and behavior of these disorders. A great deal of research today continues to search for metabolic and physiological abnormalities that may be clues to the cause and to the cure of particular illnesses. New discoveries have come from explorations both within cells, to find the gene or genes involved in genetic transmission of a disorder, and between cells, especially at "synaptic clefts," the name given to those spaces that exist between each of the billions of brain cells. We have focused a great deal of attention on these spaces because we have found that drugs that alleviate psychiatric symptoms, such as the neuroleptic drugs as well as drugs that imitate psychiatric symptoms like the amphetamines, act at the level of neurotransmitters—chemicals that carry impulses across these spaces. Although we have made great strides in the biochemistry and neurophysiology of the brain and an understanding of the neural basis and the localization of certain feelings and certain thought processes in the brain, we have as yet failed to find any metabolic or physiological abnormality consistently present in any of the major psychiatric illnesses. Even when and if we find this magic abnormal metabolite we will be only halfway home—for we still won't know whether the abnormality causes or results from the disorder.

Paradoxically, the more we learn about the mind the more we realize that we can never reduce human thought, feeling, or behavior to a biochemical reaction. Our knowledge of biology by no means rules out the significance of psychological factors, nor our knowledge of genetics the significance of environmental factors. The more we know about one area, the more significant the other area seems to become in explaining the whole picture. The more we develop and use psychopharmacologic drugs, the more we realize that these drugs usually must

Dr. Armand M. Nicholi, Jr. is an associate clinical professor of psychiatry at Harvard Medical School at Massachusetts General Hospital in Boston. He has been on the teaching faculty of Harvard University for over 25 years. His research ranges from the breakdown of the family structure to the modern drug culture, and he is recognized as an authority on the widespread nontherapeutic use of drugs and the biological and psychological consequences thereof. Dr. Nicholi is an editor and contributing author of the authoritative guide of his field, The Harvard Guide to Modern Psychiatry, *and has served as a consultant to a wide range of organizations including the U.S. Surgeon General's Office, the U.S. Peace Corps, and the White House.*

be combined with psychotherapy to be most effective. Perhaps once we discover the elusive abnormal metabolite, we may find it influenced by a combination of genetic, environmental, biological, and psychological factors. The integration of these factors certainly constitutes psychiatry's greatest challenge.[1] One thing we can say for sure: All of the modern research and new technology has not altered significantly the statement by the famous neurosurgeon Penfield when he wrote in 1975, after a life's work of research on the brain, "In the end I conclude there is no good evidence in spite of new methods ... that the brain alone can carry out the work that the mind does. I conclude that it is easier to rationalize man's being on the basis of two elements than on the basis of one."[2] Though we have accumulated new and significant evidence of how the mind influences the body and the body the mind, we must still agree with Penfield that brain and mind are two distinct entities. We cannot reduce the mind of man to neurochemistry and neurophysiology.

What we can conclude is that new knowledge of the mind reveals not only its paradoxical nature but also its enormous complexity. Recent scientific research leaves us with an acute awareness of how little we really know. It reminds us of the statement by Dr. Lewis Thomas in the *New England Journal of Medicine*: "The only solid piece of scientific truth about which I feel totally competent is that we are profoundly ignorant about nature. Indeed, I regard this as the major discovery of the past one hundred years of biology ... it is this sudden confrontation with the depth and scope of ignorance that represents the most noteworthy contribution of 20th century science to the human intellect."[3] New knowledge, if kept in proper perspective, increases not our arrogance but our humility—perhaps because as our island of knowledge increases, so does our shoreline of ignorance.

The Influence of the World View of the Scientist

Does the world view of the scientist influence his work as an investigator conducting research and as a clinician treating patients? Many scholars in the history of science would answer that question with a resounding "Yes." Some, like Thomas Kuhn in his widely quoted "The Structure of Scientific Revolutions," have argued that the scientific process is less than an objective critical empirical investigation of the facts. They claim the work of scientists is greatly influenced by their culture, by social and psychological environment, by what Kuhn calls the "paradigm"—that is to say, the preferred or prevailing theories, methods and studies of that particular discipline, and above all by their world view—their specific beliefs about "the order of nature." Kuhn writes that two scientists with different views of the "order of nature...see different things when they look from the same point in the same direction...they see different things and they see them in different relations to each other." And we might add that they tend to see and to accept those data that conform to or make sense in light of their world view. So evidence exists that the world view of scientists and the presuppositions that view implies may influence not only the problems scientists choose to investigate but also what they actually observe and fail to observe. Let me give a brief example from my discipline.

A great deal of research today continues to search for metabolic and physiological abnormalities that may be clues to the cause and to the cure of particular illnesses.

Sigmund Freud, the Viennese physician whose scientific contributions some historians have ranked with those of Planck and Einstein, founded psychoanalysis. Most of the basic concepts of dynamic psychiatry derive from Freud's theories. Psychoanalysis is: (1) a theory of the mind and of human development, (2) a method for investigating the unconscious, and (3) a system of treatment for certain emotional disorders. In addition to his scientific contributions, Freud embraced the world view which he called "the scientific *Weltanschauung*." His world view comprised an atheistic philosophy of life. He referred to himself as an "infidel Jew," and he rejected the religious view of the universe—especially the Christian world view. He attacked this view with all of his intellectual might and from every possible perspective. He observed in some of his patients the neurotic determinants of their religious beliefs, and a tendency for these beliefs to disappear once the neurotic need was resolved or once the authority of their father was no longer prevalent. Freud concluded that God was a projection of the childish wish for an all-powerful father who would protect one from the unpredictable, harsh elements of nature. Freud spent the last 30 years of his life writing about religious issues. This began as a serious endeavor with the publication

of his *Totem and Taboo*, a study of the origins of primitive religions published in 1913, through to the publication of his last book, *Moses and Monotheism*, published in 1939. He just could not leave the subject alone. A great deal of evidence exists that Freud's world view was less than a comfortable one for him, that he continued to write about religious issues because he was looking for a more satisfying world view, that religious faith was by no means a closed issue for him, and that he was extraordinarily ambivalent about God's existence. Throughout Freud's letters you find statements such as, "If some day we meet above," statements about his "one quite secret prayer," about meeting his predecessors in "the next world," and about "God's grace." During these last 30 years of his life he carried on a continuous correspondence, an exchange of hundreds of letters, with a Swiss theologian, Oskar Pfister. He admired Pfister and wrote that Pfister was "a true servant of God, a man in the very idea of whom I should have had difficulty in believing, and that he feels the need to do spiritual good to everyone he meets. You did good in this way even to me." He later said that Pfister was "in the fortunate position of being able to lead [men] to God."[4]

I might add here parenthetically that I have studied for many years the letters and writings of Freud in order to ascertain the basis of his intense antagonism toward religious faith. I have concluded that his main obstacle—one not uncommon among thinking intellectuals—is his inability to reconcile a benevolent, omnipotent creator with human suffering. In 1928, in a letter to Pfister, for the first time in any letter that I have ever read by him, Freud becomes quite angry and quite discourteous. He writes, "And finally—let me be impolite for once—how the devil do you reconcile all that we experience and have come to expect in this world with your assumption of a moral world order?"[4] And then, in a 1933 lecture called "*Eine Weltanschauung*," he says:

> It seems not to be the case that there is a Power in the universe which watches over the well-being of individuals with parental care and brings all their affairs to a happy ending. On the contrary the destinies of mankind can be brought into harmony neither with the hypothesis of a Universal Benevolence nor with the partly contradictory one of a Universal Justice. Earthquakes, tidal waves, conflagrations make no distinction between the virtuous and pious and the scoundrel or unbeliever. Even where what is in question is not inanimate nature but where an individual's fate depends on his relationships to other people, it is by no means the rule that virtue is rewarded and that evil finds its punishment. Often enough the violent, cunning or ruthless man seizes the envied good things of the world and the pious man goes away empty. Obscure, unfeeling and unloving powers determine man's fate. The system of rewards and punishments which religion describes to the government of the universe seems not to exist.[5]

Freud, of course, seemed to be unaware that in the Christian world view "the government of the universe" is temporarily in enemy hands. A few summers ago, before Freud's daughter Anna Freud died, I asked her about her father's difficulty with the problem of suffering. She expressed great curiosity about it. She asked "is there a God who sits there in heaven and decides who will get cancer and what specific adversity will affect each individual?" I expressed to her the notion that theologians such as Pfister would describe the presence of an evil power in the universe that might account for some of the suffering. She seemed unusually interested in this notion and came back to it several times during our discussion.

We must also remember that Freud suffered considerably; emotionally as a Jew growing up in an intensely Catholic society, and physically with an intractable cancer of the pallet that required an endless number of operations.

Evidence exists that the world view of the scientist and the presuppositions that view implies may influence not only the problems the scientist chooses to investigate but also what he actually observes and fails to observe.

The Influence of Freud's World View on His Scientific Investigations

How did this world view of Freud influence his work as a scientific investigator? Did it in any way influence not only what data he observed, but how he interpreted this data? I think there is a great deal of evidence that it did. Let's look at the issue of religious faith. Freud saw only the neurotic determinants of religious faith in his patients. He appeared to be totally unaware of those who possessed a healthy faith, of those who had a positive transforming spiritual experience. He must have seen healthy expressions of faith in his patients. He certainly saw this in his close friend Pfister toward

A great deal of evidence exists that Freud's world view was less than a comfortable one for him.

whom he expressed such affection and admiration, and with whom his friendship extended over 30 years. Pfister actually discussed this with him in his letters and said that Freud seemed to be aware only of "pathological forms of religion," while he himself had embraced a healthy form that he regarded "as the core and substance of evangelism." In 1928 Freud published a paper titled "A Religious Experience." In it he discusses a letter he received from an American physician telling Freud of his religious conversion. The physician had written to Freud because he read in an American newspaper an interview in which Freud said that he gave no thought to the subject of survival after death. The physician told of the shock he experienced in seeing a "sweet-faced woman who was being carried to the dissecting table." The physician wrote, "in the course of the next few days God made it clear to my soul that the Bible was His Word, that the teachings about Jesus Christ were true and that Jesus was our only hope. After such a revelation I accepted the Bible as God's Word and Jesus Christ as my personal saviour. Since then God has revealed himself to me by many infallible proofs." The letter continued, "I beg you as a brother physician to give thought to this most important matter, and I can assure you if you look into this subject with an open mind, God will reveal the truth to your soul, the same as he did to me and a multitude of others...." Freud sent a polite answer saying that he was glad to hear that this experience had enabled the physician to retain his faith. As for myself, Freud wrote, "God has not done so much for me. He had never allowed me to hear an inner voice; and if in view of my age he did not make haste it would not be my fault if I remained to the end of my life what I now am—infidel Jew." Freud said he received another letter from the physician saying the physician was offering prayers for Freud that God might grant Freud "faith to believe." Freud said he was still awaiting the outcome of this intercession. And then he went on to give a psychoanalytic explanation of the psychological factors involved in the physician's conversion.[6]

So we ask, how does one explain Freud's total inability to accept certain data concerning nonpathological faith that he must have observed clinically in his patients, in his friend Pfister, and even in correspondence from strangers? Perhaps the only explanation we can offer is that the data did not make sense in light of his world view and the presuppositions predicated on that view.

The Christian World View and the Clinician

Does the world view of scientists influence their work as clinicians? Does it have an impact on their roles in treating and caring for patients? If the clinician really believes the patient is made in the "image of God" he then realizes the patient, every patient, will transcend in time and significance every other institution on earth, and therefore cannot help but approach that patient not only with great respect, but also with a sense of reverence and wonder. The clinician who embraces the Christian world view has certain marching orders—broad, clear guidelines as to how to approach his patients. These guidelines include such simple directives as "be kind and compassionate," but also a whole new complex standard for conducting doctor-patient relationships. This standard—referred to as *agape*—comprises a unique kind of love, a love devoid of sentimentality yet considerably more than kindness. A love based not on feeling but on the will, though as we carry it out by exertion of the will, it contributes to how we feel and to our sense of fulfillment. *Agape* involves stepping out of our own needs sufficiently to become aware of the needs of others and then acting to meet those needs, whether we feel like it or not. *Agape* therefore involves thought, effort, time, accessibility, and at times self-sacrifice and self-denial. It's a difficult kind of love to practice—but it's the key to all successful relationships, especially the doctor-patient relationship.

The practical application of this standard in everyday practice is by no means easy or obvious. Close detailed attention must be given to how the physician can carry out this standard in establishing a successful doctor-patient relationship within the confines of a professional relationship and without patronizing or condescending.

Shaking hands firmly with the patient brings to the first moment of contact an element of personal warmth and respect.

Simple Standards for the Clinician

The physician's attitude toward the patient sets the tone for his whole relationship with that patient. Whether the patient is young or old, neatly groomed or disheveled, out-going or withdrawn, articulate or inarticulate, highly integrated or totally disintegrated, of high or low social economic status, the sensitive clinician realizes that the patient, as a fellow human being, is considerably more like himself than he is different and that even if he understands only a fraction of the patient's mind, the patient will contribute significantly to the physician's understanding of himself and of every other patient that he sees. The physician also realizes that each patient, regardless of how prosaic in appearance and background, is considerably more complex than can be grasped or described no matter how brilliantly detailed the diagnosis of the physician; that each patient offers the therapist the potential for increasing his own professional skills and understanding, as well as for contributing to the body of knowledge in his or her specialty. These realizations motivate the physician to approach each patient with no little degree of humility, care, and respect.

A patient consulting any physician suffers stress, not only because of symptoms prompting the consultation but also because of conditions inherent in the doctor-patient relationship. The patient, for example, is usually confused about the significance of his symptoms, unaware of their cause, apprehensive about what the doctor will recommend, and often embarrassed or humiliated at exposing what he considers exceedingly personal details of his life. Under such circumstances he is particularly vulnerable, and for this reason deserves even more consideration than in ordinary social interactions. Too often, however, he receives less. Even the simple introductory handshake is often neglected—perhaps because of the doctor's hectic schedule, perhaps because the doctor shares a common human tendency to withdraw from illness, or more likely because the clinician has never been formally taught to heed such issues.

The mundane, yet often neglected practice of simply shaking hands helps set the tone for the initial relationship between doctor and patient. Shaking hands firmly with the patient brings to the first moment of contact an element of personal warmth and respect. The simple gesture eases the tension preceding the initial interview, and reassures the patient who almost always approaches the doctor with a degree of apprehension. To the patient the physician represents not only an awesome stranger who will probe the most intimate aspects of his or her life, but also a highly knowledgeable authority with the power to make life and death decisions. Because so many people harbor this threatening image, a simple handshake at the beginning and at the end of the first session helps the doctor relieve initial anxiety.

How the physician addresses the patient ought to be given some consideration. Does the physician use the first or last name only, dispensing with the title of Mr., Miss, or Mrs. before the patient has granted that liberty? Does the physician dismiss these common courtesies as stuffy formality? Or does he use them to express respect for the patient as a fellow human being?

The physician's ability to convey a genuine interest in his patient, to facilitate the patient's telling of his story, and to establish a solid therapeutic alliance depends in large measure on the physician's capacity to listen effectively.

In essence, all that takes place in the initial stages of a physician-patient relationship can be measured against a single simple standard: Is the physician in his exchange of initial courtesies as warm and respectful to the patient as he would be to a dignitary visiting his home? Meeting such a visitor for the first time, the physician would introduce himself, offer his hand, and take pains to make the visitor welcome and comfortable. He would honor the visitor's title until given permission to dispense with it. He would strive to be relaxed and composed without being aloof or stilted, and to be warm and responsive without being familiar or effusive. He should do the same in his first meeting with a patient—especially if he considers that patient within the context of his Christian world view.

It's important to emphasize that although a professional relationship sets clearly defined limits and demands some restraint and reserve, it by no means precludes warmth and kindness. Furthermore, to the extent that most patients need to see the physician as a friend, as someone strongly "for" them—and to the extent that they consider a friend

to be "a person with whom one is allied in a common struggle" or "a person whom one knows and trusts" (as the American Heritage Dictionary defines the term)—then to that extent a professional relationship also does not preclude friendship. These qualities are far too often missing in the physician's office today, and contribute in no small way to what appears to be a deteriorating relationship of the physician's image in our society. The office of Christian physicians ought to be a model for these kinds of relationships. One other point involves the capacity of the physician to listen to the patient. The physician's ability to convey a genuine interest in his or her patient, to facilitate the patient's telling of his story, and to establish a solid therapeutic alliance depends in large measure on the physician's capacity to listen effectively. Listening effectively involves first and foremost respecting the patient enough to keep out of the patient's way as he attempts to tell his story. To keep from obtruding, to keep quiet, to keep the spotlight focused completely on the patient—these are among the physician's most difficult tasks.

Humor can exert a wonderful humanizing influence in interpersonal relationships, easing tension and facilitating communication. It helps for the physician to maintain a sense of humor. A hearty laugh between physician and patient underscores Addison's comment that "mirth is like a flash of lightning, that breaks through a gloom of clouds." One must carefully distinguish, however, between laughing with the patient and laughing at the patient. Laughing at the patient or making fun of symptoms through mockery, sarcasm, or irony will inevitably set a discordant tone and become an obstacle to the relationship.

Conclusion

Seeing the patient as a object created in the image of God automatically influences the tone and attitude of a physician toward his or her patient. It precludes approaching the patient merely as a "case," whose symptoms must be assessed in order to attach the appropriate diagnostic label. This view of the patient fosters an attitude that helps the physician look beyond the patient's pathology to observe the fellow human being with unique characteristics and with the same hopes, fears, aspirations, feelings, and perhaps the same conflicts as his own—a suffering human being whose illness has made him dependent on the physician and particularly vulnerable. This approach will ensure a degree of humility in the physician and prevent the patronizing arrogance afflicting some who held a measure of power over others. It will also facilitate giving the patient the same warmth and courtesy accorded a respected guest, a cherished relative, or, one would hope, the physician should he or she become a patient. More important, the physician will more likely have a desire to serve the patient—to give hope, to allay fears, to alleviate pain, and in short, to treat the patient as an object made in the image of God.

Wanting the best for the patient and acting accordingly—whether a particular patient evokes positive or negative feelings—necessitates no little degree of spiritual maturity on the part of the physician. It requires of the clinician, regardless of feelings he may have to the contrary and regardless of the particular status of the patient, always to act in the best interests of the patient. In my view, this encompasses all that we mean when we speak of "kindness and compassion," what we mean by *agape*, and what we mean by treating a patient as an object made in the "image of God." ✤

NOTES

[1]Nicholi, A.M., 1988. "Introduction," *The New Harvard Guide to Psychiatry*. Cambridge, MA: Harvard University Press.
[2]Penfield, Wilder. 1975. *The Mystery of the Mind*. Princeton, NJ: Princeton University Press.
[3]Thomas, Lewis. 1977. *The New England Journal of Medicine*.
[4]Freud, E.L. & Meng, H. 1963. *Psychoanalysis and Faith: The Letters of Sigmund Freud and Oskar Pfister*. New York: Basic Books.
[5]Freud, A. 1933. "New Introductory Lectures on Psychoanalysis," in *Standard Edition*, vol. 22, J. Strachey (ed.). London: Hogarth Press.
[6]Freud, A. 1928. "A Religious Experience," in *Standard Edition*, vol. 21, J. Strachey (ed.). London: Hogarth Press.
[7]Nicholi, A.M. 1988. "The Therapist-Patient Relationship," *The New Harvard Guide to Psychiatry*. Cambridge, MA: Harvard University Press.

His likeness to Christ is the truth of a man, even as the perfect meaning of a flower is the truth of a flower. ... As Christ is the blossom of humanity, so the blossom of every man is the Christ perfected in him.

George Macdonald, Unspoken Sermons, Third Series, "The Truth"

Towards a Social Theology of Punishment

JACK BALSWICK

Professor of Sociology & Family Development
Fuller School of Psychology
180 North Oakland
Pasadena, CA 91882

It is suggested that a biblical view of punishment must be recognized as incorporating both motive and act, and justice and mercy. Based upon this recognition, a model is presented which seeks to balance an emphasis on inflicting pain or loss upon the offender with an emphasis on rehabilitating the offender. In rejecting the contemporary societal view of punishment as too individualistic, the model further emphasizes concern for society, which incorporates the ascending biblical ideas of public safety, deterrence, restitution, and restoration or shalom.

In a society which has become increasingly relativistic, it is understandably tempting for Christians to take unambiguous and uncomplicated positions on a contemporary moral issue such as punishment. In seeking to use the Bible as their source book, alternative Christian groups have offered unambiguous "Christian" views of punishment, which are often contradictory. The biblical view of punishment is far from uncomplicated, however, and what might be most helpful is the development of a social theology which recognizes and incorporates the complexities of punishment as found in the Scriptures.

To punish is to cause a person to undergo pain, loss, or suffering for a wrongdoing. Punishment implies the infliction of some penalty on a wrongdoer. As a concept used in the legal system, punishment is the penalty imposed on a criminal for a criminal offense. A criminal offense is an offense against society, and it is within a societal context that an attempt will be made to develop a social theology of punishment.

The Balanced View of Punishment in the Bible

The biblical view of punishment is best understood as a balance among several seeming incongruities which form the motivational basis for punishment. The biblical view of punishment can be seen as balancing the motivational incongruities of *act* vs. *motive* and *justice* vs. *mercy*. Before attempting to develop a social theology of punishment, I will present a brief discussion as to how the biblical view of punishment seems to balance each of these sets of apparent incongruities.

