PERSPECTIVES on Science and Christian Faith

JOURNAL OF THE AMERICAN SCIENTIFIC AFFILIATION

In this thematic issue on

"Connections"...

Mind Life

Aggression, Suicide, and Serotonin

Knowledge of the Unseen:
A New Vision for Science and Religion Dialogue

Defining Consciousness: Christian and
Psychological Perspectives

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

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Perspectives on Science and Christian Faith

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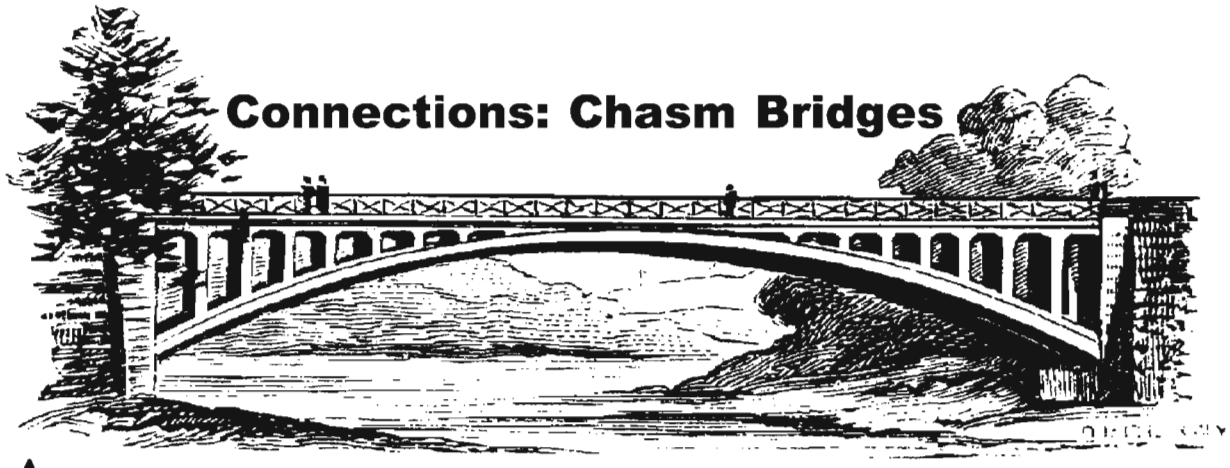
The View from Shepherd's Knoll ...



As a bridge spans a chasm and joins two isolated regions, so connections bring unity to fragmented knowledge. Our cerebral cortexes contain large association areas that are functionally wired to connect isolated bits of sensory inputs. These connections allow purposeful response to our environment. For example, seeing a coiled timber rattlesnake beside one's path in the woods and simultaneously hearing her distinctive warning rattle elicit an acute avoidance response from an appropriately programmed and connected brain.

As our seven- and nine-year-old daughters mature, they consistently illustrate the power of connection. Adopted three years ago from Ukraine, they were challenged to adapt to a new culture, to learn English, to experience Christian family living, and to rediscover bonding as a basis of security. Experiencing connections became the means of growth. Associating strange-sounding English words with familiar objects formed the early steps in learning a new language. Experiencing consistently unavoidable consequences that followed both wise and unwise choices connected the principle of "sowing and reaping" with personal responsibility. Posing insightful childish questions that attempted to connect new information with the familiar provided the basis for making sense of their new world.

As scientists much of our academic training was based on a narrow discipline perspective. Reductionism within scientific disciplines has proved to be a fruitful scientific paradigm in the modern era by stimulating the rapid advance of scientific knowledge and technology. Yet, we have also experienced nature's coherent continuity. During the past few decades, significant scientific advancements have emerged from transdisciplinary approaches and have created new fields such as physiological psychology, molecular biology, and environmental science. In our own scientific society, we have gone further to connect our faith perspective to our work in science. Working from a Christian faith perspective, we understand that design, unity, and rational order in the cosmos reflect the activity of a creating God. To study nature without considering the Creator is to fragment knowledge.

In this "Connections" thematic issue, four writers advance bridging concepts that illustrate the interconnectivity of reality. David Glanzer describes a concept of mind that links biological brains within a community of persons and joins the immanent flow of spirit. Donald Calbreath emphasizes a human behavior that is more than deterministic biochemical function and is consequently accountable for actions. To bridge quantum mechanics and metaphysics, Hyung Choi suggests replacing material and supernatural distinctives in science with new paradigms that involve knowledge of the unseen. Finally, William Struthers explores consciousness, not only as the mind/brain/soul link, but as rooted in relationship, thereby connecting consciousness with others, with the environment, and with God.

Jocund Reading,
Roman J. Miller, Editor

News & Views

The Need For Theology

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The reports of the April 2000 "Nature of Nature" conference in the July/August 2000 *Newsletter of the ASA and CSCA*[1] by Glenn Morton and Bryan R. Cross bring out—I think inadvertently—a serious deficiency in the Intelligent Design movement. More broadly speaking, they reveal a problem in many of today's conversations about science and religion: A failure to appreciate the need for theological expertise in such discussions.

At the beginning of his report, Morton lists some of the disciplines represented by speakers at the conference: Philosophers, historians, physicists, biologists, mathematicians, paleontologists, and those involved in the study of mind. Perhaps there were professional theologians present but they are not listed here and play no role in any of the reports. I realize that some of the participants mentioned have some theological training and competence, but it is the omission of theologians *qua* theologians and the consequent downplaying of the importance of theology with which I am concerned.

Why does this make any difference? The answer is quite simple. Theology is, according to one classical definition, "the teaching about God and divine things,"[2] and a number of the discussions at the conference involved God. Without trying to exclude anybody else, one would think that those who are supposed to have formal training in speaking about God would be worth hearing in such discussions.

A couple of examples will illustrate my point. Morton says that the discussion about design and DNA "revealed a poorly thought out aspect of the Intelligent Design movement. Exactly how does God interact with the material world?"[3] God has come immediately to the center of the debate.

In fact, the topic which is introduced here is one with which theologians have wrestled over the centuries, that of providence and divine action. They have developed a number of different theologies and models in response to precisely the question which has been posed: How does God interact with the material world?[4] Just the variety of the responses to the question (Barbour lists nine possible theologies with accompanying models) shows that theologians cannot claim to have a definitive answer to the question, but their investigations have brought to bear knowledge of the Bible and of the world, and have pointed out the strengths and weaknesses of various approaches. Scientists and philosophers may find themselves re-inventing the theological wheel if they start discussing this topic without knowledge of the theological tradition.

The second example highlights even more clearly the need for theological competence. In his notes on the conference, Cross reports the response of philosopher Rob Koons to the question of whether it was possible to be a methodological naturalist without being an ontological naturalist: "Of course. But why would you want to? I maintain that our method should follow our ontology, and vice versa."[5]

"Why would you want to?" For a start, because there are some significant theological arguments in favor of doing so. A consistent theology of the cross and/or a kenotic theology of divine action (the two are closely related) suggest on theological grounds that we should be able to understand the world scientifically without reference to God, even though God is in fact at work in the world through natural processes.[6] Moreover, some of the church fathers can be cited in support of a concept of the functional integrity of creation that leaves no gaps in the developmental economy of the world.[7]

Of course one may or may not accept such theological positions and their implications. But the issue does have theological components which need to be studied theologically. To dismiss them with a rhetorical "Why would you want to?" is hardly adequate.

Koons' statement suggests that philosophy, and ontology in particular, is to play the role of theology. In reality, God's character, made known in his self-revelation, should inform both our ontology and the methods we consider adequate for investigating the ways in which God interacts with the world and manifests himself in it. If this does not happen, then we are in danger of forcing God to fit our conceptions of reality.

All this having been said, let me warn against some misunderstandings. First, theological expertise is not salvific. We are justified by faith, not by our theology—which is, in simplest terms, just thinking about what we believe. Professional theologians do not necessarily rank highest (whatever that might mean) among Christians. But in serious discussions involving "God and divine things," they ought to have a significant voice.

Second, while I have spoken of the need for "theologians," my concern is not really full employment for this profession. It is, rather, the need to bring theological understanding of some depth to bear on the types of questions which were discussed at the "Nature of Nature" conference. If theology is thinking about what we believe, all Christians in possession of their faculties ought to be theologians to some extent. A person can have considerable knowledge of the theological tradition and skill in thinking theologically without being a professional theologian. A person can also be a good amateur scientist, philosopher, or historian, and the views of competent amateurs deserve to be heard. But all other things being equal, those who devote most of their time and effort to a field of study and who have been given some recognition for that work ought to be given attention when subjects in that field are under consideration.

Third, theology certainly needs to be open to insights from other fields of study, and theologians ought to have some knowledge of different disciplines. Work in science or history may, and often has, raised questions with which serious theology must deal. Many theologians do not know enough about scientific issues, and theological education needs improvement in this regard. But scientists, even those who are religious believers, are often equally ignorant of theology. If there is to be serious science-theology *dialogue*, then workers in one field need to have some familiarity with, if not expertise in, the other. Until we reach that point, there needs to be at least respectful listening to dialogue partners.

In any case, other disciplines cannot be allowed to determine the theological agenda. Natural reason is to have a ministerial, not a magisterial, role for theology.[8] Virtually the whole history of Christian thought should serve as a warning about the distortions that Christian belief can incur if a priori philosophical views are imposed upon it.

Finally, I am not arguing here (though I do in other venues) for my own theological views. The question at present is not about the best theological position—Protestant or Roman Catholic, conservative or liberal, etc.—which should be taken with regard to particular issues of faith and science. The point is that some recognized competence in theological thinking and knowledge of the theological tradition is needed in science-theology dialogue in general, and in discussions of intelligent design hypotheses in particular.

Notes

[1] "Reports from 'The Nature of Nature' Conference," *Newsletter of the American Scientific Affiliation & Canadian Scientific & Christian Affiliation* 42, no. 4 (2000): 1, 3.

[2] J. A. Quenstedt, *The Nature and Character of Theology* (St. Louis: Concordia, 1986), 15. This is an abridged and edited translation by Luther Poellot of the first chapters of the 1696 edition of Quenstedt's *Theologia Didactico-Polemica sive Systema Theologicum.*

[3] Morton in "Reports," 1.

[4] A discussion of traditional views is Benjamin Wirt Farley, *The Providence of God* (Grand Rapids, MI: Baker, 1988). A presentation of various ideas in connection with science understandings of the world is Ian Barbour, *Religion and Science: Historical and Contemporary Issues* (San Francisco: HarperCollins, 1997), chapter 12.

[5] Cross, "Reports," 3.

[6] Dietrich Bonhoeffer, *Letters and Papers from Prison*, enlarged edition (New York: Macmillan, 1972), 311 and 360–1; George L. Murphy, "The Theology of the Cross and God's Work in the World," *Zygon* 33 (1998): 221; and Nancey Murphy and George F. R. Ellis, *On the Moral Nature of the Universe* (Minneapolis: Fortress, 1996).

[7] Howard J. Van Till, "Basil, Augustine, and the Doctrine of Creation's Functional Integrity," *Science and Christian Belief* 8 (1996): 21.

[8] Siegbert H. Becker, *The Foolishness of God* (Milwaukee: Northwestern, 1982).

Mind Life

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Defining mind reductively in terms of brain activity or function is incomplete in that (1) it confounds the emergence of mind from brain with the instantiation of minds in the brain, (2) its localization of mind "between the ears" makes it difficult to recognize instantiations of mind outside the brain, and (3) identifying the mind and person too closely with the body situates interpersonal processes such as language and culture outside mind and person and makes it unnecessarily difficult to model their essential qualities of shared mind. An alternative understanding, that the brain is in the mind rather than the mind in the brain, situates mind in the space between the personal embodiment of minds in brain and the personal community of minds in personality and spirit. Mind is the name for agents which have the capacity to be multiply instantiated across brains in an ontology of distributed embodiment. These between-ness, socially distributed and shared, multiply instantiated mind qualities are inherited, preserved, and transcended in the integrative emergence of personhood from the community of minds. While this understanding derives naturalistically even from reflection on the nature of the instantiation of information in machines, it also results in a description of reality in its nonmaterial dimensions, suggesting obvious ways in which this scientific (naturalistic) map of instantiation and emergence may be congruent with theological maps which chart the flow of spirit in immanence and transcendence.

The predominant contemporary understanding of mind in Western popular and scientific cultures is that mind can be understood in terms of brain functions. According to *Webster's Third New International Dictionary*, mind is "an organized group of events in neural tissue occurring mediately in response to antecedent intrapsychic or extrapsychic events which it perceives, classifies, transforms, and coordinates prior to initiating action whose consequences are foreseeable to the extent of available information." Minsky's definition says much the same thing, "Minds are simply what brains do."[1]

If the mind is what the brain does, and the brain is inside the person, it follows that the location of mind is in our interiors, that it is something which exists or happens inside us, within our brains. This is not necessarily to say that mind can be reduced to brain, because an interior, brain-oriented perspective can support theories of mind which treat mind as an irreducible, emergent phenomenon.[2] Still, what mind emerges *from* is the brain and mind is dependent on the brain. The mind belongs to the brain, and the brain belongs to (in) the whole body, or person. Within the person is the brain and within the brain the mind.

This view is incomplete for, at least, three reasons. First, it has the holarchy backwards. According to systems theory, higher levels in a holarchy always contain their lower levels. The test of what is higher is that if any given level is destroyed, all the levels above it are destroyed, and the levels beneath it remain.[3] If the brain is destroyed, so too is the mind it embodies, but if part or all of the mind is destroyed that does not in itself destroy the brain. So, following these criteria of systems theory, the brain is in the mind rather than the mind in the brain. Second, locating the mind within the brain makes it hard to account for the vast variety of expe-

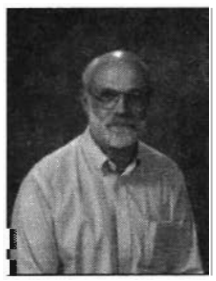
riences of shared mind, empathy for example. The fact that psychologists have such a hard time with the theory of empathy is explained by the largely unexamined assumption that mind is strictly personal and interior, which of course is true if mind is nothing more than brain functions. I cannot share my brain with you, but I certainly can share my mind—the problem is that a limited ontology of mind construes "sharing my mind" to be strictly metaphorical. Finally, identifying the mind and self too closely with the body, which is narrowly bounded in the individuality of its flesh, has two unfortunate consequences for personality theories—our understanding of personality is too closely bound by the position of the body in localized space and time, and interpersonal and transpersonal processes such as community, language and culture are dissociated from the person's inherent nature. Ironically, it is this overemphasis on the body (materiality) of mind which tends to feed the myth that community and culture are not embodied.[4]

The purpose of this paper is to play with the idea of mind in order to jog loose our overly material, overly evolutionary, emergent biases about the nature of mind. The hope is to create an expanded space for our understanding of mind, a space which can function to more adequately support the task of explaining interpersonal and transpersonal phenomena. While this exploration of mind is intended to be fully "scientific" (naturalistic), suggestions are made regarding ways in which theological accounts of reality may parallel this naturalistic account.

Mind Emergent and Instantiated

The view that the mind is what the brain does is one-half of a complete theory. Given this theory of mind, research questions center around how brain does mind. If, in general terms, mind is an emergent phenomenon of brain activity, then what are the supporting brain structures? Is mind nothing but brain activity (reductionist argument), or does mind have an influence on brain activity? The vantage point for examining mind is close-up, grounded in the utility of mental processes for the person. Developmental perspectives and developmental psychology until recently have utilized almost exclusively this bottom-up (emergent), evolutionary research approach. For example, psycholinguistics studies how language emerges from genetically predisposed brain structures, how various brain structures support the tasks of language comprehension and production, how learning contributes to the emerging patterns that support a mature language system, and how language acquisition ultimately contributes to the formation of self and person. This developmental story is told bottom-up, from the perspective of the brain and its increasingly differentiated structure and purposeful activity. Gauvain writes: "Psychologists have yet to devise a language for describing thinking that is not entirely in the head of the child or is only partially in place."[5] It is a research paradigm that nicely embodies the dominant Western paradigm of autonomous individuality.

While the bottom-up, emergent account of mind is a useful and productive approach, when taken as the whole truth, it becomes false when it ignores the parallel top-down developmental story of how the culture (and language) creates the person and his or her brain.[6] There are two directions of mind-brain formation: bottom-up, brains support the emergence of certain types of mind; and top-down, mind can be instantiated in brains, patterning the organization of neural networks. This top-down perspective has been explored by the idealist philosophical tradition, represented perhaps most clearly in Hegel's claim that mind exists external to the brain, and comes to be embodied in brain, or stated more strongly, that brain is one form of mind. Rather than the mind being a part of or function of brain, what the brain is and does is a function of the controlling influence of mind.[7] Hegel's *Geist*, translatable as either mind or spirit, is typically translated into English as spirit, clearly conveying the transcendental quality of spirit-Geist, but glossing over the more embodied connotations of mind-Geist.



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Most students of mind agree in general terms that anything a person knows inextricably involves the contribution of the particular transformations of brain-mind in perception, categorization, valuation, etc. Thus, they observe that we cannot know the world apart from our brain-mental contributions to the process. This observation itself is theory-ambiguous. From a brain-central theory of mind, this observation (that the brain is so intimately involved in knowledge) supports a strong claim for the interiority of experience and essential isolation of the person. From an idealist perspective, the observation prompts attention to the constructed and categorized realities that subsume the individual within language and culture. Note that both perspectives recognize mind between; the mind is the interface between whatever might be "out there" and whatever is "in" neurons.

Mind is lost
either when reduced to brain
or elevated to spirit.
Mind lives
in the space between.

If we focus on the "between-ness" and bi-directionality of mind, both perspectives taken together are correct, and either perspective without the other is partial at best. From the perspective of the brain, mind is what represents the experiences of the body in neural memory. From the perspective of spirit, mind is that which instantiates (incarnates, embodies) the scripts and energies of person and spirit. Mind mediates between the particularities of individual experience and the larger contexts that give those experiences meaning. Mind's job is to take body perceptions and enfold them in categories of common experience, and to take cultural categories of experience as templates of perception.

The problem with materialist mind is not that it is a brain-emergent life form, but that all its life is synonymous with neural life, and mind's meaning can be subsumed in its biology. And the problem with idealist mind is not that it pre-forms brains, but that it encompasses within the one term, mind or spirit, the whole of the immaterial and through extension the material. In becoming the name of reality, mind loses its differentiating potential, which is of course precisely the point for mystical purposes. Christian thought emphasizes both aspects of reality in the bi-directional events of incarnation and ascension, immanence and transcendence.

Brains support both the emergence of mind and the instantiation of mind. Emergence and instantiation are two directional perspectives with respect to the same thing. Mind is lost either when reduced to brain or elevated to spirit. Mind lives in the space between.

Mind Agents—An Exploration

Information

What are common names for those beings that, in the interaction of brain with world, are or become neither brain nor world, but something immaterial bridging two kinds of material realities? One possible name for this type of reality, these connecting patterns, is information. Very early in the development of computing technology, the computer as information processor emerged as a dominant metaphor within computer science, and was extended by cognitive psychology to the understanding of the function and processes of the brain. The computational capacities and particularly the ability to store computational programs in memory shaped the vision of a machine that could function as an expert assistant for many data-driven activities. From the perspectives of the cognitive sciences, an intelligent information processor would be a much more representative metaphor of the computer than the more popular desktop metaphor, an unusual type of filing cabinet attached to a typewriter.

When we are considering the behavior of the brain, we often explain the world it is dealing with in terms of information because this metaphor fits common (Western) sense. The information metaphor provides an information processor, a world external to the processor, and the information. The information represents the world to the processor and evokes the processor's tasks. It is neither the world nor the processor, and the influence of both world and processor are present in a two-way "flow" within the information itself. The information in some sense "knows" the most about what is happening, encoding the world in processor-interpretable packets.

Radios are information processors. A radio is a kind of brain, one with very short-term memory, and no autopoietic (self-organizing and self-maintaining) capacity.[8] Radio waves, and particularly the information in the structure of radio waves, while not the radio, are essential to "radio-ness." We would not manufacture radios nor have any idea what the concept of radio might mean in the absence of patternable radio waves. They structure the radio with their current pattern of electronic

activation, activation not producible by the radio on its own. What makes a radio and keeps it from being dismantled (maintains its life span) is its ability to interpret radio waves from outside its own being.

The information the radio processes brings the radio to life, and in that sense the information has more "life" than the radio. When we listen to a radio we do not listen to the electronics, but to the information being broadcast. But the metaphor of information has the disadvantage of not connoting the life processes of the information. The information metaphor is a static metaphor, which plays well with other material transfer metaphors. Information is always *about* something *else*. The mind concept connotes more animate qualities, more life, than does the information concept. Still, information is a candidate for one kind of mind, and the treatment of the concept of information within cognitive and computer science often moves it toward a constructive role and active identity in its own right.

Software

Computer metaphors have infiltrated common culture to the extent that it is not unusual to hear people refer to their minds or thoughts as software, or to their basic perceptual and memory mechanisms as hardware. A computer has long term memory and the potential for autopoietic memory.

It has been said that the mind is the software of the brain. Within this metaphor, the mind creates the brain by endowing it with particular and characteristic algorithmic functions. In learning, the brain's physical structure is modified by its thoughts. This perspective makes sense of saying that thoughts have (structure or create) brains, prior to brains having thoughts. Thoughts enliven brains, as software activates hardware. While thoughts need brains to exist, brains do not create thoughts. Thoughts propagate in brains like radio waves in radios and software run on computers.

The software concept, particularly in its emphasis on process, names a kind of mind.

The problem with the software metaphor is that, at the level of type of machine, analogies between current serial computers and brains fail dramatically. Computer hardware is literally hard, while neurons are living biological beings. This makes a difference. "Interpreting software" for the brain is anything but a passive, serialized, unmotivated affair. The software metaphor has more life agency than the information metaphor, but not as much as the mind metaphor can contain. Still, the software concept, particularly in its emphasis on process, names a kind of mind.

Word and Language

Increasingly, the concept of an autonomous computer-resident-being is becoming more ordinary. What began with animated screen savers has developed into "assistants." As I type, an animated little computer icon with feet, whom I call Bot (see Fig. 1), observes my behavior from within a small window on my desktop.[9] My understanding of my interaction with Bot is framed in animate, even human metaphors, though I think I know very well what this animation "really" is.

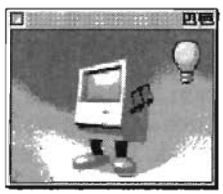

Fig. 1. Bot, Microsoft's Office Assistant

Bot's existence is revealed in his screen presence, which has an objective, observable reality. Supporting this reality is the physical construction of his appearance and animation from the digital manipulation of bits of information managed collectively by a program. The program displaying Bot can support more than one type of visual presence—there are a paper clip and a butler. Is the screen presence "really" Bot, or only one image of him?

Perhaps an answer can be found in Bot's origins. The Bot program was written by a person with some mental vision of Bot to implement. The intents and images of Bot's creator fashioned Bot to fulfill these intents and images. This creation was most likely an iterative, interactive process—as the shape of Bot took objective form, both the vision and its implementation evolved. So perhaps the "real" Bot is to be found in the mind of his creator. If so, is the Bot I see still connected to his creator, or does the program allow an independent existence?

Bot as a program created by a programmer is perhaps the most persuasive explanation of Bot's reality and origins. But did Bot even exist before I experienced and named him? Bot came into existence for me only when I began to interact with him. Certainly his name, and the attribution to him of animate and personal qualities, are not in the program (even if in the programmer-creator). In these and other significant respects, Bot is created

by my top-down projections. For me, Bot has functioned not only as stimulus for complex mental activity, but also as an objectification that allows my mental activity visible form. My naming, gender assignment, affective responses, and philosophical thoughts are all attributable to Bot's existence. In this process Bot comes to embody or encompass or make visible and memorable some rather extensive and complex parts of me.

Bot has functioned not only as stimulus for complex mental activity, but also as an objectification that allows my mental activity visible form.

When I interact with Bot, I am interacting with more than an interesting character distracting me from work. Bot has a function larger than being cute. He watches me type, and when he observes a pattern he is familiar with, he initiates a dialog with me, offering to help accomplish a task. Quite often he is actually helpful. In accomplishing this task, Bot gives concrete, visible expression to the programmers' intent, style, and "personality" that characterize the experience of this software. Bot provides an animate and anthropomorphic face, an objectifiable identity, to the entire being of the computer in its active role as word-processor.

Where is Bot? Let us remain firmly connected to the reality of Bot on the screen. But clearly, Bot is also in my mind (and maybe, as "Bot," prior to writing about him, only in my mind?). I do not have to have my computer turned on in front of me to have Bot. I can walk away from this machine and remember Bot, visualize him, and describe him to others. Even more interestingly, this activity is not one-way on "my" (self-conscious) part, in that Bot exists only when I will to make him conscious. Bot has some sort of "independent" mental existence within me. He can speak to me or become visible to me, can awaken "of his own volition," when I am engaged in other tasks and have no intent to remember him. Am I remembering him, or is he raising himself to my awareness?

Furthermore, Bot not only comes to live in me, I also share some of my life with him. To the extent that Bot gives visible face to the function of the computer, he is the agent to which I am committing these words for memory. Bot is the visible face of my computer. Bot is he who holds my thoughts. It is he who keeps my memories, in a non-neural representation, and allows reactivation of these thoughts (in their neural representation) in the future. Bot also has the ability to share my thoughts with the world, to be the memory of me for others, and to handle the unconscious (operating system) levels of communication necessary for others to share these memories and thoughts through the web of their links to the Bot-world.

It seems the substance of Bot-nature is extended beyond the material shape of Bot's existence. If we were to dissect him to see what gives him substance, we would find that the material form of his existence does not go very far toward explaining the process or purpose of his creation. If we look for Bot within the computer program shaping his realized presence, would he still be recognizable or even exist as Bot for me? If we dissect Bot, we kill him. And if dissection were the answer, would I not have to be dissected too? But, of course, I am not the only co-creator of this creature, so dissection in order to understand Bot-nature through Bot-parts does not appear to be a viable enterprise.

Since dissection destroys, we could choose to observe Bot to discover the regularities of his behavior and the visible forms of his appearance. Thus, we would preserve Bot's life, allowing the phenomena to co-exist with the observation and analysis. But here too are problems. How are we to be convinced of the continuity of Bot's identity, given the different forms in which he may appear? And given that our purpose in examining Bot is to think about mind, it is hard to see how observing Bot's behavior could help—since behaviorists themselves claim that the chief benefit of the method of behavioral observation is that it is mind-less.

We could study Bot through an examination of my subjectivity and my experience of Bot. In addition to keeping Bot's life intact, this would seem to get close to the source of at least some of Bot-life, and we would be convinced at the outset that we were studying mind. But would we be satisfied that we are studying Bot? What about who Bot is, or is not, for your subjective experience? And if Bot is somehow a common reference point for all our Bot subjectivities, is there not at least some Bot-nature which grounds, or transcends, individual Bot subjectivity. Looking inward to examine what is communally named in common experience as "out there" will never totally convince us that we are seeing the same thing.

It seems that to know Bot, or to know Bot fully, we would need to engage in all these inquiries, yet

none would give us the essential Bot. Perhaps Bot is (rather literally) the screen place where all these configurations of physical and mental reality come together in their clearest focus or instantiation. But then remember that the millions who also have this program (what exactly is a program, and do they have *this* one?) also have Bot (or some highly related Bot-nature) on their screens. What is the best language for "my" Bot—one instantiation of Bot, or the instantiation of Bot, or a presence of the Bot spirit? These questions would be easier to answer if we all shared one screen.

So, does Bot have a mind? To the extent that Bot is a projection of my imagination (and mind), Bot "has" mind; he "is" mind. But beyond my Bot-mind, does Bot have a mind of his own? If Bot is nothing but (reducible to) a pile of digitized electrons or screen pixels, then we would not want to attribute mind to him, and in fact would take issue with the assemblage being a "him." But then, too, for my Bot-mind, in what sense do my brain cells have mind? I am intelligent, but each of the neurons in my brain is dumb—knowing nothing (in the sense that "knowing" matters to me), only behaving as genetically programmed.

Whether or not Bot is a phenomenon of mind is not the most relevant question. It is not so much a question of whether Bot has mind (or is mind), but whether our projecting mind onto Bot will be an interesting, useful, and revealing activity of our minds. Is animating Bot a useful epistemological move? If the animated image acquires none of my personalizing projections, will I see reality more clearly, or be blind to reality?

As an empirical experiment, we can simply recognize the mind which is Bot. His existence is revealed in varying ways: in the visual screen presence, in software representation, in the thoughts of the creator, and in the projections and memories of those who experience him. Each form is real Bot, and no form is all of Bot. Bot both evolved and was created. Bot is both dependent and independent. Bot is the name for all these energies embodied in all these forms.

It has seemed natural to use the language of life in talking about Bot. Is then Bot really alive or only metaphorically alive? It would take another paper to explore how we use the word life, but in keeping with the methods of this paper, we can simply choose to recognize the life in Bot, since enlivening our models is a useful modeling strategy. Bot has enough dynamic qualities to be considered alive, if for no other reason than to see whether that designation is thought/model coherent and leads to other interesting thoughts. It is also helpful to have such a clear example of a kind of life, clearly not human, yet dependent on humans for existence.

Bot-like reality exists in such widely distributed fashion, making it much simpler for certain purposes to refer directly to the mental Bot-potential, or to the central tendencies of Bot instantiation, than to the actual beings or medium in which Bot is instantiated. I am referring to the *idea* of Bot, or the concept named Bot. Like the atom, such a fiction is usually more useful for the purposes of understanding than are "real" forms and processes we might identify in specific individual atoms. This Bot-nature, at the point it loses its individuality, also loses its proper noun status, and becomes as generic as the atom. Epistemologically, we have to make this abstracting move in order to comprehend and manage the complexity of combinatorial connections that create our known realities.

Language is the most visible form of mind.

The most significant purpose of this Bot exploration is to consider the generalized claim that all words are Bot-like mental beings. But most words are even more alive than Bot, because they are part of a more extensive system of mental reality. Bot-mind in fact derives much of its being from its incorporation into this language reality. A word appears to me, just as Bot initially did. I hear it, or maybe see it (the same thing?) and recognize something new to my experience, something outside of my mind. Yet it has a place in my mental screen, its location of occurrence, which at least allows it the initial connections it needs to establish itself and suggest its function.

Language is the most visible form of mind. Language is not reducible to brain or to the individual. Language is itself not ourselves, or our person, but lives within us and the communities of culture. It is located in mind space.

Memory

With respect to me, Bot is only one identifiable mental process. I am full of them. Every memory—every potential for reestablishing a prior brain state in close approximation (never the same activation pattern twice)—is another identifiable mental process created partly by me, partly by agency other

than me. The literal remembering which I attribute to my brain is seldom so simply located, because the parts of the activation which engage my perceptual system are the most proximal causes of the remembering and participate in the acts of activation.

Kotre writes a compelling story about the memory that is centered in his grandfather's white gloves, which no longer materially exist.[10] He does a beautiful job of showing how broadly distributed this memory is, how it cannot be contained in any simple way within any given person's brain. Yet Kotre emphasizes that memory is in the brain. Why? Perhaps because he also has captured the important fact that memory is alive, and the only candidate for life (in our dominant conceptual culture) is within biological beings. In the same way that we have recognized the life of mind in the space between, so too we can recognize that the life of memory is most accurately modeled in this space. In general terms, all the kinds of mind we have considered are kinds of memory.