Motive and Act

A criminal offense includes two elements: the *act* of the offense and the *intent* of the offender. In determining the type of punishment to be served up to the offender, our current legal system takes both of these elements of a crime into account. For example, an automobile driver who accidentally hits and kills a person in an act of reckless driving can only be charged with manslaughter, rather than murder, because the *intent* to kill was not present. On the other hand, the person who picks up a gun and fires it at another with the *intent* to kill, but misses the would-be victim, would be charged with intent to murder. In neither case will the offender be charged with first degree murder, for this charge must carry with it both the premeditated intent to kill and the act of killing. Neither, however, will the persons in the above examples go "scott free," for each is held accountable for either their *act* or *motive* in relationship to another person. That this is so is an encouraging sign that our criminal system is at least in part a reflection of biblical ethics. The Bible clearly teaches that punishment for an

offense must take into account both the act and the motive. This is perhaps most clearly stated in Exodus 21:12–15:

> Anyone who strikes a man and kills him shall surely be put to death. However, if he does not do it intentionally, but God lets it happen, he is to flee to a place [God] will designate. But if a man schemes and kills another man deliberately, take him away from my altar and put him to death. (NIV)

An understanding of the Ten Commandments will also yield God's intent for a moral law which balances act and intent.

Punishment in the Bible must be understood as encompassing both *justice* and *mercy*. This dual concern is, of course, part of the larger biblical teachings about law and grace. Our understanding of the relationship between law and grace is perhaps most clearly addressed by Paul in his statement, "Christ is the end of the law so that there may be righteousness for everyone who believes" (Romans 11:4). As Paul elaborates on this text we learn that there is nothing wrong with the law itself, for it points the way to live according to God's intention. The problem with the law is that because no one is perfect, the law can't be fulfilled. Christ is the "end of the law" in the sense that he is the perfect fulfillment of the law. Because of Christ's perfection and righteousness, our righteousness is not dependent upon keeping the law but upon our faith in Christ.

We can understand the relationship between justice and mercy in the same way, for God demands justice because of His holiness, but demonstrates mercy through the giving of Jesus Christ. God has provided an example of how, when we assume human control over punishment within our society, we also might demand justice but demonstrate mercy.

In a general sense, *justice* shows *concern for the victim*, while *mercy* shows *concern for the offender*. The emphasis in the Old Testament seems to be more for the victim than the offender. An attempt to build a philosophy of punishment only upon Old Testament teachings, as some Christians seek to do, yields a view which shows little concern for the offender. What the Old Testament says has to be tempered by the examples of mercy shown by Jesus. When the Pharisees brought to Jesus a woman who had been caught in adultery, they were quite right that the law of Moses demanded that she be stoned. (Actually, according to the letter of the law, both she and the man with whom she committed adultery were to be stoned; Deuteronomy 22:22–24). Jesus, however, showed mercy when he replied to the Pharisees, "If any one of you is without sin, let him be the first to throw a stone at her." After her accusers had left, Jesus turned to the woman and said, "Then neither do I condemn you. ... Go now and leave your life of sin" (John 8:8-10). Before God, all of us are accused and found guilty. But by giving the life of Jesus Christ, God showed mercy to us. Christ's example has shown us how we might be more merciful, too. It is with an eye towards God's great mercy that we are to understand Jesus' comments in Matthew 5:38–39, "You have heard that it was said, 'Eye for eye, and tooth for tooth.'... But I tell you, do not resist an evil person. If someone strikes you on the right cheek, turn to him the other also."

A Social Theology of Punishment

With this consideration of how punishment was viewed in the Bible, we are now ready to develop a social theology of punishment suitable for application in contemporary society. A social theology of punishment must balance an emphasis upon inflicting the pain of punishment upon the offender, and an emphasis on attempting to rehabilitate the offender.

Jack Balswick is professor of Sociology and Family Development at Fuller Theological Seminary. He holds degrees from the University of Iowa (M.A., Ph.D.) and has done post-doctoral study at Trinity Divinity School. He has twice been appointed a Senior Fulbright Scholar, to Cyprus in 1972-73, and to Korea in 1982. He has authored over 60 professional articles and 6 books, the most recent being The Inexpressive Male *(1988),* Life in A Glass House: The Minister's Family In Its Unique Social Context *(1989, with Cameron Lee), and* The Family: A Christian Perspective on The Home *(1989, with Judy Balswick). The topic of this article is part of a forthcoming book,* Social Problems: A Christian Understanding and Response *(1990, with J. Kenneth Morland).*

Figure 1 depicts how this balance might be conceptualized. In Figure 1, the emphasis upon inflicting pain on the offender is represented on a continuum of low at the left side to high at the right side, while the continuum emphasizing rehabilitation ranges from low at the bottom of the figure to high at the top. The different ways in which these two emphases can be balanced is represented by the different points within the box. Thus, where there is a low emphasis on inflicting pain upon the offender and a low emphasis upon rehabilitating the offender, we have a condition which can be called societal *neglect*. A society in which this is found would tend toward anarchy—the absence of government or law—for which there is no collective mechanism to handle wrongs which one person may inflict upon another.

A society which has a high emphasis on inflicting pain upon the offender, but a low emphasis upon rehabilitating the offender, is practicing *retribution*. Retribution shows concern for the need of revenge for the victim, and demands that an offender must "pay" for the offense committed (Sheleff 1987:3–24). The law of revenge as practiced by the ancient Hebrews not only provided punishment similar in nature to the offense, but specified the maximum limit the punishment could take (Exodus 21:23–35). There is a sense in which retribution not only attempts to "equal the score" between the offender and the victim, but it might also serve to have a unifying effect upon society by drawing attention to the legitimacy of the societal norm which had been violated.

A low emphasis on inflicting pain on the offender combined with a high emphasis on rehabilitating the offender constitutes *reformation*. There are some who believe that reformation should be the only consideration used in deciding the most appropriate punishment. Those who hold to this position are often identified as "secular humanists," who understand behavior as "determined by our genes, our environment, and the associations of infancy," with "the result that all too frequently the criminal is regarded not as an offender but as a victim of his circumstances who needs treatment rather than punishment" (Hughes 1983:113).

The problem with the reformation view is not only that it fails to show concern for the victim, but that it also fails to treat the offender as a responsible human being. To not hold a person responsible for his or her own behavior renders a person less than the choice-making, responsible human being that God created. As C.S. Lewis has stated, "when we cease to consider what the criminal deserves and consider only what will cure him or deter others, we have tacitly removed him from the sphere of justice altogether; instead of a person, a subject of rights, we now have a mere object, a patient, a 'case' " (Lewis 1970:287).

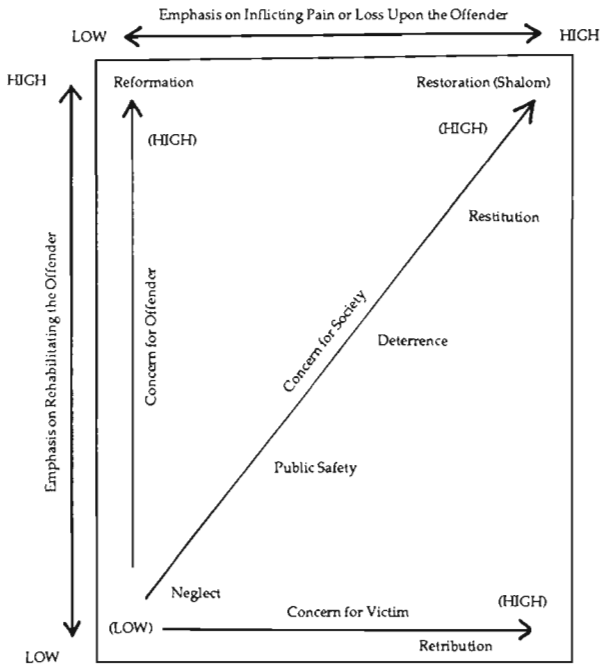


Figure 1. Towards a Social Theology of Punishment

A third reason for punishment, one which must be balanced with concern for the victim and concern for the offender, is *concern for society*. Punishment motivated by concern for the good of society is usually referred to as *deterrence*. The reasoning behind deterrence is that punishing the offender will, by example, discourage others from committing the same offense. Inversely, if the offender is not punished or is only lightly punished, then others may be less resistant to committing the same offense (Nathanson 1987:15–32). Where there is low concern for society (represented in the lower left corner of Figure 1), deterrence as a motivational force is low. As concern for society increases (represented in Figure 1 as a movement toward the upper right corner), there is an increase in deterrence. However, punishment for the good of society can be motivationally expressed at several different levels.

At a lower level, the act of removing the offender from society can be motivated by a desire for *public safety*. Merely getting the offender off the streets is a less ambitious motive than holding the offender up as an example, and thus is represented a little further down on the "concern for society"

continuum than is *deterrence.* To the upper end of this same continuum are *restitution* and *restoration,* which represent two "concern for society" motives which are more ambitious than mere deterrence. Although punishment in modern society is rarely based on concerns for restitution and restoration, these are two of the dominant reasons for punishment given in the Bible.

Restitution

In *restitution* the punishment recompenses in some direct way the harm done to the victim. Chapter 21 of Exodus contains a number of examples of punishment as restitution:

> If men quarrel and one hits the other with a stone or with his fist...he must pay the injured man for the loss of his time and see that he is completely healed. (21:18)

> If a man hits a manservant or maidservant in the eye and destroys it, he must let the servant go free to compensate for the eye. (21:26)

> If a man uncovers a pit or digs one and fails to cover it and an ox or a donkey falls into it, the owner of the pit must pay for the loss; he must pay its owner, and the dead animal will be his. (21:35) (NIV)

Exodus 22:1 teaches that in certain cases restitution needs to be more than the loss inflicted on another: "If a man steals an ox or a sheep and slaughters it or sells it, he must pay back five head of cattle for the ox and four sheep for the sheep." So strong was the Old Testament emphasis upon restitution that inability to pay back a loss to the victim could result in the offender being "sold to pay for his theft" (Exodus 22:2). The rest of chapter 22 of Exodus continues to detail types of punishment which are to be carried out based upon the principle of restitution.

The Bible clearly teaches that punishment for an offense must take into account both the act and the motive.

The absence of restitution as a form of punishment in society today may reflect the hyper--individualistic emphasis which pervades contemporary society. Our legal system seeks to make the punishment given to the offender equivalent to the harm done to the victim. But rarely is the offender made to recompense the victim directly. Only through restitution can the victim hope to be, even in part, recompensed for the real loss incurred at the hands of the offender. The absence of restitution may be one of the reasons why victims in our society cry out so harshly for revenge. Our legal system rarely provides any other way in which the victim can feel that his or her loss is being "paid for." Restitution might be especially appropriate when the victim is society at large. An example of this took place a few years ago when a highway contracting company in Nebraska pleaded guilty to bid-rigging. Instead of sending the guilty to prison, the judge ordered them to endow a $1,475,000 Chair of Ethics at the University of Nebraska (Bennett 1987:269–270).

To not hold a person responsible for his or her own behavior renders a person less than the choice-making, responsible human being that God created.

Restitution may also be a more effective way to bring about rehabilitation in the offender. In the existing system, most offenders leave penal institutions more hardened than when they entered. Part of this may well have to do with the lack of logic between the offense committed and the punishment given.

Restoration

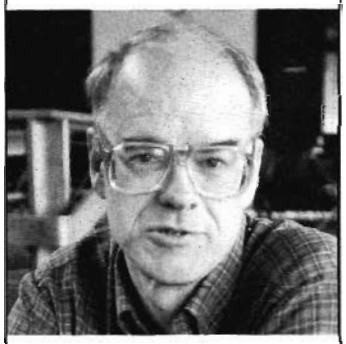
The upper right corner of Figure 1 represents an ideal where there is high concern for the victim, high concern for the offender, and high concern for society. A society which combines these three motivations for punishment is practicing *restoration.* At the interpersonal level, restoration is the process of attempting to repair or reestablish the accord which was present before an offense occurred. Restitution can begin the process of restoration at the interpersonal level. This is so because restitution focuses upon reestablishing equity in the relationship between the offender and the victim. Interpersonal restoration is possible only after there is a change in both the offender and the victim. The offender must go through a process of sorrow, confession, true repentance and asking forgiveness for the wrong committed.

The Christian basis for interpersonal restoration is the biblical model of *reconciliation.* In the Old Testament, reconciliation was made possible when a

SEARCH

Scientists Who Serve God

HE'S STILL A "ROCK-HOUND"



Davis A. Young teaches in the Dept of Geology, Geography, & Environmental Studies at Calvin College, an arm of the Christian Reformed Church. His writings have helped many Christians accept the idea of a very ancient earth.

A Young Geologist in a Theological Young Family

Born in 1941, Davis grew up in a Philadelphia suburb. His father, Edward J. Young, was a well-known professor at Westminster Theological Seminary. Another professor's son had a collection of minerals called zeolites which so fascinated Dave that he took up mineralogy as a hobby and at age twelve resolved to become a geologist. He spent many hours in Philadelphia's Fairmount Park, where Wissahickon Creek had cut a gorge through mineral-bearing schists on its way to the Schuylkill River. When his father spent a sabbatical year in San Francisco writing a commentary on Isaiah, the family had to stop at every rock shop in the Rockies and Sierras on its trip west.

As Orthodox Presbyterians, the Youngs supported the concept of Christian day schools, but Dave attended public schools. Although his sister went to Calvin College, he chose Princeton so he could major in geological engineering. He credits the Princeton Evangelical Fellowship for helping him mature in faith, after a firm theological grounding in his warmly Christian home. A Princeton professor guided Dave through a senior thesis project, confirming his boyhood career choice. He graduated from Princeton in 1962.

After a Rocky Start, A Satisfying Career

Davis then spent three years earning an M.S. in mineralogy and geochemistry at Penn State. There he participated in Inter-Varsity Christian Fellowship on campus and met his wife Dorothy, a Baptist. After they married, the couple attended a General Conference Baptist Church. The next three years they spent at Brown University in Rhode Island, where in 1969 Dave received his Ph.D. in geology. By then he was already teaching at the Washington Square campus of New York University.

The Youngs settled in Westfield, New Jersey, where they threw themselves into the life of a growing Orthodox Presbyterian church. Dave became an elder and helped start a Christian day school. He learned to get a lot of work done while commuting back and forth into New York City by train. He took students on field trips to Central Park and enjoyed many other things about teaching at N.Y.U.

In 1973, however, the financially troubled university did not renew the contracts of five untenured geology faculty members. The Youngs moved to the small southern town of Wilmington, North Carolina, where Dave helped develop a new department at a branch of U.N.C. The town had a Reformed Presbyterian church and a nice beach, but classical music on FM radio was scarce, Dave recalls, "and I was a long way from any interesting rocks."

In 1977 Calvin College in Grand Rapids, Michigan, wanted to hire an experienced geologist to form a new department. They waited another year for Dave Young to fulfill his five-year contract in North Carolina. Geologist Clarence Menninga was already at Calvin, teaching in the Physics Dept. By 1982 the college could offer a major in a department filled out by geologist Jim Clark and geographer Henk Aay.

Several years ago, when Davis Young heard that N.Y.U. was getting rid of its stored geological specimens, he managed to acquire most of them for Calvin. Those rocks have found a good home.

So, it seems, has Professor Young. Ω

Scientific Investigation

HOW OLD IS THE EARTH?

THE ROCKS OF SAGES

All rocks consist of minerals, but not all minerals are rocks (xample: a gold nugget). Minerals have a definite chemical composition; rocks are generally aggregates of mineral grains formed by natural processes.

Igneous rocks form when molten material called *magma* solidifies. Volcanic lava is magma that is still liquid when it reaches the earth's surface. Igneous rocks include glassy obsidians, finely crystalline basalts, and coarsely crystalline granites (usually composed of quartz, feldspar, and mica).

Sedimentary rocks are deposited when loose material is laid down, then cemented. Shale comes from clay deposits, sandstone from sand, gypsum from calcium sulfate in sea water, some limestones from dissolved calcite, others from the remains of corals or other tiny organisms.

Metamorphic rocks have been changed in appearance or composition by heat or pressure. Marble is metamorphosed limestone, quartzite comes from sandstone, slate from shale. Various materials change into schists, often glistening with mica and other minerals.

Petrologists study rocks. Mineralogists study minerals. Paleontologists study fossils. Seismologists study earthquakes. Geomorphologists study major surface features; geochronologists assign dates to their formation. Petroleum geologists hunt for oil and gas, and so on. (If a stratigrapher is a "sedimentary geologist," is a geophysicist a "metamorphosed physicist"?)

Davis Young calls himself a "hard-rock" geologist. That distinguishes him from certain other kinds, including paleontologists who study the fossil remains of plants and animals preserved in sedimentary rocks. Nineteenth-century paleontologists developed the concept of a "geologic column" based on a succession of fossil types in sedimentary strata (layers) piled on top of each other. The basic facts of fossil succession, which today seem to require an ancient earth, were known at least twenty years before Charles Darwin proposed a biological mechanism to explain how such changes could have taken place.

Facing a Solid Mass of Evidence

Even a hard-rock geologist has something to say about the age of the earth, however. Although he has studied rocks in Ontario, New Mexico, and elsewhere, Young's favorites are some relatively uncommon "syenites" of the New Jersey Highlands. His field studies of those rocks were published in *Geological Society of America Bulletin* (1971) and *Journal of Petrology* (1972). Young cites the petrology and structure of that region to show how well radiometric dating methods can confirm ages estimated from structural features alone.

Today's accepted scientific picture of earth history is based on evidence piled up in thousands of studies all over the world. To cope with that mass of information, geologists use many technical terms that may be confusing to nonspecialists. Yet the basic principles are not difficult to understand.

How the Ages of Rocks Are Determined

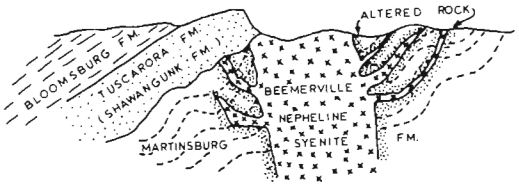
Three major generalities have enabled geologists to assign relative ages to many rock formations. (1) The "principle of superposition" states that in any undisturbed stack of layered sedimentary or volcanic rocks, a layer at the bottom must have been deposited earlier than the layer immediately above it. Sometimes layers are folded or even inverted, or a layer of rock has intruded in molten form after others have been deposited, or certain layers present in one sequence are missing from nearby sequences. Such exceptions can usually be identified by geologic field mapping over a large area.

According to (2) the "principle of cross-cutting relationships," any body of rock whose borders transect the layering of other structures in surrounding rocks must have been emplaced in that situation later than those rocks. And (3) the "principle of faunal succession" generally makes it possible to estimate the age of a layer of fossil-bearing sedimentary rock from the assemblage of fossil organisms it contains. This rule was worked out from field observations, not from evolutionary theory.

Today it is possible to use the decay rate of radioactive isotopes in certain minerals to assign absolute dates to major events in earth's history. Evidently the earth began to cool about 4.5 billion years ago. The oldest rocks dated so far are about 3.9 billion years old, and traces of life appear in rocks about 3.5 billion years old. The "Cambrian explosion" of multicellular life began about 570 million years ago.

Davis Young sees no reason to doubt the validity of those conclusions.

Ω



Field relationships of a body of nepheline syenite in northern New Jersey. It intrudes the (Ordovician age) Martinsburg Formation and is overlain by the (Lower Silurian age) Tuscarora Formation. the syenite rock, which would be assigned an age of 425 to 450 million years on that basis, was dated by a radiometric technique at 437 million years. Sketch from David A. Young, *Creation and the Flood* (Baker, 1977, p. 191).

Theological Reflection

GENESIS INTERPRETED

"Rock of Ages" is a familiar hymn written over two hundred years ago. Its title is a metaphor of Christ, taken from 1 Corinthians 10:1-4. To know Jesus Christ, the Rock of Ages, was more important to the hymn writer than knowing the age of rocks. That's also true for geologist Davis A. Young.

A resurgence in the United States of what is known as "flood geology" followed the 1961 publication of *The Genesis Flood* by theologian John C. Whitcomb and civil engineer Henry M. Morris. Davis Young found himself in sympathy with their high view of biblical inspiration, but he thinks the "scientific creationist" movement they inspired is based on a misunderstanding of fundamental geologic facts and principles.

Good Theology Should Not Be Linked to Bad Geology

Young's plans to collaborate on a book with his father, an Old Testament scholar, changed when his father died in 1968. Having absorbed his father's concern for a truly biblical theology, though, the young geologist began writing *Creation and the Flood* while teaching at N.Y.U. He wanted the Bible to speak for itself, without letting either a "neo-catastrophism" build up a pseudo-science from selected biblical texts or a "theistic evolutionism" superimpose its own agenda on Scripture.

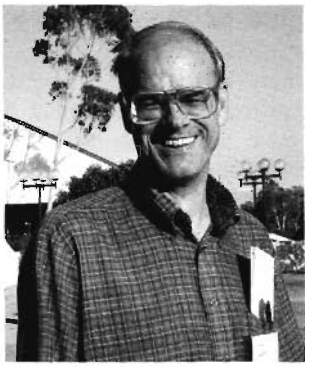
By the time Davis Young's *Creation and the Flood* was published in 1977, the "young-earth" movement was beginning to enter the U.S. political arena, soon stirring up a backlash of resistance from the scientific community. Christians armed with young-earth publications sought to influence textbook selection in a number of states and even introduced legislation mandating "balanced treatment" of their views. The press almost always referred to them as "fundamentalists," "religious right-wingers," or simply "creationists."

One balanced treatment law enacted in Arkansas was struck down by a Federal District Court in January 1982. Another, in Lousiana, worked its way through the court system and was finally struck down by the U.S. Supreme Court in June 1987. Both rulings labeled so-called creation science a religious position masquerading as science.

"Creationism" Is Not the Only Christian View of Creation

Davis Young worries when Christians promote the idea that the earth had a brief, sudden, catastrophic history, dominated by a single global flood. That damages the credibility of Christianity, he believes, and in the long run will hinder evangelistic and apologetic efforts.

In his 1982 book, *Christianity and the Age of the Earth*, Young tried, without rancor, to alert Christians to such dangers:



I regret the fact that in this book I must call those with whose views I disagree, "creationists," because I am a creationist, and I believe the biblical record of creation. Unfortunately, however, those who advocate the creation of the world in seven literal days only a few thousand years ago have come to be known generally as creationists. Hence, the reader should not draw the conclusion that I am opposed to creation simply because I use the term "creationist." I would like to say only that my understanding of creation as taught in Scripture differs from that of those whom I term "creationists." (p. 10)

If Christians would stop defending (or even refuting) a false "creationism," Young wrote, more of our energies could go into "interpreting the Bible and the world that God in His mercy and grace has given us."

Ω

WHERE TO DIG

To reach valid conclusions, one must dig into many facts and careful analyses of those facts. On the age of the earth, a good place to dig is in two books by Davis A. Young mentioned on these pages: *Creation and the Flood* (subtitled "An Alternative to Flood Geology and Theistic Evolution," Baker Book House, 1977); and *Christianity and the Age of the Earth* (Zondervan, 1982). The latter is now back in print, available from Artisan Sales (P.O. Box 1497, Thousand Oaks, CA 91360).

In *Science Held Hostage* (IVP, 1988) by Howard J. Van Till, Davis A. Young, and Clarence Menninga, Young discusses the geology of the Grand Canyon and the ways he feels it has been misinterpreted by young-earthers.

Some people do not accept the validity of radiometric dating methods. For them, Daniel E. Wonderly has compiled evidence from other methods of arriving at the age of the earth: *God's Time Records in Ancient Sediments* (Flint, MI: Crystal Press, 1977), and *Neglect of Geologic Data* (subtitled "Sedimentary Strata Compared with Young-Earth Creationist Writings," IBRI, P.O. Box 423, Hatfield, PA 19440, 1987).

These and many other books on issues of science and theology are available from the American Scientific Affiliation Bookservice, c/o Mark Ahrenholz, Logos Bookstore, 510 Commonwealth Ave., Boston, MA 02215.

Thoughtful Worship

WHEN CHRISTIANS DISAGREE

Theologians disagree on how to interpret Genesis, just as "geologians" at times disagree on how to interpret physical data. When the facts fail to rule out all but one reasonable hypothesis, scientists generally try to withhold final judgment while seeking new information and exploring all possibilities. Davis Young urges Christians to do that too.

Putting Our Heads Together

Davis Young (r) meets with other Christian geologists.

We have much to learn from other views, including those at odds with our own. We need to listen to believers from various traditions and to scholars from various fields. Such interactions are characteristic of the American Scientific Affiliation, a large Christian group within which Young has recently organized an Affiliation of Christian Geologists.

In 1984-85 Young joined others in a year-long study of "Creation and Cosmogony" at the Calvin Center for Christian Scholarship at Calvin College. That enabled him to explore more deeply what many Christian thinkers have said about the biblical doctrine of creation. His articles in two 1987 issues of *Westminster Theological Journal* and in the 1988 *Reformed Journal* show that scholars with a very high view of Scripture have held a range of opinion on what God's Word actually says about creation.

"On the Literal Meaning of Genesis"

Augustine of Hippo (A.D. 354-430), one of the greatest Christian theologians, urged common sense and openness. Since non-Christians may be well acquainted with natural phenomena, he wrote:

> 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 embarrassing situation, in which people show up vast ignorance in a Christian and laugh it to scorn. The shame is not so much that an ignorant individual is derided, but that people outside the household of faith think our sacred writers held such opinions, and, to the great loss of those for whose salvation we toil, the writers of our Scripture are criticized and rejected as unlearned men....

The quotation is from a full English translation of Augustine's *On the Literal Meaning of Genesis* (by J. H. Taylor, S.J., Newman Press, 1982, p. 42). In that major work, Davis Young discovered many other themes applicable to today's controversies over "scientific creationism." In particular he found that Augustine considered the six-day framework of Genesis 1 to have nothing to do with the passage of time; instead it formed a logical structure for the biblical writer. Clearly, Augustine's reading of the "days of creation" cannot be seen as an accommodation to modern scientific discoveries.

It is evident that interpretating Genesis 1 is not simple, if a serious scholar like Augustine acknowledged difficulties in "seeing clearly the meaning of the sacred writer in the matter of those six days." Augustine stressed that he was striving for the most *literal* reading of the text, not figurative or allegorical one.

Davis Young admits that he doesn't agree with all of Augustine's interpretations. Yet he appreciates Augustine's approach to Scripture and to disagreements *about* Scripture. Augustine's devout example should help Christians approach the early chapters of Genesis "with far less dogmatism and far more humility than we often do."

Ω

This issue of **SEARCH (No. 07)** was prepared by Walter R. Hearn of Berkeley, California. Design and layout by ASA managing editor Nancy C. Hanger. Opinions expressed in SEARCH are those of individuals and may not be representative of the entire ASA membership. Scripture quotations are from the Revised Standard Version unless otherwise noted.

SEARCH brings scientific questions to the attention of pastors and the Christian public by focusing on the work of Christians in science. SEARCH is an occasional publication of the American Scientific Affiliation (ASA), Robert L. Herrmann, executive director. To obtain a free single copy, send stamped, self-addressed envelope to: ASA, P.O. Box 668, Ipswich, MA 01938. Be sure to state the number of the issue being requested. Multiple copies to one address: 15¢/copy plus $1.50 postage and handling charge; prepaid orders only, please.

The 1989 version of ASA's 48-page guidebook, *Teaching Science in a Climate of Controversy*, helps teachers cope with questions of science and religion. It is available postpaid from ASA at $6 for one copy, $5 each for 2-9 copies, $4 each for 10 or more copies (multiple copies to one address, please).

For information on ASA Annual Meetings, other ASA publications, or how to become a **Member**, **Associate**, or **Friend** of ASA, write to:

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

sacrificial atonement (the Hebrew verb *kaphar*, meaning "to cover") was offered for sin (Leviticus 6:30; 16:20). Jesus radicalized the concept of reconciliation by tying it to the seeking of reconciliation from an offending brother: "Therefore, if you are offering your gift at the altar and there remember that your brother has something against you, leave your gift there in front of the altar. First go and be reconciled to your brother; then come and offer your gift" (Matthew 5:23–24). It is noteworthy that the Greek word for "being reconciled" is *diallattomai*, which means "to be changed entirely." Reconciliation or interpersonal restoration is for the benefit of the offended as well as the offender. It is God's desire that all broken relationships be restored.

Although punishment in modern society is rarely based on concerns for restitution and restoration, these are two of the dominant reasons for punishment given in the Bible.

It is significant that Jesus taught that Christians should take the initiative in seeking reconciliation. The basis of this is found in the reconciliation made possible by Christ's atoning death: "Be reconciled to God. God made him who had no sin to be sin for us, so that in him we might become the righteousness of God" (II Corinthians 5:20–21). The theology of the cross provides a basis for Christians to pursue and achieve reconciliation with an offending person.

Reconciliation or restoration in the offender-victim relationship must not be superficially rushed, however (Sheleff 1987:357). Victims must be given time to admit to and experience deep feelings of betrayal, grieving, anger, rage, and desire for revenge. The last thing they need (quite literally) is to be urged to forgive the offender. Forgiveness is possible only after the victim has been able to let go and disarm the emotional power that the offense has over his or her life. Forgiveness never means condoning or excusing the offense. It must be a conscious choice on the part of the victim to let go, a choice which can be aided by the empowering of God's grace. (See Lewis Smede's book, *Forgive and Forget*, for an excellent discussion of this.) Before true reconciliation can take place, the person who instigated the offense must also be fully penitent for the wrong committed. When true repentance from the offender and forgiveness from the victim take place, restoration takes the form of interpersonal reconciliation. In terms of the biblical parable of the good neighbor, interpersonal restoration is the process of becoming a neighbor to one another.

In addition, however, a biblical view of punishment calls for restoration at the societal level. Societal structures themselves can be, at least in part, responsible for creating an environment within which certain types of criminal offense are likely to occur. Social structures, for example, which allow a few to accumulate vast wealth, while others are left poor and destitute, are by their very natures structures which encourage criminal activity. Such social structures are evil and must undergo restoration.

In his 1985 book, *Sense and Nonsense About Crime*, Samuel Walker argues that a radical reorientation of our economic structure has eroded real economic opportunity. He believes none of the major crime reduction strategies, including well-intended social programs, are effective because they merely tinker with the existing system. Walker concludes that, although it is futile to strike back at crime directly, "We can attack crime indirectly by attacking economic opportunity directly" (Walker 1985:224). In biblical terms, this criminologist is suggesting that *restoration* is needed at the societal level.

A biblical view of justice leaves no room for a mere legalistic application of punishment for the poor in a system in which their only recourse is to steal in order to have enough food to live. The Bible demands that Christians be the creators of justice, and not merely the reinforcers of an existing order.

The absence of restitution may be one of the reasons why victims in our society cry out so harshly for revenge.

In contrast to Aristotle's classical model of *preserving* justice, biblical justice is *creative* justice (Mott 1982). Whereas classical justice is oriented towards sustaining people in their place in the existing social structure, biblical justice is oriented towards *re-creating* social structures so that all members can participate fully and equally in society. As Mott states:

> The difference between scriptural and classical justice

> lies in the understanding of what is to be the normal situation of society. The Scriptures do not allow the presupposition of a condition in which groups or individuals are denied the ability to participate fully and equally in the life of the society. For this reason, justice is primarily spoken of by the biblical writers as activity on behalf of the disadvantaged. (p. 65)

Mott further argues that biblical justice is dominated by the *principle of redress*, "which postulates that inequalities in the conditions necessary to achieve the standard of well-being be corrected to approximate equality" (p. 67). He finds this principle in such biblical texts as Psalm 107:39–41: "Then their numbers decreased, and they were humbled by oppression, calamity and sorrow; he who pours contempt on nobles made them wander in a trackless waste. But he lifted the needy out of their affliction and increased their families like flocks." Redress can also be seen in the Old Testament concept of the "Year of Jubilee," which stipulated that after every fifty years all confiscated land, whether sold or foreclosed, is to be returned to the family whose heritage it is (Leviticus 25:25–28).

Conclusion

I have argued that a biblical view of punishment will incorporate high concern for the victim, high concern for the offender, and high concern for society. From a societal point of view, one of the chief purposes of punishment is to keep the offender from repeating criminal acts in the future. Given that the recidivism rate among released prisoners is between 65 and 70 percent, the existing penal system is failing as a form of punishment. An examination of recent research suggests, I believe, that punishment is most effective when it most approximates the concerns of a biblical view. For example, in a study of more than two thousand juvenile offenders from four Illinois jurisdictions, John Wooldredge found that close supervision in open community facilities was more effective when compared with probation alone or with sentencing to high security detention homes (Wooldredge 1988). Wooldredge further found that among those juveniles sent to detention facilities, the rate of recidivism was the *highest* among those whose stay was the *longest*. A review of studies of juvenile correctional treatment between 1975 and 1984 reported that recidivism was reduced most when strong external controls, heavy structuring of daily schedules, and surveillance by community agencies were used (Lab and Whitehead 1988). At the individual level, a biblical application of punishment will seek to reintegrate the offender into community life, while not negating the seriousness of the offense committed.

A biblical application of punishment will also include an attempt to restore social structures to a more biblical ideal. Ideal societal structures are characterized in the Bible as *shalom*. *Shalom* is "the human being dwelling at peace in all his or her relationships: with God, with self, with fellows, with nature" (Wolterstorff 1983:69). Society will have been restored to a state of *shalom* when it is characterized by a *just peace*. Where peace and order are present without justice there is no *shalom*. Punishment of offenders in an unjust state which fails to address the problems of injustice or alienation reflect a secular rather than a biblical view of punishment.

A biblical view of peace and justice requires that both interpersonal and social structural restoration be a motivating goal behind the use of punishment in a legal system. Punishment is misplaced when it focuses only on retribution for the victim and rehabilitation for the offender; it must see the restoration of a just peace at all social structural levels. Such a situation is poignantly described in Isaiah 11:6–8: "The wolf shall dwell with the lamb, and the leopard shall lie down with the kid, and a little child shall lead them." Without losing concern for the victim and the offender, a biblical view of punishment will also encompass the holistic connotation of *shalom* as societal well-being. ✤

REFERENCES

Bennett, G. (1987). *Crimewarps: The Future of Crime in America*. Garden City, NY: Anchor Books.

Currie, E. (1985). *Confronting Crime: An American Challenge*. New York: Pantheon Books.

Hughes, P. (1983). *Christian Ethics in Secular Society*. Grand Rapids, MI: Baker Books.

Lab, S.P. and J.T. Whitehead (1988). An analysis of juvenile correctional treatment. *Crime and Delinquency* 34:60–83.

Lewis, C.S. (1970). The humanitarian theory of punishment, in *God in the Dock: Essays on Theology and Ethics*. Grand Rapids: Eerdmans.

Mott, S. (1982). *Biblical Ethics and Social Change*. New York: Oxford University Press.

Nathanson, S. (1987). *An Eye for An Eye? The Morality of Punishing By Death*. Totowa, NJ: Rowman and Littlefield.

Sheleff, L.S. (1987). *Ultimate Penalties: Capital Punishment, Life Imprisonment, Physical Torture*. Columbus, OH: Ohio State University Press.

Smedes, L. (1984). *To Forgive and To Forget*. New York: Harper and Row.

Walker, S. (1985). *Sense and Nonsense About Crime: A Policy Guide*. Monterey, CA: Brooks/Coe Publishing.

Wolterstorff, N. (1983). *Until Justice & Peace Embrace*. Grand Rapids: Eerdmans.

Wooldredge, J.D. (1988). Differentiating the effects of juvenile court sentences on eliminating recidivism. *Journal of Research in Crime and Delinquency* 25:264–300.

Of Messages and Molecules: What is the Essence of Life?

DAVID L. WILCOX

Biology Department
Eastern College
St. Davids, PA 19087

The concept that the nature of chemical reactions can form an adequate basis to explain or describe the essence of life is examined and rejected. The proposed alternative suggests that the real essence of life is the information or patterns which, although carried on DNA, are not determined by it. Several implications of the concept of informational entities are then explored.

The Argument For a Chemical Essence

The initial premise of this paper is that the more completely we understand biochemistry, the more unlikely it seems that such chemistry represents the "essence" of life. Although such a statement runs counter to most current thought, I contend that it is amply justified by recent developments in genetics.

Nineteenth-century materialists considered life an emergent phenomenon of simple inorganic reactions, a necessary product of the laws of chemistry. Life was thus thought to be a predictable outcome of highly probable reactions. Today, the materialistic conviction of a "chemical essence" remains strong. Biological chemistries are known to be elegant and precise in both place and time, parts of highly determined and exactly governed systems of reactions. Nevertheless, the boundary conditions for the reactions are set and controlled by specific chemical constraints. No maneuvering room seems left for an *elan vital*, a soul, or the body as a whole. All life is chemically governed chemistry. Has the molecule preempted the seat of the soul?

In the same fashion, developmental biology increasingly points to the molecule. Bodies unroll from single cells in a pattern dependent on the distribution of chemicals in the cytoplasm of those initial cells. The early molecular patterns set the initial patterns of tissue cells, and in turn, interactive movements of those early tissue layers shape the organs and thus the organism. Morphogenetic movements and cell differentiation are controlled by gradients of inductive chemicals produced by tissues. Has development also been reduced to chemistry? Are bodies simply epiphenomena of embryonic chemistries?

Some efforts to define the essence of humanity have also looked to biochemistry. Human and nonhuman chemistries are often almost identical. Histological chemistries, as used in transplant tissue typing, show more than a ninety-eight percent overlap between human and chimpanzee. This means that biochemical differences *within* human populations are often greater than the average biochemical differences *between* the two species. If there is no distinguishable difference in our chemistries, our cells, tissues, and organ structures, are humans to be thought of as a rather odd sub-species of chimpanzee?

The Argument Against a Chemical Essence

Each of the above arguments contains seeds for its own dismissal. Precise control of the boundary conditions of biological chemistries requires a complex system of "top-down" control and structure. Even a quick look at complete biological entities reveals a *hierarchy* of such physiological or cyber-

netic constraints. Thus, whole-body norms set organ-function norms (boundary conditions), organs set cellular norms, and cells set the norms for their chemistries. Although chemical agents are used to control chemistries, the agents simply enforce the commands of the body as a whole, as transmitted down through its levels of structure. If the essence were truly chemical, high-level structure would follow patterns which *arose from* and *imaged* the fundamental characteristics of the chemicals themselves. But they do not.

The essence of the developmental "unrolling" process is that it follows a previously existing program. The initial molecular template was *created by* a holistic pattern which the fertilized ovum carries; a pattern which not only describes normal biochemistry, but also the norms for all levels of structure. (Since the new zygote ova will self-organize *in vitro*, it is evident that the fertilized ovum carries an ideal body pattern rather than being structured by the maternal adult body.) Even "preformed" embryos with deterministic cleavage are "fate-mapped" *products* of a complete pattern, a pattern which includes the path and goal of development as well as error-correction mechanisms.

In the example of human and chimpanzee chemistries, to say that there is no significant chemical difference is *not* to say that the two primates are identical, but rather that their differences are either not significant or are not chemical in nature. If their differences *are* significant, it is simple logic to say that their differences must be located elsewhere. To state that chemical identity means total identity is to assume the point to be demonstrated, that the essence of biological form is in the chemistry. One must already believe in chemical determinism.

But where then *is* the source of the differences? Where are holistic patterns stored and read? Does this logic require an immaterial *elan vital*, or soul, or can the DNA hold all levels of pattern? The latter is usually assumed to be true. Would such a concession be a return to chemistry via another route? Human and chimpanzee total DNA are almost identical. Thus, how can the chemical nature of DNA be considered the essence of life?

The Medium is NOT the Message for Life

If DNA chemistry is *not* to be considered the essence of life, what is? Obviously the total pattern of living systems must be explained. Could one say that the essence is the pattern carried *on* the DNA, rather than the DNA itself? Or, is this simply quibbling, a way to slip chemical determinism in the back door? I think not. The distinction being drawn is the difference between the medium and the message, the transmission vehicle and the entity transmitted.

A few definitions will clarify this point. A *medium* is a channel by which information can be stored and/or transferred. A system is able to act as a medium because it can exist in several possible states, which may collectively be termed its *ensemble*. Any such system can be measured for its *potential* as a medium, its capacity to store and carry information. However, it becomes a medium only if its ensemble of various states is converted into an *alphabet* by being given arbitrary assignments of symbolic meaning (as in Morse code or the English alphabet). A defined ensemble therefore becomes an alphabet through which one can encode a message. Note that the content of such a message will be independent both of the nature of the medium and of the code-word assignments. However, its expression will be dependent on them. Thus, the same paper and ink, and the same letters, can be used to encode Spanish or English, and the same words (in either language) can be used to encode either the Scriptures or pornography. Given the

David L. Wilcox received a Ph.D. in Population Genetics from Penn State University in 1981. He has taught five years for Edinboro State College and eleven years for Eastern College. He currently chairs ASA's Creation Commission and has presented papers dealing with the theoretical nature of selective fitness and the use of biblical perspectives in analyzing biological theory.

coding definitions, the message shapes (rules) the sequence of the letters.

Such a distinction can be effectively applied to DNA and the "message" of life. As an illustration, consider the following thought-experiment. At the present time, the complete DNA sequence of certain bacterial viruses (phages) has been determined and published. Using the published genome sequence of phage Phi Chi 174, for example, one could program a "gene machine" (automated DNA synthesizer) with the phage DNA sequence. After obtaining a complete product, a naked strand of DNA, one could inject it into the bacterium *E. coli*. The DNA would take over the bacterial cell and cause the production and release of infectious phage particles (viruses). The phage placed in the first bacterium was their ancestor, but did it (the infecting phage) have an ancestor? Was there an ancestral virus? Of course. The pattern of information taken from a scientific paper was the ancestor. The printed phage was on the printed page. What was the essence of the phage's life? Not DNA, but a medium independent pattern! (It may be objected that viruses such as a bacteriophage are not truly alive, since they depend upon host cells for their synthesis. The point of the argument, however, is not the exact status of viruses, but rather that all living things are the realization of patterns stored on the DNA.)

Has the molecule preempted the seat of the soul?

The objection may be raised that DNA encodes information only for how to make proteins; thus, although a message, it is still chemical in essence. The inadequacy of such an argument should be obvious. Genomes do not produce mere proteins; they produce a hierarchy of cells, organs, and organisms *made* of protein. Thus, other patterns (information) must also be written there. To some extent, this is true even for a bacteriophage. The folding pattern for packaging its RNA "chromosome" is stored on the genome of an RNA virus, as well as the information to make its needed proteins.

The easiest way to approach this question is to evaluate a human language such as English. Such languages contain a *hierarchy* of alphabets. At the first level, written letters are assigned phonetic definitions. Sequences of such sounds (words) are then assigned second-level definitions as objects, actions, etc. In turn, sequences of words are utilized to encode real-time events such as, "I ate the bread." Finally, events themselves may be assigned a symbolic meaning, as in the Lord's Supper which "shows the Lord's death until he comes." Note that at each level, a single "word" may be assigned to represent the increasingly complex object. In the example given, the highest level is represented by the term Eucharist.

To state that chemical identity means total identity is to assume the point to be demonstrated, that the essence of biological form is in the chemistry.

In the same fashion, descriptions of specific chemicals encoded on the DNA may themselves become letters used to write more global descriptions. In order to do so, to use a lower level of message as an ensemble and medium, the encoding conventions must themselves be written out on the medium. This is necessary because they must be available for us in decoding (reading) messages written in that language. Without definitions, a message is indistinguishable from a random sequence. For example, consider the code sequence for the 20 different types of amino acids used to make proteins. Each is defined at the protein level. These definitions are in the form of large proteins which can recognize *both* the code words (tRNA paracodons) *and* the amino acids which they represent. The amino acid code is therefore used to encode and thus describe (the protein definitions of) the amino acid code itself.