Recognizing the distributed nature of memory in the world and recognizing how it holds together—remembers—both in the "inner" life and the "outer" life, opens our conceptual eyes to so much more of the life of memory and mind.

The brain story of memory is the fascinating story of patterns of self-organizing and autopoietic neural activations. Memory from the brain's perspective is the approximate reactivation of earlier patterns of activity (the storage metaphor of memory in the brain is not a very productive account). From mind's perspective, memory, the replicability of phenomenal events, is not most importantly a function of brain activity (which it is), but the initiator of brain activity, and the initiating locus of much remembering is in "stimuli" external to the brain. Recognizing the distributed nature of memory in the world and recognizing how it holds together—remembers—both in the "inner" life and the "outer" life, opens our conceptual eyes to so much more of the life of memory and mind. To model memories with metaphors of living creatures of the space between is much richer and revealing than to model memory with metaphors of the physical storage of information, especially when moving beyond the relational space between person and "objects," like trees, to considering the enlivening of mind in the space created between people in conversation.

Persons Hold Minds Together

Information, software, Bots, words, and memories are all mental beings that are personally nondifferentiated. They are not persons, nor are they uniquely identifiable with any person. These mental beings are at the same time *smaller* than person, and *larger* than person. Smaller, in that a given person embodies innumerable of these beings in their complex web of associations, and these mental beings' lives are more or less transient with respect to the ground of the person's stability. Larger, in that the life of each of these mental beings is best characterized as independent of, and "external" to the individual person, connecting the person with vast domains of meaning (connection potential) that can never be fully realized by any individual person.

Mind beings form a society of mind "inside" me and allow me to participate in the society of mind "outside" me. My brain can participate in the patterns of language through particular instantiations, and while each such activation of word is unique to my brain and hence individual, the word itself functions to discount such particularity and is more shaped by the preservation of its own role within the society of language. Words use brains as only one medium in which they remember themselves.

Yet we believe, on the basis of our experience, that in some way we own mind-beings, not that they own us. There seems to be a unity to our mental experience that is more than the sum of the individual facts and memories living in us. We believe that we are more than biological hosts for competing mental parasites. Just as mind subsumes brain in higher order structures and processes, there is that about ourselves which integrates mind beings in a greater whole, something which integrates the society of mind into societies of persons.

What is unique about human beings and their brains (which in principle could apply to other types of biological or nonbiological brains) is that in bringing the potentialities of mind-beings to actual embodied life, they introduce mind-beings to each other and carry these mind-beings around in a community connected on the basis of unique personal experience. From the perspective of mind-beings, what is interesting about a particular brain is that it

provides a rich ecology in which to meet and live with other mind-beings.

"Person" comes to our attention as an obvious name for this meeting place composed of mind yet qualitatively more than mind. Although quite frustratingly difficult to define, both within common Western culture and within psychology, the person, sometimes labeled the self, has had a secure status as a seldom-questioned reality. Person has been hard to define partly because person language includes two distinguishable concepts. The first sense of person simply refers to the whole of a human being. When we use the word person in this sense, we are typically referring to an individual's entire physical body and the entire mind within. We could call this "body-person." The second sense of the word person refers to belief in the essential person, the true self, a consistent personality, an integrated personal identity that includes and relates to the most essential mental life of the individual. We could name this "spirit-person." The person (as a whole) includes both the body-person and the spirit-person. The question throughout Western thought has been whether body-person and spirit-person are names for the same thing, or different things, and if different, the nature of their relationship.[11]

The two senses of the word person are related to the bi-directionality of mind. The meaning of person depends on where we locate mind. If we place it in the brain, we allow our understanding of person to be directly connected with the body and its complex functions. Bottom-up, the person is the central processor, or as close to it as the brain can manage, perhaps the chief consciousness agent. If we place it outside the brain, we tend to either idealize the person in a collective "Unity of Spirit" (elevationism), or get rid of person (self) altogether (reductionism). If I am socially constructed, then I may have both a multitude of selves, and no individual self.

The anti-reductionist argument can be made bottom-up, following the pattern of holarchic theory, in which emergent phenomena both transcend but include their earlier developmental forms.[12] The development of body-person, mind-beings, and spirit-person as the whole person is accommodated well in this theoretical approach. Systems theories can convincingly account for the bottom-up movement of increasingly differentiated complexity and emergent integration. In this holarchic model, cut out the mind, there goes the spirit-person; kill the body, there goes everything.

From the point of view of the mind-beings which have lost only a small part of their reality in the death of one of their biological hosts, this account appears incomplete at best. Of course, the particular embodiment of the mind-being in the body-person dies, but that is a continuous process anyway, even while the body-person host is alive. Since mind-beings survive the loss of a host, and spirit-person is constructed of or emerges from mind, the question arises regarding the potential life of spirit-person after the death of body-person. Many world views develop this perspective, and it can be noted that they are giving answers to a sensible question.

The person is the ground of both emergence (from body-person) and embodiment (from spirit-person).

As with mind, however, we do not want to reduce the person to the body-person, or simply the body, nor do we want to elevate the person to the spirit-person, or simply the spirit.[13] We want most essentially to keep at the forefront the dynamic evolutionary (bottom-up) and creative (top-down) processes which produce in their bi-directional flow the unique energies characteristic of our lived experience as human beings. The person is the ground of both emergence (from body-person) and embodiment (from spirit-person).

I am more than the sum of the particular minds my brain and experiences embody. The most notable feature of the instantiation of mind in my brain is that it brings each instantiation into relationship with my whole system of brain mind instantiations. There is unique relationship potential within me that is not possible without me. The history of instantiations, of particular mindedness, is literally carried through me to each current mentation. My brain brings the minds, which exist largely outside of me, together within me. These minds are not only brought together in the physicality of their shared blood and mutual innervations, but together create a unique and individual geography of mind, which does more than map external realities. It creates and sustains new inner communities of mind which may in turn seek externalization and instantiation. I am where mind-beings meet, fall in love, and bear children. The bringing together of mind within me allows a whole new level of life, of being, of reality. A person may be understood as a brain-centered, biological individual who localizes mind and self in a particular embodiment.

The process of being a person is bi-directional: bottom-up, mind; top-down, spirit. The mind's potentials for emergence are shaped into a particular, a personal niche, while simultaneously the potentials of spirit are realized in a particular, a personal (and embodied) coherence. The meeting place "between"—between the formless potentials of spirit and the more materially bound structures of mind—coalesces into self structures and processes. And just as mind life has distributed embodiment, so too are these selves who emerge from mind to become distributed self-in-community. The body-person propagates its self-in-community through the sharing of physical substance and copied mental algorithms, while the spirit-person propagates its self-in-community through mechanisms of functional inference. The person expresses both individual and community, not as separate entities, but as complementary orientations within the emergence and actualization of embodied spirit.

We are connected, and empathy is possible, because we embody the rich potentials of shared experiences, shared words, shared memories—shared because one word can live in both of us, one memory can be distributed between us, many memories embody us.

Bot helped us think about mind; the world wide web can help us think about personal identity. The contrast between email and the web captures much of the distinction between what we might label a packet-communication model of interpersonal interaction and our shared-mind model. Email is centered in individual agents who hold their identities close to themselves and direct selected information to specific targets in a largely private space. The web, on the other hand, can and does construct me as an individual despite my relative lack of personal memory. I can be a presence to the web without constructing my own web site, my personal public memory. The confluence of messages directed to me by other web sites with a vested interest in remembering me shapes an individual identity for me. This identity is not wholly impersonal, because the web site remembering me can do so in response to my behaviors. For example, amazon.com remembers the books and music I order, and lets me know for a particular interest (book) what others with that interest have been looking at.

I can transition from an implicit or hidden public identity (others cannot see *me* when they visit amazon.com) to a personal web site in which I construct a public identity, open or closed in varying degrees to modification from visitors. Yet a prominent feature of most personal web identities is their links to other sites in the web. These pointers to sources of identity construction serve not only to direct attention past the individual, but to give a much richer sense of personal identity than is often achieved through the actual particularities of "real" contacts with the individual in contexts which reveal only parts of the person, often only those parts which we ourselves allow expression of.

In this web, or "virtual," space there is room for many forms of person construction and creation in addition to shared or personal "pages," such as listservs and game-servers. Go (ancient board game) servers, for example, make possible the embodiment of much larger communities of go players than ever before possible, or even thinkable, and some of the players in this community are Bots.

And this is the primary truth of our model of mind between. Our common, and not-so-common, experience of being connected with others, being part of their lives, and allowing them into us is much more, much different, than the transmission of static information packets between essentially isolated minds. We are connected, and empathy is possible, because we embody the rich potentials of shared experiences, shared words, shared memories—shared because one word can live in both of us, one memory can be distributed between us, many memories embody us. My person, a unique oasis in the universe, can shelter and nourish many bodies. Our experience of mind is our participation in the universe. The perception of mind is consciousness.

The Christian vision of this Reality is given voice in John's awareness that "the Word was made flesh, and dwelt among us" (John 1:14, KJV), allowing us in turn to live in the awareness that if we love and obey Jesus, God will love us and come to us and make a home with us (John 14:23). Christians join Jesus' prayer that we may be protected by the power of God's name, the name given Jesus—so that we may be one as Jesus was one with his Holy Father (John 17:11), that the love which God had for Jesus may also be in us, that Jesus himself may be in us (John 17:26).

Acknowledgment

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Notes

[1]M. Minsky, *The Society of Mind* (New York: Simon & Schuster, Inc., 1986), 287.
[2]For example, ibid., 26.
[3]K. Wilber, *Sex, Ecology, Spirituality: The Spirit of Evolution* (Boston, MA: Shambhala, 1995).
[4]Compare G. Lakoff and M. Johnson, *Philosophy in the flesh: The embodied Mind and its Challenge to Western Thought* (New York: Basic Books, 1999).
[5]M. Gauvain, "Cognitive Development in Social and Cultural Context," *Current Directions in Psychological Science* 7 (1998): 188–92.
[6]Ibid. and J. G. Miller, "Cultural Psychology: Implications for Basic Psychological Theory," *Psychological Science* 10 (1999): 85–91.
[7]G. W. F. Hegel, *Phenomenology of Spirit*, trans. A.V. Miller (New York: Oxford University Press, 1977). (Original work published 1952).
[8]F. Varela, E. Thompson, and E. Rosch, *The Embodied Mind: Cognitive Science and Human Experience* (Cambridge, MA: The MIT Press, 1991).
[9]"Bot" is the Microsoft Office "assistant."
[10]J. Kotre, *White Gloves: How We Create Ourselves through Memory* (New York: Free Press, 1995).
[11]It is interesting, but well beyond the scope of this paper, to explore the movement from Hebrew and early Christian understandings of the essential spirit as beyond, or outside the person, to the modern Christian understandings of this essential spirit as a core within the person. This paper, of course, is arguing for the position that recognizes the truth in the dynamic flow between personal inner, individual, spiritual identity and transcendent shared spiritual identity.
[12]Wilber, *Sex, Ecology, Spirituality: The Spirit of Evolution.*
[13]Ibid.

Upcoming ASA Annual Meetings

July 20–23, 2001: Kansas State University, Manhattan, KS

Aug. 2–5, 2002: Pepperdine University, Malibu, CA

July 25–28, 2003: Colorado Christian University, Lakewood, CO

2004: Trinity Western University, Langley, BC Canada

Aug. 5–8, 2005: Messiah College, Grantham, PA

2006: Calvin College, Grand Rapids, MI

Aggression, Suicide, and Serotonin: Is There a Biochemical Basis for Violent and Self-Destructive Behavior?

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Contemporary biomedical science has attempted to explain behavior in terms of genetic determinism, with specific mental states being produced by alterations in the brain concentrations of one or more specific biochemical components. The literature relating to the presumed association between low brain levels of the neurotransmitter serotonin and aggression and suicide is reviewed and critiqued. Due to the variety of methodological shortcomings in this research, conclusions based on the data cannot be considered valid. Implications for the legal profession and for Christian moral principles are discussed.

What Determines Behavior?

The debate about what molds human behavior—nature versus nurture—has been with us for a long time. However, in the last two decades or so, questions have intensified as an outpouring of new discoveries in the neurosciences has become available. Whether the phenomenon is called "sociobiology"[1] (a term popularized by E. O. Wilson) or the idea of "biological determinism" and the "selfish gene"[2] (a concept promoted by Richard Dawkins), a growing body of scientific literature suggests that many behaviors may be produced by changes in biochemical processes in the body. For conditions ranging from depression through overeating to risk-taking and sexual immorality, arguments are being made that we do these things as a result of our individual genetic make-up and as a result of biochemical imbalances in the brain.

In addition to issues of personal responsibility and behavior, there is a growing interest in the legal profession about questions dealing with neurochemical imbalances and legal liability for an individual's actions. Over the years, several court cases have dealt with the question of alcoholism and an individual's responsibility for his actions. A review article in the *Bulletin of the American Academy of Psychiatry and Law* focused specifically on information related to serotonin and behavior.[3] The writer called on forensic psychiatrists to be more aware of the current neuroscience literature on how actions are influenced by biochemical changes so that these findings could be incorporated into a better understanding of the legal issues before the courts today.

For the Judaeo-Christian tradition, the question is cast further in terms of individual responsibility, sin, and accountability to God. If we are driven solely by biochemical processes over which we have no control, then are we to be held accountable for our behavior? Do the findings of modern science create a situation in which sin no longer exists because we no longer are in control of our lives?

Given the variety of concerns that exist about the relationship between biochemistry and behavior and the implications, both legally and theologically, of current research in the field, a careful examination of the professional literature is justified. Christians

**ASA Member*

need to evaluate the available information and to explore the consequences of accepting conclusions based on this research. The focus of this paper is on the relationship between serotonin and aggressive and suicidal behavior.

Serotonin Biochemistry

Structure and Function of Serotonin

Serotonin (5-hydroxytryptamine, 5-HT) is a neurotransmitter that is formed from the amino acid tryptophan. This molecule has a chemical structure similar to that of epinephrine (adrenaline) and dopamine, both of which are known neurotransmitters. Interestingly, serotonin is also structurally quite similar to the psychedelic drugs LSD, psilocybin, and DMT (dimethyltryptamine), all three of which possess hallucinogenic properties.

The first studies on biochemical properties of serotonin dealt with the effect of this compound in blood pressure.[4] When serotonin was first isolated from blood in 1948, it was shown to promote constriction of blood vessels, increasing blood pressure. Although platelets do not synthesize serotonin themselves, they do pick up the molecules from the circulation. The molecule is also found in high concentrations in the intestinal wall (where it is synthesized) and is responsible for increased gastrointestinal mobility.

Biosynthesis and Metabolism

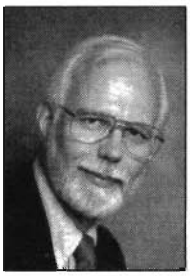
The amino acid tryptophan is the source of serotonin in the body; approximately 1% of the total tryptophan pool is converted to serotonin.[5] Tryptophan initially undergoes conversion to 5-hydroxytryptophan, which then becomes serotonin. Inactivation of serotonin is accomplished by the enzyme monoamine oxidase, which also is involved in the inactivation of other neurotransmitters. The inactivation product is 5-hydroxyindoleacetic acid (5-HIAA). In the pineal gland, serotonin is changed to melatonin, a molecule involved in the regulation of processes associated with the light-dark cycle (and implicated in such phenomena as jet lag and seasonal affective disorder).

The major tissue site for serotonin synthesis from tryptophan is the gastrointestinal tract. Other sites include the thyroid gland, pancreas, and the thymus. These tissues are primarily responsible for the serotonin detected in the blood. The brain synthesizes its own serotonin from tryptophan which is able to cross the blood-brain barrier. Serotonin cannot cross this barrier, so the body essentially has two separate pools of serotonin: a blood-borne pool and a separate and distinct brain pool. The serotonin in the brain cannot penetrate the blood-brain barrier to reach the general circulation, and serotonin synthesized elsewhere in the body cannot enter the brain. Measurements of serotonin and 5-HIAA in cerebrospinal fluid (CSF) are thought to reflect the brain content of serotonin, since the CSF is formed in a portion of the brain and then drains into the spinal column.

Serotonin as Neurotransmitter

The propagation of a nerve impulse by serotonin is illustrated in Figure 1.[6] Serotonin is synthesized and stored in vesicles in the pre-synaptic region of the neuron. When the nerve impulse moves down the fiber, it causes the release of serotonin molecules, which then pass from the pre-synaptic membrane, cross the synapse, and attach to specific receptors on the post-synaptic side. Interaction between serotonin and the receptor then continues the nerve impulse further down the fiber. Next, the serotonin dissociates from the receptor, is taken back up at the pre-synaptic site, and is either inactivated by conversion to 5-HIAA or is stored for reuse.

Where is serotonin located in the brain? How much is there? These are difficult questions to answer. Although serotonin neurons comprise only about 0.01% of the total number of neurons in the brain, these relatively few cells are connected to an extensive network of nerve fibers that extend



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throughout the entire brain. Serotonin nerve cells are clustered in the base of the brain and interact intimately with other types of neurons (mainly those stimulated by dopamine, epinephrine and norepinephrine). This complex interplay among several neurotransmitters makes the task of elucidating the specific behavior of serotonin and the influences this molecule exerts on the nervous system a daunting task.[7]

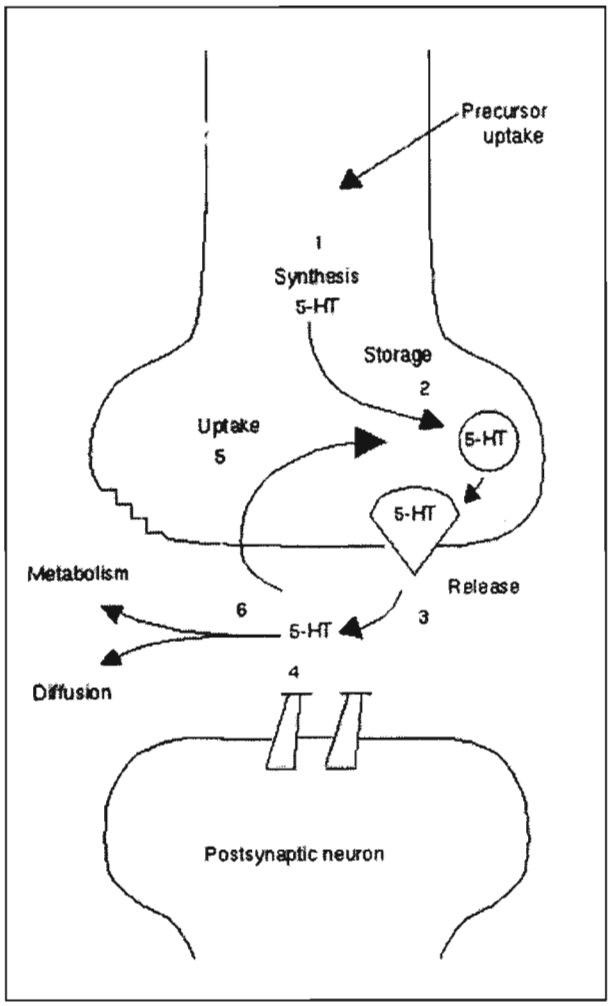

Figure 1. **Nerve Transmission by Serotonin.** Serotonin (5-hydroxytryptamine or 5-HT) accumulates in the pre-synaptic portion of the nerve (top structure) through precursor uptake (the amino acid tryptophan) and synthesis of 5-HT (1). The newly synthesized 5-HT is stored (2) and then released (3) when stimulated by a nerve impulse. The material crosses the synapse to interact with specific receptors (4) at the post-synaptic neuron, triggering a new impulse that travels further down the nerve fiber. After release of 5-HT from the receptor it is either taken back up by the pre-synaptic membrane (5) for recycling and further use or it diffuses away from the receptor (6) and can be inactivated.

Age and Gender Differences in Serotonin Content

The literature on reference values for serotonin and 5-HIAA (normal values for age and gender) is sparse and confusing. In general, the CSF concentrations of the serotonin metabolite 5-HIAA are lower during middle age (35–55 years of age) than those seen in younger and older populations.[8] This lower concentration correlates with the lowered amount of the enzyme monoamine oxidase (which converts serotonin to 5-HIAA) in the 35–55 year-old group. In addition, the number of serotonin receptors (which transmit the effects of serotonin to the nervous system) decreases with age in both men and women.

Significant gender differences exist in serotonin production and conversion between men and women. The rate of brain synthesis of serotonin in women is roughly half that in men.[9] Some researchers have suggested that this lower rate of serotonin formation is responsible for the much higher incidence of depression (3:1) and eating disorders (10:1) in women than men. However, women have the same amounts of the 5-HIAA metabolite, possibly due to higher concentrations of the enzyme monoamine oxidase in the female brains. Women also have been shown to have a lower number of serotonin receptors than men.[10]

Searching for Markers of Aggression and Suicide

A large body of research focuses on the question of whether altered levels of serotonin in the body will precipitate aggression or suicide. Benefits in identifying such a predictive biochemical marker include both an improved understanding of these behaviors and possible pharmaceutical intervention to prevent many incidents of violent behavior toward others or oneself.

One positive outcome of this area of research is the identification of specific areas of the brain where abnormalities in serotonin synthesis, metabolism, or utilization occur. If there are sites where the "cause" can be localized, this information may suggest effective therapeutic interventions. An improved understanding of the possible malfunction can lead to the development of safe and appropriate pharmacological treatment. While these medications may not cure the problem (if it is indeed a genetically determined disorder), greater control over behavior can be achieved.

Christians involved in pastoral counseling and hospital ministry need to be aware of this research. Some disorders (such as schizophrenia and manic-depressive illness) apparently have a strong biological basis for their causes. If these situations and current medical developments in the field are understood, the ability to minister to patients and their families and to communicate these issues and concerns to others in the congregation will be enhanced. Pastoral counseling can be more effective in working with individuals and in educating the body at large.

A large body of research focuses on the question of whether altered levels of serotonin in the body will precipitate aggression or suicide.

Some behavioral disorders apparently have a biological cause and can be treated with good success. In many instances, schizophrenia, which appears to have some common ground with aggression and suicide, is very manageable with appropriate medication. Even though this disorder (which appears to have a strong genetic component to it) cannot be "cured" in the conventional sense of the word, individuals with schizophrenia can lead productive lives when a proper drug regimen is followed faithfully. Over 75% of persons with Cushings syndrome (due to a tumor on the adrenal gland) experience profound depression because of excessive cortisol production. In the vast majority of these patients, removal of the tumor leads to an alleviation of the depressive state as the cortisol levels return to normal. Although we do not yet understand all of the neurochemical issues associated with bipolar depression (manic-depressive illness), the manic phase has been successfully treated for decades with the use of lithium. A similar beneficial outcome might be seen in individuals prone to violence or suicide if a biochemical cause could be identified.

Much more problematic are the current trends related to the explanation of behavior based on neurotransmitter concentrations. On the one hand, we have extensive literature suggesting that our genes are our destiny, that our behavior is determined by our biochemistry. In other words, "it's not our fault." Current research can be interpreted in such a way as to remove the idea of personal responsibility for our actions. On the other hand is the reluctance on the part of some constituencies to explore all aspects of the issue of violence. Research on violence has been branded as racist because of concerns related to the use of the data.[11] Certain ethnic groups and socioeconomic classes fear further stereotyping (often with good reason) as a result of investigations of violence in human society. Consequently, they strongly object to all studies on the topic, fearing the outcome of the study before it is even carried out.

What Parameters Are Studied?

Various approaches have been taken to investigate the relationship(s) between serotonin concentrations in the body and altered behavior. Many studies have been carried out using nonhuman organisms, including crabs, mice, and monkeys. For many reasons, it is difficult to extrapolate data and interpretations from animals to humans. Often metabolism, enzyme properties, and behavioral influences are not the same when studies from animal systems are extrapolated to humans. All of the information discussed in this article will deal with data from human subjects.

Direct information has been obtained from brain samples after death. Measurement of serotonin in these tissues gives some indication of the status of the neurotransmitter at a specific point in time. Information is not readily available concerning stability of tissue or neurotransmitter concentrations after death. Nor is there any reliable data as to the specific emotional state of the individual at the time of death. Many studies do not have a good way to assess prior drug or alcohol use, parameters that are known to influence serotonin concentrations.

In living subjects, serotonin metabolic rates can be indirectly assessed using magnetic resonance imaging and positron emission tomography (PET). The latter technique is an especially powerful tool for monitoring changes in serotonin concentration during the course of an experiment, providing real-time data on how rapidly this neurochemical is utilized in specific situations.

A somewhat less direct assessment of serotonin production by the brain has been employed in measuring cerebrospinal fluid (CSF) levels of serotonin or (more commonly) the concentrations of the metabolite 5-HIAA. The assumption is that CSF values correspond in some fashion to the concentrations in the brain, since most CSF is produced in the choroid plexus of the brain. The CSF circulates through various parts of the brain and also drains into the spinal column. Although methods for detection of either serotonin or 5-HIAA are fairly reliable, it is not clear

how well the CSF concentrations accurately reflect the biochemical processes taking place in the brain itself. The average adult only has approximately 140 mL of cerebrospinal fluid, which effectively eliminates the taking of a number of samples in succession. In addition, the hazards associated with obtaining CSF samples preclude serial testing, using multiple samples to obtain a dynamic picture of changes that may be occurring over time.

Blood platelets have long been considered to serve as a model for neurons affected by monoamines such as serotonin. Platelets actively take up serotonin and store it in vesicles similar to those in pre-synaptic neurons. This uptake can be blocked by drugs such as tricyclic antidepressants. Several studies on the relationship between serotonin and behavior have examined the number of serotonin uptake sites and the binding properties of these sites in an attempt to gain a better understanding of serotonin biochemistry in various disorders.

A few investigations have examined the serotonin content of blood as a parameter that may affect the emotional state. While concentrations can be reliably assayed using sophisticated immunoassay techniques, the relationship between blood serotonin levels and brain concentrations is questionable.

Serotonin and Violent Behavior

Any research into the root causes of violent or aggressive behavior is fraught with pitfalls. Political agendas can override the presumably dispassionate scientific objectivity of research. Groups sometimes fear that the findings will be used inappropriately, to justify discrimination or to focus undue attention on particular segments of the population. In studies of the relationship between serotonin and aggressive behavior, ethnic background has been ignored whenever possible, perhaps due to the fear of creating unneeded controversy. Although some studies allow identification of ethnicity (research on arsonists in Finland,[12] genetic studies on an isolated Dutch family[13]), race does not appear to be considered in research on violence.

Studies that relate serotonin and violence draw from three sources: (1) CSF or other body fluid measurements from those convicted of aggressive or violent behavior or those with a psychiatric problem associated with this form of behavior; (2) tryptophan restriction studies to explore how lowering of the precursor amino acid affects mood; and (3) studies of persons with seasonal affective disorder (in which serotonin levels and exposure to sunlight are linked).[14]

The most direct evidence for a link between lowered serotonin and aggression comes from CSF studies of violent individuals. These persons tend to have 5-HIAA values in the CSF that are lowered when compared to a "normal" population. Not well documented, however, is the relationship between low CSF levels of 5-HIAA (the metabolite) and brain serotonin. Do low levels of 5-HIAA in the spinal fluid necessarily correlate with low brain serotonin? In a previously mentioned Dutch family,[15] the biochemical finding was a lowered level of monoamine oxidase, the enzyme responsible for converting serotonin to 5-HIAA. In this situation, there conceivably could be a normal (or elevated) brain serotonin content that is simply not being metabolized to form 5-HIAA in the CSF. Other concerns about these studies deal with the lack of reliable assessments of the tendency toward violence. A number of different measures are used, many of which do not correlate well with other means of assessing the same parameter.

The most direct evidence for a link between lowered serotonin and aggression comes from CSF studies of violent individuals.

Several studies have been carried out to examine attempts to alter brain serotonin in presumably normal individuals. Since no good pharmacological intervention exists to decrease brain serotonin content, the strategy has been to reduce tryptophan intake in the diet. The amino acid tryptophan is the precursor for brain serotonin; the assumption is that lowering tryptophan consumption will lower production of brain serotonin. While tryptophan restriction studies are more indirect, an increase in hostile and aggressive attitudes is seen in those whose dietary intake of tryptophan is decreased. However, these experiments have not directly demonstrated that serotonin is the only brain component altered. Other presumably unknown factors could play a significant role in the understanding of these data.

Even less conclusive are the arguments that attribute increases in aggressive behavior to seasonal affective disorder (SAD) and to presumed changes in serotonin concentration in the brain.[16] SAD is considered to be a form of depression triggered by decreases in sunlight and the resultant changes in melatonin production by the pineal

gland in the brain. While an increase in serotonin (produced by consumption of pasta or other similar complex carbohydrates) can often alleviate many of the symptoms of SAD, the major contributor to this form of depression is the melatonin cycle being disrupted by the change in the amounts and timing of light and dark in the environment. Apparently, multiple factors are involved in the depression and in the resulting violence seen in individuals affected by SAD.

Serotonin and Suicide

In contrast to the limited data available from subjects who exhibit aggressive or violent behavior, information from individuals who commit suicide is more comprehensive.[17] Analyses of both brain tissue and spinal fluid yield interesting, but conflicting, information about the concentrations of serotonin and 5-HIAA in these samples. A number of studies have shown a decline in either serotonin or 5-HIAA concentrations in brainstem samples from suicide victims. However, measurements of these compounds in another area of the brain (the frontal cortex) suggest that no significant difference exists between serotonin or 5-HIAA concentrations in those individuals who committed suicide and in victims of accidents or other non-neurological fatalities. In addition, studies of 5-HIAA levels in CSF of persons who had attempted suicide show a mixed and inconsistent collection of results—some papers report decreases in values, others report essentially no differences in values.

Complications in the analysis of data in serotonin and suicide are many. Usually, no history of drug use, especially long-term involvement, is readily available. Some of the common modes of suicide (drug overdose and carbon monoxide poisoning) have not been evaluated in terms of the changes in brain chemistry that could be produced by the drug or by carbon monoxide. Brain tissue stability after death, time between death and autopsy, accuracy in removing and identifying the locale of brain samples, diet, and time of year are all parameters that will affect serotonin and 5-HIAA levels in the brain. These parameters have not been carefully controlled in the vast majority of the reported studies.

As is noted in the next section, decreases in CSF serotonin and/or 5-HIAA have often been reported in patients diagnosed with clinical depression. Many papers, looking at a possible link between low serotonin and suicide, examine depressed patients with suicidal behavior. Therefore, conclusions reached for suicidal patients must be considered even more questionable, since two variables (depression and suicide) are being mingled together in the data analysis.

Serotonin and Depression

Investigations of possible relationships between altered serotonin biochemistry and depression are of particular importance because of the possibility of manipulating these levels with drugs in an attempt to treat the depression.[18] The original hypothesis of lowered serotonin levels resulting in clinical depression has not been well substantiated. Studies show mixed results, with some researchers reporting decreased 5-HIAA values in the CSF of depressed individuals, while others observe no difference in values between patients with depression and the control population. Tryptophan depletion in the diet can induce depression in some normal individuals (presumably due to the diminished availability of tryptophan for brain synthesis of serotonin), but gives variable results in patients who are already depressed.[19] As previously noted, these studies do not demonstrate directly a decrease in brain serotonin; the presumed lowering is inferred from the dietary restriction on tryptophan. However, as we see in the next section, pharmacological manipulation of serotonin levels is widely used in modern-day psychiatric treatment for depression.