At the next level, recognition codes (enhancer sequences) for more complex structures are tagged to the descriptions of the proteins needed to make them, and new proteins are described (homeobox genes) which will be able to read the new recognition codes. One more level, and the recognition proteins are themselves tagged with a set of recognition codes, and so on. What this reveals is a complex series of hierarchically encoded languages, with independent messages written at each level. Presumably, each level of the organic structural hierarchy would be described at a specific linguistic level of that information hierarchy.

In this complex mesh of information, the *expression* of each level of coding is controlled by the level *above* it. By analogy, in English the event to be described dictates the words to be used, and they in turn dictate the letter sequence. Likewise, the

DNA information concerning a specific protein's structure is used only because those particular proteins are the appropriate components needed to build some larger structure. Each level encoded enforces boundary conditions on the level below it. Governance thus moves from whole-body pattern to cell pattern to molecular pattern rather than the reverse. Since higher-level norms govern lower-level activities and structures, the essence of life is the total organismic pattern, not the component biochemistries. Life is first a resident of a world of information before being embodied in physical creatures. The appropriate metaphor is language or computer programs, not the machine. Chemistry is about as relevant to understanding a whole organism as an analysis of the plastic of a record album would be to understanding a recording of a Brahms concerto.

Implications of an Informational Reality

The concept of living essences as patterns of information raises a variety of questions about humans and other living things. For example, an informational pattern might be considered a sort of encoded *elan vital*. This would imply that informational patterns might be *real* entities, living patterns engaging in specifically controlled observable activities during development, etc. By extension, such coherent patterns could exist *above* the organismic level. A tissue cell expresses only a small part of the larger body pattern which it contains. Might not an organism be expressing only a small part of a population level pattern which it contains? In its simplest case, both males and females carry the full pattern for *both* sexes. Thus, an entire population could be viewed as a coherent entity, an obedient creature responding to its Creator's commands. More precisely, the population-level pattern expressed in individual organisms could be so viewed. The "command" addressed to the population could be expressed as: increase and fill both ecological and morphological space.

The DNA information concerning a specific protein's structure is used only because those particular proteins are the appropriate components needed to build some larger structure.

Chemistry is about as relevant to understanding a whole organism as an analysis of the plastic of a record album would be to understanding a recording of a Brahms concerto.

The concept of living things as systems specified by coherent patterns would also change the complexion of natural selection. The total pattern carried by a population apparently is a "hyperspace" of alternative functional morphologies. A specific *organism* would be canalized (specialized), embodying a certain location in that hyperspace, but yet could be carrying in its genome a considerable variety of alternative morphological states. For example, there is some suggestion in the literature that there might be a single avian morphological package, variously expressed in different species. If so, directional selection (or explosive radiation, not to speak of mutation) could be viewed on the population level as a "deliberate" exploration of morphological hyperspace, looking for morphologies better matched to available niche space. The "command" is to increase and to fill *both* spaces. Individual organisms would act as sensory probes for such a population-level pattern. Selection would indeed be a process by which environmental information was collected, but the internal pattern would act as the collecting agent. Note that this is *not* group selection, nor is it neo-Lamarkian. Rather, it is organism-level selection *by the population-level pattern*. This proposal leaves open, however, the question of whether a process that collects and condenses environmental information is capable of building new morphological map structure. In other words, how does selection produce new morphologies?

The concept of linguistic levels also clearly defines a major difficulty with models of the origin of life. Not only must initial organisms (presumably simple cells) have their pattern encoded onto a replicable medium, they must also "know" the decoding conventions (definitions) to read that pattern. Cells can only "know" the definitions of the code words, however, if they are written down in the very language that the definitions describe. Thus, the central quandary: How is a message to be generated prior to the existence of the language used to speak it? The same question reappears again at each level of language encoded onto DNA. Thus, how are one hundred new bauplans generated in the Cambrian

if organismic-level language is not yet encoded? But if it is, where are the organisms which were encoded in it?

An entire population could be viewed as a coherent entity, an obedient creature responding to its Creator's commands.

Lastly, the idea of humanity being in "the image of God" is obviously a patterning concept, an informational definition. It seems clear that such imaging would be identified as *message* rather than *medium* or *ensemble*. The question therefore arises, at what biological linguistic level would God's image be encoded? In which language can the image be spoken? How many levels of structure and/or information would act simply as the medium used to *carry* the divine pattern? If high level structures themselves can form *ensembles* of code words for still higher level languages, could some characteristics seen in chimpanzees be used as a medium to write such an image? Are such characteristics only language-symbols, words which can be assigned arbitrary definitions and used to encode a higher level message? Or are chimpanzees a different story (message) told at the same level as our own story? Still, "In the beginning was the Word..." ✤

REFERENCES

Antonovics, J. 1987. The evolutionary dys-synthesis: Which bottles for which wine? *The American Naturalist* 129(3):321-331.

Belyaev, D.K. 1979. Destabilizing selection as a factor in domestication. *The Journal of Heredity* 70:301-308.

Davenport, R. 1979. *An Outline of Animal Development*. Reading, MA: Addison-Wesley Publishing Company.

Dhouailly, D. and P. Sengal. 1973. Interactions morphogenes entre L'epiderme de reptile et de derme d'oiseau ou mammifere. *C. R. Acad. Sci. Ser. D.* 277:1221-1224.

Eldredge, N. 1985. *Unfinished Synthesis*. Oxford: Oxford University Press.

Eldredge, N. 1986. Information, economics and evolution. *Annual Reviews of Ecology and Systematics* 17:351-369.

Erwin, D. 1987. A comparative study of diversification events: The early paleozoic versus the mesozoic. *Evolution* 4(6):1177-1186.

Grene, M. 1987. Hierarchies in Biology. *American Scientist* 75:504-510.

Gould, S. 1980. The promise of paleobiology as a nomothetic, evolutionary discipline. *Paleobiology* 6(1):96-118.

Gould, S. 1980. Is a new and general theory of evolution emerging? *Paleobiology* 6(1):119-130.

Gould, S. 1985. The paradox of the first tier: An agenda for paleobiology. *Paleobiology* 11(1):2-12.

Hampé, A. 1960. Le competition entre les elements osseux du zeugopode de poulet. *J. Emb. Exp. Morph.* 8:241-245.

King, M. and A. Wilson. 1975. Evolution at two levels in humans and chimpanzees. *Science* 188:107-116.

Kollar, E.J. and C. Fisher. 1980. Tooth induction in chick epithelium: Expression of the quiescent genes for enamel synthesis. *Science* 207:993-995.

Lawlor, D., F. Ward, P. Ennis, A. Jackson and P. Parham. 1988. HLA-A and B polymorphisms predate the divergence of humans and chimpanzees. *Nature* 335:268-271.

Levin, R. 1988. A lopsided look at evolution. *Science* 241:291-293.

Mueller, B. 1986. Effects of skeletal change on muscle pattern formation. *Bibliotheca Anatomica* 29:91-108.

Parsons, P. 1987. Evolutionary Rates under Environmental Stress, in *Evolutionary Biology*, Vol. 21. New York: Plenum Press.

Raff, R. and T. Kaufman. 1983. *Embryos, Genes, and Evolution: The Developmental-Genetic Basis of Evolutionary Change*. New York: Macmillan Pub. Co., Inc.

Salthe, S. 1985. *Evolving Hierarchical Systems*. New York: Columbia Unviersity Press.

Stanley, S. 1979. *Macroevolution: Pattern and Process*. San Francisco: W.H. Freeman.

Valentine, J. and D. Erwin. 1987. Interpreting great developmental experiments: The fossil record, in *Development as an Evolutionary Process*. Edited by R. Raff and E. Raff. New York: Alan R. Liss.

Volkenstein, M. 1987. Punctualism, non-adaptationism, neutralism and evolution. *Biosystems* 20:289-304.

Vrba, E. and N. Eldrege. 1984. Individuals, hierarchies and processes: Towards a more complete evolutionary theory. *Paleobiology* 10(2):146-171.

Vrba, E. and S. Gould. 1986. The hierarchical expansion of sorting and selection: Sorting and selection cannot be equated. *Paleobiology* 12(2):217-228.

Wallace, A. 1984. *Mechanisms of Morphological Evolution*. New York: John Wiley and Sons.

Do you wish to honor the Body of Christ? Do not despise him when he is naked. Do not honor him here in the church building with silks, only to neglect him outside, when he is suffering from cold and from nakedness. For he who said, "This is my Body" is the same who said, "You saw me, a hungry man, and you did not give me to eat." Feed the hungry, and then come and decorate the table. The Temple of your afflicted brother's body is more precious than this Temple (the church). The Body of Christ becomes for you an altar. It is more holy than the altar of stone on which you celebrate the holy sacrifice. You are able to comtemplate this altar everywhere, in the street and in the open squares.

St. John Chrysostom

Communications

Determinism and Chaos

The nature of the interaction between "determinism" and "chance" has been the subject of continued debate in one form or another from the early days of recorded human thought. Theologically, it is well known as the "predestination vs. free will" debate, although the actual connection between the theological debate and the scientific debate is tenuous at best. The development of science in the last few centuries has given it a new intensity, since scientific descriptions must fall either into the category of deterministic or chance (probabilistic), neither of which as an isolated world view is compatible with biblical concepts of human responsibility. A thumbnail sketch of the question and its implications has recently been given in this journal.[1] I believe it is fair to say that evangelical Christians with a commitment to both authentic science and authentic biblical theology largely follow the lead of those like MacKay who maintain the existence of a reality in which both determinism and chance are intricately and sometimes even mysteriously interrelated.[2]

A curious and fairly dramatic twist to this debate has been given in recent years by the scientific recognition of the state known as "chaos." In the popular mind, chaos is what one would expect in a completely random or chance-oriented environment; we have been delivered from chaos by the existence of order (deterministic relationships). Some of the early ideas of creation dealt with God's overcoming chaos with order, again emphasizing the common expectation that these two kinds of description are mutually exclusive.

The contention that we ought to expect complex interactions between determinism and chance, or between order and chaos, has found a rather dramatic expression in recent discovery of those specific effects that have come to be known as "chaos." It is the purpose of this communication to illustrate the type of effect observed (in one of its simplest manifestations).

A recent insert, in *Science* magazine, entitled "A Simple Model of Chaos,"[3] describes a model based on population biology that illustrates nicely how "chaos" can proceed from a deterministically described process. The population of a particular insect species in one year N_t is related to the population in the following year N_{t+1} approximately by the following relation:

$$N_{t+1} = \alpha N_t (1 - N_t) \qquad (1)$$

Here N_t is expressed in appropriate units so that its numerical values fall between 0 and 1 (a negative value for N_{t+1} would imply extinction), and α is a constant that controls the specific form that the results of Eq. (1) take over a number of generations. In order to express the implications of Eq. (1) it is necessary to choose a value for α and an initial value for N_t. It is the extreme sensitivity of Eq. (1) to small variations in the initial value of N_t for certain values of α that characterizes chaotic behavior.

Figure 1 shows the variation of the "population" with the number of generations from 1 to 100, for values of α between 2.9 and 3.5, and an initial value of $N_t = 0.50$. It can be seen directly from Eq. (1) that if $\alpha = 2.0$ when $N_t = 0.50$, $N_{t+1} = N_t$, and the population is unchanged with successive generations. When $\alpha = 2.9$, early generations show alternating values which quickly decay down to a "population" of about 0.65 within 20 to 30 generations. When $\alpha = 3.0$, the decay of the two alternating values is much slower and persists out to 100 generations, so that the 99th generation shows $N_t = 0.68$ and the 100th generation shows $N_t = 0.64$.

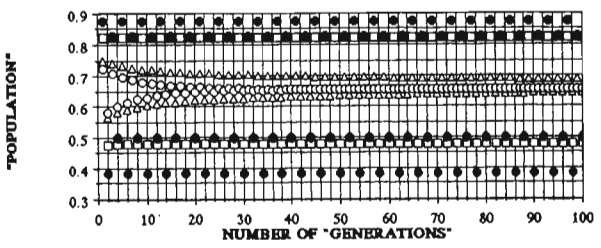
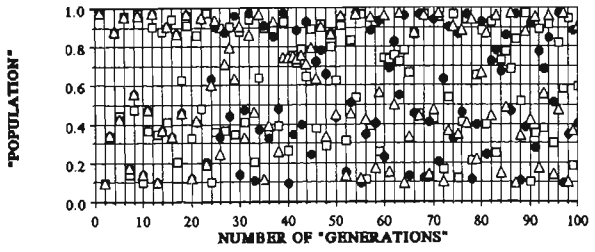


Figure 1. The variation of "population with the number of "generations" according to Eq. (1) for $N_t = 0.50$ and $\alpha = 2.9$ (○), 3.0 (▽), 3.3 (❑), and 3.5 (●).

Figure 2. The variation of "population" with the number of "generations" according to Eq. (1) for $\alpha = 3.9$ and $N_t = 0.49$ (●), 0.50 (❑), and 0.51 (▽).



When $\alpha = 3.3$, there are again two alternative values (0.82 and 0.47) but these are stable in alternate years over the range from 1 to 100 generations. When $\alpha = 3.5$, the number of alternative values (0.87, 0.82, 0.50 and 0.38) jumps to four, and these are unchanging from 1 to 100 generations. Although these four cases show increasing complexity, they also give the appearance of an ordered and structured complexity.

When $\alpha > 3.57$, this ordered behavior gives way to chaos. The data points in Figure 2 show the "populations" for $\alpha = 3.9$ and for three cases in which $N_t = 0.49$, 0.50 and 0.51, three numbers differing by only 2% from one another. Right from the first generation on, the points jump around in a random fashion. For the first 10 generations the points for the three different initial values of N_t are approximately the same, but after 20 or 30 generations, major differences between the three sets of data arising from different initial values of N_t are evident. Table 1 lists the specific "population" values shown in Figure 2 for a few selected later generations, showing the very strong influence of the small difference in the initial values of N_t.

Table 1

Values of "Populations" in Specific "Generations" [According to Eq. (1) with $\alpha = 3.9$]

"Generation" Number	*"Population"*		
	$N_t = 0.49$	$N_t = 0.50$	$N_t = 0.51$
60	0.23	0.26	0.96
70	0.94	0.43	0.48
71	0.20	0.96	0.97
72	0.63	0.17	0.10
73	0.91	0.54	0.36
74	0.33	0.97	0.90
75	0.86	0.12	0.34
80	0.93	0.89	0.66
90	0.92	0.10	0.43
100	0.40	0.60	0.91

These results illustrate how the condition of chaos can be generated from a deterministic relationship. Counter examples are also available that show how an orderly pattern or structure can be obtained from a large set of random events suitably limited by appropriate boundary conditions: the generation of order out of chaos. There is no necessary profound philosophical or theological implications in these results, but they do warn us to avoid simplistic dichotomies between deterministic and chance processes as we face interactions between science and theology. ✤

NOTES

[1]R.H. Bube, "Penetrating the Word Maze: Determinism/Chance," *Perspectives on Science and Christian Faith, 41*, March (1989), p. 37.

[2]D.M. MacKay, *The Open Mind and Other Essays: A Scientist in God's World*, edited by Melvin Tinker. (Leicester, England: Inter-Varsity Press, 1988).

[3]R. Pool, "A Simple Model of Chaos," *Science 243*, 311 (1989).

Richard H. Bube

Department of Materials Science & Engineering
Stanford University
Stanford, CA 94305

Flexibility in Interpretation

Discovery of almost any kind involves collecting substantiated information or data, and then attempting to interpret it. The information may be indisputable, but interpretations often have to be repeatedly modified in the light of new evidence. The same can be true of our interpretation of scripture as it is in the realm of science.

Modifying Interpretation of Scientific Observations

Over a quarter of a century ago I was collecting data on the clinical and radiological features, the geographical and socio-economic distribution, and other aspects of the epidemiology of the tumour that was to become known as Burkitt's Lymphoma. The data was firm and indisputable, but the hypotheses postulated to explain it had to be revised again and again in the light of new evidence. When a hypothesis is found to be inconsistent with the facts, one must be willing to modify or abandon it. Only so is progress made and truth eventually established.

Over a decade later I became involved in studying the aetiology of other diseases, including appendicitis and cancer of the large bowel. I wrote numerous papers and chapters in medical textbooks arguing that appendicitis was almost exclusively caused by a deficiency of dietary fibre in the food eaten. The disease, rare even in Western countries until the early twentieth century, became the commonest abdominal emergency operation, but it is still rare in the Third World. The evidence from many directions seemed overwhelming. Then a paper appeared, backed by massive data, that the disease was related to sanitary improvements in homes. The situation appeared to parallel that of poliomyelitis. When sanitation is bad almost all children are infected with the polio virus in infancy, at which age paralysis is rare. When sanitation improves, infection is delayed until an age when, in the absence of vaccination, paralysis is more common. A similar situation may prevail in relation to appendicitis. This was a new interpretation of the data that had been collected. There was no criticism of the collected data, but the interpretation was revised to include another aspect which was complimentary to, rather than denying, the first. I wrote immediately to the author of this new hypothesis and congratulated him and admitted my error.

My interest in the causation of bowel cancer, the second commonest cancer death after lung cancer in many Western countries, coincided with my study of appendicitis. Once again I had argued in books and journals that adequate fibre in the diet probably played a protective role, and postulated mechanisms which could explain this. At a recent international meeting on dietary fibre, much time was devoted to the relationship between fibre intake and large-bowel cancer. The hypothesis that fibre appeared to play a protective role was not disputed, but some of the mechanisms, which I had postulated whereby fibre might influence bowel cancer, had been discarded or altered by experimental studies. The basic epidemiological evidence was accepted, but the interpretation had to be modified.

Differences of Opinion in Interpretation of Scripture

Surely the same principle can apply in our interpretation of scripture. As a young Christian I believed that true respect for the divine inspiration of the Bible demanded literal interpretations of nearly all that was written. As I found it increasingly difficult to tally an entirely literal interpretation of the early chapters of Genesis with established scientific fact, particularly with regard to the age of the earth, I was challenged by a very senior physician who was a humble and godly student of scripture. "Denis," he said "are we Evangelical Christians not inconsistent when we affirm that in the last book of the Bible the Holy Spirit, trying to explain future events outside the comprehension of the human mind, relied repeatedly on imagery. Yet we express horror at the suggestion that the same Holy Spirit, in the first book of the Bible, might have used similar figurative means to explain events of the past equally beyond human comprehension?" I took his point.

C.S. Lewis went further and emphasized that all portrayal of spiritual truth, by the very nature of things, had to be in the form of imagery or parable, because we are limited to words and images of a time-space existence to try and portray truths in a spiritual realm. So often the profound truths pictorially portrayed in scripture can remain concealed because of insistence on purely literal interpretation of the vehicle used to convey the truth.

The flood that covered the world meant the part of the world known to the people in that place at that time, and there is plenty of archaeological evidence confirming the presence of a flood in the Middle East. The profound truths portrayed in the story of Noah can be entirely missed if one concentrates attention on wondering how a pair of all the literally millions of known species of birds, animals, and insects alive today could be collected, let alone fitted into the Ark.

I have given a great deal of thought to the oft-expressed concept that all biological disease and death are directly attributable to man's sin. I have discussed it with many Christian friends whose opinions I can trust, and studied the problem throughout the Bible. I can find no scriptural warrant for this theological assertion. Wherever death and sin are causally related in the Bible, it seems to me to refer always to spiritual rather than biologi-

cal death. The Genesis description of the creation of life required every creature to procreate, and procreation without death over unlimited time is quite inconceivable. In fact, life without death at a cellular level is beyond our imagination. What would be the outcome if all the myriads of eggs spawned by a single fish survived and procreated? Moreover, the causes of death in the animal kingdom are essentially the same as the causes of death in humans: e.g., radiation, deficiencies of vitamins and trace elements, or genetic defects, none of which could conceivably be attributed to sin.

This type of theology has led to the distorted and cruel conclusions that the progress of a chronic disease can be blamed on unconfessed sin. Our Lord seemed to go out of his way to refute any causal relationship between sin and disease in general, though it cannot be denied that certain sinful practices may give rise to disease as the inevitable consequence of certain actions.

The miracles of Jesus were, though certainly literally true, predominantly visual portrayals of far more eternal and fundamental truths than the merely physical events observed. Let us remember that it was the same Lord who made the world and all of nature who also reveals himself in his written word. Consequently, if discrepancies are apparent between our understanding of nature and of scripture, the fault must lie in our interpretation of one or the other. Unless we can totally integrate our scientific and Christian thinking, we are in danger of becoming spiritual schizophrenics, and this can do nothing to enhance our Christian witness.

✤

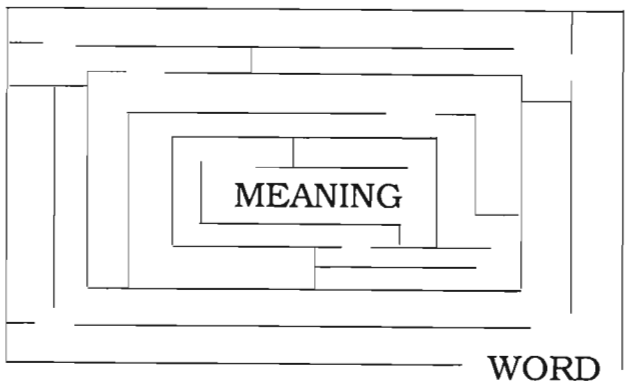
Denis Burkitt
Hartwell Cottage
Bisley, Glos. GL6 7AG
England

Please Note:

The 1987-1989 Index (vols. 39-41) of articles, communications, and book reviews in Perspectives will be published inclusive with the March 1990 issue of the journal.

An on-line subject index for journal volumes 1-41 is available from the ASA Ipswich office on IBM 5 1/4' floppy disk for a fee of $20 (3-disk set) (printed edition not available for subject index).

Penetrating the Word Maze



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

Today's words are: "human/person."

The Dictionary definitions: ***Human:*** *of, relating to, or characteristic of man; having human form or attributes.* ***Person:*** *human being, individual; the individual personality of a human being: self.* [Webster's Ninth New Collegiate Dictionary, Merriam-Webster, Springfield, MA (1987)].

* * * * * * *

There are few focal points for misunderstanding in discussing ethical issues related to human beings that are more commonly encountered than the identification of "human being" with "person." It is perfectly understandable why this happens; even the dictionary supports this approach. But when one gets into discussions of human values, the sanctity of human life, and the variety of ethical issues that hinge on the decisions made in these areas, it is critical that one make an appropriate distinction between these two terms.

Popular conceptions of what it means to be "human" take on several different forms. Probably the most common response to the question as to whether an unknown creature should be considered "human" is whether or not it looks and behaves human. Debates along this line will probably get increasingly more intricate as computer technology continues to develop, at least as far as the "rights" of human-resembling computers are concerned.

Even in these cases, however, it is likely that we will try to retain the traditional definition of "human," namely that "human" means that the entity being described is part of the human species, *Homo sapiens*. This definition is essentially a biological one, for what identifies a particular unidentified creature as being a member of *Homo sapiens* is ultimately the kind of genetic material that gives rise to its biological development. (Here, too, there may well be complications if genetic research continues to develop creatures with mixed human and non-human genetic material.)

One need not debate, however, when an unborn conceived by a woman and a man becomes

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

"human," any more than one needs to debate when such an unborn becomes "alive." Both sperm and ovum are independently alive and human, and certainly their union to begin a new creature is also alive and human. The question, "When does the unborn become alive?" is readily answered by, "At conception." Similarly the question, "When does the dying become dead?" is readily answered by, "At the cessation of all biological life."

Keeping these distinctions clear will help avoid misunderstandings, but this will not in itself really answer the kinds of questions that people are interested in asking. When the popular question, "When does the unborn become alive (or human)?" is asked, the intention is not to ask the question discussed above, but rather to ask a quite different question, "When does the unborn become personal and therefore in possession of all of the prerogatives of personal humans?"

Now, when the unborn "becomes personal" is not answered by pointing to some particular event on a time-scale, so that the unborn is not personal before the event but is personal after the event. "Becoming personal" is a process that begins at conception, develops over time with the development of the necessary biological structures and patterns, and extends beyond birth until the neocortex is functional. It is only then that selfhood can be experienced and manifested.

To speak, therefore, of a "human being" with the implication that every human being is by definition a "human person" is a profound source of confusion. A human person is a human being who experiences and manifests the characteristics of selfhood and personality, what the Bible means by the word for *soul*. It is toward human persons that most of the biblical injunctions abut the sanctity of life are directed. This does not mean at all that non-personal human beings can be treated as valueless, but simply that they do not have the same status as personal human beings if a conflict of concerns arises.

At the end of human life, becoming personally dead usually occurs some time before becoming biologically dead. Do we still have a human being after personal death has occurred? Yes, we do, we still have a human being who is biologically but not personally alive. We continue to treat this creature with concern, respect and care, not because it *has* the sanctity of life associated with personal human life, but because we remember with respect the personal human life that has now come to an end. We may have the ability to keep the biological human life going for some time after personal death—perhaps even without limit, given increasing technological facilities. Whether we *should* keep this biological life going after personal death, for a variety of good motivations in principle, is a complex and troubling question.

The critical nature of the issue is clearly seen at present in the subject of organ transplants. In order to effect a useful organ transplant, the donor must be certified as personally dead but biologically alive. The organ to be transplanted is taken from a "living human being" and given to another "living human being." Without the critical distinction between "human" and "personal," this procedure would make no sense at all.

In all discussions of ethical issues involving human beings, it is essential that the distinction be made between the general category of "human being," which is essentially settled by a biological criterion, and the category of "human person," which depends upon the presence and the activity of the required biological functions to manifest the characteristics of selfhood.

The impossibility of establishing some kind of non-personal/personal boundary means neither that non-personal human life is valueless and can be treated any way people like, nor that non-personal human life has exactly the same rights as authentically personal human life. The situation is more complex, and in a complex situation the meaningful use of words and terms becomes even more critical.

Do you think that you can define your concept of what it means to be human, without getting too personal? ✤

Richard H. Bube
Stanford University
Stanford, California 94305

Book Reviews

THE FIRST THREE MINUTES: A Modern View of the Origin of the Universe (2nd edition) by Steven Weinberg. New York: Basic Books, 1988. 198 pages, glossary, math supplement, index. Paperback; $7.95.

During the past decade we have come to take for granted that it is possible to construct a coherent scientific account of the early universe—what may well have happened during the first moments following the Big Bang. Steven Weinberg's *The First Three Minutes*, first published in 1977, was the book that brought the news of this possibility to the attention of the general public. As an active participant in the development of what is now called "the standard model" in cosmology, Weinberg, a 1979 Nobel Prize winner in physics, is eminently qualified to write on this topic. This 1988 edition of Weinberg's landmark work consists of the first edition, supplemented with a brief chapter, "Afterword: Cosmology since 1976."

The back cover describes the book as written for a general audience; the author is more explicit and candid in saying that the book is written for the reader "who is willing to puzzle through some detailed arguments." It is very well written, but it does require the reader's careful attention to follow the numerous links of detail in some lengthy chains of inference from observation to theoretical model.

Weinberg begins with a review of the familiar expanding universe model, encouraged in part by the observations of galactic redshift by Edwin Hubble over 60 years ago. The next major observational step noted by Weinberg is the discovery of the cosmic microwave background radiation by Penzias and Wilson in 1965. Interpreted as the cooled remnant of thermal radiation released into a transparent environment when the universe was a thousand times smaller than today, this microwave background stimulated the theoretical exploration of events and processes that may have occurred in the very early moments of the universe. Drawing several inferences from elementary particle physics, Weinberg outlines a highly plausible (though admittedly speculative) scenario in which a succession of physical phenomena, each consistent with the patterns of physical behavior studied in high energy physics laboratories, connect a hot Big Bang beginning with the present state of affairs in a cooled off universe of dispersing galaxies.

In presenting a readable account of how the "standard model" of contemporary cosmology was born from the marriage of the expanding universe concept with the phenomena of high energy physics, Weinberg tells a fascinating story. Yet it ends on such a note of futility. Inspired by Weinberg's story to ask the big metaphysical and religious questions about the ultimate source of this magnificently coherent universe and about the purpose of its historical development to this moment, the reader is left hanging. "It is almost irresistible," admits Weinberg, "for humans to believe that we have some special relation to the universe, that human life is not just a more-or-less farcical outcome of a chain of accidents reaching back to the first three minutes. ..." But Weinberg, completely ignoring the resources of any form of theism, offers the reader no hope of satisfaction, noting only that from the standpoint of science alone, "the more the universe seems comprehensible, the more it also seems pointless."

Typical of the many popularizations of contemporary scientific cosmology now on the market, this book is touted as being "A Modern View of the *Origin* of the Universe." In actuality it says nothing about the *origin* (source of existence) of the universe, but talks instead about the history of its *formation*. Within those limitations, it's a book well worth reading.

Reviewed by Howard J. Van Till, Calvin College, Grand Rapids, MI 49506.

THE SYMBIOTIC UNIVERSE: Life and Mind in the Cosmos by George Greenstein. New York: William Morrow, 1988. 271 pages, appendix, glossary, index. Hardcover; $18.95.

According to George Greenstein, professor of astronomy at Amherst College, the existence of life in the cosmos is astonishing—a profound mystery of immense significance. It is as unexpected as the survival of a person escaping a 100-rifle firing squad because every single rifle "coincidentally" jammed or misfired.

Greenstein divides his discussion of the habitability of the cosmos into two parts: Life and Mind. In the first part, comprising eleven chapters, he relates seventeen "coincidences" upon which life depends. Among these are the unique qualities of water, the delicate resonance required for the conversion of helium to carbon in the interior of red giant stars, the intricate balance between the four forces of nature and between opposite electrical charges, and the "flatness," "smoothness," and "horizon" problems relating to the Big Bang. (These and other coincidences are summarized in the Appendix.) Readers acquainted with the so-called Anthropic Principle—that life can exist only in a habitable universe—will be familiar with the section. Most will agree with Greenstein that the Anthropic Principle reflects an observation but does

not provide a reason for the existence of life in the cosmos.

So what is the reason that the universe is habitable? Greenstein investigates this question in chapters 12–14. His answer, in short, is that the universe *must* be habitable, for without life there would be no consciousness, and without consciousness (mind) the universe could not exist.

Greenstein comes to his conclusion on the basis of quantum mechanical theory. Using thought experiments (which are based upon actual experiments) and copious helpful illustrations, he shows, using the wave-particle duality of the electron, that individual subatomic particles do not exist unless observed by a mind. And since other objects in the cosmos—stars, planets, living systems—are collections of subatomic particles, they also would not exist unless observed. Only a conscious mind, however, is capable of observations, so nothing would exist without consciousness. Minds need particles and particles need minds. Matter, life, and mind are partners in a "cosmic dance," or symbiotic unity, analogous to the mutual dependency between *E. coli* bacteria and ruminants.

Greenstein advances an intriguing thesis, but his quantum mechanical interpretive foundation is arguable. For one, it represents a minority view among physicists—that existence requires minds. Most physicists feel that an objective world can exist without consciousness. Second, Greenstein does not address the question of how particles and physical laws existed between the time of the Big Bang and the appearance of mind in the universe.

In addition to his debatable interpretation of quantum mechanics, Christian readers will be unhappy with Greenstein's totally materialistic explanation of life and with his general swipes against religion. He admits that he is not religious (p. 26), and he totally rejects the supernatural (p. 198). He believes that all aspects of the universe, however strange or unlikely, will eventually be explained solely by physical laws. This latter point is his own personal creed, and according to him, "it is the faith of every scientist" (p. 87). In his opinion, recourse to God for an explanation of any physical phenomenon stultifies progress. Scientific explanations, on the other hand, call forth yet more questions to be answered, thereby advancing one's knowledge of the universe.

Greenstein's view of religion is, of course, rather truncated. He neglects the positive influence that a Christian world view has had on the progress of science, and he overlooks the fact that numerous religious scientists, both past and present, have made significant scientific contributions. Unfortunately, Greenstein has confused belief in the ultimate nature of reality (metaphysics) with the methodology of understanding that nature (epistemology).

In spite of its anti-Christian tone, readers will profit from Greenstein's clear presentation of the "coincidences" upon which life depends, and from his discussion of the wave-particle nature of matter and its relation to conscious observers. The reader will also get a feeling for the struggle of a purely secular scientist to explain the existence of life without recourse to the supernatural.

Finally, one should be aware of several errors in the book. First, the weak force is not stronger than the

Books Received and Available for Review

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

B. Altemeyer, *Enemies of Freedom: Understanding Right-Wing Authoritarianism*, Jossey-Bass
D. Belgum, *Religion & Personality in the Spiral of Life*, University Press of America
R. Bufford, *Counseling and the Demonic*, Word
R. Chewning (ed.), *Biblical Principles and Business*, NavPress
M. Cosgrove, *Counseling for Anger*, Word
L. Countryman, *Dirt, Greed, and Sex: Sexual Ethics in the New Testament & Their Implications for Today*, Fortress Press
J. Dillenberger, *Protestant Thought and Natural Science*, Notre Dame Press
D. Friesen & R. Friesen, *Counseling & Marriage*, Word
R. Gerber, *Vibrational Medicine: New Choices for Healing Ourselves*, Bear & Co.
P. Haas, *Morality After Auschwitz: The Radical Challenge of the Nazi Ethic*, Fortress Press
B. Hart, *Faith and Freedom*, Here's Life Publishers
D. Hocking, *The Rise and Fall of Civilization: From Creation Through the Flood*, Multnomah
R. Holloway, *Crossfire: Faith & Doubt in an Age of Certainty*, Eerdmans
T. Howard, *Chance or Dance: A Critique of Modern Secularism*, Ignatius
R. Hughes, *Agression & Expiation*, University Press of America
P. Kurtz, *Eupraxophy: Living Without Religion*, Prometheus Books
D. Liderbach, *The Numinous Universe*, Paulist Press
D. Meeks, *God the Economist: The Doctrine of God & Political Economy*, Fortress Press
H. Miller, *Who Sets the Standards? Behavior, Society, and the Church*, Pilgrim
R. Nash, *Faith & Reason: Searching for a Rational Faith*, Zondervan
H. Rolston, III, *Environmental Ethics: Duties to and Values in the Natural World*, Temple University Press
R. Rothschild, *The Emerging Religion of Science*, Praeger
C. Ryrie, *So Great Salvation: What It Means to Believe in Jesus Christ*, Victor Books
P. Seely, *Inerrant Wisdom: Science & Inerrancy in Biblical Perspective*, Evangelical Reform
R. Sider, *Nonviolence: The Invincible Weapon?* Word
B. Slosser, *Changing the Way America Thinks*, Word
J. Sturkie & G. Bear, *Christian Peer Counseling: Love in Action*, Word
J. Templeton & R. Herrmann, *The God Who Would Be Known: Revelation of the Divine in Contemporary Science*, Harper & Row
D. Thompson, *Counseling & Divorce*, Word
T. Torrance, *The Christian Frame of Mind: Reason, Order, and Openness in Theology & Natural Science*, Helmers & Howard
P. Vjecsner, *On Proof for the Existence of God, and Other Reflective Inquiries*, Penden
G. Wells, *Religious Postures: Essays on Modern Christian Apologists & Religious Problems*, Open Court

electromagnetic force (pp. 157, 169). Second, given the orientation of figures 67ff, the terms "right" and "left," rather than "upper" and "lower," should have been used to describe certain features of his illustrations. Third, page 207 comes to an abrupt end in the middle of a sentence and is not continued elsewhere.

Reviewed by Perry G. Phillips, Associate Professor of Natural Sciences, Pinebrook Junior College, Coopersburg, PA 18036.

NATURAL OBSESSIONS: The Search for the Oncogene by Natalie Angier. Boston, MA: Houghton Mifflin, 1988. 394 pages, index. Hardcover; $19.95.

I stumbled across this book through a book review in *Science* and wondered if it might serve as a textbook for a college course in which one of my goals was to introduce non-science students to ways in which scientific work is currently approached and conducted. I was not disappointed. Instead, I am thrilled to have discovered a brilliantly written account of progress and pitfalls in one particular field of molecular biology. My students' eyes were opened to the delight and inherent beauty, as well as the frustration and sheer grind experienced while "doing" science.

Natalie Angier, a science writer for *Time*, spent over a year watching the daily research routine in Robert Weinberg's laboratory at the Whitehead Institute in Cambridge, Massachusetts. As she recounts the process of experimental design, experimental replication, and the interpretation of experimental results, Angier cuts through the scientific jargon using a lush vocabulary and rich figures of speech. She reveals the methodical, objective side of scientific enquiry; but the subjective side of science is equally in view as both the principal investigator and his bench scientists follow their hunches, sometimes in quite different directions. The work in Weinberg's lab is focused on the molecular mechanisms of cellular transformation leading to cancer. Cancer is a genetic disease and the individuals involved here are tireless "gene jockeys" bringing all the latest and most powerful techniques of gene isolation and cloning to bear on this problem.

While the leading players, from the institute director through the beginning graduate student, all have their own foibles and their own motivating agendas, one could easily imagine them as general representatives having their counterparts in just about any scientific institution. Therefore, Angier's descriptions of the types of individuals drawn to this lab, the interpersonal relationships that develop there, and the hierarchies that emerge between graduate student, technician, postdoctoral fellow and principal scientist, together provide a valuable insight into the nature and character of scientific communities in general.

Although certainly not written from a specifically Christian perspective, I am enthusiastic about putting this book in the hands of Christian young people who may be thinking about scientific careers. They will be confronted by the infectious exhilaration that comes with the unfolding of God's truth in His creation, whether acknowledged or not. They will also be confronted by the dark side of life in a fallen world; e.g., the tragedy of sickness and death as scientists face cancer patients, or the scourge of selfishness as scientists struggle among themselves for senior authorship and race for the hollow prestige of precedence. These are some of the simultaneous realities experienced by those involved in the scientific enterprise.

Reviewed by Ian Johnston, Associate Professor of Biology, Bethel College, St. Paul, MN 55112.

SCIENCE AND RELIGION: Baden Powell and the Anglican Debate, 1800–1860 by Pietro Corsi. Cambridge, England: Cambridge University Press, 1988. 346 pages, index. Hardcover; $54.50.

Englishmen took their religion seriously in the 18th and 19th centuries. Each sectarian group—Anglican, Unitarian, Puritan, or Wesleyan—contained a strong pro-science group as well as those who felt that the values of science and religion were incompatible. By 1800 this opposition to Newtonian "materialistic" Christianity was found in college common rooms of the ancient universities as well as the pulpit. Culture now had a secular hue and traditional Protestant and Catholic Christianity had been eroded by latitudinarianism, unitarianism, and deism.

Pietro Corsi takes up the story of the Anglican community in this useful study of the Rev. Baden Powell (1796–1860), Savilian Professor of Geometry at Oxford. Powell's scholarly concerns embraced experimental (amateur) research on optics and radiant heat, ecclesiastical history, the history of science and university educational reform, as well as theological and philosophical questions. Powell was less an experimentalist than a popularizer and statesman for science. As a Christian philosopher he was deeply concerned with the interrelations of theology, philosophy, and science. The book traces the development of the thought of one who began his career convinced of the basic agreement between the scriptural narrative of creation and the findings of modern geology, but later became a prominent spokesman for liberal theology and an evolutionary approach to natural history.

His family sent young Baden to Oxford's Oriel College where the dons sought to meet challenges to the Anglican Church on scientific grounds as well as the classical theological-philosophical approaches. He had been hand-picked to provide intellectual leadership for the conservative High Church wing of the Anglican Church.

Instead of supporting the status quo, he sought to reform the system. His first task on being appointed to the Oxford faculty was to seek to revive the tradition of Oxfordian science. In response to the charge that "Oxford professors of mathematics and astronomy seldom or never lecture and often do not reside at all at the University," Powell noted that "it was a difficult task to collect a class since the university did not compel attendance, and many colleagues positively discouraged students from hearing public lectures on scientific subjects" (p. 115). It was not long until Powell's position on educational reform became part of the ongoing Anglican debate over scientific and religious values.

Powell was to drastically modify his early views on scripture, theology, and politics as well as his convictions on the relation of science and Christianity. His philosophical and higher critical studies, the increasing refinement of geological research, and a changing political perspective were forceful components in bringing about this change. His *The Connexion of Natural and Divine Truth* (1838) offered a new Christian apologetic which not only spoke to the role of science in the modern world but to the age-old conflict between learning and traditional Christianity.

Corsi details the issues that occupied Powell and his contemporaries in the wider context of British culture. In later life, Powell regarded the Old Testament cosmogony as a mythical composition "chosen by the inspired writer to convey his religious message" (p. 260). If particular scientific discoveries or mechanisms of biological development seemed to counter the Mosaic narrative, it was less an objection against the credibility of revelation than a demonstration that Jewish cosmology was an incomplete representation of natural events.

This interesting case study provides a wealth of detail on the ways that Baden Powell and the Anglican Church dealt with the challenges of science in the middle of the 19th century. It has much to teach those who 150 years later seek to view contemporary science through the eyes of Christian faith. Unfortunately, the price of the book will keep those without access to an academic library from reading it.

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

THE PHYSICISTS: The History of a Scientific Community in Modern America by Daniel J. Kevles. Cambridge, MA: Harvard University Press, 1987. 426 pages, index. Paperback; $12.95.

Daniel Kevles is Koepfil Professor of the Humanities at California Institute of Technology and author of *In the Name of Eugenics: Genetics and the Uses of Human Heredity.* Before deciding to major in history, Kevles spent much of his time studying the sciences.

The title of the book is descriptive of the work. Kevles' concern is not with inventors like Thomas Edison or natural philosophers like Benjamin Franklin, but with that group of people whose method was first theoretical then experimental. The dominant force in 19th-century physics was clearly European. The assumed stability of European physics is used as a measure for the growth of the American physics community.

The Physicists reads like an intricate detective novel belying attempts to mark eras in 20th-century science in some straightforward fashion. The way he weaves the plot leaves the reader brilliantly aware of the tension and complexity of real life. Kevles draws out the strands of tension between the needs of elitist physicists striving at the frontiers and the political control of science, between high culture and subordination to the strictures of war, between big science with its machines and the needs of ordinary people. He closely follows the relation between science, politics, and industry, and soundly explains the money issues that have prospered and plagued fundamental research.

The Physicists is not purely a thematic treatment like that of Bernard Cohen's *Revolution in Science.* Kevles managed to obtain the personal stories and documents of many that play key roles in 20th-century physics. He claims that the book is a history primarily of the Los Alamos generation, citing a question posed to him by I.I. Rabi as the stimulation for writing the book: "Why doesn't somebody write about my generation of physicists: 'After all, we changed the world'?" (p. xiii).

As a history of American physics it is not essentially anecdotal in style. It lacks some of the charm of autobiographies like those of Richard Feynman or Freeman Dyson. It is not, however, devoid of the sardonic quip or personal reflection and there are passages that make one cheer—like the triumph of the self-effacing grandeur of Einstein in the face of American anti-semitism in the 1930's. Not only is it interesting history but good science. The description of the development of Heisenberg's Uncertainty Principle is both lucid and captivating. He doesn't gloss over tricky issues of hard science but deftly (generalizing) explains experimental phenomena.

A remarkably urbane work, *The Physicists* is written in a dense but evenhanded style that gracefully balances the facts of history with the biographies of its central players. It is moderately accessible to the armchair historian yet provides by its rich annotation and "Essay on Sources" a key reference for someone wishing to master the field. For the student interested in writing history it is a good work to emulate.

I unequivocally recommend *The Physicists* to the ASA community. I do this not only because of its internal merit but because of Kevles' concern in this post-modern age to prevent us from treating the scientific community like

gods or devils. He submits to the reader that physicists are far from some monolithic group but rather represent a whole spectrum of human beliefs and activities.