Furthermore, most studies do not provide clear boundaries that distinguish the types of individuals seen in the research. Patients are often suicidal and depressed, depressed and schizophrenic, schizophrenic and violent, violent and alcoholic, or any combination of the above. A well-defined patient population with only a single psychological issue does not appear to be available for study.

Prozac, Other SSRIs, and Serotonin

As the need for more effective antidepressants became obvious in the late 1960s, research began on a class of drugs known today as selective serotonin re-uptake inhibitors (SSRI).[20] Prozac (fluoxetine) is probably the best-known product of this class of drugs. These inhibitors work primarily by blocking the ability of the pre-synaptic neuron to "reabsorb" serotonin after the molecule has interacted with the post-synaptic serotonin receptor to continue propagation of the nerve impulse (see Fig. 1, step 5). The net result is a prolonged exposure of the post-synaptic receptor to serotonin, effectively increasing the concentration of serotonin at that site. The rationale

behind the use of SSRIs is that the elevated amount of serotonin at the synapse presumably alleviates some of the behavioral symptoms believed to be associated with low serotonin levels.

Prozac (first prescribed in the U.S. in 1988) and its companions appear to be better tolerated than the tricyclic antidepressants they are replacing, whose side-effects include dryness of mouth, sedation, and low blood pressure. The SSRIs appear to be more effective in treating depression than other classes of antidepressants, presumably due to the increase in serotonin at the post-synapse produced by this class of drugs.

The results of research on the use of SSRIs to modify suicidal or aggressive behavior are mixed.[21] Few studies have been carried out to date. No large patient populations have been investigated. Treatment results are not consistent, since some patients show positive change while others demonstrate no improvement in behavior. Several investigations raise the possibility that SSRIs induce an increase in suicidal ideation among some patients,[22] a behavior directly contrary to that predicted by the prevailing paradigm. If a true causal relationship between lowered synaptic serotonin and these behaviors existed, a more consistent relationship between SSRI use and alleviation of aggressive or suicidal tendencies would be expected. However, this relationship appears to be either weak or non-existent.

Problems with Studies on Serotonin and Behavior

At first glance, it might appear that the available data support the idea that low brain serotonin will produce changes in behavior that have a high probability of leading to aggression, violence, or suicide. However, a closer examination of the studies raises some significant methodological questions.

Inconsistencies among Studies

One concern is the inconsistent data obtained from the various research studies. Attempts to affect the brain supply of serotonin by either depleting or increasing body tryptophan loads provide mixed results in terms of the observed behavior. Some studies show the predicted effect, while others do not. Measurements of receptor numbers and binding affinity for serotonin are plagued by the fact that there are at least thirteen known serotonin receptors in humans, with little known about exactly which receptor mediates which neurochemical process.[23] The rate of serotonin synthesis in the brains of women is much lower than for men, an observation used to explain the higher incidence of depression (and suicide?) in women. However, fewer aggressive acts are committed by women, a fact that is inconsistent with their presumed lower brain serotonin content. While SSRIs are used to increase brain serotonin content to alleviate aggressive and suicidal tendencies, a review of the literature shows mixed and contradictory results obtained from the use of Prozac and related drugs. Recent newspaper articles indicate that the pharmaceutical company which manufactures Prozac suppressed evidence that the drug produced suicidal behavior in a number of patients taking it, raising further questions about proposed links between low serotonin concentrations and suicide.[24]

Methodological Shortcomings

A variety of methodological problems plague the research findings that attempt to link decreased amounts of serotonin with behavioral change. I will simply list them briefly:

1. The amount of 5-HIAA in the CSF does not necessarily correlate with the concentration of serotonin in the brain.

2. Platelet studies are not a good indicator of serotonin activity or concentration in the brain. Similarity of biochemical properties does not imply similarity of neurotransmitter concentration or receptor number.

3. Many studies did not take into account the recent findings dealing with gender differences in the amount of serotonin in the brain.

4. Serotonin receptor populations in the brain are poorly characterized, in terms of both the number of receptors and the specific sub-types of serotonin receptors.

5. "Cross-talk" among different neurotransmitters and receptors is poorly characterized at present. We know that serotonin can produce some activation of dopamine and epinephrine receptors, and these other neurotransmitters can stimulate serotonin receptors, although the extent of these cross-interactions is not clear. Therefore, we must look at concentrations of at least three different neurotransmitters simultaneously. Little data exist dealing with this question.

6. Information about prior drug use (either prescription medications or illicit drugs) is often not available or is unreliable. We learned the hard way

from earlier research on schizophrenia that certain drugs can drastically alter the number and behavior of specific receptors. Further research into the effects of drugs on serotonin neurochemistry is definitely needed.

7. The effect of sampling technique on the values obtained for the neurotransmitter and metabolites has not been thoroughly explored. One recent paper indicates that CSF samples collected soon after the lumbar puncture procedure yield 5-HIAA values about 54% of those were obtained several hours later, after the sampling apparatus was in place.[25] The stress of the sampling procedure was thought to have produced the initial decrease in metabolite concentration. Most (if not all) of the studies conducted on living patients utilized CSF samples collected immediately upon puncture. The lower values thus obtained could well have been due to the stress of the situation and not the underlying psychological condition. This factor needs further exploration and validation.

Recent findings about serotonin and stress open some interesting doors to the impact of emotions on brain biochemical processes and later behavioral states.

8. No longitudinal studies exist to explore whether the serotonin levels decrease over time as the psychiatric problem worsens (to show that the increasingly aberrant behavior is produced by the decline in neurotransmitter concentration). In addition, no studies show that individuals who have low serotonin levels early in life are more likely to be overtly violent or suicidal later. While some significant ethical problems are involved in carrying out this type of research, the information is definitely needed to substantiate the present paradigm.

9. Information is becoming available which could suggest that psychological stress can contribute to a decrease in serotonin concentration,[26] and be the precipitating agent in aggressive or suicidal behavior. Therefore, the change in the amount of brain or CSF serotonin would be the result of altered psychology, and not the other way around.

The idea that psychological stress can alter biochemical production in humans is well documented. We are all familiar with the surge of energy, the increase in heart rate and respiration, and the heightened awareness that comes when we are suddenly frightened. A major contributor to these responses is the increase in catecholamines (such as adrenaline) in response to a sudden stress. The same increase can come over a longer period of time, when the stress is not so apparent (as has been documented with students taking an exam). Prolonged increase in catecholamine concentrations can have profound effects upon other biochemical functions in the body.

Another hormone response to stress is cortisol, a steroid hormone. Disturbances in both the total daily output of cortisol and in its diurnal rhythm can be produced by emotional stress (either short-term or long-term). Emotional stress causes an increase in the amount of cortisol and a tendency for the diurnal cycle to disappear. The loss of the diurnal cycle results in the elevation of cortisol levels throughout an entire twenty-four hour period, instead of decreasing at night. Alterations in both cortisol and catecholamine metabolism are both affected significantly by stress.[27]

The role of stress in mediating serotonin output is confusing, but intriguing. Not only does stress affect the release of serotonin, but also an intricate interplay between serotonin levels and the regulation of systems leads to the production of catecholamines and cortisol, among other hormones.[28] Coupled with the widespread speculation that long-term stress can produce altered brain function (especially in small children), these recent findings about serotonin and stress open some interesting doors to the impact of emotions on brain biochemical processes and later behavioral states.

Sensitivity, Specificity, and Serotonin

One key test for the utility of a diagnostic marker is its sensitivity and specificity.[29] Any test used to assist in the diagnosis of a disease must successfully identify those individuals who have the disease while reliably excluding those who do not have the disease. Ideally, there is no overlap between these two populations, but in real life this is not possible. There will usually be some overlap between the two groups. Two ideas are used to assess the diagnostic utility of laboratory data: sensitivity and specificity. "Sensitivity" describes the "incidence of true-positive results obtained when a test is applied to patients known to have the disease." This number indicates how well the lab test allows detection of patients with the disorder under consideration. "Specificity" is used to "characterize the incidence of true-negative results obtained when a test is applied to subjects known to be free of the disease."

Therefore, if a lab test has 100% sensitivity, it will provide abnormal results for all of those individuals who have a certain disease. A lab test that shows 100% specificity gives normal results for 100% of the population who do not have the disease. False-positive results (an abnormal value in a person who does not have the disorder) and false-negative results (a normal value in a person who does have the disorder) lower the predictive value of the test.

Using these concepts, we see that low serotonin values are not predictive for a certain type of behavior (i.e., suicide or violence). Two flaws appear in the literature. First, there are no good reference values to be used for comparison purposes. As pointed out earlier, population studies are few and comparison groups are sparse. Methodological problems mar most of the studies. Perhaps more telling is the range of conditions for which low serotonin or HIAA values have been reported. These psychological problems include alcoholism, obsessive-compulsive disorder, schizophrenia, Alzheimer's disease, anorexia/bulimia, panic disorder, anxiety, pre-menstrual syndrome, migraine, and autism.[30] Clearly, these disorders represent a wide variety of psychological and/or neurological problems. The association of low serotonin levels with each of these disorders may be more a reflection of some underlying psychological state that produces the altered neurotransmitter concentration than some unified effect of lowered serotonin values on this myriad of behaviors.

One interesting wrinkle in this area of "behavioral biochemistry" is the repeated finding that low serum cholesterol values are associated with an increased incidence of aggressive behavior.[31] Are there biochemical links between the amount of cholesterol synthesized and brain production of serotonin? Increasingly, we are seeing reports of a relationship between the amounts of certain steroid hormones (all of which have cholesterol as the precursor molecule) and changes in serotonin metabolism. These data provide just one small hint that our understanding of the connections between our biochemical selves and our behavioral selves is extremely limited.

Implications of Research on Serotonin and Behavior

Scientists who study factors that determine behavior will readily concede that a specific behavior is influenced by both environmental and genetic determinants. However, the studies considered in this paper attribute (directly or often by implication) the abnormal behavior to changes in the concentration of a specific neurotransmitter. In most primary research publications, the investigators simply indicate "an association with" or "a correlation between" low serotonin activity and behavior, but offer no mechanism of action or cause-effect relationship. Yet, a strong thread runs through both research publications and more popular science articles to involve diminished serotonin content in the brain as a precipitating agent for violent behavior. Here is a selection of quotes from the research literature on serotonin and suicide:

> The concept that suicide has a biochemical basis is relatively new.[32]

> To our knowledge, this is the first report to implicate a specific gene in the predisposition of a behavior (suicidality) postulated to be regulated by serotonin.[33]

> The link between serotonin functions and suicidal behavior might be a deficient control of aggressive impulses.[34]

The more "popular" science literature and reports in newspapers and news magazines also clearly state the belief that low serotonin is the cause of suicidal behavior:

> Some studies ... already have hinted that distinctive biological mechanisms might be responsible for suicidal behavior.[35]

> This predisposes a person to act on suicide thoughts ... Serotonin is important for restraint. If serotonin is reduced, a person is more apt to act on powerful feelings.[36]

> A mutant gene that affects brain chemistry in unknown ways may drive some depressed people to kill themselves, say Canadian psychiatric researchers.[37]

Although these quotes deal specifically with serotonin and suicide, equivalent thinking can be documented for other issues associated with low serotonin.

The overall mechanism usually suggested (when one is proposed) is that serotonin is an inhibitory neurotransmitter in the central nervous system, modulating impulse control. Decreased brain concentrations of serotonin are believed to release the brain from this control, which then allows the person to act out a variety of behaviors, especially aggressive or violent actions. If this is true, then behavior (to some extent) is determined by factors outside our control. If we cannot control our behavior, then (by implication) we are not responsible for

that behavior. There is a growing assumption in some of the medical literature, and certainly in the popular press, that we cannot be held accountable for many of our actions. Alcoholics are treated as if their condition were caused (at least in part) by some defective gene that gives rise to the excessive consumption of alcohol, even though every study that claims to demonstrate the presence of a gene for alcoholism has quickly been refuted. The destructive behavior that often accompanies depression is attributed to a "chemical imbalance."

There is a growing assumption in some of the medical literature, and certainly in the popular press, that we cannot be held accountable for many of our actions.

This line of thinking is being translated into legal considerations. In both British[38] and American[39] law journals, the legal implications of current research on biochemistry and behavior have been discussed. While the Bradford (American) article is primarily a survey of the scientific literature, the Fenwick (British) article considers some of the legal implications of violent acts committed while under the influence of a disease or temporary abnormal brain function. The conclusion of both authors is that demonstration of altered neurochemistry can successfully be used in court as a mitigating circumstance, which could lead to either a reduced sentence or acquittal.

One such case involved Tony Mobley, who had a history of violent behavior. During his 1995 trial for murder, his attorneys argued that he was not responsible for his behavior and that it was possibly due to serotonin deficiency.[40] Although the judge agreed that this possibility might exist, he denied the request of the defense to have Mobley tested and to have the results admitted in court. Mobley was found guilty and the attorney filed an appeal based in part on the judge's refusal to admit test data into evidence.

If aggressive or suicidal behavior is due to a serotonin imbalance, the logical next step is to attempt to correct that imbalance by way of pharmacology. Administration of Prozac or other serotonin-selective re-uptake inhibitors has been extensively used as treatment for these states (not always successfully). The presumed success of these pharmacological approaches provides the "easy" solution, but does not deal with the root cause of the behavior. Our society continues to become even more a society that solves its problems by taking a pill.

Some ethnic minorities have expressed grave concern about the implications of research on violence and often have actively opposed studies exploring the causes of this behavior. If violence is clearly linked to a serotonin imbalance, and if that serotonin imbalance is genetically determined (which has not been demonstrated to date), then it follows that the incidence of violence could be reduced by limiting reproduction of the defective gene. Earlier efforts to control the further development of sickle-cell disease (an abnormality of hemoglobin structure that primarily affects individuals of African descent) led to accusations of "genetic cleansing" by some segments of the population. The eugenics movement of the early twentieth century in the Unites States and elsewhere and the efforts of Hitler to eliminate "defective populations" are reminders of the persecution that can be visited upon minority populations under the guise of a greater social good.

What Does This Mean for Christians?

Dean Hamer in *Living with Our Genes* (Doubleday, 1998) argues that genes are a major influence on our personalities and behaviors. In her book, *The Biology of Violence* (Free Press, 1999), Debra Niehoff explores the relationship between brain chemistry and behavior, concluding that our behavior is based to a great extent on neurobiological processes. In the April 1998 issue of *Atlantic Monthly*, E. O. Wilson argues that religion and ethics "can all eventually be explained as functions of brain circuitry and deep genetic history." An April 21, 1997 article in *U.S. News and World Report* states: "For both political and scientific reasons—and it's often impossible to disentangle the two—everything from criminality to addictive disorders to sexual orientation is seen today less as a matter of choice than of genetic destiny." Eric Kandel, M.D., of the Center for Neurobiology and Behavior at Columbia University, recently issued a challenge to his colleagues in the psychiatric field when he proposed that biology was central to the future of psychoanalysis.[41] Kandel indicated several areas where biology would provide the definitive answers to issues in behavior (psychopathology) and sexual orientation.

Admittedly, there is more to the above picture, although the extent of the "more" is being strongly

debated. Environment certainly plays a role, but the question is that of extent. Nurture and nature are intimately intertwined, with nurture often having a lasting impact upon nature—early childhood stress and abuse, for example, appear to produce lasting changes in brain structure and chemistry. But the questions remain: Is behavior determined by our biochemistry or by our moral sense? Are we responsible for what we do or can we blame it on our biology, our genes, and then not be held accountable for the consequences?

The issues raised in this paper are but one component of a discipline known as evolutionary psychology. This field of study explores the way we behave as being expressed through our genetic make-up. Just as Darwin and his successors have given us a world in which the physical realm appears to be all there is, evolutionary psychology tries to provide explanations for our behavior in terms of biology. However, this field presents not just a scientific endeavor, but also a philosophical commitment. This component of the field was best explained by Charles Colson and Nancy Pearcey in a *Christianity Today* column (August 10, 1998):

> Some Christians have hoped to make peace with Darwinism as long as it is restricted to biology. But evolutionary psychology demonstrates that there is an inexpungable imperialism in Darwinism—a compulsion to reduce all society to material mechanisms. Just as Darwinist theory in biology aims to replace divine design with natural processes, so in ethics it aims to replace revealed morality with a naturalistic morality. Sociologist Howard Kaye observes evolutionary psychology is nothing less than a secularized natural theology—an attempt to justify a secular world view.

As Christians, we represent a counterculture to the norms of secular society. We are led, on the basis of Scripture, to conclude that each person is accountable for his or her behavior. When the broader society offers the message of biological determinism, we have a responsibility to challenge that paradigm. Moreover, we are called to proclaim truth, whether that is truth of the Bible or a truth that goes against the secular world.

Investigation of the research linking low serotonin levels to violent or suicidal behavior suggests that the basic conclusions can be successfully challenged. The research obviously is incomplete (as most workers in the field readily acknowledge). The role of stress as the initiating factor in altering brain serotonin concentrations and later behavior appears to have strong support from the empirical data. Relationships between serotonin content and aberrant behavior are being proposed without a thorough consideration of all of the parameters involved. Much of the research has not been evaluated according to criteria used to assess whether or not a particular biochemical marker is a true indicator of a specific disease. Those criteria seem to indicate that low brain serotonin is a nonspecific phenomenon associated with a variety of situations that have no apparent common denominator other than stress.

As our knowledge of neurotransmitter biochemistry increases, we need to include that new knowledge in the interpretation of data. There is a growing awareness of the interconnections between mind and body—our emotional state can profoundly influence the concentrations of specific biochemicals just as the changes in the amount of certain materials can have an influence on our mood and behavior. We cannot assume a one-way link between biochemistry and behavior.

As Christians, we represent a counterculture to the norms of secular society. We are led, on the basis of Scripture, to conclude that each person is accountable for his or her behavior.

We intuitively believe that we are more than a simple collection of chemicals and therefore are responsible for our behavior. Increasingly, we are able to challenge the naturalistic paradigm not only with reason, but with hard data. A careful review of the literature, challenging the assumptions and methodologies of the studies cited above, allows us both to do good science and to establish more firmly the idea of personal moral responsibility. In a broader context, the philosophy that underlies much of evolutionary psychology must be seen for what it is—an attempt to dethrone revealed moral law and replace it with an ethical and political philosophy that frequently serves only as a rationalization for giving in to our basest desires.

As Christians and as scientists, we have a unique role to play in the societal debates that take place around us. Too often believers are asked to alter or abandon fundamental Christian beliefs and practices because science has supposedly shown them to be incorrect in some way. If we believe that God is a

God of truth, then the claims of the secular society need to be evaluated and challenged when they contradict the revelation we have received. Those claims just may turn out to be wrong.

Notes

[1]E. O. Wilson, *Sociobiology: The New Synthesis* (Cambridge, MA: Belknap Press of Harvard University Press, 1975).

[2]Richard Dawkins, *The Selfish Gene* (New York: Oxford University Press, 1978).

[3]J. M. W. Bradford, "The Role of Serotonin in the Future of Forensic Psychiatry," *Bulletin of the American Academy of Psychiatry and Law* 24 (1996): 57.

[4]I. H. Page, "The Discovery of Serotonin," *Perspectives in Biology and Medicine* 20 (1976): 1.

[5]A. Yuwiler, G. L. Brammer, and K. C. Yuwiler, "The Basics of Serotonin Neurochemistry" in *The Neurotransmitter Revolution: Serotonin, Social Behavior, and the Law*, ed. R. D. Masters and M. T. McGuire (Carbondale, IL: Southern Illinois University Press, 1994).

[6]R. F. Borne, "Serotonin: The Neurotransmitter for the '90s," *Drug Topics* (October 10, 1994): 108.

[7]T. G. Dinan, "Serotonin and the Regulation of Hypothalamic-Pituitary-Adrenal Axis Activity," *Life Sciences* 58 (1996): 1683.

[8]A. Yuwiler, G. L. Brammer, and K. C. Yuwiler, "The Basics of Serotonin Neurochemistry."

[9]S. Nishzawa, et al., "Differences Between Males and Females in Rates of Serotonin Synthesis in Human Brain," *Proceedings of the National Academy of Sciences, U.S.* 94 (1997): 5308.

[10]F. Biver, et al., "Sex Difference in 5HT2 Receptor in the Living Human Brain," *Neuroscience Letters* 204 (1996): 25.

[11]W. Roush, "Conflict Marks Crime Conference," *Science* 269 (1995): 1808.

[12]M. Virkkunen, et al., "Cerebrospinal Fluid Monoamine Metabolite Levels in Male Arsonists," *Archives of General Psychiatry* 44 (1987): 241.

[13]H. G. Brunner, et al., "Abnormal Behavior Associated with a Point Mutation in the Structural Gene for Monoamine Oxidase," *Science* 262 (1993): 578.

[14]For a review of representative students, see V. Markku, et al., "Aggression, Suicidality, and Serotonin," *Journal of Clinical Psychiatry* 53, supplement (1992): 46.

[15]H. G. Brunner, et al., "Abnormal Behavior Associated with a Point Mutation in the Structural Gene for Monoamine Oxidase."

[16]J. Tiihonen, et al., "Seasonal Variation in the Occurrence of Homicide in Finland," *American Journal of Psychiatry* 154 (1997): 1711.

[17]For a typical review of the literature, see M. Stanley and B. Stanley, "Postmortem Evidence for Serotonin's Role in Suicide," *Journal of Clinical Psychiatry* 51, supplement (1990): 22.

[18]D. S. Charney, "Monoamine Dysfunction and the Pathophysiology and Treatment of Depression," *Journal of Clinical Psychiatry* 59, supplement 14 (1998): 11.

[19]K. A. Smith, C. G. Fairburn and P. J. Cowen, "Relapse of Depression after Rapid Depletion of Tryptophan," *Lancet* 349 (1997): 915.

[20]M. D. Lemonick, "The Mood Molecule," *Time* (September 29, 1997): 75.

[21]A. F. Schatzberg, "Noradrenergic versus Serotoninergic Antidepressants: Predictors of Treatment Response," *Journal of Clinical Psychiatry* 59, supplement 14 (1998): 15.

[22]For example, M. S. Hamilton and L. A. Opler, "Akathisia, Suicidality and Fluoxetine," *Journal of Clinical Psychiatry* 53 (1992): 401–6.

[23]J. J. Lucas and R. Hen, "New Players in the 5-HT Receptor Field: Genes and Knockouts," *Trends in Pharmacological Sciences* 16 (1995): 246.

[24]L. R. Garnett, "Prozac's Dark Side Kept Quiet," *Boston Globe* (June 11, 2000).

[25]K. K. Hill, et al., "The Effect of Lumbar Puncture on Dopamine and Serotonin Metabolites in Human Cerebrospinal Fluid," *Neuroscience Letters* 276 (1999): 25–8.

[26]B. Azar, "Environment is Key to Serotonin Levels," *APA Monitor* (April 1997).

[27]G. P. Chrousos and P. W. Gold, "The Concepts of Stress and Stress Disorders. Overview of Physical and Behavioral Homeostasis," *Journal of the American Medical Association* 267 (1992): 1244–52.

[28]J. F. Lopez, et al., "Neural Circuits Mediating Stress," *Biological Psychiatry* 46 (1999): 1461–71.

[29]R. S. Galen and S. R. Gambino, *Beyond Normality: The Predictive Value and Efficiency of Medical Diagnoses* (New York: John Wiley and Sons, 1975).

[30]E. M. Coccaro and D. L. Murphy, eds., *Serotonin in Major Psychiatric Disorders* (Washington, DC: American Psychiatric Press, 1990).

[31]P. H. A. Steegmans, et al., "Low Serum Cholesterol Concentration and Serotonin Metabolism in Men," *British Medical Journal* 312 (1996): 221.

[32]M. Stanley and B. Stanley, "Postmortem Evidence for Serotonin's Role in Suicide."

[33]D. A. Nielsen, et al., "Suicidality and 5-Hydroxyindoloeacetic Acid Concentration Associated with a Tryptophan Hydroxylase Polymorphism," *Archives of General Psychiatry* 51 (1994): 34–8.

[34]L. Träskman, et al., "Monoamine Metabolites in CSF and Suicidal Behavior," *Archives of General Psychiatry* 38 (1981): 631–6.

[35]D. L. Wheeler, "Scholars Seek a Biological Basis for Suicide," *Chronicle of Higher Education* (December 13, 1996).

[36]"Low Serotonin Levels Linked to Suicide," interview with Dr. J. John Mann of Columbia Presbyterian Medical Center, *Tacoma (WA) News Tribune* (November 19, 1996).

[37]"Gene May Drive Some to Suicide, Report Says," *Seattle Times* (February 8, 2000).

[38]Peter Fenwick, "Brain, Mind and Behaviour. Some Medico-Legal Aspects," *British Journal of Psychiatry* 163 (1993): 565–73.

[39]J. M. W. Bradford, "The Role of Serotonin in the Future of Forensic Psychiatry."

[40]M. Curriden, "Guilt by Heredity? His Lawyer Says It's in the Killer's Genes," *The National Law Journal* (November 7, 1994): A12.

[41]E. R. Kandel, "Biology and the Future of Psychoanalysis: A New Intellectual Framework for Psychiatry Revisited," *American Journal of Psychiatry* 156 (1999): 505–24.

Knowledge of the Unseen: A New Vision for Science and Religion Dialogue

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While contemporary physics and cosmology take seriously the knowledge of invisible realities, the discussion of the unseen in religion has been largely neglected in the recent science-and-religion discussion. Neglecting the issue in theology is ultimately self-defeating since God is considered the Unseen. In light of contemporary understanding of the unseen in science, we contend that that there are significant parallels between scientific and theological claims concerning the unseen. The epistemic distinction between the seen and the unseen does not necessarily imply the ontological demarcation between the natural and the supernatural. New heuristic frameworks such as a multi-dimensional model are suggested for more holistic and dynamical understanding of reality that includes both the seen and the unseen.

Science, in the last century, has found strange aspects of the physical world that seem quite different from what classical physics has taught us.[1] In hindsight, it is an irony that while modernity in its positivistic spirit started out with the notion that the reality perceived by our senses is the only knowable reality there is, we now end up with the idea that the true nature of physical reality is quite different from what we experience through our senses. The legend of the tangibility of matter, or what may be called "the matter myth," which served as the basis for the certainty of knowledge, was lost.[2] Here, *within* science, were raised the problem of reality (an ontological problem), issues of the limits of human knowledge (an epistemological problem), and the problem of testability (a methodological problem). Relativity and quantum physics, which serve as the pillars of contemporary science, and more recently chaos theory, are now presenting us with a radically new physical view of the world in which positivistic, deterministic, and materialistic philosophies no longer have secure places. They present us with deeper, greater, and more mysterious aspects of nature.

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Scientists now proceed to the area that traditionally belonged to metaphysics, discussing the possibility of the ultimate reality of the universe, the origin and finality of the cosmos, the problem of consciousness, and the like. The natural sciences, as they touch upon the edge of objectivity and empirical testability, raise many questions about the world to which science itself cannot provide definite answers within its limited framework. In these frontiers of science, our metaphors are running out and our common sense often breaks down. We have to wrestle with the limits of our knowledge, logic, and rationality. Here in science the fundamental epistemic problems are naturally raised, as they were in religion and theology in earlier centuries.

We now start to take seriously, especially in fundamental physics and cosmology, the things that are not seen. As recent developments in theoretical physics and cosmology witness, as speculative as they may be, some theories quite beyond what can be directly measured by physical apparatus are possible and are indeed commonplace. It not only raises a *possibility* for the epistemology of the unseen in general, but also makes its ontological discussion feasible.

The Unseen in Science-and-Theology Discussion

An important area that has been largely neglected in the recent science-and-religion discussion is the issue of the unseen. Exploring the knowledge of the possible rich texture of the unseen—the "physical" or otherwise—should be a part of our endeavor to restore what we have lost from the treasury of human ideas. Science can benefit from this creative imagination, and theology will be able to address again a fuller view of the world.

There is a significant epistemological and methodological parallel between scientific and theological claims concerning the unseen. The claims of the unseen in both disciplines are often inferred from the seen. Of course, the inferential nature of science has been known since the time of Aristotle. However, during the last few centuries, the discussion of the unseen in religion has been severely limited because of the positivistic epistemology which suspects anything that does not fit in the grand narrative of the matter myth.

A partial justification of the discussion of the unseen in science-and-theology comes from various limit theorems that we have discovered in science during the last century. These include Heisenberg's uncertainty principle, event horizons, and possible singularities of the universe. In mathematics, we have found equally fundamental limits, such as Gödel's Incompleteness Theorem, Turing's Incomputability Theorem, Chatin's theorem for unprovability of algorithmic randomness, and the unpredictability in deterministic chaos systems.

At first, it looks as if these theorems impose permanent barriers to human knowledge. However, careful examination tells us that many of these theorems and principles have to do with the limits *of our epistemic ability* as we investigate things from *within* specific systems. This means that if we view these theorems and principles in a different way, then they can be seen as the windows that open up our minds for the things that are beyond the confinements of the system. For example, Heisenberg's principle has led us to a new vision of microscopic realities beyond the visible and tangible macroscopic apparatus. D'Espagnat thus aptly described quantum mechanics as a "window to the unseen."[3] The limit of the speed of light also leads us to the recognition that there *are* regions of the universe hidden from our observation. Gödel and Turing's results may imply that there are more things that the human mind can do than what perfect machines can execute.[4] This may point to a possibility that the human mind might possess a power to reflect on something beyond what is a mechanical process of nature. The study of chaos system illustrates the fact that there may be certain orders in this world beyond our predictive power. In some sense, the limit principles and theorems free us from the bondage of small mental frameworks as they point to greater systems that lie beyond themselves.

As we think further on the issues of the unseen in science-religion discussions, it is useful to examine some analogous issues we have in theoretical physics. We have many theories that deal either with the things that are partially unobservable or with the things that are, even in principle, unobservable. Among the examples are the ideas of David Bohm's "hidden variables," the theory of "beables" by J. S. Bell, various interpretations of quantum physics, quantum cosmological models near the Planck scale, and higher-dimensional theories presented by superstring theory and M-theory. There has also been a spectrum of the unseen with different degrees, from those which have closer connections to the observable, to those which have more remote connections, and finally to those which seem to have no testable connection. Of course, direct application of these ideas to the unseen in religious discourse is not likely, since there exists a considerable linguistic and characteristic gulf between them. However, these examples in physics provide us with very useful metaphors and analogies as well as important cautions against naïve conclusions and extrapolations in science-and-theology discussions.

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Contemporary physics clearly has shown how counterintuitive nature can be as we step out from the scale of ordinary experiences. This posits a clear caution against a premature and dogmatic talk about God in terms of our ordinary logic and rationality. Von Neumann's impossibility proof for hidden variable theories is a good example for mistakes of this type. As J. S. Bell later found out, von Neumann used a well-established theorem in statistics to categorically refute hidden variable theories. This theorem, which was completely valid in classical statistics, turned out to be inapplicable to Bohm's counterintuitive nonlocal theory.

Our epistemic limits provide the freedom for metaphysical construction but at the same time ... theories beyond the observable may be constrained by the structures of the observable.