Of interest to the Christian may be his description of the shift in polarity from the 19th-century university where liberal arts and ministerial training were the prime objectives and scientific research was something relegated to the basement or back room without experimental facilities, to the modern university where the prime function is science and the liberal arts are a necessary nuisance in the path to obtaining a bachelor's degree.

Kevles gives as one reason for anti-science sentiments in the 20th century, the feeling that the university no longer teaches values and that mankind is in danger of becoming subject to something he can no longer control and will be forced to conform to some essentially inhuman ideal. Though this theme is better treated in *The Measure of Man*, C.S. Lewis' *Abolition of Man* or Heidegger's *The Question Concerning Technology*, the fact that it is integral to the theme of *The Physicists* shows Kevles' sensitivity to troublesome issues of a larger philosophic sort.

Reviewed by Douglas F. Olena, Adjunct Professor of Philosophy, La Salle University, Philadelphia, PA 19100.

HERMENEUTICS VERSUS SCIENCE? THREE GERMAN VIEWS by Hans-Georg Gadamer, Ernst Konrad Specht, and Wolfgang Stegmüller, edited by John M. Connolly and Thomas Keutner. Notre Dame, IN: University of Notre Dame Press, 1988. 176 pages, bibliography. Paperback.

Three German scholars here debate the nature of science and literary interpretation. The basic issue is whether the hermeneutical disciplines (scriptural exegesis, literary criticism, jurisprudence, history, etc.) are different in some way from the natural sciences. In other words, are those interpretations, like scientific hypotheses, decidably true or false?

The German essays have been translated and edited by John M. Connolly, associate professor of philosophy at Smith College, and Thomas Keutner, lector in philosophy at the Fern Universitat Hagen. They have written an extensive 67-page introduction which places the current debate within its historical context and demonstrates its relevance to Anglo-American philosophy. Drawing on recent developments in semantics, they offer a reconstruction of the central question of decidability.

The remainder of the book consists of selected essays by the three German scholars. The explanatory introduction helps the non-philosophical reader understand these technical writings. The book then concludes with an extensive 6-page bibliography.

Gadamer holds that the interpretation of texts can never be completed. On the basis of this "openness of the text," a valid interpretation doesn't exclude the validity of differing, or even contradictory, interpretations. Godamer bases his undecidability thesis on the "hermeneutical circle," the view that the meaning of the whole can only be grasped on the basis of its parts, while understanding the parts presupposes a grasp of the meaning of the whole.

Stegmüller investigates whether the "hermeneutical circle" can in fact be construed as marking a method which distinguishes the hermeneutical disciplines from the natural sciences. His search proves futile. Therefore he argues that literary-critical interpretations are to be taken as methodologically equivalent to scientific hypotheses, for example, in astronomy or biology. In doing so Stegmüller defends the objective character of literary criticism: critics do in fact reject interpretations, and it is the task of the methodologist to state the rational grounds for such rejection.

Specht argues that the two opposing positions to some extent be reconciled. He contends that one kind of interpretation is clearly decidable. On the other hand, he makes a case for undecidable interpretations that nonetheless can be rationally evaluated.

The editors' historical background begins with the differing Catholic and Lutheran views of biblical interpretation, then proceeds to nineteenth-century controversies and contemporary discussion in German philosophical hermeneutics. After an overview of the essays, they offer their answer to the central questions at stake in the debate about decidability: whence comes the idea that all interpretations ought to be decidable, and *why* is a certain type of literary interpretation undecidable?

The editors conclude that "what marks the humanities is their concern with meaning and, hence, with self-knowledge: all interpretation is guided by the reader's prejudices ... interpreters who become aware of themselves, of their own prejudices, understand this: that interpretations are undecidable" (unlike scientific hypotheses). "The fact that some propositions cannot be decided, once and for all, does not mark a deficiency, but instead an opportunity for deeper self-knowledge. There is more than one kind of knowledge, and the kind which the humanistic disciplines offer us comes first and foremost from their capacity to confront us, through eminent texts, with ourselves."

The editors have succeeded in making scholarly essays dealing with basic and complex issues intelligible to readers not at home in their discipline. Although it will not be widely read by ASA members, I recommend it for any who are delving into the issues of biblical hermeneutics, scientific enquiry, and the relationship of those two perspectives for understanding the natural world.

Reviewed by Charles E. Hummel, Faculty Specialist, InterVarsity Christian Fellowship, Grafton, MA 01519.

THE OPEN MIND AND OTHER ESSAYS: A Scientist in God's World by Donald M. MacKay, edited by Melvin Tinker. Leicester, England: Inter-Varsity Press, 1988. 231 pages, notes, index. Hardcover; £12.95.

A reading of this book reminds us how much we miss Donald MacCrimmon MacKay (1922–1987), and how increasingly we will miss his clear voice speaking on the crucial interactions between science and Christian faith. After reading this collection of papers, I am not sure if I have ever had a creative thought about these interactions that did not have its root in ideas set forth in one form or another by MacKay.

For readers who may not be familiar with him, Donald M. MacKay was Professor of the Research Department of Communication and Neuroscience in the University of Keele in England. His scientific interests in the functioning of the human brain provided a natural environment within which to work out his thoughts on integrating scientific and biblical perspectives concerning men and women. In the Foreword, Oliver Barclay remarks that MacKay "has been justly described as 'one of the world's foremost thinkers on the organization of the brain'." A prolific writer, MacKay is well known for a series of books on the interaction of science and Christian faith, including *The Clockwork Image* (1974), *Human Science and Human Dignity* (1974), and *Science and the Quest for Meaning* (1982). He was active in scientific research at Keele, and in scientific lecturing and Christian witness around the world until his death in 1987. For many years he served as a principal editor of *Experimental Brain Research* and *Biological Cybernetics*, and edited the *Handbook of Sensory Physiology*. On the two occasions that the American Scientific Affiliation met with the Research Scientists Christian Fellowship at Oxford in 1965 and 1985, MacKay was a keynote speaker.

Melvin Tinker has carefully gone through the published papers by MacKay and selected eighteen of his shorter papers to present a panorama of his thought: three of them represent material not previously published. MacKay's insistence on careful thought and logical presentation of argument may make some of these papers a little hard going for the unwary reader, but each paper is brief (half of them are less than 10 pages, and only one is longer than 20 pages) and makes its point with an economy of exposition. Careful attention to and evaluation of the arguments will be more than rewarded.

The title of the book is taken from one of the papers, "The Open Mind—An Evangelical Approach to the Bible." The succinct way in which MacKay deals with this issue is characteristic of his approach:

> Already, perhaps, we begin to see the falsehood of the antithesis between open-mindedness and evangelical commitment. At every turn, the Christian must be *open* to correction from God, in whatever way and by whatever channel he chooses,... But of course to be open in this sense is not the same as to be *uncommitted*,... *Open-mindedness*, in other words, it quite different from empty-mindedness; and it is only by confusing the two that the alleged antithesis can be declared. (p. 146)

The papers cover a wide range of issues including human engineering, artificial intelligence, value-free knowledge, determinism, and creation. A sample of a few of the chapter titles illustrates the tantalizing wealth of material presented here: "Man as mechanism," "What determines my choice?", "Brain research and human responsibility," "Artificial intelligence—a Christian appraisal," "Value-Free knowledge—myth or norm?", "The sovereignty of God in the natural world," "The mythology of chance," and "Christian priorities in science."

MacKay is often outspoken and his friends have always valued the clarity of his position. In the very first paper on "Persons and things," these characteristics are strikingly illustrated by several quotes:

> I want to help dispel any impression that one's faith and one's science have to be kept safely insulated from one another, each in its private preserve.... The scientist's description of the brain leaves no room for any 'mystery-box' that might conceivably be a 'seat of the mind.'... Our whole approach is wrong and can only lead to nonsense, if we think of the mind as living like a ghost in some local part of the head. (pp. 13, 14)

MacKay is consistently uncompromising on sound, authentic science *and* a "Christian conviction of the truth of his faith ... [because] he has come to know a living person—the person of Jesus Christ" (p. 17).

Several papers introduce us to, and elucidate for us, one of the phrases that MacKay coined and became well known for: "nothing-buttery"—the false claim that a description of one type, for example a scientific description, makes meaningless and/or unnecessary a description of another type, for example a theological description.

MacKay was fascinated by the problems raised by maintaining both the possibility of the mechanistic functioning of the brain, even one that was completely describable in scientific deterministic terms, and the reality of human responsibility and ability to make meaningful choices. His desire to unravel these problems led him to formulate a number of challenging analogues to illustrate the falsehood of the statement that "two claims to determination are mutually exclusive." One particularly interesting one is given in the paper, "What determines my choice?"

> Suppose that a neurophysiologist sets up a computer to solve the Hodgkin-Huxley (H-H) equation under specific boundary conditions. Provided he does the job properly, he can truthfully claim that the behavior of the computer is determined by the H-H equation and his boundary conditions. At the same time an electronic engineer analysing the chain-mesh of physical cause-and-effect in the machine can equally truthfully claim that *this* determines completely the behavior. Any appearance of conflict here would of course be illusory; for the claims to determination are framed at disparate logical levels, from alternative logical standpoints: they are not competitive but complementary. (p. 57)

This is the introduction to the celebrated argument advanced by MacKay, and subsequently subjected to support, skeptical scrutiny, or critical debate by many others, that the acceptance of a completely deterministic operation of the human brain does not in any way preclude the authentic concept and practice of human choice and responsibility. This case is so central to MacKay's whole thought that it reappears in half-a dozen other places and contexts in this book. It deserves the attention and cogitation of any serious student of the philosophy of science and Christianity.

There are so many other gems of insight in this book that it is tempting to try to summarize many more of them. But this is not the function of a review. In this case, the function of this review is to encourage the reader to get hold of MacKay's book himself and gain the clarity of perspective that can be gained there. This is not to claim, of course, that one will or should simply accept every argument that MacKay advances; certainly MacKay himself would not want this. But there are so many riches of insight here, and so many clear-cut hittings of the nail on the head, that its reading and study are sure to be rewarding.

Reviewed by Richard H. Bube, Professor of Materials Science and Electrical Engineering, Stanford University, Stanford, CA 94305. (This review was initially written for the Victoria Institute, the Philosophical Society of Great Britain.)

DARWIN AND THE EMERGENCE OF EVOLUTIONARY THEORIES OF MIND AND BEHAVIOR by Robert J. Richards. Chicago: The University of Chicago Press, 1987. 688 pages, illustrations, notes, appendices, bibliography, index. Hardcover; $34.95.

Theories of human behavior that may be termed evolutionary have been around for at least 200 years. Robert Richards, associate professor of history, philosophy, and behavioral science at the University of Chicago, has set out to trace the development of these ideas. It is not just the theories themselves that have changed but also the meanings attributed to the idea that mind has evolved. In the "received view," the idea of man attributed to Darwin is of:

> A completely material creature, subject to its evolutionary history, to its consequent biological form, and to its immediate natural environment. Darwinian man has a brain that requires no guiding mind; reason that cannot transcend its animal origins; religious aspirations that have become barren ... and morals that are subjective and Benthamitic. (p. 5)

In my experience, there are those who summon inner strength to face this view of humanity, embracing it as that held by modern science and therefore true. Some also accept it as the inevitable conclusion of science but feel obliged to declare war on science. Yet others reject it, arguing that the idea itself simply cannot be both true and meaningful. What are we to make of such products of this mind as the idea that thought is without meaning? But Richards adds another twist: Whatever may be said of modern science, this is not the view held by early evolutionists, many of whom supported their theories with "a carefully worked out metaphysics ... completely opposed to mechanistic materialism" (p. 6).

Important to Richards' approach, lending both coherence and historical flow, is his concern that ideas be examined in context. Darwin's views form a major focus but are seen in light of his personality, education, and cultural and intellectual world. This includes some 100 years of thought by early species transformists like Erasmus Darwin and Cabanis, while Darwin's own ideas become background for succeeding thought. Extensive use is made of Darwin's notebooks, personal contacts, and reading list in tracing his ideas. The book is well ordered, and Richards is adept at explaining the scientific theories whose history he traces.

It may take a historian to produce a good history of science, but the subject is not, in that rather unfortunate phrase, "of mere historical interest." The course of a person's thought, and the origin and development of ideas, make more sense in such perspective. Richards sees this as important in doing history of science; it is also a sound reason for studying it even if one's main concern is the science itself. If Darwin's thought cannot be fully appreciated without knowing what he built on, and if we cannot follow Spencer or Baldwin apart from Darwin, Wallace, and Huxley, how can we expect to understand the controversies surrounding contemporary models without a knowledge of what went before?

Richards' natural selection model of scientific development, elaborated in Appendix 1, views conceptual systems as analogous to evolving species. A person's ideas are discrete but "genetically related" to earlier configurations. Consider the chapter on Herbert Spencer. His thought is often dismissed with little more than a disdainful flourish; here Richards seeks to restore its place in the history of ideas. But this does not mean defending it as correct. He argues first that Spencer fares better by nineteenth-century standards, then shows that as Spencer has affected later thought, one cannot simply ignore him. Too many historians "judge progenitors of modern science by the sole criterion of similarity of ideas—as if Triassic reptiles could not have given rise to modern mammals because they look so different" (p. 244).

The chronological presentation is further ordered by concern with such themes as why Darwin delayed publishing his principle of natural selection for over 20 years. Richards believes Darwin himself had reservations until shortly before 1859 when he found a way to explain the instincts of neuter insects. These problems will be of particular interest to historians of science, while for those who like myself are more familiar with evolution than its history, Richards provides a detailed, readable introduction.

In Appendix 2, he leaves off reviewing what others have said on mind and morals and attempts to show that a non-relativistic ethics can be derived from evolutionary theory and that evolution does not prove that all behavior is self-interested. He goes a step beyond other attempts; a very large step. Unlike most others, he tries to justify the idea that ethical behavior, such as altruism, is good. Showing that such behavior helps preserve genetic stock justifies it empirically, but not morally. Murderous impulses may also have developed by natural selection, and he wants to be able to say only one is good, though either can improve fitness.

Yet I do not think he succeeds. Like Darwin, he restricts ethics to altruism, and like much of sociobiology, he seems to assume that if one shows altruism is adaptive one has shown it is biologically based. Must something have a biological cause to have a biological consequence? Richards says that to postulate a biological explanation for why we do something does not make it impossible to argue that it is a good thing to do. While a most interesting point, this leads to my final objection; he does not derive the morality of altruism from evolutionary theory alone, but uses another assumption, one not derived from evolution.

But it is perhaps a bit misleading to quickly list reasons I think he is unsuccessful without even describing his model. It is among the most sophisticated models of its type. First published in *Philosophy and Biology*, it has become one of the key arguments to be answered. And as with the rest of this book, one will find this section to offer a wealth of stimulating ideas.

Reviewed by Paul K. Wason, Assistant Director of Development, Bates College, Lewiston, ME 04240.

THE COMPARATIVE RECEPTION OF DARWINISM by Thomas F. Glick (ed.). Chicago, IL: University of Chicago Press, 1988. 505 pages, index. Paperback; $17.95.

"It is curious how nationality influences opinion," Darwin mused when he saw Germany and France reacting differently to his theory. A longer-term, wider-scale study of that phenomenon took place approximately a century after Darwin. The American Council of Learned Societies and the University of Texas at Austin convened the Conference on the Comparative Reception of Darwinism in 1972. This book is a reprint of the 1974 compilation of its papers, with a new preface.

A panel of scholars present their findings relating to nine countries and regions, plus separate chapters on "Darwinism and Historiography," "Religion and Darwinism," and "Darwinism and 'Darwinian' Evolutionism in the Study of Society and Culture."

Each area is covered from the standpoint of: (1) The sequence and circumstances of the primary diffusion of the Darwinian corpus, and the works of major Darwinian biologists and apologists. (2) The sequence of pro- and anti-Darwin arguments in the country from 1859 to the end of the main period in which polemic ensued on the subject in each country or societal segment. (3) Factors in the society that encouraged or inhibited the reception of evolutionary ideas. (4) The sociology of Darwinism—the social and political backgrounds and linkages of pro- and anti-Darwin forces. (5) Differential penetration by educational levels, disciplines, regions, and cities. (6) The impact of Darwinism on subsequent scientific research. (7) The impact of Darwinism on other areas of intellectual endeavor, including the extension of evolutionary models to the social sciences.

Three appendices cover "Evolutionism in America: The Persistence of the War between Religion and Science," "Evolutionism in the Soviet Union and America: The Persistence of the War between Materialism and Idealism," and "A Nineteenth-Century Evolutionary Methodology: The Conditional Mode as Historic 'Proof'."

The book is comprehensive in scope. Its main interest will probably be to historians of science; however, it will also be useful to communicators—including pastors, educators, and missionaries—since it provides insight into what cultural factors and presentational approaches made some societies more fertile for reception of a new concept than others.

Reviewed by David Fisher, Editor, Radio Academy of Science, Wheaton, IL 60189-1122.

DARWINISM AND DIVINITY by John Durant (ed.). New York: Basil Blackwood, 1985. 210 pages, index. Paperback.

Editor John Durant is Staff Tutor in Biological Sciences, Department for External Studies at the University of Oxford. He has written numerous articles on the history of evolutionary and behavioral biology and the social relations of modern science. Other chapter authors are professors at various English universities, as detailed below. The book is an outgrowth of a conference of the British Society for the History of Science held in 1982.

Darwin's *Origin of Species* was about more than biology; it has implications for views of God, the universe, and the human condition. In chapter 1, "Darwinism and Divinity: A Century of Debate," Durant summarizes the religious significance of evolutionary theory—citing Freud, T. Huxley, William Jennings Bryan, Harvard sociobiologist Edward O. Wilson, and others. He says Darwin considered his theory to be the Creator's means of populating the earth, but that later writers moved into "the deification of the evolutionary process." He states

that many religious people are rightly outraged "at the advance of an evolution-centred world-view that has the audacity to parade its secular, liberal values as if they were the objective findings of science."

In chapter 2, "The Relations Between Darwin's Science and His Religion," historian of science John Hedley Brooke examines what Darwin thought about the religious implications of his work. He weighs two conflicting claims—that Darwin's increasing biological knowledge drove him to disbelief, and that his religious doubts and personal tragedies, such as the deaths of his wife and child, drove his scientific interpretations away from the concept of a kind and provident God. Brooke concludes, "...the relationship between Darwin's science and loss of religious conviction was more symbiotic than unidirectional."

Chapter 3, "Herbert Spencer's Henchmen: The Evolution of Protestant Liberals in Late Nineteenth-Century America," is written by historian Jim Moore, author of *The Post-Darwinian Controversies*. He analyzes how liberal Protestants accommodated their theology to evolutionary philosophy—some using evolutionary logic to justify capitalism, others to condemn it—and motivated Americans to their "manifest destiny" to bring global peace and prosperity.

In chapter 4, "Biological Evolution and Christian Theology—Yesterday and Today," physical chemist and theologian Arthur Peacocke claims genetic variation and natural selection are modes of divine creation and incarnation.

> ... the creator may be imagined to unfold the potentialities of the universe that he himself has given it, selecting and shaping by his providential and redemptive action those that are to come to fruition—an improviser ... of unsurpassed ingenuity.

In chapter 5, "The Effects of Religion on Human Biology," anthropologist Vernon Reynolds and sociologist Ralph Tanner argue that religious beliefs sometimes have adaptive value. They explore this concept along lines of reproduction, including mores of abortion and infanticide.

In chapter 6, "The Religion of Evolution," philosopher Mary Midgley evaluates the validity of religious beliefs held by "atheistic or agnostic evolutionists." She argues that evolution is the creation-myth of our age—telling us our origins and shaping our views of what we are. J. Huxley criticized traditional religions for "dogmatism" and "aspiring to a false certitude;" the author says "what has been ceremonially ejected at the front door re-enters at the back one in a different guise" when certain "religionists of evolution" speak.

In chapter 7, "Let There be Light: Scientific Creationism in the Twentieth Century," sociologist Eileen Barker analyzes reasons why scientific creationism has become influential.

Seven authorities explore related subjects from seven thought-provoking angles, fleshing out an important interdisciplinary topic. Recommended for under-graduate level students and above.

Reviewed by David Fisher, Editor, Radio Academy of Science, Wheaton, IL 60189-1122.

CULT ARCHAEOLOGY & CREATIONISM: Understanding Pseudoscientific Beliefs About the Past by Francis B. Harrold and Raymond A. Eve. Iowa City, IA: University of Iowa Press, 1987. xii + 163 pages.

This book is the outgrowth of a symposium at the 1986 meeting of the Society of American Archaeology, with contributions from specialists in archaeology, physical anthropology, sociology, history, and psychology, representing such prestigious institutions as Yale, Harvard, and UCLA. Kenneth L. Feder is a consulting editor of *Skeptical Inquirer* and John Cole is associate editor of *Creation/Evolution*.

They are "concerned with unsubstantiated beliefs about the human past" in two "pseudoscientific" categories: creationism and cult archaeology. Pseudoscientific refers to those views which "claim scientific validity for their ideas and use terms associated with science [but] do not actually use scientific method...." The term, "cult archaeology," is left rather ambiguous, but it is associated with adjectives such as paranormal, occult, superstitious,and fantastic, and is applied to such things as Velikovsky's theories, von Daniken's books, visitors from outer space, pre-Columbian voyages of exploration to the New World, and the Loch Ness monster.

The book opens with an excellent introductory chapter on the nature and dangers of cult archaeology that sets the stage for the viewpoints that follow, and closes with a summation and call for action and further research. Most of the papers deal directly or indirectly with research on students' beliefs in regard to creationism and pseudoscience, focusing on a survey of students in three institutions in Connecticut, Texas, and Southern California. The instrument used in this survey is reproduced in an appendix. While the data is treated as preliminary and they plan extensive refinements to the instrument, the findings and conclusions regarding the cultural, educational, racial, geographic, and gender differences are interesting, thought-provoking, and, at times, startling.