Bell's theorem on a local hidden variable theory teaches us another important lesson in our discussions of the unseen. Until the publication of Bell's theorem, physicists had taken freedom in imagining the ontological status of the quantum world and thought that one's choice between local hidden variable theories and the Copenhagen interpretation would be just a matter of personal taste. However, it turned out that in certain cases, one's choice in this "metaphysics" made a difference in physics by resulting in different experimental outcomes. Thus, the alleged "metaphysics" of yesterday has become the "physics" of today. Certainly this illustrates vividly that our epistemic limits provide the freedom for metaphysical construction but at the same time that theories beyond the observable may be constrained by the structures of the observable.

In hindsight, the epistemic limits that we have encountered in physics and mathematics in the twentieth century should not have been so surprising. They came as surprises because we wrongly believed that, in the spirit of scientism, science may be extended indefinitely and that our logic and mathematics were certain. At the dawn of quantum physics, Heisenberg clearly saw the problem inherent in all scientific investigations. He understood that "what we observe is not nature itself, but nature exposed to our method of questioning."[5] We have limits due to our methodology, predetermined scopes, sensory-perceptive assumption, logic and rational ability, mathematical languages and metaphors, and our limited experimental tools, among other things.[6] Most of these limits stem from the fact that we are not the wholly other in our relationship with the things that we want to investigate. All investigations of a subject matter from within are inherently limited.

These limits exhibit two important characteristics. First, they are epistemological, *not ontological.* In other words, definite knowledge is not available, not because there is nothing to learn but because our ability is limited. Hence, there is no reason to suppose that any ontological discontinuity exists at these epistemic limits. Second, these epistemic limits are usually *limits, incompleteness,* and *uncertainties, not* epistemic *impossibilities.* Our knowledge beyond these limits may be partially available, either because partial investigations are possible or because these limits usually do not come all at the same time. In our science-and-religion discussion, the epistemic limits on our side naturally allow for the possibility of one-directional knowledge transfer—that is, there exists the possibility of divine revelation from the other side even though we do not have much control over how the information may be transferred to us.

The "Natural" and the "Supernatural"

Across these limits in fundamental investigations of the world, no inherent *ontological* distinction exists between the seen and the unseen, and between the "speakable and unspeakable" as J. S. Bell put it.[7] In light of this epistemology of the unseen in science, we must rethink terms such as "natural" and "supernatural." We can no longer identify what we can observe as natural things nor can we equate what we cannot observe with supernatural ones. What then is the criterion for this ontological demarcation? Is it not just an imaginative mental category that we inherited from the prejudice of modernity? When we talk about "nature," are we talking about the totality of things that exist? The affirmative answer to this question requires a radical revision of our conceptual categories for there is no way of distinguishing the "natural" and the "supernatural."

There is a further issue—nature, as we know it, contains phenomenon of consciousness as its part. Given that the most immediate human experience is our conscious experience and that nature at its most fundamental level is neither tangible nor separable—as quantum mechanics tells us—can we then

define nature as material existence? What then is "material"? For the distinction between the natural and the supernatural to be meaningful at all, there must be a way to distinguish them. Historically, Thomas Aquinas coined the term "supernatural" as he tried to reconcile Aristotelian naturalistic philosophy with Christian theism. Later in the seventeenth century, as mechanical philosophy became very popular among scientists and philosophers, the idea of nature acquired a different sense. Mechanical philosophy had sought to explain all natural phenomena in terms of matter and motion. The natural then effectively became mechanical. As pursuit of certain knowledge continued through the Enlightenment period, whatever was not "natural" became unqualified as an object of knowledge, and subsequently acquired a sense of being unreal.

My contention is that the distinction between "natural" and "supernatural" should now be discarded as an unjustified and unfruitful category that stems from modern prejudice.

In light of our contemporary understanding of the world, the sharp demarcation between "natural" and "supernatural" is not tenable since we can no longer subscribe to the hard naturalism that is based on the mechanical notion of matter. One can still subscribe to soft naturalism which allows for the possibility of reality beyond what is material. However, we then need to redefine what we mean by nature and naturalism. My contention is that the distinction between "natural" and "supernatural" should now be discarded as an unjustified and unfruitful category that stems from modern prejudice. The only valid demarcation may be the distinction between the seen (observable) and the unseen (unobservable) as they can readily be distinguished by our *epistemic* limits.

We now see science as our active mental and physical engagement with nature. Even as we strive to be as "objective" as possible using various objectification processes in science, quantum mechanics clearly demonstrates that there is no purely objective way of knowing nature. All fundamental knowing processes are neither totally objective nor totally subjective, but are interactive. Here, both in science and religion, we see epistemological parallels such as our active participation, epistemic limitations, possible ontological continuity, and communal discernment. Depending upon what should be considered as data for religious or theological knowledge, we can have some methodological parallels between science and theology as well.[8] This presents an interesting possibility for the unity of knowledge of the seen and the unseen on a deeper level. Abner Shimony, a philosopher of science and a quantum physicist, for example, suggested the possibility of constructing an integrated epistemology based on his naturalistic metaphysics. One of his points of departure is the idea that science and metaphysics should mesh and complement each other unless convincing reasons are given why it should fail.[9]

Willem Drees' *Religion, Science and Naturalism* offers a naturalistic approach to theology with the premise that "the natural order is *the whole of reality that we know of* and interact with; no supernatural or spiritual realm distinct from the natural world shows up *within* our natural world, not even in the mental life of humans." Drees leaves room for religion in that "we have a sense of gratitude and wonder with respect to the reality to which we belong."[10] As one can see from Drees' case, ontological presuppositions often preclude the possibility of certain types of knowledge since *ontology informs epistemology*. Ideas concerning "how the world is" tell us something about "what can be known about the world." It seems inconsistent that Drees precludes the unseen, while physics, which he regards as the best description of fundamental aspects of nature, takes the unseen seriously.

Since ontology informs epistemology and vice versa, it is important to discuss some models for ontology which include the realm of the unseen. The case of David Bohm serves as a great example for this.[11] Bohm explicitly constructed a model for the unobservable or "hidden" physical reality. But he did not stop at nonlocal hidden variable theories for quantum physics. He went on to construct a metaphysical system consistent with his own hidden variable theory.[12] His discussion on the "implicate" and "explicate" orders provides us with a concrete example of how one might bridge the gulf between theories of the unseen in physics and theories of the unseen in traditional metaphysics. In his metaphysics, the "explicate" order in which we experience the world is the enfolding or manifestation of what is actually lying in a deeper dimension, which he called the "implicate" order. There is no discontinuity between these two, though we can only experience what has been enfolded unto us. Bohm's metaphysics was not presented just as an analogy or metaphor; it was meant to be a description of the single seamless reality that would encompass both the visible and the invisible.

Another promising possibility for the description of the unseen that goes beyond physical experience is using the concept of higher-dimension. Ever since Plato's famous allegory of the cave, people have thought about the possibility that there may be a radically new way of looking at the true nature of the world. In science, this new vision of the world was introduced by Riemann in the nineteenth century and again by Einstein in the early twentieth century. It has revolutionized our understanding of the natural world. Some leading theologians and philosophers such as Karl Heim, Paul Tillich, and Huston Smith have alluded to this new way of thinking about the world and have pointed out that this "dimensional" metaphor or model can be very useful in dealing with many religious enigmas and problems.[13] Though Kant has persuaded the modern mind that human thoughts are categorically limited within three-dimensional space and one-dimensional time, the theoretical physics community today talks about the possibility that we may be living in a real higher dimensional spacetime, containing perhaps ten or eleven dimensions. Currently we do not know whether these theories can ever be put to the test, but physicists are working hard to come up with some predictable results in a low energy limit.

This dimensional framework immensely expands our imaginative horizons. The model can provide a heuristic framework in which we can talk about immanence and transcendence at the same time since it is possible for different dimensions to possess different properties. For example, a spatial dimension possesses entirely different characteristics than that of the time dimension but they can be seamlessly combined to form a unity. For Tillich, human spirituality signifies "openness" to the greater reality beyond the physical one, and this spiritual dimension of humanity is what makes humans distinctive. Karl Rahner also contends that the human being essentially experiences themselves as a *transcendental being*, as *spirit* beyond the realm of the ordinary space and time. Karl Heim suggested that this dimensional metaphor would preserve both distinction and unity between the spiritual and the physical.

The Unseen and Divine Action

This dimensional model can represent a dynamical relationship between the seen and the unseen. The Greek fathers, such as St. Basil, talked about God's *logos* operating in the creation of divine *energia* or "energy" which flows toward all creation. This divine "energy" represents *manifesting* grace in contrast to the *unknowable* divine essence.[14] This echoes Paul's assertion that *invisible* qualities of God have been made *visible* in creation. In this model, such religious concepts as revelation may be treated in a natural way since it is possible to consider one-directional information flow from a higher dimension to a lower one. A lower dimension does not have access to a higher dimension (which therefore imposes epistemological limits), but together they form a continuum of reality (which therefore preserves ontological continuity). The dimensional model can also explain well the problem of God's action in nature. In this new vision, we do not even need to look for openness in the "physical" order to avoid the problem of suspension or violation of natural laws. Divine action can be understood simply as higher order laws working seamlessly with lower order laws.

In this new vision ... divine action can be understood simply as higher order laws working seamlessly with lower order laws.

Even in the naturalistic framework, the openness of natural order is quite obvious from the fact that all our scientific laws are constructed a posteriori. *No law, deterministic or not, closes the possibility of the existence of other laws*—just as the perfectly deterministic Newtonian laws of mechanics do not exclude the possibility of the other perfectly deterministic laws of electromagnetism prescribed by Maxwell's equations. If electromagnetism had not been known to humanity, the lifting of a massive object by a magnetic field without mechanical support would have been considered a "violation" of the natural order. However, for those who have known the laws of electromagnetism, the lifting event never violated nor suspended the Newtonian laws. Newtonian laws were working perfectly as well all along. The idea that deterministic laws necessarily imply the causally closed universe is simply misguided.

On the road of science, we have experienced many turns and surprises. Today theoretical physicists are considering the possibility that these Newtonian and Maxwellian laws, along with other laws of physics, may be just different manifestations of a single law on a deeper level for which we might not have a tool for direct investigation. Usually deeper or more general laws tender surprising phenomena,

as we have experienced in twentieth century physics. Phenomena such as lasers, superconductivity, Bose-Einstein condensation, and Einstein-Podolsky-Rosen effects were completely foreign and impossible in classical physics.

I am not promoting "anything goes" in nature. On the contrary, in the spirit of true science, I am suggesting a serious consideration of the unseen—that our current limited vision should not blind us to the possibility of the greater reality that we have not yet seen or known.

This dimensional model can represent a dynamical relationship between the seen and the unseen ... [and] can be a fruitful ground for theological reflections.

This new heuristic framework, which radically departs from the framework of modernity, can be a fruitful ground for theological reflections. Of course, I have no reason to suppose that any model, which has been developed in science or mathematics, is sufficiently adequate in describing the reality that may lie beyond the accessible empirical or rational order. However, as our experience and knowledge of the world increases, we happily admit that all we can do in science and theology is to try to find a better and ever more adequate language that may enable us to describe in some limited way the things that may ultimately be indescribable. As we expand our minds' horizons, we also expand our understanding of God, for we know God is the ultimate reality—far greater than any human imagination of the unseen.

Notes

[1] The development is well described in John Wheeler, *At Home in the Universe* (American Institute of Physics, 1994). See the collection of works by American Physical Society, *More Things in Heaven and Earth: A Celebration of Physics at the Millennium*, ed. by Benjamin Bederson (1999). For more philosophical discussions, see J. Hilgevoord, ed. *Physics and Our View of the World* (Cambridge: Cambridge University Press, 1994).

[2] See, e.g., Paul Davies and John Gribbin, *The Matter Myth* (New York: Simon & Schuster, 1992).

[3] Bernard D' Espagnat, *Reality and the Physicist: Knowledge, Duration and the Quantum World* (Cambridge: Cambridge University Press, 1989).

[4] Roger Penrose, *Shadows of the Mind* (Oxford: Oxford University Press, 1994).

[5] Werner Heisenberg, *Physics and Philosophy* (New York: Harper & Row, 1958).

[6] John D. Barrow, *Impossibility: The limits of Science and the Science of Limits* (New York: Oxford University Press, 1998).

[7] J. S. Bell, *Speakable and Unspeakable in Quantum Mechanics* (Cambridge: Cambridge University Press, 1993).

[8] See the works in Russell, Stoeger and Coyne, eds., *Physics and Philosophy and Theology* (Vatican Observatory, 1988) and Mark Richardson and Wesley Wildman, eds. *Religion & Science: History, Method, Dialogue* (New York: Routledge, 1996).

[9] Abner Shimony, *Search for a Naturalistic Worldview* vol. I: *Scientific Method and Epistemology;* and vol. II: *Natural Science and Metaphysics* (Cambridge: Cambridge University Press, 1993).

[10] Willem Drees, *Religion, Science and Naturalism* (Cambridge: Cambridge University Press, 1996).

[11] Alfred N.Whitehead also rigorously integrated his scientific theory with metaphysics. However, since many *theological* works were done already on his metaphysics, I will not deal with it here.

[12] David Bohm, *Wholeness and the Implicate Order* (London: Routledge & Kegan Paul, 1980); D. Bohm and B. J. Hiley, *The Undivided Universe* (London: Routledge, 1993).

[13] See Karl Heim, *God Transcendent* (London: Nisbet and Co., 1935); Paul Tillich, *Systematic Theology* vol. 3 (Chicago: University of Chicago, 1963); Huston Smith, *Forgotten Truth: Primordial Tradition* (1976).

[14] Vladimir Lossky, *The Mystical Theology of the Eastern Church* (Crestwood, NY: St. Vladimir's Seminary Press, 1986).

Communications

Defining Consciousness: Christian and Psychological Perspectives

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Psychological Paradigms

The psychologist is precariously fixed on the bridge that connects the "hard" natural sciences of biology, chemistry, and physics with the "soft" social sciences of sociology and anthropology. The mind/body, free will/determinism and nature/nurture problems are significant issues that the psychologist investigates to connect the "spiritual" aspect of life with the empirical world. While psychology is a discipline that has undergone a number of changes in its brief history, developments in other fields have had a considerable influence on how people view psychological questions and issues. Consequently, many cognitive and physiological psychologists have found themselves engaged in research that necessitates an interdisciplinary approach.

Bolles has described the history of psychology as a story of scientific fads.[1] These fads have ranged from phrenology in the nineteenth century to current neural network models and brain imagery. The advances and discoveries made in cognitive science and neuroscience over the past thirty to forty years have helped us develop a better understanding of how complex and wonderful our mental life is. Cognitive science is best defined as an interdisciplinary approach geared toward studying the workings of the mind and developing an integrated model of mental processes. Similarly, neuroscience is defined as an interdisciplinary approach to studying the structure and function of the nervous system.

Progress made on psychological, technological, biochemical, and philosophical fronts has brought us closer to understanding the mind/brain/soul link than at any other time in human history. Despite these advances, it is painfully obvious that there is still a considerable task ahead in developing a complete theoretical and experimental understanding of the human mind. No longer the *Black Box* of the behaviorists, the *Gray, Neural Computer* is a more contemporary model describing the brain, the organ of the mind. Cognitive science and neuroscience have changed the way we conceptualize our mental life.

Consciousness as the Object of Psychology

Consciousness and immediate experience are quite possibly the first objects of investigation for psychology as a science. The scientific study of consciousness may find its roots in William James and his descriptions of the "stream of consciousness."[2] In the mid-1900s, consciousness was embedded in the Black Box of the mind and was avoided by behaviorists primarily interested in overt behavior and not the mind, unless it could be indexed by behavioral data.[3] Cognitive psychologists re-ener-

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gized the study of the mind in the late 1950s, and mental activity came back into the mainstream of experimental psychology. Researchers in this area have made substantial progress in understanding the architecture and processes of mental life.

Defining Consciousness

Many experimental psychologists (as well as philosophers and theologians) have had difficulty providing a clear, complete, and exhaustive operational definition for consciousness. Consciousness is a slippery term and many (more than we have time to review) have attempted to formulate a coherent description of what this term represents. The great American psychologist, William James, avoided explicitly defining consciousness. He believed that we are all familiar with consciousness through introspection; it is a self-evident phenomenon requiring no operational defining. It was this introspective technique which was used to excess by many early psychologists that, in part, lead to a reactionary movement by the behaviorists. Later in his life, however, James would change his position arguing that consciousness was a nonentity and had no place as an object of empirical investigation.[4] For others who have persisted in the scientific study of consciousness defining it has been wrought with complexity.

> This consciousness that is myself of selves, that is everything, and yet nothing at all-what is it?[5]

> It [consciousness] is not to be confused with reactivity. It is not involved in a host of perceptual phenomena. It is not involved in the performance of skills and often hinders their execution. It need not be involved in speaking, writing, listening or reading. It does not copy down experience, as most people think. Consciousness is not at all involved in signal learning and need not be involved in the learning of skills and solutions, which can go on without any consciousness whatever. It is not necessary for making simple judgments or in simple thinking. It is not the seat of reason and indeed some of the most difficult instances of creative reasoning go on without any attending consciousness. And it has no location except an imaginary one.[6]

B. F. Skinner recognized in his book, *Beyond Freedom and Dignity*, that behaviorists had been accused of neglecting the study of consciousness.

> The role of the environment is particularly subtle when what is known is the knower himself. If there is no external world to initiate knowing, must we not then say that the knower himself acts first? This is, of course, the field of consciousness, or awareness, a field which a scientific analysis of behavior is often accused of ignoring. The charge is a serious one and should be taken seriously. Man is said to differ from the other animals mainly because he is "aware of his own existence." He knows what he is doing; he knows he has a past and will have a future; he "reflects on his own nature"; he alone follows the classical injunction "Know thyself." Any analysis of human behavior which neglected these facts would be defective indeed.[7]

> The problem arises in part from the indisputable fact of privacy: a small part of the universe is enclosed within the human skin. It would be foolish to deny the existence of that private world, but it is also foolish to assert that because it is private it is of a different nature from the world outside.[8]

One form that definitions of consciousness may take is in the description of the phenomenal, experiential state in which a person is. Consciousness is the subjective experiencing of a stimulus or mental state. This state has been referred to as qualia and has received a significant amount of attention from philosophers.[9] Using an introspective technique, people experience a unique scent when a rose is placed under their nose. Flanagan agrees with this type of definitions and believes that consciousness is a term that encompasses the variety of mental-state types which we experience.[10] When we experience the world, we experience its sounds, tastes, and pains. Consciousness is the domain under which our perceptions are actualized. This category emphasizes our interaction with the world and the subjective, phenomenological nature of our mental life.

A second class of definition refers to consciousness as an emergent architectural concept: a central executive, processor, or attention allocation.[11] With

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these definitions, consciousness is not an experience but a center where cognitive algorithms, heuristics, and higher-order processing take place. It is a location inside the Black Box that is responsible for the analysis of internal and external stimuli and output (i.e., behavioral) selection. Consciousness might be defined as short-term memory, working memory, a mental space where processing of information takes place, or a self-monitoring center. The emphasis is on developing a model (i.e., a flowchart, a blueprint) that spatially represents where the responsibilities of consciousness are carried out. This approach attempts to discern the constructs of mental life as well as its functions.

A third category of definitions defines consciousness as awareness. The ability to identify an object or to focus on specific aspects of our environment is the dominating characteristic of consciousness. Awareness is the process of locating and isolating environmental stimuli (or internal stimuli) so that it is processed for additional information. The *awareness* of my physical state (hunger) influences my behavior (going to the refrigerator). Awareness of our environment involves the separation of what is "me" from the environment, that which is "not me." We also can be aware of selective aspects of our internal environment (hunger pains). An awareness of both the "me" and the "not me" necessitates self-representation, other-representation, and an ability to compare the two. The ability to identify and highlight stimuli and to engage in advanced processing is what consciousness is. "Know thyself" and "know thy environment" form the basis of consciousness.[12]

Considerations for the Christian

Why should Christians be concerned with the study of consciousness? At least two reasons are clear. The importance of consciousness as the locus for decision making and establishing relationships is significant for Christians in psychology, cognitive science, and neuroscience because these two abilities are near the heart of the Christian experience. While Scripture may have little to say about the link between mind and brain, the nature of the "stuff" that it is made of, or the architecture of mental life, it does highlight our mental life as an integral part of our relationship with Christ.[13]

Another issue is the mind/brain link. How does the brain work as the organ of the mind? The mind/body problem (or mind/brain problem) is one of the classic issues of the psychologist. Some Christian scholars have challenged the notion of Cartesian substance dualism.[14] Jeeves perceives the recent advances of cognitive science, which tighten the link between mind and brain, as the evidence that may lead us away from an unnecessary Cartesian dualism. He contrasts the view of the immortal, "spirit-stuff" soul as incompatible with a Hebrew, biblical image of our personhood.[15] The physical and spiritual are not separate, but interconnected under God's fully sustaining power. Human beings are regarded as related to one another into the physical creation through the intimate presence of God and in reliance upon the constant state of his faithfulness and steadfast love. A conscious soul is not composed solely of spirit-stuff that is nonphysical. Consciousness can be seen as an instrument that emerges from the mind/brain link. Jeeves writes:

> Mind is a label that we use to refer to the remarkable things they, human beings, and no doubt other creatures, can do in handling the vast amounts of information bombarded them all the time, reflecting on the information, and then going beyond it in anticipating and planning. In a sense, consciousness is an instrument of mind.[16]

The principles of free will and moral autonomy are important to the Christian world view. Without free will, "no praise, no blame" becomes the moral code. If we have no free will, then we have no moral accountability. If we are only biochemical machines who have no choice in what we do, say, or think, sin becomes a meaningless construct. Without Christ's death as payment for our sins and our informed, intentional decision to accept him into our heart, the Christian world view becomes hollow and irrelevant. This position, however, may be a result of my personal church tradition and might not be of help to those in other traditions who lean toward predestination. It is this theological aspect toward theory development that may generate discussion in the Christian community.

Cole has stated that the physical process of the mind/brain is the vehicle for expression of Christian experiences.[17] Mental events have neural correlates which anchor consciousness to the "real world." This close relationship, Cole believes, is compatible with the afterlife. It is our consciousness and its role as the vehicle of moral relationships with God and others that is at the core of the Christian faith. Might the information-processing pattern of our brain be placed in our resurrected bodies? The impact that this has on our understanding of heaven and the afterlife, once again, may be influenced by our church tradition.

Neuroscience and cognitive science have helped to give us a new understanding of how learning

occurs at the molecular and cellular level, to identify brain regions important for conditioning, and to provide insight into the psychopathology of many mental disorders. Computer models and neural networks have provided a new way of understanding the workings of the mind as an information processing system. A number of researchers have investigated the link between mind and brain (Sperry, Gazzaniga, Eccles, Crick, Sachs, Chalmers), and Christians (Jeeves, Brown, Myers, Ashbrook) have contributed to this discussion.

Researching Consciousness

Flanagan has suggested that the way to develop a theory of consciousness is through what he calls the Natural Method, researching consciousness in a multi-disciplinary approach (i.e., anthropology, phenomenology).[18] While most experimental psychologists and neuroscientists view phenomenology with suspicion, it is necessary to investigate the introspective qualities of consciousness such as qualia (the phenomenological, experienced properties of a mental state). The inclusion of evolutionary theory may add a principle of coherence to these many lines of analysis. Flanagan believes we will come to a consensus about consciousness by treating each discipline with equal respect.

The Function of Consciousness

One of the most interesting questions about consciousness is that of its function. Flanagan believes the only way to address this question of function is by developing evolutionary and general psychological theories.[19] An evolutionary analysis of function is forced to address the ability of consciousness to enhance survival and procreation.[20] We are better equipped to deal with our environment when we are able to process information, plan ahead, and respond to environmental events. The inclusion of qualia allows for emotional responses and a subjective experience of the world in a manner that is fundamentally different from a stimulus-response experience that is emotionally void. This emotional aspect further aids survival.

Flanagan makes no mention of possible religious functions of consciousness. There is no inclusion of theological analyses. Brand offers an alternate function of consciousness, which is to be aware of self and the Creator.[21] I would argue that the purpose of consciousness is not primarily for survival, but is for entering into relationships. The Relationship Principle may be defined as the underlying function of consciousness that processes information for the purpose of interaction. Our consciousness (1) enhances survival, (2) acts as the binding loci of qualia, and (3) acts as the decision maker/information processor through which we (4) establish and enter into relationships. Items 2–4 display the Relationship Principle in that the ability to process information, experience our environment(s), make moral choices, and enter into an experiential exchange with that which is "not me" are expressions of our humanness. These abilities are at the core of the Christian faith: a covenant with a life-giving, just, redeeming, and loving God who wishes to be known.

A Christian Perspective

Cognitive science, neuroscience, and theology are interdependent. Together they deepen our understanding of the human condition and draw us to a clearer vision of how God's handiwork is displayed in some of his greatest gifts to us: our mental life and our ability to know him in a loving relationship. It would be improper for Christians to maintain a fragmented approach to studying these gifts. Being fully informed of the theological and epistemological positions that exist regarding human nature is important for the Christian. For example, those in Reformed traditions may have various viewpoints about the nature of free will. The tradition which psychologists adopt or in which they were raised can influence how they approach a cognitive process like decision making. There are, potentially, a myriad of ways in which these traditions might act as paradigms to dictate how theories of consciousness are developed. With this in mind, we must be continually educating ourselves with respect to our theological traditions, and this is no small task.

Consciousness is a topic that combines the simple essence of our self-awareness with the complexity of the neural system that underlies it. As Christians, I believe that our task is to approach consciousness with a respect for the recent discoveries made in cognitive science and neuroscience. We must be careful, however, of adopting definitions that might lead to a consciousness that leaves God out of the picture. We also need to examine our theological traditions and determine how they shape our theoretical paradigms. I believe that the Relationship Principle may be able to unify the study of consciousness by acting to root the function of consciousness in relational exchanges. Consciousness is not just survival and reproduction, but is the vehicle through which we enter into relationships with our environment, each other, and, most importantly, our Creator.

Notes

[1]Robert C. Bolles, *The Story of Psychology: A Thematic History* (Pacific Grove, CA: Brooks/Cole Publishing Company, 1993).
[2]William James, *The Principles of Psychology* (New York: Holt, 1890).
[3]B. F. Skinner, "Can Psychology Be a Science of Mind?" *American Psychologist* (November 1990): 1206–10.
[4]Daniel Bjork, *William James: The Center of His Vision* (Washington, DC: American Psychological Association, 1997).
[5]J. Jaynes, *The Origin of Consciousness and the Breakdown of the Bicameral Mind* (Cheektowaga, ON: University of Toronto Press, 1978), 1.
[6]Ibid., 46–7.
[7]B. F. Skinner, *Beyond Freedom and Dignity* (New York: Knopf, 1971), 190.
[8]Ibid., 191.
[9]Daniel Dennett, *Consciousness Explained* (Boston, MA: Little, Brown and Company, 1991).
[10]Owen Flanagan, "Consciousness and the Natural Method," *Neuropsychologia* 33, no. 9 (1995): 1103–15.
[11]P. Churchland and R. Porter, "Levels of Analysis," in *Perspectives on Cognitive Neuroscience*, ed. R. G. Lister and H. J. Weingartner (New York: Oxford University Press, 1991); Francis Crick and Christof Koch, "The Problem of Consciousness," *Scientific American Mysteries of the Mind* Special Issue vol. 7, no. 1 (1997): 18–26, 33; and F. Rohrlich, "Cognitive Emergence," *Philosophy of Science* 64 (1997): Proceedings S346–58.
[12]N. Georgieff and M. Jeannerod, "Beyond Consciousness of External Reality: A 'Who' System for Consciousness of Action and Self-Consciousness," *Consciousness and Cognition* 7 (1998): 465–77.
[13]T. W. Hunt, *The Mind of Christ* (Nashville, TN: Broadman & Holman Publishers, 1995).
[14]Malcom Jeeves, *Human Nature at the Millennium* (Grand Rapids, MI: Baker Books, 1997).
[15]Warren Brown, Nancey Murphy, and H. Newton Malony, eds., *Whatever Happened to the Soul?* (Minneapolis, MN: Fortress Press, 1998) and M. J. Boivin, "The Hebraic Model of the Person: Toward a Unified Psychological Science among Christian Helping Professionals," *Journal of Psychology and Theology* 19, no. 2 (1991): 157–65.
[16]Jeeves, *Human Nature at the Millennium*, 185.
[17]Dick Cole, "Against the Integration of Psychology and Christianity: A Bold Proposal for an Alternative Paradigm," *Journal of Psychology and Christianity* 17, no. 3 (1998): 210–9.
[18]Flanagan, "Consciousness and the Natural Method."
[19]Ibid.
[20]D. T. Kenrick, E. K. Sadalla, and R. C. Keefe, "Evolutionary Cognitive Psychology," in *Handbook of Evolutionary Psychology*, ed. C. Crawford and D. L. Krebs (Mahwah, NJ: Lawrence Erlbaum Associates, 1998).
[21]Jay Brand, "Challenges for a Christian Psychology from Cognitive Science," *Journal of Psychology and Christianity* 16, no. 3 (1997): 233–46.

Books Received and Available for Review

This is a partial list of the books available for review. Please contact the book review editor if you would like to review one of them or receive a copy of the complete list. Richard Ruble, Book Review Editor, *Perspectives on Science and Christian Faith*, 212 Western Hills Drive, Siloam Springs, AR 72761. richard@tcainternet.com

Mariano Artigas, *The Mind of the Universe: Understanding Science and Religion*, Templeton Foundation Press, 356 pages, 1999
Joe Ator, *Darwinism and the Creation Science Movement*, Star Bible Publications, 88 pages, 2000
John Ashton, ed., *In Six Days: Why 50 Scientists Choose to Believe in Creation*, Master Books, 360 pages, 2001
Robert Benne, *Quality With Soul: How Six Premier Colleges and Universities Keep Faith With Their Religious Traditions*, Eerdmans, 218 pages, 2001
Ronald Cole-Turner, ed., *Beyond Cloning: Religion and the Remaking of Humanity*, Trinity Press International, 152 pages, 2001
Robert Crawford, *The God Man World Triangle: A Dialogue Between Science and Religion*, St. Martin's Press, 234 pages, 2000
David Darling, *Life Everywhere: The Maverick Science of Astrobiology*, Basic Books, 288 pages, 2001
Tim Goldsmith & W. Zimmerman, *Biology, Evolution and Human Nature*, John Wiley & Sons, 370 pages, 2001
Michael Gross, *Travels to the Nanoworld: Miniature Machinery in Nature and Technology*, Perseus Publishing, 250 pages, 2001
Arthur Holmes, *Building the Christian Academy*, Eerdmans, 122 pages, 2001
J. R. Hyland, *God's Covenant With Animals: A Biblical Basis for the Humane Treatment of All Creatures*, Lantern Books, 107 pages, 2000
Tim Jensen & Mikael Rothstein, eds. *Secular Theories of Religion: Current Perspectives*, Museum Tusculanum Press, 280 pages, 2000
Steve Kroll-Smith, et al, eds., *Illness and the Environment: A Reader in Contested Medicine*, NYU Press, 476 pages, 2000
James Le Fanu, *The Rise and Fall of Modern Medicine*, Carroll and Graf, 425 pages, 1999
John Leslie, ed., *Modern Cosmology & Philosophy*, Prometheus Books, 363 pages, 1998
David Loye, *Darwin's Lost Theory of Love: A Healing Vision for the New Century*, iUniverse.com, 308 pages, 2000
John Mason, *The Human Family and the Creator-God*, Vantage Press, 250 pages, 2000
Ralph Muncaster, *Can Archaeology Prove the Old Testament?* Harvest House Publishers, 48 pages, 2000
R. L. Nyborg, *The Case Against Evolution*, University Publishing House, 156 pages, 2000
Michael Paterniti, *Driving Mr. Albert: A Trip across America with Einstein's Brain*, The Dial Press, 207 pages, 2000
Dayton Roberts, *Creation-Care in Ministry: Down-To-Earth Christianity*, AERD, 200 pages, 2000
L. A. Santander, *My Cosmic Pessimism: A Philosophical Critique to the Existence of a Cosmic Almighty Mind*, Pentland Press, 100 pages, 2000
Susan Schreiner, *The Theater of His Glory: Nature and the Natural Order in the Thought of John Calvin*, Baker Book House, 164 pages, 2001

Essay Review

Cooperation as the Genesis of Design

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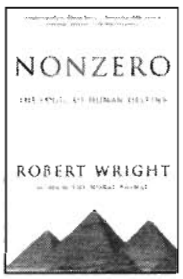

Robert Wright, *Nonzero: The Logic of Human Destiny* (New York: Vintage Books, 2001). 435 pages. Paperback; $15.00. ISBN: 0679758941. (New York: Pantheon Books, 1999). Hardcover; $27.50. ISBN: 0679442529.