The paper by Alice B. Kehoe is an interesting exposition of scientific creationism as a world view, not science. Kehoe explains that creationism is outmoded science; it defines science as knowledge, with the object of searching for truth. In contrast, she holds that mainstream science "is not a search for 'truth,' but the proposing and testing of hypotheses that seem in accordance with empirical observation."

Raymond A. Eve and Francis B. Harrold consider the source of pseudoscientific beliefs according to four categories: cognitive biases, mass media, science education, and sociocultural biases. Cognitive bias (erroneous reasoning, overgeneralization, etc.) and the deficiencies of the mass media are familiar subjects in the current debate over American education and society. However, the next two sources raise less well-worn issues. Significant numbers of science educators were found to be teaching creationism. In one survey, as many as 11 percent of science teachers agreed that the earth was probably less than 20,000 years old, and "20 percent agreed that the Bible is an authoritative and reliable source of information even with respect to such scientific issues as the age of the earth and the origin of life." Among many findings in the socio-cultural bias area is the assertion that large numbers rejected the evolutionary theory, not on scientific grounds, but simply because it conflicts with their beliefs. This data needs to be evaluated with caution, however. Far too often, the bias of scientific writers is such that astronauts building the pyramids and the reality of God are placed in the same disparaged category. Were these science teachers speaking of faith, whether consistent with science or not, or were they teaching biblical hermeneutics as geological and paleontological science? The areas of science education and sociocultural bias are ripe for serious research by evangelical social scientists who are not ideologically committed to scientific creationism.

On the whole, the book is well written and even-handed, albeit from a secular, non-Christian perspective. The subject is timely and needs serious attention; however, there are shortcomings as well. One should consider Thomas Molnar's thesis in *The Pagan Temptation* when considering the source of pseudoscientific beliefs. Molnar makes a very strong case that the triumph of rationalism and skepticism from the Enlightenment to now has left a vacuum which is being filled by a return to paganism. Can the authors of this book and many others like it be missing the driving force behind the flood of pseudoscientific beliefs in modern times? The point is made more than once that the scientist must maintain a non-hostile, reasonable point of view. The equating of one's own political position with Good and the opposition's political position with Evil, as in Kehoe's article cited above, and the use of pejorative words such as, "We are facing slick writers and rogue professors," on page 131 of Stephen William's otherwise admirable plea for discussing both sides and avoiding sarcasm and invective, is not only wrong, but it is also counterproductive. This biased attitude is quickly noticed, not only by the committed believer in creationist and pseudoscientific positions, but also by many who are presently uncommitted—such as judges, legislators, and school board members. The shortcomings of scientific creationism are, to this reviewer, obvious. However, is the scientific, non-theistic theory of evolution really such an unquestionable "fact" as the scholars of this book, and most authors of similar works, imply?

Reviewed by Eugene O. Bowser, Technical Services Librarian, University of Northern Colorado, Greeley, CO 80631.

BUT IS IT SCIENCE? by Michael E. Ruse (ed.). Buffalo, NY: Prometheus Books, 1988. 406 pages. Hardcover; $23.95.

Subtitled "The Philosophical Question in the Creation/Evolution Controversy," *But Is It Science?* offers 28 readings representing diverse approaches and ranging beyond philosophy. Editor Michael Ruse is a philosophy professor at Guelph, Ontario, specializing in the history and philosophy of biology. He had produced six books and seventy papers before testifying at the McLean vs. Arkansas trial in 1981. His first of nine contributions, apart from editorial material, is a paper designated Prologue, about his experience as a plaintiffs' witness. It had appeared in Ashley Montagu's *Science and Creationism* (1984, Oxford University Press, 415 pages). Nearly all selections in Ruse's eclectic mixture were published at least a few years ago. Some seem redundant, therefore; others have been rendered accessible to readers by collection into one book, from various and even obscure sources.

Four sections follow the autobiographical article. Each has an introduction by the editor. He also concludes the volume with a four-page glossary and two-page note on recommended further reading—both of these are inadequate.

Part One deals with the nineteenth century. Anomalously, the first reading is Genesis 1 and 2, without citation of the translation (probably RSV, 1952). Whole Bibles are available to make this superfluous, and much of the controversy concerns different chapters. Portions of Archdeacon Paley's 1805 analogy to a watch as evidence of a watchmaker, Darwin's theory, Sedgwick's objections, and T.H. Huxley's discussion are helpful. Two very good, quite heavy papers by Ruse dominate the section. He unfortunately fails to distinguish between modern creationism and the wide range of pre-Darwinian views from which it developed. That erroneous correlation fosters continued polarization into false dichotomies; this reviewer expected Ruse to know better.

Part Two surveys current evolutionary interpretations. Francisco Ayala covers concepts of mechanisms for speciation. Stephen Jay Gould and John Maynard Smith discuss the relative importance of natural selection and other factors, gradualism, punctuated equilibrium, and saltation. These meaty papers require a great deal of chewing, because technical terminology exceeds the glossary. Sir Karl Popper's famous 1976 reference to "Darwinism as a Metaphysical Research Program" is followed by Ruse's review of Popper's philosophy. However, Popper's revised opinion that declared Darwinian theory "scientific" is only cited in a footnote, too easily missed. "Universal Darwinism" (1983), by Richard Dawkins, concludes the section with remarkable clarity, lucidity, logic, and readability.

Part Three examines creationism. The history by Ronald Numbers is a particular treasure. Michael Ruse gives a fine abstract of the textbook *Scientific Creationism*, without

criticisms (for detailed rebuttal, see Arthur Strahler's *Science and Earth History: The Evolution/Creation Controversy*, 1987, Prometheus Books, 552 pages). Duane T. Gish's 1973 paper follows, more readable than many by his opponents, but marred by such errors as denial that Precambrian fossils exist; it is left unchallenged. Three concluding selections comprise: Act 590 (Arkansas Legislature, 1981), Michael Ruse's Witness Testimony Sheet, and Judge Overton's U.S. District Court Opinion.

Part Four brings a sparkling exchange between Ruse and two dissenting philosophers, Larry Laudan and Philip Quinn, on changing demarcation criteria for science, and whether Overton applied the right ones. Quinn has the final word. He suggests a dilemma for academics called to testify in court: their best arguments may prove incomprehensible enough to be ineffective, while sullied versions might work. Thus, he sees a workable compromise in the Ruse/Overton approach.

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

KOURION: The Search for a Lost Roman City by David Soren & Jamie James. New York: Anchor Press, 1988. xii + 223 pages, index. Hardcover; $21.95.

This is an archeology book for the non-archaeologist. Technical terms are used sparingly and are almost always defined. The authors have gone to great effort to introduce the reader to the real world of archaeology, but they have done it with a humorous, conversational style that reads as easily as a good adventure tale.

David Soren, a Phi Beta Kappa from Dartmouth with a Ph.D. in classics from Harvard, is a pioneer seismic archaeologist (one who excavates earthquake devastated sites). He was guest curator and lecturer in the American Museum of Natural History in New York City, and left a chairmanship of the Department of History and Archaeology at the University of Missouri to become head of the classics department at the University of Arizona. Previous books include *Carthage a Mirage of Antiquity, The Sanctuary of Apollo at Kourion,* and *Studies in Cypriot Archaeology.*

Jamie James is on the staff of *Discover* magazine and has an extensive publication record in other journals, ranging from *Rolling Stone* and *Life,* to *The New York Times* and *Connoisseur.*

Kourion is an attractively bound, nicely produced book, illustrated by numerous well-chosen, clear black-and-white photos and two sections of color photos. The first color photo section has five beautiful artist's reproductions of the site that enable the reader to visualize the buildings and life at the time of destruction. Interested readers may also refer to Soren's article in the July 1988 *National Geographic* for some of the famous *National Geographic* color photos. There are no footnotes, but there is a two-page bibliography.

Soren and James stress historical background, from the anecdotal account of how Soren came to be an archaeologist, to a brief sketch of the history of the Roman Empire as it affected Kourion. There were several earthquakes in the fourth century A.D., but the major earthquake of 365 A.D., which destroyed Kourion and devastated many sites in the Eastern Mediterranean, is seen as a turning point in the history of the area. Soren concluded that Kourion was already a Christian village at the time of the big earthquake, albeit with a strong pagan element as witnessed by the temple to Apollo Hylates; therefore, they have included a chapter relating the history of the Christian Church in Cyprus. We are treated to an entertaining account of Soren receiving the inspiration to excavate Kourion while living and working in a room in Carthage filled with the ashes of sacrificed infants, and traveling to Cyprus as a rather odd-appearing, "visibly undernourished," upstart with little solid backing. The incongruous nature of the figure cut by Soren in the story is obviously heightened for its dramatic effect. The director of antiquities in Cyprus later told Soren that he was not fooled by any of the bluff; nevertheless, he saw the genuine potential in Soren and gave him permission for a "dig."

One should not, however, conclude from the style of the book that it is nothing but a funny cocktail-hour tale. Even though the narrative is on a very basic level, a surprising amount of information about Kourion, archaeological methodology, the constraints placed upon the archaeologist by the nature of the remains, and the artifacts discovered at Kourion have been painlessly woven into a sprightly detective story. The reader is shown how data from local tradition, guide book accounts, literary evidence from ancient contemporaries, the results of the excavations, and just plain luck are combined, illuminated by a vivid imagination, and emerge as a full-blown interpretation. The authors are refreshingly candid about the tentativeness of the conclusions that can be drawn from any excavation. The next excavation of the site, new evidence from other sites, new techniques, and development of new scientific tests may radically alter some of today's conclusions. The "Afterward" relates archaeology to the reality of "the people he is excavating," although the language is far too romantic and overdrawn. They "butted in" on Camelia and her mule without an invitation, "but she has graciously attended us and answered every question we have put to her." There is a "friendship" and an "intimacy that exists between an archaeologist and the people he is excavating." Nevertheless, the point made throughout the book that archaeologists are no longer merely looters and tomb robbers is well taken. Soren and James have emphasized very well that the modern archaeological team is a diverse set of highly skilled specialists: archaeologists, forensic anthropologists, architects, paleontologists, geologists, and many others. The intent of the new archaeologist is to rediscover the culture and the daily life

of a living people, not just dig up artifacts associated with petrified bones.

This is a fun book that attains its goal of being understandable by those unacquainted with archaeology and archaeological jargon. Even so, it makes a serious presentation of archaeological methodology and the limitations on what can be known about an ancient people. It would be a good book to capture the interest of mildly curious survey course students and introduce them to the subject of archaeology, as well as to an increasingly important source of data for the more traditional historian.

Reviewed by Eugene O. Bowser, Technical Services Librarian, The James A. Michener Library, University of Northern Colorado, Greeley, CO 80639.

THE FLOOD MYTH by Alan Dundes (ed.). Berkeley, CA: University of California Press, 1988. 452 pages, index. Hardcover; $48.00/Paperback; $15.95.

No, this is not another attack on biblical historicity by a radical higher critic, nor is this another attempt to explain the Genesis deluge scientifically. In fact, *The Flood Myth* deals only to a limited extent with The Flood; rather we have here description and analysis of flood traditions from all around the world. The perspectives are primarily those of the anthropologist, folklorist, or student of the ancient Near East, but there is material of interest to the natural scientist as well. Although the book offers no comprehensive overview of the biblical flood, Christians who want to synthesize biblical and extra-biblical material relating to the flood narrative will find this work to be a valuable resource.

The Flood Myth was edited by Alan Dundes, a Professor of Anthropology and Folklore at the University of California in Berkeley and a long-time student of myths. Noting the wide diversity of views about the flood, Dundes observes that

> the question of the historical authenticity of the biblical flood myth is still being hotly debated in the twentieth century. For this reason the narrative continues to be studied by theologians as well as by anthropologists, classicists, folklorists, and geologists. This casebook is designed to bring together some of the highlights of the massive scholarship inspired by the flood myth.

Dundes' "casebook" is an anthology of 26 essays relating to a variety of aspects of flood myths. The context of each essay is presented in an introduction by editor Dundes that incorporates valuable bibliographic material.

The first several selections focus on the biblical material and related Near Eastern flood legends. One judicious inclusion is the electrifying paper that George Smith read before the Society of Biblical Archaeology in December, 1872, in which he recounted his landmark discovery of the flood narrative in what is now known as the Gilgamesh Epic. More recent essays present helpful summaries and comparisons of extant Near Eastern flood literature. Included, too, is Tikva Frymer-Kensky's 1978 review of the significance of the Atrahasis epic for our understanding of the early chapters of Genesis. She stressed that the embedding of the flood story in a more comprehensive "primeval history" in Atrahasis suggests that we should see the Genesis flood not as an isolated story but in organic unity with creation, fall, and post-flood episodes. In turn, the similarity in structure and theme between Genesis and Atrahasis has important implications regarding the theological points being made in Genesis. While evangelical readers may warm to her suggestions, most likely they will be less enthusiastic about a 1939 essay by Eleanor Follansbee which claims that flood heroes, including Noah, can be identified as vegetation deities.

Succeeding articles move from the Near Eastern scene to flood myths more broadly considered. An excerpt from Sir James Frazer's exhaustive compilation of flood traditions is included. A couple of essays interpret flood myths in terms of primitive psychology. One essay is excerpted from a book by Geza Roheim who contended that flood myths are essentially retellings of dreams in which the considerable bladder pressure that develops by morning is symbolized by a vast urinary flood! In the same vein, editor Dundes postulates that males envy female parturition and that flood myths provide a way for males to imitate female creativity via the destruction and repopulation of the world. Significantly, Dundes does not see the literal and psychological exegeses as mutually exclusive. In theory there could have been an actual deluge or deluges, but in his judgment the wide diffusion of flood myths could be attributable to their symbolic content. Neither Roheim nor Dundes neglected to apply their psychological theories to the biblical flood narrative. I rather suspect that evangelicals will have some difficulty in reinterpreting Noah's flood as a dream induced by a full bladder!

Several detailed analyses of flood traditions follow. Considered are traditions from Mesoamerica, South America, Australia, the Cameroon, the Philippines, Thailand, central India, Sri Lanka, as well as Jewish legends. A variety of conclusions about similarities, dependency, diffusion, and the like are drawn from this material.

Only the final four essays reach into the realm of the physical sciences and their relationship to the flood. These include a chapter ("Science and the Universality of the Flood") from Don Cameron Allen's famous 1949 book, *The Legend of Noah*, Rhoda Rappaport's fine paper on the flood in 18th-century geological thought, an essay by James Moore on Lyells' contribution to the discussion about the Noachian deluge, and lastly a reflection by Stephen Jay Gould in the aftermath of his testimony at the Arkansas creationism trial.

If the reader is looking for the definitive solution to

the flood question, this is not the book. Nevertheless for anyone seriously interested in the flood, this anthology provides important data and perspectives that are not otherwise easily accessible to the reader.

Reviewed by Davis A. Young, Professor of Geology, Calvin College, Grand Rapids, MI 49506.

LIBERTY AND LAW: Reflections on the Constitution in American Life and Thought by Ronald A. Wells and Thomas A. Askew (eds.). Grand Rapids, MI: Eerdmans, 1987. 174 pages. Paperback.

This book is too broadly conceived. It takes more than a desire to "reflect on the Constitution and the constitutional" to unify a collection of essays. Three of the eight essays deal with the Constitution in the early republic; two compare other constitutions (German and South African) with the United States'; and the final two articles seek constitutional relevance today.

The editors, professors of history at Calvin and Gordon College, sought "the best writing available by Christian scholars" while "diversity of views" was to be the "hallmark" of their efforts. They obviously failed in the first objective, and revealed more of their own perspective in a comment in the concluding chapter after categorizing Francis Schaeffer as a "guru" of the Christian Right:

> When those of the radical left and Christian right lament the state of things, we might reply, "What's new about that? They've been alienated for years." But when *respected and sober commentators from the liberal center* agree that malaise and alienation are the proper terms with which to understand our age, it is time to take notice.... (p. 159) [emphasis added]

Nevertheless, several of the essays are worth reading, including Ronald Wells'. In "Freedom, Truth, and American Thought, 1760–1810" Richard Pointer, history professor at Trinity College, documents the prevalence in the early Republic of the belief that truth would always prevail in a climate of freedom; the "truth triumphant" notion. "The innate strength of Christian truth was sufficient to insure its prevalence," especially when "strong arguments and good reason" joined "the softness of civility and good usage." In spite of the parallel recognition of the fallenness of man, the noetic effects of sin often went unnoticed. Nineteenth-century Americans did not seem to question where, how, and with whom truth was going to triumph. They believed that God himself would eventually triumph, of course, and in the meantime Christian truth would be accepted anywhere it was given a fair hearing. All this strengthened democracy, but American Christians tended to equate a consensus of public opinion with "truth."

Pointers article lays the foundation for Kathryn Pulley's "The Constitution and Religious Pluralism Today," an essay which strays far from the Constitution. Does religious pluralism in a free society "threaten Christian absolutes"? A scholar should be objective and fair, but surely there must be limits to the "detached observer" perspective. Observe this paragraph:

> The primary difficulty many Christian theologians have with universal theology is how to interpret New Testament passages that seem to imply that the Christian system is superior because of Jesus Christ. Much interfaith dialogue struggles to deal with this traditional view of Jesus as God incarnate. The reinterpretations take various forms but the goal is to develop an alternative that will allow Christianity to be a part of the religiously diverse world, without asserting its superiority to any other faith system. (p. 150)

I wonder what the apostles and prophets would have done with such an approach? Why is there a "struggle"? Scripture states that Jesus was God incarnate. In the climate of "religious pluralism" and "toleration" described in the article, surely one is free to either accept or reject such a claim. There is no necessity to accommodate Scripture to a "religiously diverse world." Dialogue, yes. Syncretism, no.

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

THE FIRST AMENDMENT: The Legacy of George Mason by T. Daniel Shumate (ed.). Fairfax, VA: George Mason University Press, 1987. 189 pages, index. Paperback; $11.50.

Do words in a legal document mean what they mean *now* or what they meant when they were written? Therein lies one of the historically most important debates over the meaning of the term *constitutional.* Are we really governed by the Constitution or merely by officials put into office because of the structure of government as set up in 1789? Frederick Schauer, Professor of Law at the College of William and Mary, argues that neither "original intent" nor history really matter, that all legal documents, including the United States Constitution, can change right before our eyes as the meaning of words are altered by common usage. Precision of speech and nuances of language must give way to societal changes. We are cut adrift with no assured hermeneutical principles to guide us. No one knows quite what "freedom of speech" means, so the courts should have liberty (what does *liberty* mean?) to tell us—without the restraint of how the writers of the Constitution used the term.

Who or what, then, will restrain the restrainers and control the controllers, if not the words of the Constitution in a checks-and-balances environment? Simply the light (or glare) of public scrutiny. An unfettered press will lead us to good government because governments "do not always act in accordance with the interests of the people." Presumably the press (plural) does. And "the interests of the people," are they a single, unified entity?

Obviously not. Professor Schauer ridicules the generalized, abstract phraseology of much of the Constitution, but these kinds of abstractions are worse. Political factions and governments usually claim to be acting in "the interests of the people", or "for the common good" and "in the national interest", and courts now commonly claim a "compelling public interest" to justify all sorts of actions.

If words are "maltreated or abused," as Socrates observed, they "cannot protect or defend themselves." Well, they can if they are left to speak for themselves. Usually words left alone in context and without unnecessary interpolations and interpretations can communicate to succeeding generations. A study of the historical and cultural context is always in order, but the words themselves communicated to the original recipients and they can also communicate to us. One current example of this problem is the contemporary interpretation of the "Establishment Clause" of the First Amendment as if it militated against the "Free Exercise Clause" instead of complementing it. The eighteenth-century meaning merely prohibited the establishment of a tax-supported national church. (And that did not apply to the states since Connecticut, New Hampshire, and Massachusetts continued with tax-supported churches through the National Period until 1833.)

The lengthy introductory essay by the editor and Robert Rutland's "George Mason and the Origins of the First Amendment" are the strongest parts of the book. Professor Rutland reminds us of the great respect for law and legality expressed even in the American Revolution. The leaders of that day found the concept of legitimacy both in Calvinist terms of God's ordination of human government and in Enlightenment terms of natural law. They viewed themselves as defending English liberties and traditions collected in the English Constitution and given expression in the English Civil War of the 1640's and the Glorious Revolution of 1688.

Professor Rosemary Keller's "Religious Freedom: As Amended by the Founding Mothers" is a psycho-sociological-anecdotal analysis that does not fit well with the rest of the book. She has a clever but misleading title, since it implies that the historical significance of a handful of disparate, dissenting women is of a similar magnitude to those leaders who actually established the United States and its constitutional system. Historical significance is measured in terms of importance either towards continuity or change. Keller's interesting women deviate on both counts. By her own admission, the "broad spectrum" of colonial women viewed the world with "settled domestic piety."

"No space was available [in the Puritan order]," Keller writes, "for the women whose religious experiences bypassed ministerial authority and who sought to define her own faith." Need it be said that the same could be written equally of men at the same time and place? The Puritans were interested in discovering the "whole counsel of God" as revealed in Scripture, and were not interested in those who thought their personal experience had a greater authority than Holy Writ. To be sure, there were long discussions seeking to sharpen systematic theology, but the authority was always the Bible, not "religious experience." The Puritans did indeed believe in "freedom of conscience," but that conscience was always "captive to the Word of God." It was not based on a supposed subjective autonomy of each individual person.

An astounding generalization in Keller's article is that women in general had a "long ingrained low self-esteem underscored by the legacy of Eve and their domestic world...." The psychological terminology is anachronistic and overlooks the historical context. Men also had the legacy of Adam and the same domestic world of toil, mostly as subsistence farmers. Puritans as a whole, male and female, had a low *self*-esteem in the sense that they constantly prostrated themselves before the throne of God in *self*-abasement, awed at the terrible holiness of a Righteous and Omnipotent God.

The First Amendment is an uneven book. It gives valuable insights into the historical context of the First Amendment, but where it seeks to be relevant, it is not.