In *Nonzero: The Logic of Human Destiny*, Robert Wright, whose earlier work includes *Three Scientists and Their Gods* and *The Moral Animal*, proposes to explain history by using game theory as formulated by John von Neumann and Oskar Morgenstern in the middle of the twentieth century. Game theory distinguishes between "zero-sum" games where the players compete against one another and there are winners and losers, and "non-zero-sum" games where the players' interests overlap. This overlap of interest creates a situation where competition is subsumed by cooperation. Wright's thesis is that the history of life, including humans and all other organisms, evidences an increase in complexity, and that this complexity can be attributed to the proliferation of "ever larger, and ever more elaborate non-zero sum games" (p. 6). He is not talking about how life began. He is arguing that once it began, game theory, because it is a vehicle for evaluating competition and cooperation, can explain the emergence of "larger and richer webs of interdependence," (p. 6) that is "the accumulation of 'non-zero-sumness'" (p. 7).

Two ideas are basic to his thesis. The first is that non-zero-sumness exists as potential and that its potential is unlocked through competitive zero-sum games. The second is the idea that

> organic evolution and human history ... constitute a single story, ... that the two processes have common dynamics ...; [that] at some basic level, cultural evolution and biological evolution have the same machinery, ... the same fuel; the energetic interplay between zero- sum and non-zero-sum forces ... [and that] the two process have parallel directions – long-run growth in non-zero-sumness, and thus in the depth and scope of complexity" (p. 243).

There is also a third concept, not so central as the first two, but important to the way Wright develops his argument: the belief that human beings everywhere "are genetically endowed with the same mental equipment, that there is a universal human nature ... [a] psychic unity of humankind" (p. 19), and that this unity explains why cultural evolution tends to move in the same direction across the world, though it occurs at different rates. It also explains why the modern world was all but inevitable. This basic unity is revealed through universal feelings like greed, hatred, generosity, gratitude, obligation, empathy, and trust. We express it in our moral indignation, or in our sense of just grievance occasioned by things like laziness, stinginess, and cheating. We discern it in our innate curiosity, in

*ASA Member

our tendency to develop social hierarchies, in our predisposition to be competitive and status hungry, and in our universal propensity to build things, a proclivity Wright believes is tucked away in our DNA. Taken together such a universal genetic heritage means that "people are good at finding zones of mutual self-interest and striking deals of mutual obligation" (p. 114), despite our not being designed to live in close proximity to many of our own kind.

In opposition to evolutionists like Stephen Gould to whom he often refers, Wright thinks that humans are not chance products of a process dominated by randomness, but were destined and have a destiny. Therefore, he has subtitled *Nonzero*, "The Logic of Human Destiny," and in its pages he seeks not only to describe how we got where we are, but also to predict where we might be going. Of course such predictions are not detailed. Rather they are extrapolations of his conviction that both past and future are contained in the present, that as yesterday lives in today, so tomorrow lives in them both. For Wright, randomness, if it is to have any effect beyond itself, needs order, and order, if it is to transcend mere stasis, needs randomness. Randomness and order braided together are creative. Thus Wright does not want to argue that the world in which we find ourselves was "literally inevitable." He believes it was highly likely.

As Wright describes it, life is a machine that generates and deepens meaning, and creates and fulfills the potential for good (p. 331). Thus, for Wright, history has seen moral progress but not inevitable moral progress. Material prosperity has made it easier for people to acknowledge the humanity of others. Humankind seems to be moving away from tyranny and toward freedom. However, there is no guarantee that good will prevail. Evil in the form of tribalism combined with "the growing power, compactness, and accessibility of lethal technologies" (p. 231) could triumph. Wright believes that in a sense the fundamentalists are correct. We have reached a pivotal juncture in the destiny of the world. Our age is justifiably obsessed with eschatology.

Having said all this, it might be helpful to integrate Wright's theme within its philosophical tradition. There is a millennia-old argument over whether human history is distinct from or an aspect of natural history. Can human history be reduced to a set of laws that, if known, would render it predictable? Or are humans uniquely free, and in the end does that uniqueness make their history unpredictable? The first position can be traced to Herodotus (484–425 BC), the second position to Homer (eighth century BC). Herodotus, as he described and catalogued cultures, sought evidence of unifying themes that would not only render cultures mutually comprehensible but would fix them firmly in the natural order. For this reason, he is known as "the father of history." But history as a natural process is not the only possibility. A view of history as a heroic endeavor also has its champions, one of the earliest of whom was Homer. Homer envisioned history as the creation of heroes who through fortitude changed the course of events. Because events were ultimately at the command of individuals, there was nothing inevitable about human history. It would always be quintessentially idiosyncratic.

Wright is firmly in Herodotus's camp. Indeed, at one point he says:

> Far be it from me to minimize mathematics—or science or technology. But we should certainly minimize the importance of any one person in these fields, because all three are on autopilot. The bent for innovation is so deeply human that progress doesn't depend on anyone in particular (p. 119).

Of course history is more than scientific discovery and technological progress, but those endeavors tend to inform much of Wright's analysis, which means that there is a certain Marxist quality to the book, a tendency to reduce people to *Homo economicus*. Indeed, Wright, though he does criticize Marx on occasion, generally has positive things to say about him.

Historically Christians have taken an intermediate position in the debate over history as a natural process or history as the interplay of persons. Via the *logos* doctrine, Christians have affirmed that the God who created the world presides over both the processes of the world and the lives of his creatures, so in that sense natural and human history share much with one another: they are created, sustained, and guided by God. However, Christians also have

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affirmed that the *logos* is not a rational or natural principle or set of principles but is a person, and that as such the *logos* is engaged in a personal relationship with his world and his creatures. In that sense, human history is much as Homer imagined it: the interplay of separate personal wills. Therefore, Christians can affirm with Wright that there is human destiny but we would insist that it is not as impersonal as he imagines it to be.

Wright's overall thesis then is hardly new. What is new (as least so far as I know) is his use of game theory to explain variety in biology and culture. To ask if Wright is convincing at this point is to ask the wrong question. It is better to ask if Wright's thesis is plausible. On one level the answer is yes. The idea that competition results in cooperation has appeal, and, with selected examples, we can certainly illustrate that development. But, as Emil Cioran once observed, history, because it contains everything, proves nothing. Thus on another level the answer is a qualified no. This qualified no is not just because other examples support the counter idea that competition, rather than fostering cooperation, causes coalitions to break down. It is because variety in biology and culture has been explained so many times in other ways.

It seems plain to me that there is a certain direction to history, that things, though they endure, are not as they were, and that a particular technological complexity plays a significant role in accounting for that. However, it is less obvious that human history and natural history are really powered by the same basic dynamic. Nor is it obvious that game theory would be the best way to account for that shared direction. It may be that humans have learned to cooperate, but why should we believe that in doing so we are simply following principles expressed eons ago by slime mold? Were that all there was to it, why should we have to learn to cooperate? After all, we do not have to learn to fall.

Wright addresses this objection in a very arresting way via teleology. To justify his assertion that history, whether natural or human, is teleological, Wright adopts Richard Braithwaite's definition of teleology: "persistence towards the [hypothesized] goal under varying conditions" (p. 312), but modifies it by adding the caveat that the adjustments must reflect the activity of information processors. Then he nominates genes (and by implication memes) for the role. Organic evolution and cultural evolution are to be distinguished from a falling object or the flow of a river because organic evolution and cultural evolution derive their directedness from the activity of information processors (genes or memes) while that which falls or flows simply passively obeys the law of gravity and follows the path of least resistance.

Modifying Braithwaite's definition as he does enables Wright to differentiate the directedness he sees in life and culture from the directedness evidenced in phenomena like falling or flowing. At the same time, it enables him to embrace Dawkins' terminology and convert it into an argument for design. Living organisms are precisely what they appear to be. They look as if they are designed because they were. They appear to have a teleological dimension because they do. Evolution itself is a teleological process, and hence it has not only expressed that reality in the obvious design of living creatures, but eventually was able to lift information processors like genes to the level of information processors like brains—brains that allow for far greater flexibility, far more rapid responsiveness, and far greater adaptive complexity than genes. The value of cooperation lies embedded in the very fabric of nature waiting to be exploited. Genes can utilize it through random mutation structured by reproductive success, or animals like us can discover it by learning about it.

If his argument seems to be just a bit too neat, perhaps it is. Wright admits that there are more difficulties with his thesis than he has bothered to enumerate, and that his terminology "has been a bit loose" (p. 281). These weaknesses do not seem to concern him. What he wants to do is to initiate a discussion, to argue that such questions are not as wrong-headed as philosophers like Popper or Kant might have imagined.[1] To an extent he has succeeded, but there remain several issues he fails to address adequately. I will discuss two.

First, let us consider what Wright terms "the weirdness of consciousness" (p. 323). He identifies the question of consciousness with "the question of subjective experience *in general*" (p. 307) and observes that "a truly scientific perspective shows consciousness ... to be a profound and possibly eternal mystery" (p. 331). Adopting "the hard core scientific view that consciousness is a mere epiphenomenon, lacking real influence," Wright says: "If consciousness doesn't *do* anything, then its existence becomes quite the unfathomable mystery" (p. 307). "[If] subjective experience ... lacks a function; it is redundant, superfluous" (p. 321). This is an insightful observation and one that gives rise to exactly the right question. That Wright fails to give an adequate account of such a mystery is unsurprising. To date no one has come close, and Wright himself, by suggesting that the question may be shrouded in eter-

nal mystery gives us reason to suppose that he doubts anyone ever will. Nevertheless, he recognizes that consciousness is key to the mystery of us and is key to grasping the nature of our morality.

Second, there is the issue of what Wright means when he talks of meaning. Though he admits to using less precision than he might when addressing other questions, when it comes to defining what he means by meaning, Wright tries to speak with some precision. He borrows his definition for meaning from the philosophical pragmatist Charles S. Peirce who claimed that the meaning of a message lies in the behavior it induces. However, Wright qualifies Peirce's observation by advising us that the behavior induced must be appropriate to the information in the message. By inserting "appropriate" as a qualifier, Wright reminds us that information, if it is not comprehended, can result in inappropriate behavior. It is also true, though Wright does not say this explicitly, that the meaning of messages can be misunderstood even if one grasps their information content. (For example, poetry or allegory conveys information on one level and meaning[s] on others.) Thus meaning cannot be reduced to behavior or even to information. Wright, though he tips his hat in their direction, never really acknowledges either of these problems, yet they illustrate why the chemical reactions initiated by DNA and those stimulated in brains are fundamentally different. At the very least, the former requires no comprehension, the latter does.[2]

William Dembski captured this problem very neatly in his own review of *Nonzero* which appeared in the August/September 2000 issue of *First Things* and was appropriately entitled "The Limits of Natural Teleology." He points out that because it leads to increasing complexity, Wright's "nonzero dynamic ... confers a direction on biological and cultural evolution" (p. 47). Dembski argues that the two are in fact quite different since intelligence would seem to be required for the one but not for the other (p. 50). And there, Dembski says, lies the problem with Wright's thesis: in an effort to avoid resorting to an intelligent agency to account for design in biology, Wright puts inordinate weight on natural selection (p. 51). However, I think the position adopted by Wright is even more implausible than Dembski allows. If the same mechanism that generates biological variety also generates cultural variety, if consciousness is not required to explain the cunning variety in the biological realm, and if mathematics, science, and technology are all on autopilot and sending us toward a predestined end, then it is not easy to see how the world would differ significantly from the way it is now were we unconscious automatons. It is not only that Wright puts an inordinate weight on natural selection to explain design in biology, he puts an inordinate weight on natural selection to explain human culture as well, and in doing so he reveals the problematic nature of thoroughgoing materialism.

Nonzero then is a long argument that attempts to account for design in nature and even implicitly in human culture without assuming an intelligent agency behind design. Though Wright frequently refers to the Jesuit Pierre Teilhard de Chardin who combined his religious and paleontological training in an effort to develop a Christianized version of evolution, there is little to suggest that Wright was positively influenced by the religious side of Teilhard de Chardin's thesis. Instead *Nonzero* reads as though it was intended as a refutation of Teilhard de Chardin's theism.

One cannot finish *Nonzero* without marveling again at how readily our universe lends itself to interpretation. Confronted with it, we sense a profound enigma and cast about for plausible solutions. They abound, and their abundance increases our sense of mystery. If *Nonzero* did nothing more than add yet another teleological interpretation to the dozens available, it would still be worthwhile. But it is also thought provoking, full of information, and great fun to read.

Notes

[1]It is interesting in this context that Wright rejects Popper but appeals repeatedly to Kant's essay, "Idea for a Universal History with a Cosmopolitan Purpose." He particularly likes Kant's reference to the "unsocial sociability" of humans. The "Idea for a Universal History with a Cosmopolitan Purpose" was an essay Kant published in 1784, three years after he published his *Critique of Pure Reason*, a year before he published his *Foundations of the Metaphysics of Ethics*, and four years before his *Critique of Practical Reason* came out. In this essay and his subsequent work, Kant strove to lay the foundations of an ethic that would stay viable in the absence of transcendental imperatives. While it is true that Kant remained drawn to the teleological perspective, even after he had done so much to debunk it, it is also true that by and large he resisted its attraction and that his philosophy is far more sympathetic to Popper's position than to Wright's.

[2]At one odd place Wright seems to touch on this in a very oblique way. Though he argues repeatedly (indeed it is fundamental to his book) that cultural and genetic evolution are aspects of the same phenomenon, he observes en passant while discussing memes that cultural evolution in fact is quite different from genetic evolution (p. 90). He is correct but for reasons that have nothing to do with the speed or neatness of the respective processes.

Book Reviews

Environment

THE CARE OF CREATION: Focusing Concern and Action by R. J. Berry, ed. Leicester, England: InterVarsity Press, 2000. 213 pages, notes, bibliography, indexes. Paperback; $17.99. ISBN: 0851116574.

This book will have failed if it is regarded as merely another book on the environment from a group of "green" Christians, however dedicated and informed. It is both less and more than that. It is less because it is specifically and mainly a theological commentary on a particular document (*An Evangelical Declaration on the Care of Creation*); it is more because this is not simply an exercise in advocacy: the commentators are united in their Bible-based understanding of the environment as God's creation entrusted to our care and wonder.

Three truisms are given: (1) A virtually unanimous, somber acknowledgment that humans have damaged their environment; (2) A general feeling of helplessness by individuals: What can *I* do about climate change, species extinction, genetic holocaust and so on; and (3) A Christian's dithering between a Scylla of welcoming disasters as a sign of the "end-times" and a Charybdis of shipwreck on pantheism and New Age nightmare.

The resulting frustrations led to a meeting in 1992 at the Au Sable Institute. The report of that meeting stimulated the forming of the Evangelical Environmental Network and through that, in 1994, the formulation of the *Declaration* mentioned above. John Stott's introduction follows the text of the *Declaration*.

Part II of the book titled "Context" starts with a description of the history that led to the meeting that formulated the *Declaration*. Chapter 1 republishes a lecture given by Lynn White, Jr., at a meeting of the American Association for the Advancement of Science in 1966. His conclusion was that the disruption of the global environment is the product of a dynamic technology and science originating in the Western medieval world. The growth of the disruption can only be understood by realizing that it is deeply grounded in Christian dogma, White says, especially in the interpretation of Gen. 1:28. Christians were slow to react, but gradually discussion developed.

Many Christians think that God's command means creation must not only be used but preserved. The growing concern for the environment among Christians caused reaction in the "anti-environmental movement." In chapter 5, Richard T. Wright describes some of the negative reactions rooted in a free enterprise ideology. These reactions are often funded by industries dependent on exploiting natural resources. Exploitation is, of course, opposed by environmentalists. Wright points to the "Contract with America" published by the Republican Party in the 1990s. For Christians wanting to live environmentally responsibly the result was frustration: The Endangered Species Act was not renewed and the United States did not take any action to curb greenhouse-gas emissions in accordance with the Kyoto Accord. Wright says that it is odd that free-trade capitalism is supported by many Christians. He mentions E. Calvin Beisner.

It is almost cynical to read in the *Declaration*: "... we support the development of just, free economies which empower the poor and create abundance without diminishing creation's bounty." That statement should be changed. A "free" economy gives power to the "rich" and does not give the "land" and the "poor" a chance. Statistics support that the income-gap between the rich and the poor grows, and the GNP grows. In agricultural areas, small farms disappear. The larger farms that remain grow mostly one kind of crop and often use chemicals for growth. Gradually the ground loses its richness. The people that live in the country are moving in large numbers to cities, which use and destroy even more land. Also, pollution is increased by the many cars needed to get people to work in cities (see Northcott, pp. 171–4).

It would seem that these trends are against God's laws. God set aside one day a week to rest workers, and one year in seven to rest the land. Slaves were to be set free in the seventh year, and the land was to be given back to its original users in the fiftieth year. A major reason that Israel went into exile was that God's provisions were not followed (2 Chron. 36:21, Lev. 25, Moltmann, p. 112). God reminded the Jews of these laws just before they went into exile (Jer. 34:8–20).

Calvin DeWitt points out in chapter 4 of "Context" that people became the predominant destructive force on earth. DeWitt quotes Rev. 11:18: "the time has come to judge those who destroy the earth." He lists, referring to Psalm 104, seven degradations of the earth, followed by seven provisions of creation. DeWitt mentions ten excuses used by many evangelical Christians to avoid being creation-keeping disciples.

Part III "Commentary" has fourteen chapters, written by different authors, some mentioned above. Others include: Alister E. McGrath, Richard Bauckham, Jurgen Moltmann, Ghillean T. Prance, Howard J. Van Till, Peter Harris, Stephen Rand, Susan Drake Emmerich, Ron Elsdon and Michael S. Northcott. Some points discussed are: Does Gen. 1:28 mean that humans are totally in charge of creation or is he just a keeper (steward) for God? O'Donovan says "Man" is a just steward of the creation. As such he has to guard the creation. Harris says that we

should start our speculations knowing that God is the Creator. Then if we worship him, we will be less tempted to see our personal redemption as the beginning and end of God's concern with us. Elsdon points out that creation and Gospel cannot be separated, and Greek philosophy has influenced Christian thought.

I am tempted to quote from other chapters, but read the book for yourself. This book is not only for scientists but for all believers. It shows the necessity to take action now. Believers should not be the last ones to advocate earth keeping; they should be in the forefront of earth care.

Reviewed by Jan de Koning, 20 Crispin Crescent, Willowdale, ON, Canada.

AN EARTH CAREFUL WAY OF LIFE: Christian Stewardship and the Environmental Crisis by Lionel Basney. Downers Grove, IL: InterVarsity Press, 1994; Vancouver, BC: Regent College Publishing, 2000. 168 pages. Paperback; $18.95. ISBN: 1573831727.

Basney was a professor of English at Calvin College from 1985 until his death in 1999. He taught previously at Houghton College from 1968–1985. He also has published other articles and poems relating to the theme of Christian stewardship, which he describes in this book.

It might be expected that a book on environmental stewardship would include such topics as renewable energy resources, the thermodynamics of recycling, and practical efforts directed toward conservation. This book, however, is not so concerned with technological development as it is with the development of our values. Basney is particularly concerned with the lifestyle values that Christians portray to the world.

This book is passionately and eloquently written and is a lively and refreshing read in comparison to many of the dry, technically oriented books presented by Christians about the environment. The book will also expose many of us less liberally educated to the literary works in the areas of environmental stewardship. It even provides a very nice appendix on sources that the interested reader could use to explore more literary works in the environmental genre.

The book is arranged in a progressive manner that begins with a discussion of how our culture and environment are related. Basney vividly describes how our culture influences our perception of what we see in our environment. He gives the example of a supermarket, from which we can mistakenly infer a land of great abundance. Breakfast cereals appear as a seemingly endless variety filling long aisles in the supermarket. But, Basney points out, this seemingly endless variety of cereals are all common to only four grains and, Basney states, these grains are grown as "plants on life support." The inference of a land of plenty is false, says Basney, we are actually in an environmental crisis. Throughout the following chapters, he echoes this theme of being blinded by our culture to the true nature of things whether it is the food supply, land development, or manufactured items.

Basney then makes the case for reconnecting ourselves to the land as an effort to change our manner of thinking and of supporting ourselves at a more subsistent level. He pleads the need for people in the church to become aware of the environmental situation and not live blinded by culture. He offers solutions based on observation of nature, of practical use of subsistence gardening. Though these may appear to be practical things, the underlying message is directed toward things less tangible. It is directed to our way of thinking, of seeing, and ultimately to the way we live as Christians. This is the value of the book, not technical, but personal; not scientific, but spiritual.

As scientists, we can easily be critical of Basney's solutions. We may say that the use of his automobile to enable his life in the country, and the use of a wood-burning stove are in the end counterproductive. We may say he would be thermodynamically ahead if he were to live in an energy efficient condominium within walking distance of his employment. But such a critique would be meanspirited when Basney so eloquently describes and critiques *us* for the way we live a life without seeing. It may be that there are external benefits to life in the country and the physical effort of turning soil, planting seeds, and harvesting our own food. It has certainly provided for a great little book that ought to give scientists and nonscientists some food for thought.

Reviewed by Gary De Boer, Assistant Professor of Chemistry at LeTourneau University, Longview, TX 75601.

THE SATANIC GASES: Clearing the Air about Global Warming by Patrick J. Michaels and Robert C. Balling, Jr. Washington, DC: Cato Institute, 2000. 234 pages, including index. Paperback; $10.95. ISBN: 1882577914.

Michaels, professor of environmental sciences at the University of Virginia, and Balling, professor of geography at Arizona State University, have spent much of the past decade publicly challenging the prevailing consensus amongst atmospheric scientists that the risks of climate change are real and significant, and that the policy community should take action to mitigate these risks. In *The Satanic Gases*, Michaels and Balling pull their contrarian arguments together into a collective volume that they, and the Cato Institute, claim will bare the "truth" about the climate change issue.

Throughout the book, the authors lament the difficult role of the contrarian within scientific debate. They argue that those who hold views that differ from the mainstream theories of the science community have a more difficult time getting research funding, are challenged much more rigorously by peer reviewers, and are less likely to have papers accepted by scientific journals than research-

ers who undertake studies that are likely to agree with prevailing views. On this point, I believe the authors have a valid claim. While the science community has always prided itself on encouraging adversarial debate and uses a peer review process to challenge weak aspects of scientific arguments, our human nature still causes us to become defensive and somewhat resentful toward those who try to call us wrong. What Michaels and Balling do not seem to understand, however, is that contrarian views must also be presented in a spirit of integrity and honesty, not in a highly selective fashion. It is here that I have the greatest discomfort with the contents of *The Satanic Gases*.

The book is also replete with contradictions. The authors contend that the "consensus" viewpoints with respect to what we can and cannot say about the science of climate change, e.g., assessment reports of the Intergovernmental Panel on Climate Change (IPCC) cannot be trusted because the scientific experts involved are virtually all employed by government institutions and universities, which are in turn driven by political and fund-seeking agendas. Yet they liberally quote the IPCC report wherever it fits their arguments. They argue that all scientific research is biased by personal, ethical, and economic interests of the researcher, but then they try to marginalize the views of individuals such as Sir John Houghton, chair of the key IPCC science working group, by pointing out that he is a Christian who allows his views of the supernatural to influence those with respect to the natural. They claim that funding research through academic and government mechanisms tends to encourage results biased toward political and economic agendas, yet imply that their own indirect funding by the private sector generates no such bias.

More disturbing, however, is the very selective but charismatic manner in which the authors use scientific results from the tomes of available climate science literature but ignore the much broader information base (often in the same papers) that disagrees with their theses. When the arguments presented by Michaels and Balling are placed into the context of that broader scientific literature base, one finds that most of their arguments have been repeatedly refuted within the literature, and that they either misunderstand much of the results or misrepresent them to support their underlying thesis that human-induced climate change is a non-issue. Both as a Christian and a scientist, I find this dishonesty, presented within public media that has not been subject to any peer review, troublesome.

When in criminal court, one would only expect a fair trial if the jury listens to the arguments of a trial defense lawyer within the context of the counter arguments presented by a prosecutor (and vice versa) and the advice provided by the trial judge. Likewise, I suggest this book only be read within the context of the broader literature available on the topic. Other excellent scientific books that present a much more balanced perspective of what we know and do not know about climate change include the various IPCC reports (all extensively peer reviewed) and Sir John Houghton's *Global Warming: The Complete Briefing* (Cambridge University Press, 1997). The latter, apparently much to the annoyance of Michaels and Balling, includes a chapter describing how the author brings personal belief and ethics into his assessment of the climate change issue. Other books by investigative science writers that help provide a better context for some of the politics behind the climate change debate include Lydia Dotto's *Storm Warning: Gambling with the climate of our Planet* (Doubleday, Canada, 1999) and Ross Gelbspan's *The Heat is On* (Addison Wesley, 1997).

Reviewed by Henry Hengeveld, Senior Science Advisor on Climate Change, Environment Canada, Toronto, ON M3H 5T4.

Ethics

MORAL ACQUAINTANCES: Methodology in Bioethics by Kevin Wm. Wildes. Notre Dame, IN: University of Notre Dame Press, 2000. 214 pages, index. Paperback; $20.00. ISBN: 0268034508.

There is an ever-increasing stream of books and essays concerning bioethical issues such as physician-assisted suicide, organ transplantation and allocation, genetic research, and the distribution of health care resources. Christians and secularists are quite busy in this emerging field arguing for particular positions and societal actions. Some issues in bioethics seem to find quick agreement among ethicists as to appropriate courses of action, and problems are quickly resolved. Other areas in bioethics (e.g., abortion, euthanasia, fetal tissue research) find ethicists deeply divided as to what is ethically permissible and appropriate. Some of these differences are traceable to the fact that there is no specific training at present that makes one a "bioethicist." Lawyers, theologians, philosophers, physicians, scientists, nurses, and a variety of other experts produce articles and books in the field of bioethics. Yet, subject matter background alone does not seem to adequately account for the range of approaches, since many times people with the same disciplinary background reach dramatically different positions on key bioethical issues.

Wildes, an assistant professor of philosophy and medicine at Georgetown University and Associate Director of the Kennedy Institute of Ethics, wades into these issues not from the standpoint of direct contributor to a specific issue but from the vantage point of methodology. He explores the methodological underpinnings of bioethics and finds a bewildering array of approaches and value assumptions that underlie current work in this multidisciplinary field.

He believes, rightly in this reviewer's mind, that we have not spent enough time thinking through the moral views in our pluralistic society that lie underneath the musings of particular bioethicists. His consistent focus throughout this carefully argued book is on how we conceive and define controversies in bioethics and how we seek a moral course of action. Wildes opens with a critical

look at various foundational methods already in use within the field of bioethics including Singer's utilitarian project, Donagan's theory of morality, natural law, contractarianism, and virtue theory. An entire chapter is devoted to discussing the appeal to four middle-level principles of Beauchamp and Childress, i.e., justice, autonomy, beneficence, and nonmaleficence, that, they believe, have the power to unify this field. These principles, when applied to the various foundational methods employed in the field of bioethics, should yield common ground.

Wildes, along with other critics, believes that these principles are so vague and "content-thin" that they succeed at their fundamental task but at the expense of masking deep differences among the various approaches used in bioethics. He puts forward an alternate "moral acquaintances" approach (expanding on Englehardt) that starts at the opposite end of that of Beauchamp and Childress, i.e., focusing on differences among approaches rather than commonalities. Wildes believes that holding to a conception of distinct moral "communities" in discourse within one another better fits the dramatically different value systems that underlie contemporary approaches to bioethics. We should not mask our differences, he argues, but rather recognize them explicitly and then while working out of them, seek to find common ground via the inevitable compromises of social negotiation. He rejects the notion of complete moral pluralism where no consensus or common ground is possible and believes that through the application of acquaintanceship we can better resolve moral controversies and dilemmas of medicine, health care, and human biology.

This volume is a worthy addition to college libraries and can be used fruitfully in conjunction with one or more books of readings for a bioethics course. The approach Wildes suggests may have wider application beyond bioethics in areas such as creation/evolution, ecclesiology, and eschatology where Christians disagree with one another.

Reviewed by Dennis W. Cheek, Director, Office of Research, High School Reform and Adult Education, RI Department of Education and Adjunct Professor of Education, University of RI, 255 Westminster Street, Providence, RI 02903-3414.

VOODOO SCIENCE: The Road from Foolishness to Fraud by Robert L. Park. New York: Oxford University Press, 2000. 230 pages, including index. Hardcover; $25.00. ISBN: 0195135156.

Park, professor of physics and former chairman of the Department of Physics at the University of Maryland, has also directed the office of public affairs in Washington for the American Physical Society for almost two decades. In this role, he has been a frequent writer of op-eds and science features for the *New York Times*, the *Washington Post* and other newspapers. In *Voodoo Science*, Park exposes the various forces that contribute to the promulgation of bad science within a society predisposed to believe in magic and miracles.

Park begins by recounting three separate incidents during the past two decades where inventors claimed to have found magic sources of energy: Joseph Newman's energy machine, James Patterson's magic energy beads, and Pons and Fleischmann's "discovery" of cold fusion. Although all of these inventions appeared to contravene some fundamental laws of physics, they were widely profiled by media, more to entertain than to inform a gullible general public.

In Chapters 2 and 3, Park discusses how our brains function as belief machines that constantly process information received by our senses to generate new beliefs about the world around us. He argues that these belief engines encourage us to develop and hold fast to beliefs that closely resemble those we grew up with, and that such faith in our beliefs can often lead us over the fine line between perseverance and fanaticism. Closely linked to this belief machine is the placebo effect, where the brain is fooled into thinking the problem is being taken care of when in fact the action taken has no real effect on the problem. Those who put their faith in natural medicine as a cure for serious illnesses are often responding to this placebo effect. The antidote to this belief machine, according to Park, is science, by which higher centers of the brain provide us with the aptitude to recognize patterns in what we observe and to develop testable laws and theories to explain them.