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

A FIGHTING CHANCE: The Moral Use of Nuclear Weapons by Joseph P. Martino. San Francisco, CA: Ignatius Press, 1988. 283 pages. Hardcover; $15.95.

Joseph Martino has written a lucid, challenging book that deserves our attention. He forces the reader to expand his mental horizon, to think both deeply and carefully about a very complex subject. Some may consider the book a sophistic exercise, believing its subtitle to be oxymoronic. Others may prefer to ignore it because it raises such disconcerting questions. But no American Christian, especially not those of us in leadership positions in either our professional or religious lives, should be ignorant of the issues presented in this book.

Martino, a retired Air Force Colonel, has 35 years of experience in dealing with military applications of technology. His book reveals a precise and in-depth understanding of the technical issues related to nuclear war. In addition, his appreciation of the theological and moral aspects of the problem has caused reviewers to describe this book as "the finest moral and intellectual history of the nuclear weapons debate" (Angelo Codevilla, Hoover Institute), written with "hard-headed theological reasoning" (Phil Lawler, *The Boston Pilot*).

A frequent response to moral dilemmas is to avoid them. Simple pacifism can be seen as such a response to the questions about using or not using nuclear weapons. This kind of response often ignores significant questions such as: What responsibility do proponents of pacifism have for citizens of unrestrained tyrannical governments?

More than 120 million people have been killed this century by such—a number more than three times that of all the war deaths in the same period! Martino has the courage to address such questions.

His book examines several popular "solutions" to moral problems associated with using nuclear weapons, and shows how these solutions create more serious moral problems than the ones they purport to solve. Nearly half the book is spent on the doctrine of the Just War and its application to nuclear warfare. In his discussion of the Just War Doctrine, Martino does not approach American history with rose-colored glasses. He is candid in his appraisal of the uses of force by the Allies in World War II: some of it was immoral. However, he does not come to the despairing conclusion that our security interests cannot be reconciled with moral standards—a conclusion that Martino blames for leading some to immoral total war concepts. Instead, he provides constructive and positive suggestions that bridge the apparent dichotomy between security needs and morality.

This book is well organized. Each of its 29 chapters is focused upon a specific aspect of the subject and treats that aspect cogently, boring in upon its fundamental logical and factual questions. Unfortunately, the book lacks an index—a surprising omission nowadays for any serious, scholarly publication. However, this is only a minor defect because of the book's excellent topical organization.

In conclusion, I recommend this book highly, although I did not enjoy being forced to think carefully about its frightening subject. It is a book that every serious Christian involved in the military or defense-related establishment within and outside of government should consider.

Reviewed by D.K. Pace, Johns Hopkins University Applied Physics Laboratory liaison with the Naval War College, 7333 Better Hours Court, Columbia, MD 21045.

TOO MANY PEOPLE? A Problem in Values by Christopher Derrick. San Francisco, CA: Ignatius Press, 1985. 110 pages. Paperback.

The basic idea of this book, by an English author who was a pupil and long-time friend of C.S. Lewis, is that the population explosion is really an urban implosion and "too many people" really means "not enough food." He is not primarily interested in arguing about sexual morality and the ethics of contraception, abortion, and sterilization, although he holds orthodox Roman Catholic beliefs about them. He is well acquainted with the literature on the population explosion, and evaluates the ideas of such famous authors as Malthus, Ehrlich, Meadows, and Salas.

Derrick contends that the population explosion has resulted from the ability to keep people alive through childhood and into their reproductive years. He argues that "we can only say that 'too many people' *exist* if their numbers threaten the purpose of their own existence; so we need to know what that purpose is." Three purposes are suggested: people are to be of service to others and to society at large; each person is an end in himself; and human beings exist primarily for God. Each of these ideas is evaluated, and the third answer is supported by his statement: "Given the existence and primacy of God as our first beginning and our last end, it is hard to see how 'too many people' can mean anything at all."

Eventually there will come a time when our history will end and God will have determined how many people had been on our planet. Until then, we need to do all we can to relieve poverty-stricken people, but we can't decide how many people should exist. "There is a God, and we're for him. That's why we cannot sit in judgment upon our own existence, our own numbers."

In the Appendix, parallelism between the cause of population control and the cause of nuclear deterrence is considered.

Those of us who have spoken or written on the population problem will profit from considering this author's beliefs.

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

COUNSELING FAMILIES by George A. Rekers. Waco, TX: Word Books, 1988. 212 pages. Hardcover.

This book is the fourteenth in the "Resources for Christian Counseling" series. Gary Collins, the general editor of the series, provided the preface. There are three appendices, endnotes, a subject index, but no scripture index. The author, a clinical psychologist, has experience as a marriage, family, and child counselor.

The author discusses family counseling from the viewpoints of its need, underlying problems, biblical perspectives, goals, approaches, methods, and challenges. The book is made up of illustrations, scriptures, explanations, the findings of scientific research, and advice. The appendices contain models of family counseling and selected references on family counseling for further study. This book will be a useful resource to those who deal with the changing American family.

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

MANAGING SEXUAL FEELING IN THE CHRISTIAN COMMUNITY by Dean Kliewer. Fresno, CA: Link Care Missions, 1987. 77 pages. Paperback.

The author, a practicing clinical psychologist, is Director of Research Ministries with Link Care Center. The book is from the Focal Points Series which seeks to provide dialogue on pivotal issues in an attempt to help Christians relate to a changing world.

The chapters cover sexual passages, sexual growth for the servant of God, sexual growth as emotional growth, and preparation for sexual behavior. Twenty-four books comprise the annotated reference section. The book's purpose is to help Christian adults grow and achieve wholeness in the arena of sexual feeling, thought, and behavior.

The author relates some of his sexual experiences as he grew up and eventually got married. He discusses common sexual fears, Christians and sexual issues, and suggested dimensions of sexual maturity. The fact that Christians have just about as many sexual problems as non-Christians indicates that this book deals with a relevant problem. The book is candid, caring and informative, and will be of help to the Christian community.

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

RELIGION, HEALTH, AND AGING: A Review and Theoretical Integration by Harold George Koenig, Mona Smiley and Jo Ann Ploch Gonzales. New York: Greenwood Press, 1988. 228 pages, index. Hardcover; $42.95.

This book is a comprehensive survey of the literature with over 500 references analyzed by Harold G. Koenig, M.D. in Geriatric Medicine Research at Duke University; Mona Smiley, Assistant Professor of Adult Education, Incarnate Word College; and Jo Ann Ploch Gonzales, M.S. in education from Incarnate Word College. The well-known ASA author David O. Moberg wrote the foreword, which states:

> Three significant contemporary trends meet in this book. One is the expansion of the aging population that provides a large proportion of the patients of most medical specialties and health services. The second is an increasing emphasis on the unity of each person that is reflected in such concepts as 'total wellness,' 'wholistic well-being,' and 'holistic medicine.' The third is the rising interest in spirituality that is evidenced by a wide range of renewal phenomena in traditional Christianity, as well as by numerous new religious movements and countless pseudo-religious cults and practices.

The volume also mentions opposing views, such as Freud's contention that religious influences on the psyche are "reflective of neuroses and illness producing." A questionnaire is appended which gathers the opinion of the elderly on many aspects of religious influence.

Beginning with a list of illnesses linked with psychological stress, the authors mention the "Gallup polls which have shown that among people over age sixty-five, more than 80 percent consider religion to be an important influence in their lives" in its belief, ritual and experience.

"Only about 20 percent of all who are revived volunteer any experience in a life beyond death's door; generalizing to all deaths from one fifth is a bad error. Worse yet, about half recount horrible experiences immediately upon recovery." "Lower suicide rates have also been reported among more religiously oriented individuals." Our Judeo-Christian scriptures are commended because they direct "thoughts toward helping others in worse situations and discourage self-centeredness and isolation."

Evidence for religion's beneficial effect on physical and mental health is given, although some religious institutions have opposed medical care in life-threatening circumstances. The text recommends research in the future on religious and health topics.

A study indicated that existence of social networks, such as those provided by religious institutions, are positively related to good health practices. These include no smoking, lower alcohol intake, better eating habits, regular exercise, and normal weight maintenance.

The authors list significant statistics. About one-third of those over 65 live alone; almost two-thirds of these are women. More than fifty million Americans were reported to have a significant religious experience. Lourdes in Southern France has a medical bureau that has certified about fifty cases as genuine "miracles" over 130 years. Scientific investigations have yet to prove that prayer works, but it would be hard to convince many religious older adults that it does not.

Twelve case studies are related in detail. The author concludes:

> When asked how they coped with difficult life situations, physical illness and increasing disability, a significant proportion of participants noted that their religious beliefs and activities were the most important thing that kept them going.

Barbara Payne, director of The Gerontology Center, Georgia State University, wrote the chapter on "The Social Gerontologist's Perspective," focusing on the social aspects of aging and the effects of significant numbers of older persons on society. She selected John Wesley and two other old persons as examples of how religion affects mental and physical health. She believes that seminaries are aware of the need for gerontology in the training of the clergy.

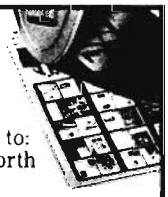
In his chapter on "The Physician's Perspective," Koenig gives the views and opinions of a number of physicians. Because half of visits to physicians are for complaints

without physiologic basis, there is the need for physicians to consider social and cultural factors in the diagnosis and treatment of their patients. In 1987, a survey of Illinois physicians revealed their views on religion and health. Two-thirds strongly agreed that religion had a positive effect on the mental health of their older patients, and nearly half agreed to its positive effect on physical health.

Mona Smiley's chapter is entitled "The Ministerial Perspective." She estimates that up to one-half of ministers' counselling and pastoral calling time is devoted to the aged. However, not many clergy have received pastoral training appropriate for dealing with the elderly.

Ten implications for clinicians and avenues for future research are presented in Chapter 13. In his conclusion, Koenig writes that major problems involve determining: (1) what encompasses the term "religious"; (2) how its components should be measured; (3) what the validity is of the information acquired; (4) what types of mental and physical health dimensions should be examined and how they should be measured; and (5) what confounding variables need to be controlled in comparative analyses.

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



LAUGHTER, JOY AND HEALING by Donald E. Demaray. Grand Rapids, MI: Baker Book House, 1986. 228 pages, bibliography. Paperback; $7.95.

Demaray is a professor of preaching at Asbury Theological Seminary. Some of his other books include *Alive to God Through Prayer, Watch Out for Burnout!, Alive to God Through Praise,* and *A Guide to Happiness.*

This book is, as described by its author, a daily mental health supplement. There are thirteen weekly divisions, with a thought for each day. Almost every thought contains at least one biblical reference, along with anecdotes, research data, and the author's experience. It is *not* a rigorous treatment of the effects of laughter and joy on personal health. It *is* an effective guide to improve one's outlook on life, and as a result, to experience an increase of joy. Various weekly titles include: Laughter Therapy, Sources of Joy and Laughter, Worship and Joy, Faith and the Joyous Spirit, and Gratitude.

Today's society places much emphasis on the quantity of life. Often the church echoes this theme. *Laughter, Joy and Healing* helps restore balance by illustrating the need for quality of life. God does not desire His children to suffer—He wants us to be joyful. Unfortunately, people tend to disregard this divine command and succumb to Satan's desire to make them miserable like unto himself. Demaray contrasts the joy of Christ and His early church with modern-day theology. One example relates to Christ's first public miracle: the changing of water to wine at the wedding feast. Jesus' action powerfully shows God's sanction of both joy and marriage. Christ wept at the wickedness of the world, but shared the joyous Spirit of God freely with all who would listen. His chosen Apostles did likewise following His death and ascension. It was several hundred years later that man removed the joy of His Spirit from the church. One is prompted to ask why.

I highly recommend this book to anyone who seeks to serve God. It presents several biblical teachings in a new light, allowing us a better understanding of the Lord and His love for us, while helping us experience joy on a daily basis.

Reviewed by Thomas N. Teichrieb, 2803 E. Orange Grove, Orange, CA 92667.

THE UNIVERSE NEXT DOOR: A Basic World View Catalog (2nd edition) by James W. Sire. Downers Grove, IL: InterVarsity Press, 1988. 219 pages, notes, index. Paperback.

Thirteen years ago in 1976, James W. Sire brought out the first edition of this book. It set forth excellent summaries of the major presuppositions and positions of a number of basic world views: fundamental paradigms chosen on faith, from within which all other aspects of life are judged. He thereby called attention to the basic importance of the philosophical, metaphysical, and theological frameworks within which different people view the world.

Now, in the second edition, he has extensively revised and retitled the chapter on "The New Age," has added sections on Marxism and secular humanism, and has updated the bibliography and references of the book. It is his purpose to encourage readers to identify their own world view among the various options, and to participate in some reflection as to why they think their particular world view is true.

In this second edition, Sire considers the following world views: Christian theism, Deism, Naturalism with its offshoots of Marxism and Secular Humanism, Nihilism, Existentialism—both theistic and atheistic—Eastern Pantheistic Monism, and the New Age (to which he devotes over one-fourth of the text). Of each world view he asks, in one way or another, several basic questions: What is

reality? What is a human being? What happens at death? How can we know anything at all? How do we tell right from wrong? What is the meaning of human history? He points out that if we think that our answers to these questions are too obvious to be questioned, we are totally unaware that there are many others in the world who do not share them.

At the conclusion of the book, Sire lists four characteristics that a valid world view should have: the ability to provide inner coherence, to comprehend the data of reality, to explain what it claims to explain, and to be subjectively satisfactory. He sees these met most completely in Christian theism: "To be a Christian theist is not just to have an intellectual world view; it is to be personally committed to the infinite-personal Lord of the Universe. And it leads to an examined life that is well worth living" (p. 219).

All of these world views are expounded in detail with great clarity in a way that makes it possible for the reader to gain a greater understanding of his own world view and those of many others in the world. Such an awareness and mutual understanding is a prime requisite for meaningful interaction and sharing of the Christian gospel with others in the world who presently hold a different world view from our own.

As in any work with such ultimate implications, it is possible to wish that the author had been able to pursue certain directions more fully, provide some more specific insights, or avoid some pitfalls a little more completely. It is evident that this second edition has taken into account the comments of many sympathetic readers and friends. It is in that spirit that I make the following suggestions. (1) By limiting itself to Christian theism, the book leaves us with several questions unanswered that it would be very helpful to have treated. Expositions of Jewish theism and Muslim theism would be very helpful for comparison and contrast with Christian theism. (2) Although the interpretation of scientific insights plays a significant role in several of the world views, particularly Naturalism but also the New Age, the book hardly touches on these in any specific way. To bring the cosmological perspectives of Naturalism up to date, for example, some mention of Hawking would be quite helpful. (3) Although certainly the same questions are asked in each world view discussion, it would be pedagogically helpful if exactly the same questions were asked of each world view so that the answers could be directly compared. In the chapter on Nihilism, for example, the pattern characteristic of the other chapters is not followed. (4) The treatment of paradox, contradiction, and complementarity is a little confused and the book would benefit from some clarification (pp. 129, 188). In the latter case it is claimed without real justification that complementarity fits nicely into the pattern of the New Age. (5) Certain claims are left completely to references that might have been more fully expounded and analyzed. Examples are the "corollaries between psychic phenomena and twentieth century physics" (p. 166), the authenticity of which can be strongly questioned, and "negative evidence from out-of-the-body experiences" and "the idea of reincarnation" (p. 182), which would be helpful to have more detail on at hand. (6) Although the desire to update the book on the New Age undoubtedly contributes to the space spent on that subject, one might question whether the New Age really merits so much coverage. One might certainly question whether Shirley MacLaine's thought merits 12 pages in a book like this, even given the justification that "seldom have the many inconsistencies of New Age thought been so obviously displayed" (p. 202).

But these comments are occasioned by the high quality of Sire's treatment and its wide importance for today, especially perhaps for students who are in the process of developing and choosing their world views. The book is so good that one regrets even its minor shortcomings. It certainly deserves wide reading and a place on the bookshelf of every pastor, teacher, and serious Christian.

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

Letters

Response to the Review of ***Evolution: A Theory in Crisis,*** *by Michael Denton*

I am writing in response to the recent (December 1988) and lengthy review of Michael Denton's *Evolution: A Theory in Crisis*. The reviewer (T.E. Woodward) presented a very favorable account of a book whose claims to scholarship or integrity are woefuly deficient. The book is praised as an "intellectual and spiritual delight," a "forceful critique" and a "careful historical review." Furthermore, the impression is given that informed reviews likewise share the same positive appraisal. I take serious objection to all these points.

To start in reverse order, five out of seven reviews I could obtain in my University library pointed out the serious errors of logic, synedoches, direct misquotes, gross factual mistakes and even spelling errors in Denton's book. The only slightly positive comments came from the *Parabola*—an eastern mysticism journal—and from Stephen Rose who approved of the critique of the *path* of avian evolution of flight even though he acknowledged the serious errors and oversimplifications in the book.

Why are all these reviewers so irate? Basically, the same old creationist tactics and ill-founded objections. Consider Denton's facile explanation of why evolution—the object of the critique is macroevolution—is accepted by the scientific community: the "priority paradigm." This Kuhnian notion (already problematic in Kuhn's own work) is given the sole task of founding Denton's portrayal of a theory in "crisis" which is nevertheless not abandoned.

Denton's lack of precision—he conflates natural selection with chance—and expertise is also evident in his treatment of technical disputes within biology. These include the punctuationalists attempts to decouple macroevolution from microevolution, the cladist attack on Darwinian phylogenies, Kimura's neutralism and discussions of the *paths* of evolution (such as avian flight). The standard creationist tactic consists of "research by exegesis," or eisogesis in this case; quotations from opponents in some minor technical dispute are judiciously chosen to make both positions seem untenable leaving agnosticism or creationism the only remaining alternatives. Denton's mishandling of these technical disputes enables him to conclude that there is no reason to believe that evolution of the higher taxa ever occurred.

Denton unearths the typological perception of nature which was legitimately abandoned due to its lack of explanatory power. Denton proposes that all mammals are "derived" from a mammalian "archetype," fish from a fish archetype and so on. But how many archetypes will Denton need to account for the incredible diversity of past and present species? Secondly, how are these species "derived" and what are the limits to change since he allows for microevolution? Thirdly, how can this anachronistic typology account for the examples of species which are not rationally explainable in terms of types and which constitute powerful evidence for the fact that evolution has occurred? Thus, whales with femurs, *Archaebacteria*, strange mammals on Madagascar, marsupials, toothed birds ... are either ignored or dismissed by some sleight of hand—see Denton's treatment of *Archaeopteryx*. The whole discontinuous/continuous argument of Denton founders on his lack of precision and his failing to take into account significant research on the transitions between species or "types."

Perhaps the best example of Denton's lack of intellectual acuity can be seen in his mishandling of molecular homologies. He confuses cousin-cousin relationships with ancestor-descendant relationships and comes up with the profound conclusion that both fish and humans are "equidistant" from lamprey. From the gross differences that both fish and mammals have from lamprey he fallaciously concludes that all vertebrate groups are equidistant from each other. The remarkable agreement of molecular data with traditional evolutionary phylogenies beggars description. There is no reason why humans need to be more closely related to chimpanzees than most other species of primates. Ironically, even Denton's diagrams of nested sets point to the hierarchical nature of taxonomy (already derived from paleontology and comparative anatomy) which is yet another line of evidence for the fact of evolution.

Denton's major flaws lie in his scholarship and integrity. Firstly, his citations of leading biologists often distort and twist their intent (his discussion on taxonomy where he makes Halstead sound like a cladist!). Secondly, he ignores arguments which he cannot criticize. Thus, key evidences for the fact of biological oddities and "imperfections," some of the better fossil transitions, comparative anatomy, biogeography, and the remarkable congruence of the geological column with evolutionary hypotheses are not even addressed.

On a personal note, I must confess to the surface persuasiveness of Denton's book. The selective treatment of evolutionary biology—focused on difficult transitions and especially abiogenesis—and the impressive if fraudulent citations belie the true nature of the book's argument. On a second and more perspicacious reading I was at first disappointed and then finally infuriated by the unsustainable attacks on evolution and the even more repulsive misuse of sources. Denton rightly belongs with other recent misbegotten attacks on evolution such as Ian Taylor's *In the Minds of Men*—their popularity is inversely proportional to the biological or historical knowledge of their readers. Unfortunately, the desire to see evolution refuted often grants evolution's critics a prior claim to truth. If we should go about refuting evolution it will require sound arguments and careful scholarship; nothing less is worthy of the evangelical community.

Marvin Kuehn
48 Carling Street, #1
Hamilton, Ontario L8S 1M9
Canada

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

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

CANADIAN SCIENTIFIC AND CHRISTIAN AFFILIATION

A closely affiliated organization, the **Canadian Scientific and Christian Affiliation,** was formed in 1973 with a distinctively Canadian orientation. The **CSCA** and the **ASA** share sponsorship of the publication. **CSCA** subscribes to the same statement of faith as the **ASA** and has the same general structure. However, it has its own governing body with a separate annual meeting in Canada.

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

CENTRAL CALIFORNIA
CHICAGO-WHEATON
DELAWARE VALLEY
EASTERN TENNESSEE
GUELPH, ONT
INDIANA-OHIO
NEW ENGLAND
NEW YORK-NEW JERSEY
NORTH CENTRAL
OREGON-WASHINGTON
OTTAWA, ONT
ROCKY MOUNTAIN
ST. LOUIS
SAN DIEGO
SAN FRANCISCO BAY
SOUTH CENTRAL
SOUTHERN CALIFORNIA
SOUTHWEST
TORONTO, ONT
VANCOUVER, BC
VIRGINIA-KENTUCKY
WASHINGTON-BALTIMORE
WESTERN MICHIGAN
WESTERN NEW YORK

ARTICLES

COMMUNICATIONS

BOOK REVIEWS

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

VOLUME 41 NUMBER 4 **DECEMBER 1989**