Chapters 4 through 7 provide a broad range of further examples, all based on firsthand experiences of the author, of the belief engine working overtime. These include the physical impracticality of the American science fiction-like dreams of space travel, a second look at the politics behind and the public fascination with the cold fusion debate and other inventions that defy the fundamental laws of physics, and a close examination of the controversy about the health effects of electromagnetic radiation. All involve a few fringe scientists who seek to promote their theories and beliefs before a gullible public, and a science community which is ill-prepared to deal with bad science.

The next two chapters deal with the evolving role of the courts as gatekeepers of credible science and the unwitting role of official secrecy surrounding government investigations in fostering public and political belief in illusions such as UFOs and star wars technologies. The final chapter examines more closely the role of many scientists in presenting information about our universe to an impressionable audience in terms that portray a sense of mystery and awe at the strangeness of it all—an awe that encourages resurrections of old superstitions as new pseudo-scientific concepts.

Voodoo Science is easy to read. With a sense of humor and from a perspective of personal involvement, Park recounts many incredible stories of how fraudulent science is often given credibility by the media despite the fact that their preposterous claims seem to break all of the accepted laws of genuine science. Park decries the tremendous public cost of voodoo science, not just in terms

of the billions of dollars squandered but also in the human cost of imaginary fears and distorted views of how the real world works. Yet, he suggests that, within the bigger picture of evolving scientific knowledge, voodoo science is simply like background noise that may be annoying but does little to interrupt the overall flow of genuine scientific discovery.

I enjoyed reading the book, and could relate much of what he had to say about voodoo science to my own personal experiences in this area. Yet I found idolatrous his almost religious belief in the role of the scientific method as the only way to truth, the source of all wisdom, and as a required antidote to faith in our inherited beliefs. Park presents a world view that has little room for the Creator. While human faith in the many false gods of our society is foolishness, a blind trust in science to lead us to knowledge through the mists of our mental belief machines is equally foolish. Hope in better understanding lies in a Christ-centered world view, not in the science-centered world view proposed by Park.

This book would be good material for classroom discussion of fraudulent science's presence within our society and the costs associated with such science. Yet it may be equally important as a topic for discussion amongst Christians with respect to the misplaced supremacy that some would give science as the ultimate source of truth.

Reviewed by Henry Hengeveld, Senior Science Advisor on Climate Change, Environment Canada, Toronto, ON M3H 5T4.

Faith & Science

THE JOURNEY INTO GOD: Healing and Christian Faith by Kenneth L. Bakken. Minneapolis, MN: Augsburg Fortress, 2000. 264 pages. Paperback. ISBN: 0806640480.

The thesis of this book is the word "*theosis*," a Greek term that roughly translates into "transformed into God." It is a call for the Christian Church to rediscover its historic ministry of healing and wholeness as we understand anew Christ's call to be servants of one another.

The author wears many hats as an ordained pastor in the Evangelical Lutheran Church in America, a physician, and president of Health Vision Ministries. He writes with fervency and spiritual insight on the inadequacy of the current biomedical model and for the use of the many untapped resources for health and wholeness in normative Christian faith and practice. He argues that while physical, emotional, and spiritual healing have real value, "... the ultimate purpose of our journey is *theosis*—transformation into the image and likeness of God" (p. 135).

The book is a series of meditations, rather than scholarly arguments. There are eleven chapters, each carrying the reader another step along the way to appropriating the *theosis* concept into life. I found it both interesting and useful reading and will be putting the volume into our local (Presbyterian) church library. I think that other ASA members, particularly those involved in healing professions, will find it of keen interest.

Reviewed by John W. Burgeson, Stephen Minister, First Presbyterian Church, Durango, CO 81301.

INTELLIGENT DESIGN: The Bridge Between Science and Theology by William A. Dembski. Downers Grove, IL: InterVarsity Press, 1999. 304 pages. Paperback; $19.99. ISBN: 0830815813.

Dembski is an excellent writer who introduces the reader to a relatively new and exciting concept of Intelligent Design (ID) in nature. It is an alternate explanation of the world, which does not presuppose a Creator. It does not depend on miracles or speculate on the nature of intelligence. It states that marks of intelligent design in nature can be identified.

The author is eminently suited for the task, holding qualifications in mathematics, philosophy, and theology. His argument is that ID in nature is a valid subject for scientific investigation, an idea that has wide implications in academia. The book challenges naturalistic atheistic evolution, a comprehensive world view that rejects a creator and the idea of ID.

Dembski postulates that ID is a theory of information without an a priori commitment to Christian theism. He suggests that this approach will provide theology, philosophy, and science with the appropriate tools to challenge atheistic naturalism. It is linked to the notion of specified complexity, an idea that was subsequently taken up and developed in the writings of Michael Behe and others. The author has updated and rewritten whole sections of his recently published articles on this subject and brought them together in this very interesting book.

ID is the kernel of the book. The eight chapters are arranged in three easily readable sections followed by an extensive bibliography with explanatory notes and an index. The first section is a general introduction to the topic and explains how, in the latter part of the nineteenth century, atheistic naturalism banished ID from science. Charles Darwin proposed that naturalism was a mechanism to explain life. The origin of life, however, demands an explanation because nature seemed as though it was planned. Some have suggested that Darwin dismissed design because he assumed it could not be a proper scientific explanation of nature. Postulating that God's existence is "beyond the scope of man's intellect," he sought an alternate explanation. Later, other people exploited Darwin's ideas agreeing that design in nature was superfluous to the basic theoretical concepts of undirected evolution. Yet in Dembski's view, science and theology should have remained a coherent pair. After all, design was the basis of British natural theology with the flowering of science at the close of the seventeenth cen-

tury. Dembski discusses its demise in chapter three, the concluding part of this section.

The middle section is the core of the book. Here Dembski expands on the concept of naturalism, a view that nature is self-sufficient. He shows that design can be observed in nature and is accessible to scientific enquiry. Chapters seven and eight properly conclude the final section, offering a means of resolution of the perceived partition between science and theology and showing that ID establishes the crucial link between the two. The distinction between undirected natural causes and intelligent causes is the basis of these arguments from design and this issue is adequately covered in the discussion. These chapters examine divine action as a means of understanding intelligent causation and hence design. As Dembski's argument develops, he shows that within theism God is the ultimate reality.

The book contains many interesting and new ideas to reflect on and apply. Dembski believes that rejecting naturalistic evolution does not mean the acceptance of a young-earth creationism.

Dembski has presented an innovative concept to a wider group of readers and has achieved his purpose in clear, readily understandable language. The importance of this book is that it is written for the general reader. It introduced me to a new area of ideas, which, in another way, have been known to all who believe in God's creation. Here is a book that challenges naturalistic atheistic evolutionary theories and contributes to our understanding of divine action in our cosmos. I highly recommend it. I think it should be required reading for those interested in evolution-creation issues. It also should be available in tertiary institutions and civic libraries.

Reviewed by K. N. P. Mickleson, 21 Windmill Road, Mt. Eden, Auckland 3, New Zealand.

A GEOCENTRICITY PRIMER by Gerardus D. Bouw. Cleveland, OH: The Biblical Astronomer, 1999. 58 pages.

The title of this book may seem strange to a modern scientist. Had not the idea of a geocentric universe died long ago? Apparently not. In Bouw's opinion, "Our main conclusion is this, that criticism[s] of the Bible on the grounds of heliocentrism are unfounded." This is a conclusion with which many Christians would surely agree. However, I do not find that the conclusion follows from the treatise of the text. The text's thesis is that the Bible declares the earth to be fixed, spherical, and the center of the physical creation. I have several problems with this notion.

The cosmological context in which the Old Testament was written was not Greek with its spherical earth, but Egyptian. Egypt pictured a flat earth—not "round." Old Testament texts clearly reflect this view. This is not strange for we today enjoy beautiful "sunsets" and not glorious earth rotations. The reading of the texts to picture a spherical earth is but an early accommodation to Greek science by church fathers. Bouw greatly criticizes accommodation in any form; he does not recognize the accommodating shift from the flat to spherical earth.

That God does accommodate himself to us and to our limitations is quite evident. An early accommodation is when he invited Adam to name the animals. "And whatsoever Adam called every living creature, that was the name thereof." If God had done the naming he might have done a better job, but he did not seem concerned with Adam's getting it all correct.

Accommodation is clearly seen in Israel's establishing a kingdom. In the story of Israel's choosing its first king (1 Sam. 8:6–10), God accommodates himself to the people's unwarranted desire for a king. God recognized their wish as a rejection of him and his ability to provide. In this deplorable way, the succession of the kings of Israel began. It was an improper felt-need that established the Jewish kingdom. God redeems the situation by proclaiming Jesus as King.

A second major criticism of Bouw is his extreme literalism. In Bouw's view, the Bible is not only inspired, but dictated word for word. This means we can learn both science and language skills in the Bible. In discussing Ps. 93:1, Bouw asks: "But is God really a clumsy grammarian?" (p. 8). Throughout the book, he repeatedly answers "No."

Bouw maintains that we must take every word of the Bible literally, and then, argues for his meaning of the words. There is no room for phenomenological or anthropological language. There is no room for accommodation of any kind. Bouw's position leads naturally to such statements as: "Can there be room for doubt that God has a man-like figure when the Bible reports 'one like unto the Son of man?'" (p. 78). "[It is] without biblical support, that a spirit has no form."

My major difficulty with Bouw's thesis is the reliance of faith upon the provability of Scripture. To require that the Bible be scientifically accurate—even prophetically so—as a ground for faith, is dangerous. It is akin to seeking a sign so that we may believe (Matt. 12:8, 39) and is far from the confession of Peter (Matt. 16:16, 17).

Suppose science found the remains of two people who could only be Adam and Eve—it was "scientifically proven" that they were Adam and Eve. The proof was to everyone's satisfaction. Would that strengthen faith? If it were also discovered that they had bellybuttons, would such a discovery influence faith? If not, would it be because of the confidence in God's ability to create Adam and Eve, who were never born, with belly buttons-just-as-though they were born? But why just belly buttons? Why stop there? Why not create "today" just-as-though "yesterday" and all previous days existed? It would be God's little joke on us. To us, it would look like the world had a history when it really did not. We would never know. Silly questions? Yes, but why are they

silly? Are they silly because our faith, like Peter's, is based elsewhere?

In light of current discussion of space among scientists, physicists will be interested in the content of vacuous space as proposed by Bouw. A postscript written by Gordon Bane extends the illogical excursions of Bouw to a new height. He concludes that the universe is both relatively young and relatively small as compared to modern thinking.

Reviewed by George Blount, 2340 Highway 66, Ashland, OR 97520.

CREATION: A Witness to the Wonder of God by Mark D. Futato. Phillipsburg, NJ: P & R Publishing Company, 2000. 121 pages. Paperback; $8.99. ISBN: 0875522033.

Futato is professor of Old Testament at Reformed Theological Seminary in Orlando, Florida. He has written widely on creation and the natural world in biblical studies. This book was originally a series of sermons each transformed into a chapter for the book. In the preface, the author states that one of his deep passions in life is experiencing God in his creation. Futato shares this passion with the reader by way of a biblically based presentation of several important attributes of God which are evident from creation.

Each of the six chapters is devoted to a particular attribute of God. Attributes included are the glory, power, wisdom, love, justice, and faithfulness of God. Each attribute is explained and illustrated from a variety of biblical texts, many of which are taken from the Old Testament. Besides describing and illustrating each attribute, Futato explains how meditating on each attribute can have an impact on the personal lives of the readers. Each chapter concludes with the words from an appropriate hymn along with a series of questions for personal reflection or group discussion.

The book is easy to read and each chapter is clearly outlined with each major point being supported with passages from Scripture. The purpose of each chapter is twofold: (1) to provide evidence for each attribute of God from creation as revealed through the Bible, and (2) to challenge the believer to ponder how a clearer understanding of each attribute should impact one's own personal life.

This book can easily be used in an adult Sunday School class or small group Bible study. It also could be used as a supplementary text in a college level environmental science or biology course that is taught from a Christian perspective. Pastors who desire to preach on the subject of creation as a witness to the wonder of God will find this book very useful. It can also be used by individuals during their own personal devotions. While this book will not answer all of the questions that one might raise regarding the extent to which the attributes of God are revealed through the natural world, it does provide a biblical basis for group discussion and personal reflection. Its primary goal is to encourage Christians to get to know God better by acknowledging and experiencing the wonder of God in creation. This goal is summarized in the preface of the book where the author quotes the following line from a familiar hymn: "In the rustling grass I hear him pass, he speaks to me everywhere."

Reviewed by J. David Holland, Biology Instructor, Springfield College in Illinois, Springfield, IL 62702.

SCIENCE & CHRISTIANITY: Four Views by Richard F. Carlson, ed. Downers Grove, IL: InterVarsity Press, 2000. 276 pages, notes, index, bibliography. Paperback; $15.99. ISBN: 0830822623.

As a professor with forty years of experience in nuclear physics, Carlson has met many students who suspected that their scientific world view precluded the possibility of believing in the Bible. In large measure, this book is addressed to those young scientists who are questioning the reasonableness of faith. Carlson is effectively saying, "Look, here are at least four points of view that show how a thinking person can be both a committed Christian and a good scientist." The many readers of this journal who have already discovered that faith and science are compatible will also profit from this insightful dialogue regarding the relationship between science and Christianity.

Carlson has recruited five contributors to articulate four contrasting views: creationism, independence, qualified agreement, and partnership. Each contributor devotes a chapter to a particular view of the relationship between science and Christianity, and each chapter is followed by the responses of the other authors. This debate-like format creates dialogue among the contributors, which is an essential strength of the book.

The first essay, "creationism," is written by Wayne Frair, a biologist and past president of the Creation Research Society, and Gary Patterson, a professor of physical chemistry. Their essay has surprisingly little to say about creation science. Rather than argue in favor of either a young-earth or old-earth theory of creation, they focus on the lack of scientific evidence capable of explaining the origin of life. They shape their exposition as a call for "sound exegesis" based on "biblical inerrancy," and conclude merely that scientists should be informed by the Bible. The problem is they never adequately define "inerrancy," nor do they demonstrate just how sound exegesis of the Bible informs science. They do, however, make a compelling case that theology and science are overlapping disciplines in pursuit of common truths.

Jean Pond, another biologist and professor, takes the opposite view in arguing for "independence." Pond essentially repeats Stephen Jay Gould's principle of "nonoverlapping magisteria" or "NOMA," which he elaborated in his 1999 book, *Rocks of Ages* (reviewed in *PSCF* 52, no. 1 [March 2000]: 60–1). According to this view, science and faith avoid conflict because they deal with completely

separate issues and really have nothing to say to each other.

Stephen Meyer has written several books and articles in support of intelligent design as the most reasonable inference to be drawn from the natural sciences. He summarizes his arguments here in a well-reasoned case for "the God hypothesis," which illustrates how "qualified agreement" can be seen in the relationship between Christianity and science.

Howard Van Till, a professor of physics and astronomy, reflects on the "partnership" between Christianity and science, a topic he has repeatedly addressed since the publication of his 1986 book, *The Fourth Day.* Van Till traces his idea of the "robust formational economy" of the cosmos back to Augustine's idea of creative potential of the cosmos. Van Till's concept parallels the Calvinist theme known as *concursus,* which says that God and human nature work in tandem. Van Till seems to be applying the concept of concursus to the creation by saying both God and nature work in tandem in bringing about the evolution of life and cosmos. Ironically, Van Till's position seems most closely aligned with Pond's view of independence. This raises the question whether Van Till is justifying his view of partnership upon the premise that science and faith reside in non-intersecting semantic planes.

Each essay is a thoughtful and passionate exposition of a personal faith within a scientific world view. The result is a highly readable personal dialogue, not a rigorous academic treatment of the metaphysics of science and theology. For the latter, one would do better to turn to recent works by Barbour, Polkinghorne, Peacocke, and Van Huyssteen.

These four essays demonstrate that Christians can share a commitment to biblical faith without agreeing on the metaphysical relationship between theology and science. Indeed, Pond hits close to home when she wryly observes: "The unifying element of a Christian interpretation of the Bible is that Christians will not agree on how to interpret the Bible."

In his introduction, Carlson sums up the debate by astutely suggesting that if there is any one key issue in the debate, it is "How does a faithful Christian read the Bible?" It comes as a disappointment then that none of the authors dig deeply into this issue. Rather, they each tend to put forward the conclusions they have drawn based on the way they interpret the Bible, leaving Carlson to sketch the basic principles of biblical exegesis in his postscript.

In topics such as this, which deal with the meaning of existence, it is all too easy for proponents of differing views to speak past one another without truly engaging each other. This book is a valuable attempt to mitigate that difficulty by creating a dialogue in print. The authors here respond to each other with gentle but incisive arguments. Even so, they frequently tend to speak past one another. The most valuable criticisms they offer stem not from argumentation, but rather from the questions they sincerely put to one another. Carlson, as editor, has the benefit of speaking last in his thoughtful postscript, and he directs pointed questions to each of the contributors. These closing questions not only challenge the five contributors to go deeper in their thinking, but also challenge the reader to go further in the healthy exercise of leading an examined life by reflecting on one's world view. In this sense, the book and the questions it provokes are good for our health.

Reviewed by Bruce Baker, Medina, WA 98039.

CAN ARCHAEOLOGY PROVE THE NEW TESTAMENT? by Ralph O. Muncaster. Eugene, OR: Harvest House Publishers, 2000. 48 pages. Paperback; $3.99. ISBN: 0736903674.

This book is a companion to a similar title *Can Archaeology Prove the Old Testament?* by the same author. Both are short, compact books—just right, if you are looking for a concise summary of archaeology finds as they relate to the Bible. The present book cites twenty books in the bibliography to point you to further research. Nearly all the books are secondary sources published by Christian presses.

The seventeen divisions in the book average three pages in length, an indication of its succinctness. The first half of the book is introductory; the second half contains archaeological evidence relating to the New Testament. This evidence involves substantiating the geographical, political, and appellation accuracy of New Testament references.

The contents of this book are aimed at verifying the accuracy of many New Testament references. Its ultimate goal is to ignite curiosity among seekers, persuade skeptics, and strengthen the faith of believers. The author is a professor at Vanguard University in Southern California. Formerly a skeptic of the Bible, he is the founder of Strong Basis to Believe, a ministry intended to help people who have doubts.

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

GOD, SCIENCE, & HUMILITY: Ten Scientists Consider Humility Theology by Robert L. Herrmann, ed. Radnor, PA: Templeton Foundation Press, 2000. 314 pages. Paperback; $19.95. ISBN: 189015143.

Sir John Templeton has inspired another collection of essays written by several scientists active in the science and religion dialogue. These writers were asked to look at their particular field of science or medicine through the lens of humility theology, a concept important to Templeton and described in the first essay by Russell Stannard:

> It takes as its starting point, not the Bible, but our experiences of the world and of life—the same basis as that adopted by science. It asks whether these show evidence for the existence of God, and if so, what type of God. It asks: does the totality of our experience make better sense in the light of the God hypothesis or not? Like the pursuit of science, this type of theology is humble in the sense that it is prepared to adapt its understanding of God to whatever the evidence indicates. As the total fund of knowledge and experience grows, so one's conception of God is expected to develop and become ever more refined. Like science, humility theology is progressive.

Humility theology might be characterized as an attitude and an approach. It is nonfoundational and emphasizes the parallels between science and theology when both take a critically realist and nondogmatic stance toward human knowledge of the world and of God. It prizes a humility before the profound mysteries of both God and the creation that combines awe with an open-minded search for knowledge and understanding. It looks for God in nature without seeking data to construct design arguments. Humility theology joins science to this search without subordinating or co-opting it.

These ten writers take the reader through some informative forays into recent research. Following a Foreward by Templeton on humility theology, Stannard looks at theology as a science; Robert Russell considers what contemporary cosmology may tell us about faith in God; Charles Harper and Owen Gingerich each reflect on the search for extraterrestrial intelligent life and its theological implications for human self-understanding; Francisco Ayala considers human self-understanding in the light of the remarkable discoveries in brain-mind studies; David Myers explores the psychology of humility; Giuseppe Del Re reflects on the contributions of chemistry to our understanding of emergence and complexity in nature; Herbert Benson and Patricia Myers, and David and Susan Larson, in separate papers chronicle studies of the positive effects of spirituality and religious commitment on physical and mental health; and Frazer Watts considers the implications of artificial intelligence research and theory on the theological understanding of mind and soul. In an epilogue, editor Robert Herrmann reflects on their contributions.

Rather than trying to summarize each paper, let me make a generalization or two. Most are informative surveys packed with a lot of interesting information, especially about the psycho-physical-spiritual dimensions of human life. For example, the papers by Benson and Patricia Myers as well as the one by Larson not only convincingly illustrate the value of religious belief in promoting recovery from illness but also challenge health professionals to take their patients' beliefs more seriously and enlist them in healing. I particularly enjoyed Del Re's essay, *The Case of Chemistry*, which gave me a deeper appreciation for the value of chemical theory and research for understanding the origin and emergence of life.

But I would judge that the case for humility theology itself is less well made. Few of the essays succeed in developing this concept as it applies to their scientific discipline, or in distinguishing it from a stance of humility any scientist should adopt when studying nature. Implied throughout but not well articulated is the message that theologians must show a humility before the astonishing discoveries of modern science and a willingness to alter their visions of God, humanity, and nature in their light. Perhaps this reflects the novelty of this theology: all are grappling with a concept in the early stages of its development. I welcome this initial foray into a new theological approach. Its *kerygma*, a call to humility in both enterprises, could serve each well, and further work in this theology is to be encouraged. But it must also find a way to maintain the integrity of each approach, the theological and scientific, to avoid the conflation of belief and science that has been criticized in both metaphysical reductionism and creationism, the danger here being the collapse of theology into science.

Reviewed by Robert J. Schneider, Distinguished Professor of General Studies, Berea College, Berea, KY 40404.

History of Science

SCIENCE, RACE, AND RELIGION IN THE AMERICAN SOUTH by Lester D. Stephens. Chapel Hill, NC: The University of North Carolina Press, 2000. 338 pages, notes, bibliography, index. Hardcover; $39.95. ISBN: 0807825182.

The subtitle of this extraordinary volume is "John Bachman and the Charleston Circle of Naturalists, 1815–1895." Five other scientists of note—Edmund Ravenel, John Holbrook, Lewis Gibbes, Francis Holmes and John McCrady—play their parts, and Audubon and Agassiz have cameo roles, but it is Bachman, a Lutheran clergyman, and by 1830, an international authority on North American mammals, who is the central figure.

However, the book is really not about Bachman at all—but about the practice of science in a culture very foreign to us. Three themes—biography, culture, and science—are interwoven seamlessly by Stephens, an emeritus professor of history at the University of Georgia, who shows his mastery of history, science, and the art of excellent writing on every page, making the book difficult to put down.

The first three chapters introduce us to the remarkable naturalist, John Bachman, sketching his developing interests in mammalogy as well as his personal life very briefly. Chapters four through eight do the same, in less detail, for his five colleagues. Bachman reenters the story in chapters nine and ten, as he argues for the essential unity of all humankind, based primarily on the scientific knowledge of the day. Even with this argument, he was captive to his culture, holding the slavery of black people

as an acceptable, even good, practice. The book describes the arguments in detail, particularly as they conflicted with those of Agassiz and others, who advocated polygenism (the separate origin, and therefore the separate species, of black persons).

Chapter eleven describes the effects the Civil War had on the six scientists and the devastating impact it had on Southern science. Chapter twelve ends the book by returning to one of the secondary figures, John McCrady, as the circle of six pass from the scene. McCrady's futile attempts to find alternatives to Darwin's thesis provide insight, I believe, into how Southern culture played a key role in delaying the recovery of science in the region.

What, then, is this book really about? Not about the six naturalists; the biographies are far too short. Not about the culture of the South; too much is missing. It is, primarily, about scientific argumentation. The debate between polygenism and monogenism was intense, complete with ad hominems, name calling, disparaging comments, and faulty reasoning—with Bachman, according to the author, holding the high ground. It reminds me of current debates about origins. Most scientists who embrace one or the other position do so, interestingly enough, on scientific, not religious grounds. In these debates, both sides, reflecting their culture, held that black persons were still considered inferior. It is interesting to read Stephens' accounts of how the subject of cross-race mating was addressed, although this issue is tangential to the book's theme and gets relatively little attention.

As the book's central figure, Bachman emerges as the "hero," with Audubon, Agassiz, and McCrady receiving considerable criticism. It is worth pointing out that William Stanton, in his 1960 book, *The Leopard's Spots*, is much less convinced that Bachman should be so praised, calling him "half theologian, half scientist." Stephens' claim is, of course, that Bachman was wholly both.

From the perspective of over a century of scientific progress, the arguments depicted in this book seem strangely quaint. They are based, it is apparent, on woefully insufficient data. Perhaps some of the arguments of today will seem similar to our great grandchildren. I suspect that will be the case.

In Acts 17:26, the apostle Paul is recorded as preaching to those on Mars Hill that God had made every nation of humanity from one man. I believe that because Scripture asserts it; I find that the science of today confirms it. It is for that reason that, when the census taker came to my door in April 2000, I answered "human" to the question "What race do you perceive yourself to be?" It was the only honest answer I could give. I highly recommend this book to my ASA colleagues, and to others, looking forward to stirring conversations with John Bachman and his colleagues in the life to come.

Reviewed by John W. Burgeson, Stephen Minister, First Presbyterian Church, Durango, CO 81301.

THE QUOTABLE SCIENTISTS by Leslie Alan Horvitz, ed. New York: McGraw-Hill, 2000. 169 pages. Hardcover; $14.95. ISBN: 00713660638.

This is an informative and entertaining book, one you can read with pleasure in small increments. It contains quotes "straight from the lips of the greatest minds in human history" (jacket quote). The editor is a New Yorker who has written several books, among them *Frontiers of Science*. He frequently writes articles for the *Science Times* and the *Washington Times*.

The quotes are divided into forty-six categories, albeit not in alphabetical order. The basis for the arrangement is not apparent, but the table of contents assists in finding each topic. A helpful addition would have been an author index. The introduction sets the stage by explaining why this book was compiled.

Some of the obvious topics include scientists, nature, evolution, and biology. Less obvious, perhaps, are taxonomy, ornithology, entomology, and unsolved mysteries. Quotes from Albert Einstein, Stephen Jay Gould, William James, Stephen Hawking, and Louis Pasteur might be expected. Less so are quotes from Michael Fox, Goethe, Tom Robbins, C. P. Snow, and the biblical book of Ecclesiastes.

One of the topics omitted is "religion" although quotes on "creation" are included. Topics touching somewhat on the metaphysical include "purpose of creation," "science and necessity," "risks and limitations of science," and "cosmology."

Some quotes will amuse. For instance, Charles Darwin's father told him: "You care for nothing but shooting, dogs, and rat-catching, and you will be a disgrace to yourself and all your family." Or how about Charles Townes' paradoxical comment: "Most of my successes have come out of failures." Finally, L. L. Whyte commented: "The mythic believes in an unknown God, the thinker and scientist in an unknown order; it is hard to say which surpasses the other in nonrational devotion."

The editor notes in the "introduction" that the majority of scientists are not quotable. He points out that scientists seem to go out of their way to write impenetrable prose. They choose jargon and circumlocutions instead of lucidity. He offers several quotes from scientists who can write bemoaning that fact that their colleagues cannot. Stephen J. Gould, the famous Harvard professor who has written many books, says, "I don't think academic writing ever was wonderful." Happily, not all scientists are inept writers. Many have an excellent command of the language which allows them to explain difficult concepts in clear prose. They also can compress a big-sized, eureka thought into a small sentence. Fortunately, Horvitz has included many of them in this volume, which I highly recommend.

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

THEISM AND HUMANISM: The Book that Influenced C. S. Lewis by Arthur J. Balfour. Michael W. Perry, ed. Seattle, WA: Inkling Books, 2000. 159 pages, appendices, notes, glossary, index. Paperback; $14.95. ISBN: 1587420058.

Balfour was a late nineteenth-century British politician who became Prime Minister, wrote the Balfour Declaration which set the stage for the formation of the state of Israel, and campaigned all his life against the naturalistic philosophy of Huxley. In addition to this short book, Balfour also wrote *Foundations of Belief.*

In 1914 Balfour was selected as the Gifford lecturer. *Theism and Humanism* was the text of these lectures as recalled by Balfour a year later. Gifford lectures were funded by the trust of Lord Gifford for the purpose of propounding Natural Religion, that is, what can be learned of God from nature.

Balfour's thesis is that a thorough study of the natural world leads more reasonably to a belief in theism than to a belief in naturalism. He includes in his study not only the argument of design, but also arguments from aesthetics, ethics, human intelligence, and the assumption of uniformity upon which all scientific endeavor is based.

The emphasis of this book is quite a change from much that has been written recently regarding the evolution-creation controversy. Balfour had no need to debunk the discoveries of Darwin. Balfour's faith was firmly rooted in the absurdity of natural selection as the only mechanism by which the world as we know it came to be. He accepts that science is quite capable of studying nature and drawing reasonable conclusions regarding its laws. It is when science tries to be a world view that Balfour believes it has gone too far. To prove his case, he challenges atheists and agnostics to explain such questions as these: How does natural selection explain human values? What is the survival value of great art or of the abstract philosophies that fascinate the human intellect?

Imagine reading the words of someone who actually studied under John Stuart Mills. This was my first experience of reading nonfiction of a century ago and I found it difficult going in places. However, it was also very illuminating.

In his 1944 paper, "Is Theology Poetry," C. S. Lewis wrote that *Theism and Humanism* was "a book too little read." Nearly twenty years later, in a 1962 letter to the magazine *Christian Century,* C. S. Lewis numbered *Theism and Humanism* among the ten books that had most shaped his philosophy of life. It is the editor's hope that the re-publication of this little book will transform it into one that is very much read and appreciated. I share this hope and recommend *Theism and Humanism* to the ASA membership.

Reviewed by Elizabeth M. Hairfield, Professor of Chemistry, Mary Baldwin College, Staunton, VA 24401.

THE SCOPES TRIAL: A Photographic History. Introduction by Edward Caudill, photos by Edward Larson, afterword by Jesse Fox Mayshark. Knoxville, TN: The University of Tennessee Press, 2000. 88 pages. Hardcover; $45.00. ISBN: 1572330805. Paperback; $18.95. ISBN: 1572330813.

The Scopes trail of 1925 was "one of the greatest trials of the twentieth century" and a defining event in shaping the debate over science and religion in this nation. In the tiny hamlet of Dayton, Tennessee, a young school teacher, John Thomas Scopes, became the centerpiece for a move designed partly as a publicity scheme and partly as a test of a newly enacted anti-evolution law. Scopes agreed to be arrested for teaching Darwin's theory of natural selection in the public schools.

The antagonist, the brilliant trial lawyer Clarence Darrow, was pitted against three-time presidential candidate and fundamentalist Christian, William Jennings Bryan. For twelve days, the controversy held the nation's attention and branded Tennessee for years to come as "a backwater of anti-intellectualism and Bible-thumping education-haters." The controversy stemmed from the Butler Act that declared that no book should be adopted to teach Darwinism; Genesis should be taught. The debate brought to a head some topics resulting from the conflict between science and the Bible: the limits of individual freedom, the authority of science, the basis for government, the truth of the Bible, and the teaching of controversial theories, especially one that "threatened a child's faith."

With these issues at the forefront, the Scopes Trial became what some people called "the most famous *nonfelony* trial of the twentieth-century" and others deemed an unabashed ruse instigated to establish a faltering state economy. Legally, the trial was inconsequential. Symbolically, as annotated by Caudill, it defined the science-religion debate for the modern times.

The Scopes Trial: A Photographic History is a triad of elements smartly compartmentalized to tell this intriguing story. Larson's captioned photographs alone effectively convey this captivating legal tale. The Scopes Trial has had a long-lived effect not only on Tennessee but also on the nation's education system as a whole. *The Scopes Trial* is an ideal single source on this notorious subject.

Reviewed by Dominic J. Caraccilo, Lieutenant Colonel, US Army, 1212 Whisperwood Drive, Columbus, GA 31907.

SCIENCE SAYS: A Collection of Quotations on the History, Meaning, and Practice of Science by Rob Kaplan, ed. New York: W. H. Freeman and Company Publishers, 2000. 254 pages. Hardcover; $19.95. ISBN: 0716741121.

This book is full of wit, wisdom, and wonder. Wit: "Stand firm in your refusal to remain conscious during algebra. In real life, I assure you, there is no such thing as

algebra" (Fran Lebowitz). Wisdom: "Enough research will tend to support your theory" (Murphy's Law of Research). Wonder: "The means by which we live have outdistanced the ends for which we live. Our scientific power has outrun our spiritual power. We have guided missiles and misguided men" (Martin Luther King, Jr.).

I love quotes. They distill into a few words the essence of a complex thought. They provide wonderful stimulation to the mind. They entertain with their novel way of looking at and expressing ideas. They have the potential not only to inform but also to inspire. They provide fodder for conversation and lectures. They point to pragmatic truth for professional scientists. They give us an insight into the operation of the quoter's mind.

This is the third book of scientific quotations I have recently reviewed. Why this genre has become so popular recently, I do not know. This is especially puzzling since scientists as a group are not known for being especially quotable. Of course, there are exceptions. Anyone reading the quotes in this volume will detect that not all the persons quoted are scientists. Sometimes good observations on science come from comedic sources: "There is something fascinating about science. One gets such wholesale returns of conjecture out of such trifling investment of fact" (Mark Twain).

This book contains many brief quotes, but also includes some longer passages. Some quotes are just a few words: "Science is a cemetery of dead ideas" (Miguel de Unamuno); none are longer than a paragraph. The quotes are organized thematically into fourteen chapters. An author index is included. "Science, Spirit, and Religion" and "Good and Evil, Life and Death" are topics of possible interest to readers of this journal. The editor has twenty-five years experience in book publishing. He heads his own literary firm and is the co-editor of *A Passion for Books*.

For the scientist and nonscientist, *Science Says* will amuse, amaze, beguile, console, inspire, and motivate. It will provide an invaluable resource for friendly or adversarial conversation, for informative or combative talks. I highly recommend it.

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

EVOLUTION, SCRIPTURE, AND SCIENCE: Selected Writings by Benjamin Breckinridge Warfield. Mark A. Noll and David N. Livingstone, eds. Grand Rapids, MI: Baker Books, 2000. 331 pages, bibliography, index. Paperback; $23.99. ISBN: 0801022177.

Veteran intellectual historian Mark Noll and geographer David Livingstone have gifted us with a very useful and interesting collection of Warfield's writings on the relationship of science and Christianity, paying special attention to his views on Darwin and evolution. This is a companion to their 1994 volume of Charles Hodge's writings on science and religion, also published by Baker Books.

Benjamin Breckinridge Warfield (1851–1921) was a leading Presbyterian scholar and prolific theologian who spent almost his entire career at Princeton Theological Seminary (1887–1921). He was an ardent defender of confessional Calvinism and is perhaps most often remembered as an advocate of the doctrine of the inerrancy of the Bible. But throughout his professional life, he was also intensely interested in the relationship of science and religion. Noll and Livingstone suggest that this longstanding interest originated from his father's cattle-breeding activities in Kentucky. Warfield's firsthand knowledge of the modification of species over time gave him a unique perspective for an American theologian.

Today biblical inerrancy is most often associated with the creationist approach to origins. Noll and Livingstone remind readers that this very conservative theologian was also an evolutionist—of sorts. Of course, he was staunchly opposed to using evolution as a basis for a scientifically materialistic philosophy of life and rejected any naturalistic reductionism that would banish the supernatural from serious consideration. But Warfield was guardedly open to the possibility that evolutionary mechanisms were operative.

A great virtue of this volume is that the editors point out that Warfield was very much interested in preserving "methodological pluralism." Crucial in this was his notion of *concursus*, originally developed in his inerrancy argument. His high view of verbal inspiration of Scripture did not rule out the "full, active participation of the human authors" of the sacred texts. Warfield argued against a mechanical view of divine dictation and in favor of the concursus of divine and human activity such that the Scriptures are "at once divine and human in every part, every word, and every particular." Warfield adopted a similar position regarding divine and natural action. Evolution, according to this line of thinking, could serve an important though limited explanatory role, but never at the expense of notions of divine providence. Warfield's idea of concursus allowed him to accept—particularly in the two last decades of his life—that some evolutionary explanations were accurate mechanistic accounts of phenomena which also required teleological explanations. Or put more simply: Divine design could be located "in the orderly and regulative laws of nature."

Warfield was deeply concerned that the relationship between science and Christianity not degenerate into one of mutual hostility. Consequently, his 1888 essay entitled "Charles Darwin's Religious Life" was most instructive. Warfield portrayed Darwin's spiritual pilgrimage with great sensitivity, and yet it was a portrait of an unnecessary tragedy. Darwin adopted a literal reading of Genesis which he used to bifurcate God's role in nature into two extreme and inevitably incompatible alternatives: either God tinkered with every detail, or he was entirely absent. Lost was the via media position that "views God as work-

ing in, with, and through the natural processes of the physical world."

One obvious fact that confronts the contemporary reader of Warfield's writings on science and Christianity is the conceit of those who take a purely presentistic approach to such matters today. Noll and Livingstone help us to see that Warfield not only anticipated many of the contours of the present science and religion dialogue, he also frequently demonstrated the value of exploring mediating positions that take both science and Christian faith seriously.

Reviewed by Donald A. Yerxa, Professor of History, Eastern Nazarene College, Quincy, MA 02170; Assistant Director, The Historical Society, Boston, MA 02215.

Natural Sciences

SPEAKING OF SCIENCE: Notable Quotes on Science, Engineering, and the Environment by Jon Fripp, Michael Fripp, and Deborah Fripp, eds. Eagle Rock, VA: LLH Technology Publishing, 2000. 241 pages. Paperback; $14.95. ISBN: 1878707515.

The subtitle of this book pretty well summarizes its contents. The editors have gathered pithy quotes from some strange (Al Gore, Homer Simpson, Bugs Bunny) and not so strange (Albert Einstein, Carl Sagan, Blaise Pascal) sources. Contained in the book are quotes from speakers spanning 4,000 years from 2000 B.C.E. to 2000 C.E. The quotes range from the hilarious to the insightful. The hilarious: "I know that this defies the law of gravity, but you see, I never studied law" (Bugs Bunny). The insightful: "Almost anyone can do science; almost no one can do good science" (L. I. Larison Cudmore).

The editors initially collected, used, and shared quotes. When their collection increased in size and popularity, they decided to publish it. The compilers include brothers and Michael's wife, all three of whom are scientists and engineers. The editors introduce the collection with two quotes celebrating quotes: Sophocles (496–406 B.C.E.) said that a quote is "a proverb, a short saying that oft contains much wisdom"; Benjamin Disraeli (British Prime Minister) said: "the wisdom of the wise and the experience of the ages are perpetuated by quotations."

The quotes are grouped into seven chapters or categories: science, mathematics, engineering, man and the environment, nature, teaching science, and the working environment. Each chapter has numerous sub-groupings. Included at the end of the book is a reference section, biographies of those quoted, and an author index. Cartoons and images of money featuring scientists illustrate some quotes.

Who are potential readers? Scientists, engineers, environmentalists, policy makers, project managers, technical public relations personnel, and teachers and students. That pretty well includes everybody. The foreword indicates that this is the first edition and implies the editors anticipate brisk sales. I hope they are right!

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

THE BOOK OF THE COSMOS: Imagining the Universe from Heraclitus to Hawking by Dennis Richard Danielson, ed. Cambridge, MA: Perseus Publishing, 2000. 556 pages, index. Hardcover; $35.00. ISBN: 0738202479.

The physical universe itself, as progressively comprehended by human beings, has prompted some of the deepest emotions and thoughts ever put on paper. Danielson, professor of English at the University of British Columbia (UBC), has assembled a wealth of quality writing—from ancient to modern—in the course of teaching honors and graduate courses on the literature of cosmology at UBC. Now to the delight of all readers, he has placed a carefully edited set of readings drawn from diverse centuries, continents, and world views in the hands of a wider audience. Greek, Hebrew, and Christian texts are skillfully woven together in the first part of the book including selections from the Old and New Testaments, Apocrypha, Heraclitus, Parmenides, Empedocles, Anaxagoras, Aristotle, Eratosthenes, and Plutarch.

The next section follows a storyline from Ptolemy to Cardinal Nicholas Cusanus who envisions an infinite universe with no center and a moving earth. "Copernicus to Newton," the third part of the collection sweeps us through both original writings by Kepler, Calvin, Brahe, Bruno, Copernicus, Galileo, Descartes, Milton, Pascal, Huygens, and Newton as well as commentary by modern authors on the views and visions expressed by these ancient sages. Part Four unfurls Newton's universe with selections drawn from ancients and moderns including William Derham, Leibniz, Halley, Cotton Mather, Kant, Herschel, Laplace, Paley, Olbers, Humboldt, Edgar Allan Poe, Maria Mitchell, and William Huggins.

The fifth part of this wonderful anthology moves us into the visionary hysteria of Percival Lowell, the cosmological speculations of Darwin, G. K. Chesteron's musings on what might-not-have-been, and the beauty and mathematical magnificence of the heavens as expounded by astronomers, physicists and writers such as Einstein, Feynman, John Wheeler, Cecilia Payne-Gaposchkin, George Bernard Shaw, Hubble, Eddington, and Hoyle. The grand finale features profound philosophical speculations about cosmic scales, magnitudes, mysteries, and meanings from the gifted pens of a diverse set of writers including Werner Gitt, Arthur C. Clarke, James Lovelock, Steven Weinberg, John Barrow, Frank Tipler, Stephen Hawking, Kitty Ferguson, Martin Rees, Alan Guth, Vera Rubin, Freeman Dyson, and Paul Davies. Interestingly, Danielson gives a Christian the last word as Owen Gingerich provides a previously unpublished sermon he delivered in 1993 at Cornell University's campus chapel, "Do the Heavens Declare?"

A very strong collection of writings, carefully chosen and brilliantly edited is enhanced yet further by delightful commentary that the author intersperses throughout the entries. Clear notations enable a reader to find the full texts of every article or book excerpted and a glossary defines terms that may be unfamiliar to readers. An excellent index permits the reader to follow a particular theme or topic of interest across the volume, in effect, creating his or her own anthology. The author also recommends other edited collections of primary and secondary material in astronomy. His collection is quite diverse in its geographic and philosophical representation. It combines both literary and scientific writers, and provides a well-chosen collection of the writings of female astronomers within the group. This is a superb book and highly recommended for personal reading and for every library. Readers will highlight their favorite quotations, share them with others, and find many uses for the deep thoughts so nicely packaged in this collection.

Reviewed by Dennis W. Cheek, Director, Office of Research, High School Reform & Adult Education, RI Department of Education and Research Professor of Education, University of RI, 255 Westminster Street, Providence, RI 02903-3414.

LUCIFER'S LEGACY: The Meaning of Assymmetry by Frank Close. New York: Oxford University Press, 2000. 259 pages. Photographs, illustrations, index. Hardcover; $27.50. ISBN: 1572330813.

In this book, Close, a particle physicist and currently a professor at the University of Birmingham, UK, offers an appreciation of symmetry and its profoundness in natural philosophy. He looks at symmetry and the deep structures of the universe and questions whether a single act that took place at the origin of our universe is responsible for the asymmetric derivations existing today.

Recently Close was at CERN (an international research organization based in Geneva, Switzerland) where scientists are now preparing to uncover the asymmetries at the heart of the Big Bang. While at CERN, his studies suggested that life is the result of cosmic asymmetry. Close's book explores matter and antimatter, positive and negative charge, and exposes common shibboleths to the truths surrounding them.

Recent scientific studies have made it clear that the true understanding of our universe will come only from identifying and understanding the asymmetries that surround us. One example that Close uses is the moderately well-known teaser which questions the use of mirrors to query why reflections are reverse left and right but not top and bottom. To the contrary, *Lucifer's Legacy* is not all "smoke and mirrors" for it provides an intriguing study of seemingly simple ideas by uncovering the underlying uniformity of a great-unsolved mystery.

Not only cosmic life but also our own everyday variety is full of other examples of asymmetry, from the human body to the molecules of life. *Lucifer's Legacy* explores the origins of asymmetry on the molecular level to the universe at large. Intriguingly inspired by a chance encounter with a statue of Lucifer in the Tuilleries Gardens in Paris, Close takes the reader on an interesting tour of asymmetry in the world around us, from the development of human embryos to the mysterious Higgs boson.

Reviewed by Dominic J. Caraccilo, Lieutenant Colonel, U.S. Army, 1212 Whisperwood Dr., Columbus, GA 31907.

THE STAR OF BETHLEHEM: An Astronomer's View by Mark Kidger. Princeton, NJ: Princeton University, 1999. 306 + xii pages with index. Hardcover; $22.95. ISBN: 0691958237.

Identification of the star seen by the magi in Matthew 2 has long been a popular topic. Planetariums often have programs about "the Christmas star," and some discussion of the topic can attract interest in a church's education program. Knowledge of the Bible, history, and astronomy is needed for an adequate treatment. The author of this book, a researcher at the Instituto de Astrofisica de Canarias in Tenerife, concentrates on providing an up-to-date account of astronomical knowledge relevant to the subject.

In the course of his discussion, Kidger gives interesting accounts of a number of astronomical phenomena: comets, meteors, novae and supernovae, planetary conjunctions, and occultations. Many scientists may be aware that there are important astronomical records from ancient China, Korea, and Japan, but probably will not have studied the matter in any detail. Chapter 9 is a helpful introduction to this topic.

One questionable assumption that Kidger makes is that the magi, whom he thinks were probably from Babylonia territory, were part of a long-established project of looking for astrological signs of the birth of a king of the Jews. This leads him to argue that the "star" must have been a rare event, for otherwise the predecessors of the magi would have come to Jerusalem long before the birth of Jesus. But even if one holds that there was a single well-defined messianic expectation in Israel a thousand years before Christ's birth, and even if (as is plausible) the Babylonians learned of this, there is simply no reason to think that the magi would have attached great attention to this belief and made it part of a centuries-long program of observation and interpretation.

Kidger's conclusions are, nevertheless, reasonable and offered in an appropriately tentative spirit. He thinks it likely that the magi noted a number of signs in the heavens, some of which have been discussed individually in connection with the Star of Bethlehem by other writers. The triple conjunction of Saturn and Jupiter in 7 B.C., a massing of those planets with Mars in the next year, and pairings of Jupiter with the moon and Saturn with Mars in the next year all occurred in Pisces, a constellation associated with the Jews. These events might have alerted the magi to the imminent birth of a king of the Jews. The final

sign, which actually started them on their journey then could have been the nova seen by Chinese astronomers in 5 B.C. DO Aquilae is the star, which, the author suggests, can most plausibly be identified with the Star of Bethlehem.

I do not think, as I have said, that the star would have had to be as rare an event or combination of events as Kidger believes. Both the triple conjunction and the nova by themselves, for example, are legitimate candidates. With that qualification, however, Kidger does a very good job of setting out the astronomical data relevant to the problem. Anyone interested in "the Epiphany star" (to give it a more precise name) will find his book a very useful resource.

Reviewed by George L. Murphy, St. Paul's Episcopal Church, Akron, OH 44313.

HERE BE DRAGONS: The Scientific Quest for Extraterrestrial Life by David Koerner and Simon LeVay. New York: Oxford University Press, 2000. 264 pages, notes, color plates, index. Hardcover; $27.50. ISBN: 0195128524.

Written jointly by an astronomer and a biologist, *Here Be Dragons* is a comprehensive overview of the scientific quest for life and intelligence in outer space. The authors are Koerner, an assistant professor of astronomy at the University of Pennsylvania, and LeVay, an independent consultant and former associate professor at the Salk Institute for Biological Studies. They both write well and show their expertise in the respective fields in this book. The text is intertwined with astronomy and biology. One can easily tell who wrote which passages of the main text.

Specifically, the book covers such topics as the birth and evolution of the universe, origin and evolution of living organisms on Earth, conditions for sustaining life, probabilities of finding other planets with conditions suitable for sustaining life, past and present projects for searching for extraterrestrial life and intelligence, possible variations of the terrestrial type of life, and the potential existence of other universes. The last two topics should be interesting to those who love scientific speculations.

The book mentions creationism and intelligent design of the terrestrial life. However, in contrast to *Alone in the Universe* by David Wilkinson (reviewed in *PSCF* 50, no. 1 [March 1998]: 61-2), it does not offer any religious ramification to Christians when extraterrestrial intelligence is indeed found. Wilkinson, suggested that we openly welcome aliens with Christian love, an idea with which members of the American Scientific Affiliation would agree.

The color plates in *Here Be Dragons* are beautiful and illustrative. Unfortunately, a few of them are missing from the book. It is noteworthy that several references and notes are given in Internet addresses only. This "hi tech" referencing will handicap those readers who do not use the Internet. Finally, the title of the book, *Here Be Dragons*, does not appear to relate to the main theme of the book. Without its subtitle, what would one think is the subject of this book?

Reviewed by James Wing, 15107 Interlachen Drive, Unit 1014, Silver Spring, MD 20906.

SUPERSYMMETRY by Gordon Kane. Cambridge, MA: Perseus Books, 2000. xviii + 199 pages, index. Hardcover; $26.00. ISBN: 0738202037.

Kane is a physicist who has written a few books. All of the ones with which I am familiar are attempts to explain modern physics to a reasonably intelligent lay audience, or to physics students. I read one of them before, and it was quite good. *Supersymmetry* is an attempt to explain the topic of the title. There is no discussion of religious matters, other than some appropriate speculation about how things came to be the way they are.

Unfortunately, there are problems here. Either I am not interested enough in supersymmetry, or Kane does not do a good enough job of explaining it, or the topic itself is nearly incomprehensible, or more than one of these factors is true. Kane leads up to his subject in three chapters. In the process, he explains the Standard Model well, and is good in writing about the history of the development of his subject. Although String Theory is not the topic of the book, he is as lucid as anything I have read about that, also. He is also pretty good about making a case that lots of money should be spent on particle physics. Here is what he says about his topic:

> Supersymmetry is a surprising and subtle idea—the idea that the equations representing the laws of nature don't change if certain particles in the equations are interchanged with one another ... It turns out that the idea has remarkable consequences for explaining aspects of the world that the Standard Model cannot explain, particularly the Higgs physics. The most important implication may be that supersymmetry can provide a window that enables us to look at the entire world of string theory from our full-size world, so that experiment can provide guidance to help formulate string theory, and so that the predictions of string theory can be tested. Supersymmetry ushers in the second phase of the search for understanding ...
>
> If the world we live in does exhibit the property called supersymmetry, even though it has been hidden from our view until now, we will have a systematic way to peer at the most basic law(s) that govern nature and our universe. Without supersymmetry that may not be possible. Though there is considerable direct evidence that the world is indeed supersymmetric, this is not yet certain. It is worth a lot of effort to find out (pp. xvi-xvii).

That is about as clear an explanation as Kane can give. He does say more, of course. He writes about problems that a discovery of supersymmetry would solve, and how the ideas of supersymmetry are going to be tested.

A long time ago, there was a physicist named George Gamow. In his Mr. Tompkins books, his *Biography of Physics*, and in other writings for the public, Gamow made it easy for people who were living in a Newtonian paradigm to think that they understood Einstein, Bohr, Heisenberg and Schrödinger. His topics, weird as they seemed, were made comprehensible to the "average" interested reader. However, neither Gamow, nor anyone else, has been able to explain the weak force in such a way that I could adapt his explanation to explain it to my wife, or to a nonmajor physical science class. Kane has not done that for supersymmetry, either. Supersymmetry, like the weak force, may just be too far removed from the everyday world as we perceive it to admit of a clear ten-minute explanation. If so, this book is probably going to be about as good an explanation as we are going to get.

Reviewed by Martin LaBar, Professor of Science, Southern Wesleyan University, Central, SC 29630.

Origins & Cosmology

CAN RELIGIOUS BELIEVERS ACCEPT EVOLUTION? by John C. Caiazza. Huntington, NY: Troitsa Books, 2000. 134 pages. Hardcover; $34.00. ISBN: 1560726601.

The author's summary answer to the title question is, yes, as long as religious believers do not accept the anti-supernaturalistic philosophy that is often packaged with it. He calls this mechanistic philosophy "hyper-Darwinism." The author is identified only as "John C. Caiazza, Ph.D." with no credentials listed. Yet the book demonstrates that he has read from a variety of perspectives.

Caiazza explores various aspects, subtitling the book "25 Questions Answered Regarding the Conflict between Evolution and Revealed Religion." Among the twenty-five, he asks: "How many definitions of evolution are there?" He lists ten, ranging from accepting the ages implied by cosmological and geological data and the paradigm that all life is phylogenetically connected, to the evolutionary extrapolation that there is no God or that he is irrelevant. He also asks: "Isn't Evolution Just a Materialist Philosophy Meant as a Replacement for Religion?" He answers, no, but it is often promoted that way. He believes that "a certain minimalist theory of evolution which eschews metaphysics and hyper-Darwinism altogether may be possible."

"Is it possible to replace evolution with creationism or some other theory?" He thinks not. "Does evolution have anything to say about society and social ethics?" He answers: "Malcolm Muggeridge once accosted Edward O. Wilson, the best known promoter of sociobiology ... to ask him how sociobiology accounted for the sacrifices of Mother Theresa ... There is no obvious translation of palpably charitable acts into any actual form of survival, no matter how precisely conceived in terms of the preservation of one's genes. The precise point of being human is being able to transcend or choose among one's impulses, genetic and otherwise."

Much of the material in this book is familiar to regular readers of *Perspectives*, but it is sometimes rephrased in provocative new ways. It may be useful as an introduction to the subject for high school students or college freshmen, or as a resource for a term paper. Its targeted readership is similar to that of Robert Fischer's *God Did It, But How?* and on a less technical level, of Thaxton and Pearcey's *The Soul of Science*.

The two-page Selected Biography can be somewhat useful. References include Aristotle, Bergson, Darwin, Eiseley, Gould, Huxley, Kuhn, Chardin, and Edward Wilson. In addition there are religious viewpoints from Chesterton, Behe, D. James Kennedy, and Cardinal Newman. One weakness of the book is a lack of footnotes. There are some good quotations that I have not seen elsewhere; exploring them in context would be much easier if citations were given. I also wonder about a $34 price for a 134-page book.

The closing paragraph contains one of the better descriptions of theistic evolution:

> The religious believer, when looking over the past span of the history of the physical universe, of which organic evolution is a part, will be filled with that sense of wonder and awe that evolutionary writers like to refer to. However, they will proceed from there to look at the living God who is the creator and master-mind ... and perhaps update the analogy of God as the mathematician or geometer, to God as cosmic engineer, or heavenly computer programmer, or ultimate quantum observer. From Blake's portrait of the creator God using a pair of compasses to lay down the vast circumference of the universe, we have a new image; the creator God sits at a computer console typing in the "exec" file that will be used to create the universe, and which will call up all the vast assembly of sub-programs, including the algorithm that creates life-forms by means of evolution.

Reviewed by David Fisher, Editor of "Truth in the Test Tube," a Russian broadcast of Trans World Radio, Aurora, IL 60504.

SHOW ME GOD: What the Message from Space Is Telling Us about God by Fred Heeren. Wheeling, IL: Day Star Publications, 2000. 393 pages; index. Paperback; $14.95. ISBN: 1885849532.

This is a revised version of the first edition, which was published in 1995 and reviewed in *PCSF* (vol. 48, no. 1 [March 1996]: 56). The revisions include new scientific findings and additional interviews with scientists. The author of the book is a science writer who is composing a four-book series, of which this is the first volume. The title of the book and the photograph of Einstein on the cover conspire to give the appearance of somewhat sensationalist pseudoscience. However, this is one situation where you should not judge a book by its cover. This book is a tremendous resource for the Intelligent Design (ID) argu-

ment for God—the best of its kind that I have seen. It is readable and substantial at the same time. It is chock-full of interviews with world-class scientists (including Alan Guth, Robert Jastrow, Stephen Hawking, Robert Wilson, and several others). Although almost all of Heeren's interview subjects are atheists or agnostics, he uses their statements to support ID. The book is filled with references to scientific articles and books for those who want to dig deeper. There are also ninety-eight photographs of subjects ranging from planets and galaxies to portraits of famous scientists. In addition, the book is sprinkled with humorous conversations between the author and his imaginary book editor designed to bring the scientific discussion "down to earth."

The book is divided into four parts, which are further subdivided into twelve chapters. The first part deals with science's search for extraterrestrial life. Heeren discusses humanity's desperate desire to find extraterrestrial life, the scientific odds for and against its existence, and what its discovery or lack thereof might imply for theology. Heeren believes that the odds against the existence of extraterrestrial life are overwhelming, and that its discovery would only indicate that God created life on worlds other than Earth.

The second part of the book proposes that God is the best explanation for the existence of the universe. Heeren explores theories that indicate the universe is uncaused, including steady state cosmology, cyclic cosmology, and Stephen Hawking's proposal that time never had a beginning (even though there was a big bang). He concludes that the universe is an effect that must have been caused by something like the God of the Bible. Heeren also discusses the second law of thermodynamics and its implication for a beginning. He details many scientific evidences for the big bang theory and also discusses the history of its development, including scientists' initial opposition to it. He debunks young earth creationism (both scientifically and theologically) and explains its popularity in purely social and historical terms.

Part three delves into the ID argument. Heeren discusses nine evidences for fine-tuning in natural laws and cosmological characteristics that allow for the existence of the universe, the earth, and life. He shows that the large size of the universe and the immense time since creation are not wasteful but are necessary for the existence of life anywhere in the cosmos. Heeren discusses various forms of the anthropic principle, which are attempts to exclude God from the fine-tuning that we see in the universe. The last part of the book presents the Gospel as a logical conclusion to the preceding chapters. Heeren also shows how many of the biblical heroes of faith started out as great skeptics.

The book concludes with some "bonus sections," the first of which is a humorous, but poignant, short story about the search for extraterrestrial life. The story is aimed at those who claim that they would believe in God if only he gave them a clear and indisputable sign. Another bonus section shows how the Judeo-Christian world view was instrumental in the lives of many great scientists. Heeren briefly looks at the lives of fifty scientists (from Agassiz to Whewell) and how their faith influenced their science.

This book is primarily intended to cause skeptics to question their naturalistic assumptions, but I suspect that it will be more valuable to Christians who are looking for scientific apologetic material (for their own sakes or for others) or common ground between science and Christianity. This book is a great resource for any of these purposes and I wholeheartedly recommend it to *PCSF* readers.

Reviewed by Dan Simon, Assistant Professor of Electrical Engineering, Cleveland State University, Cleveland, OH 44115.

OMPHALOS: An Attempt to Untie the Geological Knot
by Phillip Henry Gosse. Woodbridge, CT: Ox Bow Press, 1998. 376 pages, index. Paperback; $34.95.
ISBN: 188198710.

This is a reprint of a book originally published in London in 1857, two years before Darwin's *Origin of Species*. Long out of print, unavailable to students of origins issues, it has reappeared as a study text for historians who would like to see how one scientist struggled to reconcile what he understood of both science and the Scriptures.

References to Gosse's book appear often. Martin Gardner gives it a sympathetic treatment in *Facts & Fallacies* (1957). He wrote (in chapter 11): "Not the least of its remarkable virtues is that while it won not a single convert, it presented a theory so logically perfect, and so in accordance with geological facts that no amount of scientific evidence will ever be able to refute it." More recently, Chris Morgan and David Langford's *Facts and Fallacies* (1981) mentions it as an "ultimate invincible theory," overcoming "all conflict between evolution and the Bible." Gosse's son, Edmund, in his 1905 book, *Father and Son*, reported at length his father's bewilderment of the expressions of derision that came from believers and nonbelievers alike following the publication of *Omphalos*.

Phillip Henry Gosse was no pseudo-scientist, but a respected and admired naturalist of his time. Thomas Huxley called him "an honest hod carrier of science," by which term he paid respect to Gosse's powers of observation and writing. Gosse is associated with the development of salt water aquariums and published many books on water creatures of the English countryside. He was an admirer of the new scientists, as seen in this quote from his son:

> Where was his place, then, as a sincere and accurate observer? Manifestly, it was with the pioneers of the new truth, it was with Darwin, Wallace and Hooker (*Father and Son*, p. 128).

But Gosse was also a biblical literalist. The Bible does not lie, and the facts of nature must take second place to

the revealed word, a word which he was convinced he knew and knew well. When his wife died painfully of cancer in February of 1857, he turned his attention to a reconciliation of the issue.

Omphalos appeared in print that fall; within two years it had disappeared into history's rubbish heap. Twenty years ago, I found a second generation photocopy at Gordon-Conwell. For the past two decades, a photocopy of that photocopy has resided on my bookshelf.

Gosse's argument is simple. If you had been present in Eden twenty minutes after Adam's creation, you would have observed his navel, a scar left from a birth that never happened. In his digestive tract would have been the remains of a meal he had not eaten two hours before. His feet would have had calluses from walks he had never taken. A nearby tree, cut down, would have shown real rings of unreal years of growth. Gosse goes on and on with this argument, separating all time into historic time, what Gosse calls "diachronic" time, and un-historic time, unreal time, virtual time, what Gosse calls "prochronic" time. He argues two propositions: (1) All organic nature moves in a circle; and (2) Creation is a violent irruption into the circle of nature.

Gosse quotes the philosopher Chalmers, who wrote: "We have no experience in the creation of worlds ..." From this statement, Gosse concludes, at least for the organic world (he disclaims any arguments for the inorganic), that any act of creation must involve the creation of a being with a history that never took place. He writes:

> we cannot avoid the conclusion that each organism was from the first marked with the records of a previous being. But since creation and previous history are inconsistent with each other; as the very idea of the creation of an organism excludes the idea of pre-existence of that organism, or any part of it; it follows, that such records are false, so far as they testify to time; that the developments and processes thus recorded have been produced without time, or are what I call "prochronic" (p. 336).

The objections to Gosse's thesis are well known. The two objections most often cited are (1) that it is simply a variation of Russell's hypothesis, "last Thursdayism," the hypothesis that we were all created, complete with memories of unreal events, on Thursday morning of last week, and (2) that it must be rejected because "God can't lie" and a false history must be taken as evidence that he did lie. But Gosse's arguments go well beyond Russell's hypothesis, and he argues well that any fiat creation, even by God, must necessarily include unreal history. His arguments need to be taken seriously.

Gosse's thesis is not, of course, "scientific." While it may be true, it is not testable, nor does it suggest future research projects. It is a dead end. Gosse recognized this. Nevertheless, he urged his fellow scientists to continue as if unreal history were real and to construct their theories independent of his thesis.

For many years, I have asked my friends at the Institute for Creation Research for comments. To date, they have declined that opportunity. Holding, as they do, that fiat creation did happen, it seems that part of *Omphalos* ought to play a part in their theorizing. One thing seems certain. If one posits fiat creation of any kind, an appearance of age must be a part of that hypothesis. That fact makes scientific tests of the claim difficult, if not wholly impossible, leading to the observation that "Scientific Creationism" is simply an oxymoron.

I highly recommend this book to my ASA colleagues interested in origins issues. It is a good read. For the biblical literalist, one who has honestly and thoroughly confronted the scientific data, I see it as the only intellectually coherent position possible.

Thanks to Jack Haas, George Murphy, Emrys Tyler, Loren Haarsma, and Richard Ruble for help in improving this review.

Reviewed by John W. Burgeson, Stephen Minister at First Presbyterian Church, Durango, CO 81301.

CREATION VS. EVOLUTION by Ralph O. Muncaster. Eugene, OR: Harvest House Publishers, 2000. 42 pages. Paperback; $3.99. ISBN: 0736903518.

This small book appears to be Muncaster's sixth book. Previous books include: *Are There Hidden Codes in the Bible?* and *Can You Trust the Bible?* This book is a typical anti-evolutionary tract which has so many factual errors that one certainly cannot mention them all in a mere seven-hundred-word review.

The book begins with the standard false dichotomy that life was created by God or by random chance. Random chance is viewed as being incompatible with a theistic view of the universe. This concept is standard fare among the anti-evolutionists and creates the theological problem that God is impotent in the face of chance.

The book then proceeds to erroneously claim that the most brilliant scientists alive today support creationism (p. 6) and then follows that claim with quotes from Isaac Newton, Lord Kelvin, and Werner von Braun—all long dead and buried (p. 7). These happen to be the only scientists quoted in the book. Despite this lack of quotes from modern scientists, the author boldly proclaims that "informed microbiologists now almost unanimously reject macroevolution" (p. 9). It would be nice, if once, such claims were documented.

Some other inaccuracies which will interest the serious scientists who might read this review is the erroneous claim that the electron microscope is what is used to reveal the molecular variations in DNA and RNA (p. 11). Muncaster falsely tells us that there is evidence for the existence of spiritual beings in dimensions higher than the

four of space-time (p. 12). What this evidence is he does not say. He erroneously tells his readers that geology has proven that the creation account in the Bible is in the precise order of events outlined in Genesis 1 (p. 16). As a practicing geoscientist, I can assure the readers here that this simply is not so. Finally, he makes the false claim that physics has caused Stephen Hawking to reconsider the existence of God in the universe. I think this will be news to Hawking (p. 30).

The errors multiply in this book. Biologists will be amazed to learn, contrary to all known observations, that mutations are not inherited by offspring, except among a few bacteria (p. 24). To one who loves anthropology, this book makes its most egregious errors when it turns to that subject. Of Neanderthal man, the author claims that recent genetic DNA research indicates that the chromosomes do not match those of humans. They do match those of bipedal primates (apes). Considering that no one has sequenced a Neanderthal chromosome, this is an extraordinarily false claim. He claims that Neanderthals made "crude" tools without telling the reader that less than twenty people on earth today have been able to master Neanderthal flint-knapping techniques. He claims that there is no evidence that Neanderthals engaged in religion, ignoring lots of evidence for it (as outlined in the June 1999 *PSCF*). Finally, Muncaster claims that Peking Man, instead of being *Homo erectus*, was an ape whose brain was eaten by humans. Of course, he gives no reference for this astounding claim and cites no anthropologist. These claims betray a total lack of research on the human fossil record.

When touching on physics, the book descends to real silliness. The author states:

> How can we conceive of no time? No matter? No space? It requires a perception of dimensions beyond time and space. Convincing a nonphysicist that this is true is often futile and depends on an individual's capacity to accept facts suggested by evidence of things beyond what we can perceive (p. 30).

Muncaster claims that life could not exist if there were a slower or faster rotation of the earth or if the atmospheric nitrogen/oxygen ratio was different from the present. This claim, of course, ignores the vast evidence for a faster rotation of the earth in the Devonian in the daily growth rings of coral, and it ignores the evidence indicating that the Cretaceous oxygen level was 30% rather than today's 21%.

This book is another example of the shambles into which conservative Christian apologetics has fallen, requiring the creation of a host of factually incorrect items in order to support Scripture. In this book, the facts related are wrong and contrary data is ignored. It is sad to see such books rated four and one-half stars on Amazon.com. If this is the best Christian apologetics has to offer, then we are truly in trouble.

Reviewed by Glenn R. Morton, Aberdeen Pouch, c/o Kerr McGee, 16666 Northchase, Houston, TX 77060.

SHATTERING THE MYTHS OF DARWINISM by Richard Milton. Rochester, VT: Park Street Press, 1997. 308 pages. Hardcover; $24.95. Paperback; $16.95. ISBN: 0892818840.

In 1972, Theodosius Dobzhansky presented his famous paper, "Nothing in Biology Makes Sense Except in the Light of Evolution," at a gathering of the National Association of Biology Teachers. Ever since, barely a year goes by without a prominent scientist, scientific organization, or philosopher of science repeating Dobzhansky's thesis that there is really no serious alternative to evolution, because the evidence for evolutionary theory is so overwhelming. Harvard evolutionary biologist Ernst Mayr perhaps best illustrated this confidence when he concluded a recent *Scientific American* essay with the claim that "no educated person any longer questions the validity of the so-called theory of evolution, which we now know to be a simple fact"—a hyperbolic pronouncement belied by numerous national surveys.

But the criticisms of the neo-Darwinian synthesis keep coming, and as much as many people would like the origins debate to just go away, it does not. The scientific establishment dismisses almost all the anti-Darwinian treatises as creationist pseudoscience, but occasionally there are anti-evolutionary books written by noncreationists. This book is one of them. Ordinarily, anti-evolutionary tracts originate in North America (occasionally Australia), but this book was initially published in Britain in 1993 under the title, *Facts of Life*. And it generated a fire-storm of controversy.

Milton, a British science journalist who maintains an "alternative science" web page, contends that Dobzhansky and company have got it all wrong: Darwinism is "still a theory." He concedes that while it may well be the "most elegant and powerful model ever constructed in the life sciences," the neo-Darwinian synthesis is "no longer able to contain the data it seeks to explain." It lacks "the decisive and incontestable empirical evidence" that would end all debate and demonstrate its correctness. Milton attempts to substantiate this thesis with a lively examination of fairly standard anti-evolution arguments ranging from questions surrounding interpretation of radiocarbon dating, the geological column, and the fossil record to concerns about the validity of the mechanisms of evolution. He devotes considerable attention to what he sees as "the improbability of spontaneous genetic mutation leading to beneficial novelties." Mutations, he contends, are far more likely to cause genetic defects than improvements.

All of this got Milton quite a bit of press in Britain in the mid-1990s—much of it bad. The positive comment received was overshadowed by Richard Dawkins' scathing attack in the *New Statesman*. It would be hard to imagine anything more negative and angry. Calling the book "silly-season drivel," Dawkins likened Milton's work to the rubbish one would likely find in a flat-earth or perpetual motion manifesto. Dawkins refers to Milton as "an unqualified hack," who misunderstands just about all the

science in a book that "betrays, on almost every page, complete and total pig-ignorance of the subject at hand." In the expanded American edition, Milton describes this rough treatment as "intellectual fascism." He is especially critical of the charge by Dawkins and others that he is a closet creationist. Since he insists that he does not hold to "any religious beliefs of any kind," Milton attributes the creationist label to "intellectual dishonesty."

Probably Milton's most intriguing argument, in an otherwise standard critique of neo-Darwinism, is also one that will not endear him to many in either the creationist or neo-Darwinian camp. He hints that for all its recent successes at the molecular level, biology is still wedded to a mechanistic, reductionistic view of science. Biology, Milton asserts, needs a revolution akin to that of quantum physics—one that encompasses the "wholeness or hidden connectedness" of life at all levels. Milton is suggestive but frustratingly vague; I certainly would have liked a much more developed argument on this important point. Perhaps I will not have to wait long. On the day that I finished reading Milton's book, the *New York Times Book Review* contained generally favorable reviews of two books—both published by Harvard University Press—suggesting that new forms of nonreductive holistic biological thought are needed to understand the mystery of life better. The neo-Darwinian synthesis might in fact be revised from within the ranks of evolutionary biology. If that occurs, it would indeed be ironic if Dawkins would be forced to admit that his fundamentally conservative defense of neo-Darwinism itself needed to evolve.

Shattering the Myths of Darwinism is unlikely to turn the minds of the readers of this journal. But as a document of the never-ending controversy over evolution, it is both significant and fascinating.

Reviewed by Donald A. Yerxa, Professor of History, Eastern Nazarene College, Quincy, MA 02170; Assistant Director, The Historical Society, Boston, MA 02215.

THE ETERNAL TRAIL by Martin Lockley. Reading, MA: Perseus Books, 1999. 334 pages. Hardcover; $26.00. ISBN: 0738201650.

This is quite an impressive work by quite an impressive person. I met Lockley of the University of Colorado-Denver at the infamous Paluxy River dinosaur footprint site in the early 1990s. Sixty or so geologists gathered for an official field trip of the Geological Society of America. Lockley was wearing a T-shirt that introduced me to one of my favorite adages: "I never would have seen it, if I hadn't believed it." Reviewing his book has given a greater appreciation for his specialty and for his perspectives.

The book's subtitle, *A Tracker Looks at Evolution*, is a bit misleading. This is really a series of brief essays on natural history. The book is divided into chapters that roughly "evolve" from a philosophical introduction into a chronological progression beginning with chapter two, "Paleozoic Prelude," on through chapter ten, "The Signature of Humanity." Lockley reflects on the traces left behind by a full bestiary spectrum from slimy marine denizens without hard parts (at the onset of the Cambrian explosion), through trilobites, "monster myriapedes," amphibians, all manner of reptiles, birds, and the diversity of mammals from reptilian protomammals, mammoths, sloths, giant wombats, and even "Big Foot."

Lockley's descriptions and interpretations are like realistic versions of fictitious detective cases. Lockley works Sherlock Holmes magic with observations of trace fossils. Subtle pairs of parallel grooves in sandstone may be enough evidence to reconstruct the feeding and mating behavior of certain trilobites. The geometry of pterosaur tracks enables a modeling of its anatomy. The spacing of their tracks may also reveal the manner of pterosaur mobility before and after flight. In many of the cases cited, it is apparent that the skeletal remains themselves may tell us less about the animal than its tracks. Lockley has great appreciation for patterns in anatomy deduced from tracks. In particular, there is the linking of foot morphology with factors of symmetry and evolutionary sequence. He sees this pattern in four-legged creatures from amphibians, reptiles, "protomammals," dinosaurs, to large mammals and humanoids. His exact arguments are complex and confusing for the unfamiliar. However, his writing is not to blame. The presentation of evidence is generally well done. Based on the logic, I am convinced that the conclusions are plausible. It all reads like a mystery plot, pointing to a great conspiracy.

In chapter six, "With God on our Side," Lockley clearly chastises young-earth creationists for their abuse of science. In the same section, he accuses the cold rationality of naturalism of folly. Those who demand proof of God's existence tend to be those who have made science, rationality, and intellectual endeavor into a religion, and the main avenue through which they find meaning in life. Even as we gain an improved understanding of natural phenomena, so ever deeper, more complex, and more intriguing questions arise. Here we are reminded of Isaac Newton's opinion that "a limited amount of knowledge leads away from but that with increased knowledge one finds the way back."

When "experts" at the British Museum were sent pictures of a Yeti ("Abominable Snowman"), they asserted that these were obviously from a bear or monkey. Lockley says: "This attempt to discredit the evidence apparently backfired and insulted the intelligence of the British press and public. Sherpas and other trackers are far more capable of identifying the tracks of native species than office-bound, civil servant, zoologists in London" (p. 264). In contrast to this disdain for positivists, chapter four shows a great appreciation for "The First Dinosaur Tracker," evangelical Christian Edward Hitchcock (pp. 108–9).

Lockley mentions the more modern theo-cosmologies of Einstein and Paul Davies to indicate that metaphysical, religious thought is not antithetical to good science. He also adds that "... an argument can be made that the habit

of separating science from theology is a bigger problem 'than mixing them' because it leads to fragmentation of thinking." Lockley himself is certainly no biblical creationist. The glimpses of theological reflection we see from him imply a vague unseen force behind the progress of evolution, mysterious design with purpose. If we must stick him with a label, then perhaps "post-modern scientist" is respectfully suggested.

I recommend *The Eternal Trail* to everyone. It is particularly appropriate for paleontologists, and natural history buffs, but anyone interested in the history of science and the relationship of the scientific enterprise to teleological questions should be quickened by the surprises therein.

Reviewed by Jeff Greenberg, Dept. of Geology and Environmental Science, Wheaton College, Wheaton IL 60187.

Social Sciences

ARE SOULS REAL? by Jerome W. Elbert. Amherst, NY: Prometheus Books, 2000. 398 pages, index. Hardcover; $28.00. ISBN: 1573927910.

Elbert, a physicist, answers the title question with a "no." The book has an exceptionally thorough index. This is the first book I have reviewed that has no pages with Roman numerals at the beginning, and no subtitle.

I agree with Elbert that quantum indeterminacy does not explain free will, but I disagree with most of what else he has to say. Elbert, who is nothing if not widely read, apparently accepts only scholarship that says that Jesus was not supernatural, and that a good portion of the Bible was invented by the authors. He does not believe that there is any such thing as free will. I will let Elbert speak for himself.

Here is his thesis:

> I will argue that *our traditions give us an archaic and misleading view of the world and our nature*. Some of our ordinary ideas about the soul and what it is to be human appear to be mistaken. Recent results from many scholarly fields lead to ideas about human nature and our relation to the world that are radically different from the traditional views. These results will affect what we believe about such basic issues *as the nature of our consciousness, our freedom to choose right and wrong*, and even *what Jesus actually taught his followers* (p. 19. Because of the page numbering, this is the first page of the first chapter).

His view of Scripture is:

> It appears that the Bible originated by entirely natural processes and that its supernatural events are fictitious. As a result, we have little reason to trust other ideas about supernatural events that are loosely linked to the Bible. So, we are prepared to investigate whether the soul exists, without worrying about the fact that it is *assumed* to exist in passages in the Bible (p. 109).

He concludes:

> Even though the common belief in souls is probably mistaken, it is understandable that most people believe souls give people abilities that seem beyond the reach of material processes. People will probably change their opinions about souls in the not too distant future. The public will be better educated and most will not believe that the Bible is literally true. As the natural bases for our existence become better understood, people will lose faith in "explanations" based on supernaturalism. The idea of a future eternal life will seem cultlike and less likely. As confidence in immortality diminishes, people will seek fulfillment in their natural lives, as perhaps the majority already do (p. 360).

Reviewed by Martin LaBar, Professor of Science, Southern Wesleyan University, Central, SC 29630.

LITERARY CONVERTS: Spiritual Inspiration in an Age of Unbelief by Joseph Pearce. San Francisco: Ignatius Press, 1999. 452 pages. Hardcover; $24.95. ISBN: 0898707900.

There are many fascinating aspects of the century just ended. One of them is the relationship public figures had to Christian faith. This book focuses on literary figures of the century who were Christians or who became Christians during their writing careers.

Among the many well-known figures included in the book are G. K. Chesterton, T. S. Eliot, C. S. Lewis, Hilaire Beloc, Graham Greene, Maurice Baring, Dorothy Sayers, and Malcolm Muggeridge. Many lesser-known writers are also mentioned. The book includes artistic figures like Alec Guiness and Robert Speaight. The author describes the interconnections among these various writers such as friendships, literary interactions, and spiritual contacts. The preface describes these people as linked in a network of minds.

The focus in the book is on the Catholic Church and on those who were or who became part of it. Those, like Lewis, who were in other communions, are described in such a way as to emphasize their closeness to Catholicism. For those who love the literature of the twentieth century, or who are interested in how Christians can provide mutual support in the sphere of their work, or who want to learn more about favorite authors, or perhaps who want to learn about authors not yet known to them but with whom they share a common world view, this book can be highly recommended. The material is fascinating and the presentation is engaging.

Reviewed by David T. Barnard, President and Vice-Chancellor, University of Regina, Regina, SK S4S 0A2.

A DARWINIAN LEFT: Politics, Evolution and Cooperation by Peter Singer. New Haven: Yale University Press, 1999. 70 pages. Hardcover; $9.95. ISBN: 0300083238.

Ethicist Singer has been described as "perhaps the world's most controversial ethicist" (*New York Times*) and a "dangerous philosopher" (*The New Yorker*). Yet he is also seen as "the most effective philosopher alive" (Brian Appleyard), "certainly among the most influential" (Michael Specter). A utilitarian, Singer is well known for bold and often outrageous views in support of euthanasia, infanticide, and animal rights. His recent appointment to the Ira W. DeCamp Chair of Bioethics at Princeton University created an uproar that found its way to the front pages of the *New York Times*.

In this slim volume, part of the *Darwinism Today* series, Singer attempts to effect a rapprochement between Darwinism and the political left, one that establishes the role of evolutionary psychology in both ethics and politics. With Marxism in disarray, Singer believes that the left needs a new paradigm based upon a scientific understanding of human nature. The left, he argues, "must take seriously the fact that we are evolved animals." While Marxists have certainly found Darwinian materialism congenial, Marxist theories of history have not meshed well with a biological view of human nature. A cherished leftist notion is that human nature is malleable. This has been the basis for the left's hope in the creation of a different kind of human society in the future. Darwinism, on the other hand, has preached that human nature is fixed by competitive evolutionary forces.

Singer holds out Darwinism to the left because he believes that sociobiology and evolutionary psychology have supplemented survival of the fittest competition with more sophisticated understandings of cooperative behavior. Focusing only on the competitive side was the mistake of the right and Social Darwinism, but sociobiology seems to show how selective forces can encourage behavior that either appears or may actually be altruistic in its motivation, "even though in specific circumstances it brings benefit to the apparently altruistic individual." A crude example would be the recent television ad for cell phones that shows a man becoming aware that he might win the admiration and presumably future affection of attractive young women by publicly donating to a charity. Of course, Singer does not use this example, but it does humorously illustrate his point. Altruism, according to this evolutionary approach, does not focus on the disinterested motivation of an individual, but on the impact of the action on reproductive fitness.

Singer ends his brief essay with a sketch of how a Darwinian left would be less utopian and more realistic than the traditional left of the last two hundred years. A Darwinian left would not deny that there is a human nature, nor would it insist that human nature is inherently good or infinitely malleable. It would not hold out the vision that human conflict and strife would someday cease, nor would it automatically ascribe all human inequalities to prejudice and oppression. A Darwinian left would, on the other hand, attempt to ground politics in the best evidence of what human beings "actually are like." Significantly, it would reject any inference "from what is natural to what is right." It would promote structures that foster cooperation rather than competition, as well as accord a higher moral status for "nonhuman animals" and "a less anthropocentric view of human dominance over nature" – all the while standing by "the traditional values of the left by being on the side of the weak, poor and oppressed."

While some might welcome aspects of this more modest conception of the political left, Singer's attempt to anchor it in sociobiology is not convincing. Apart from the problematic nature of the reductionistic project of sociobiology, even on its own terms sociobiology does not provide the warrant Singer needs for his argument. As Peter Berkowitz has already noted in a withering review essay, the altruism of sociobiology is a "kin altruism" that "discourages sacrifice on behalf of total strangers, because such sacrifice reduces the time, energy, and wealth we can devote to family and kin group, who alone share some of our genes." Beyond that, one wonders how the interspecies altruism that Singer holds so dear can be explained in terms of selfish genes. Nevertheless, this is an important book because it illustrates the difficulties encountered when one adopts a thoroughgoing, reductionistic evolutionary framework as the primary basis for understanding complex human activities like politics. And it challenges those like myself, who object to such reliance on sociobiological explanations, to give more attention to the scientific origins of complex social activities without yielding to the temptation, in this case, to reduce all politics to behavior.

Reviewed by Donald A. Yerxa, Professor of History, Eastern Nazarene College, Quincy, MA 02170.

WHO ARE WE? Critical Reflections and Hopeful Possibilities by Jean Bethke Elshtain. Grand Rapids, MI: Eerdmans Publishing Company, 2000. 178 pages. Paperback; $20.00. ISBN: 0080283888.

The Christian view that we lose ourselves only to truly find ourselves is not in keeping with the spirit of the age. Drawing on the works of Deitrich Bonhoeffer and Pope John Paul II, Elshtain reinforces the view that we are human insofar as we are in relationship with and for the other. This is not easy to understand because "we no longer understand the meaning of the donative gift, of putting ourselves at the disposal of another."

Two problems get in the way of a view of our common humanity that is in the Christian tradition. The first is pride. Elshtain defines false pride as the assumption that we are the sole and only ground of our own being. Once this assumption is made, other things are entailed. We easily become comfortable with the assumption that everything can be marketed, and we only exempt some aspects of our lives from this assumption. We value scientific-reductionist, mechanistic, utilitarian evaluation rather than the broader approaches used by the humanities (and, many of us would say, by a fully informed science).

"Thus core distinctions marked by Augustine—*frui* and *uti*—are occluded. *Frui* means to enjoy and to cling with love to something for its own sake; *uti*, by contrast, is a form of use, employing something in order to obtain that which we love, provided it is worthy of love."

The second obstacle to a rich view of humanity is sloth. This is described as not simply inactivity but acquiescence in the conventions of the day, and a refusal to take up the burden of self-criticism. This results in forgetting that we are made to "serve God wittily, in the tangle of our minds" (words put in the mouth of Sir Thomas More by Bolt in his play, *A Man For All Seasons*). "Sloth has clung to us and we cannot exalt the Lord any longer; instead, we worship at the altar of our own projects."

So what can the future hold for us when these problems confront us? Elshtain says that optimism is not warranted. However, "hope, that great theological virtue, urges us to a different stance, one aware of human sin and shortcoming but aware also of our capacities for stewardship and decency and our openness to grace." She proposes several responses that we can make in hope. We must name things we see accurately and appropriately. We must be prepared to offer a reasoned defense of our positions while insisting that there is truth to be found. We must combat meaninglessness by displaying what incarnational being-in-the-world is all about. And we must make sure that our churches play a critical role as interpreters of the culture to the culture.

This is one of the most stimulating books I have read in a long time. I highly recommend it.

Reviewed by David T. Barnard, President and Vice-Chancellor, University of Regina, Regina, SK S4S 0A2.

Theology & Philosophy

SCIENCE AND ITS LIMITS: The Natural Sciences in Christian Perspective by Del Ratzsch. Downers Grove: InterVarsity Press, 2000 191 pages. Paperback; $12.99. ISBN: 0830815805.

Science and Its Limits is the second edition of an earlier work, *Philosophy of Science*, by the same author. This excellent book provides insight into what science can and cannot say about the world and a creator. Ratzsch, professor of philosophy at Calvin College, has crafted a winsome analysis of science's influence in the twentieth century and posits ways Christians can respond.

The beauty of *Science and Its Limits* is in succinctly delineating between philosophical and scientific interpretations of science. Ratzsch deftly identifies how philosophical presuppositions infuse all aspects of science, and uses extrapolations to show the full ramifications of seemingly innocuous presuppositions. Ratzsch exposes various dichotomies to show the benefits and deficiencies of several philosophies of science and then finishes the book by showing how Christianity provides a uniquely holistic understanding of science.

The book falls roughly into three parts: a survey of the philosophy of science culminating in Kuhn's influence (chaps. 1–3); a contemporary analysis (chaps. 4–6); and the intersection of science and Christianity (chaps. 7–10). The first two chapters are pithy analyses of the traditional scientific method progressing through to positivism, falsification, paradigms, and postmodernism. Ratzsch then moves on to sketch contemporary philosophy of science concluding that an overly optimistic emphasis on either empirical or philosophical theories causes significant difficulties.

The last four chapters mark a distinct change in tone as the focus moves to an integrated understanding of science from a Christian perspective. Chapter 7 addresses four "Scientific Challenges to Religious Belief," providing a grounding for an integrated understanding. On this framework, Ratzcsh then surveys intelligent design (chap. 8) before moving on to the more difficult, and controversial, issue of how, where, and "to what extent Christianity bears on the specific content and internal workings of science" (p. 141).

This book provides an excellent introduction to the philosophy of science, summarizing the main issues in a succinct, readable, and current form. The book is an asset to all involved in the science-religion dialogue, and deserves consideration as a textbook. Ratzsch is to be commended for giving "Christians an initial understanding of what natural science is, what it can do, how and why it works, and what it cannot do."

Reviewed by Fraser F. Fleming, Associate Professor of Chemistry, Duquesne University, Pittsburgh, PA 15282.

THE END OF THE WORLD AND THE ENDS OF GOD: Science and Theology on Eschatology by John Polkinghorne and Michael Welker, eds. Harrisburg, PA: Trinity Press International, 2000. 290 pages. Paperback; $27.00. ISBN: 1563383128.

This book arose from a three-year multidisciplinary consultation on eschatology that included natural scientists, social scientists, systematic theologians, ethicists, and biblical scholars. It was held in Princeton and Heidelberg. Each chapter is the contribution of a member of the group, which creates a certain unevenness of style. Nevertheless, common stances emerge. For instance, hope in the future is grounded in the resurrection of Jesus, and it involves the discontinuity of death and continuity of the person.

The book is organized into four parts. Part I addresses the contributions of the natural sciences. I most like the opening two chapters. William Stoeger, a Jesuit astrophysicist, describes the possible ways natural events can, and most certainly will, bring about the destruction of the world we know. Against such a pessimistic backdrop

Polkinghorne, former professor of physics and now an Anglican priest, presents the discontinuity/continuity of the Christian resurrection hope. Although the future world will have to operate by different laws (discontinuity), persons in the New World retain their personhood (the continuity).

Part II addresses cultural and ethical aspects. The meaning of hope, secular descriptions of the future, the role of the church, and cultural aspects of time are the basis of the discussion. I was particularly impressed by Larry Bouchard's critique of the writings on the future of Tipler and Sagan and of Christoph Schwöbel's affirmation that the church is the place where the promised discontinuity/continuity is already being experienced every time a sinner becomes a new creation.

Part III addresses selected biblical texts relating to end times. One of the Old Testament scholars, Patrick Miller, gives an exposition on Isa. 24–27. Throughout this prophecy of coming judgment erupt psalms of joy. So it is with the Christian hope: judgment must come but in the end creation will be restored to the primeval joy it experienced when the morning stars sang together. Hans Weder, a New Testament scholar, examines the parable of the seed. Like the farmer who awaits the harvest, we have no proof for the coming Kingdom, but we have much evidence including the existence of growth.

Part IV attempts to present a realistic future. All the authors are theologians. Gerhard Sauter points out that we "hope against hope"; the Christian hope is not amenable to the Western mood of "life goes on." Kathryn Tanner contrasts the concept of being dead while living with living while being dead—separation from Christ is a kind of death; eternal life can be experienced even in the suffering and death of this life.

Jurgen Moltmann is concerned with what happens when we die. Reincarnation is not possible as that would break the continuity, but some form of purgation may be a part of the way God completes the work he has begun in each of us. (The reformers rejected the concept of penance, not the idea that the history of God's relationship with each human continues after death.) He also speaks of the importance of appropriately remembering the dead: without a "culture of remembrance" that tries to do justice to the dead, there will be no "culture of hope" that will open up a future for our children.

Miroslav Volf describes the new creation: (1) no one will suffer want; (2) evil will be exposed and judged and the evil-doers transformed by God's grace; (3) there will be nothing in the past to resent and nothing in the future to avoid; and (4) all creation, along with human beings, will be in a state of eternal peace and joy in the communion of the triune God.

Welker summarizes what we know from the Bible about Jesus' resurrection body. He points out that Jesus was not immediately recognized. When he was, the response was not "Good to have you back, Jesus." Although it was the same Jesus, it was a new presence. If you want definite answers to questions like how the world will end, this book will disappoint you. However, if you have sometimes thought you were the only person asking questions such as what it means to be raised a spiritual body or how fallible humans can be made like Christ, you will find much in this book to assist you. I recommend this provocative collection of essays with enthusiasm.

Reviewed by Elizabeth M. Hairfield, Professor of Chemistry, Mary Baldwin College, Staunton, VA 24401.

EMBRACING THE POWER OF HUMANISM by Paul Kurtz. New York: Rowman and Littlefield, 2000. 227 pages. Hardcover; $24.95. ISBN: 0847699668.

Secular humanism is a philosophy of virtue and values without religion. There is perhaps no better person to learn about it from than Kurtz, the "Father of Secular Humanism." The author of over thirty books, Kurtz describes a nontheistic, meaningful, and moral way of life based on rationality, courage, moral empathy with no belief in the supernatural. In this volume, his essays are divided into five sections: the exuberant life, independence, altruism, humanism, and ethical truth.

Kurtz believes "that the world would be a better place if the religious, transcendental, and paranormal myths that have dominated human history could be overcome ..." (p. 215). He is skeptical of the doctrine of "original sin," believes that humans are capable of good and evil, thinks that moral decencies are widespread in human civilization, and argues that science and technology can produce enrichment and happiness.

Perhaps the most telling part of this book is the Afterthought entitled "Surviving Bypass and Enjoying the Exuberant Life." In it Kurtz writes, "My bypass surgery jolted me into the realization that I am not superman, nor am I eternal" (p. 214). He continues, "As a freethinker, I have no illusion about the immortality or the afterlife. It is only this life that counts" (p. 214). The distilled essence of secular humanism is this: Since this life is all that counts and you only live once, claim all the happiness you can. That pretty well summarizes the viewpoint of secular humanism, and it also points to its inadequacies from the Christian's perspective.

The shortcomings of secular humanism are legion. It does not provide: (1) a final accounting, the rewarding of good and the punishment of evil; (2) a hope beyond the grave; (3) a faith which enables people to endure suffering with other-worldly meaning; and (4) an unfilled void in the human heart apart from Christ. Of course, all of this follows from a rejection of biblical theism. So if you want to know more about secular humanism than you have read in this review and to test the rationality of your faith against a secular thinker, this book is a good place to start. Kurtz, according to Brandon M. Stickney, is "today's *superhumanist*, who, with unmatched energy, courage, and compassion, brings the words of reason to the mil-

lions so lost in today's New Age and paranormal-spiritual obsessions" (p. xvii). On the other hand, if you want to strengthen your faith in the reality of Christian humanism, you know what Book to read.

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

THE BIBLE ON CULTURE by Lucien Legrand. Maryknoll, NY: Orbis Books, 2000. 190 pages, index, footnotes. Paperback; $25.00. ISBN: 157075330X.

Legrand is a member of the Paris Foreign Mission Society and teaches New Testament at St. Peter's Institute of Theology in Bangalore, India. His experience living in India has given him a world view and set of experiences that make this book particularly effective.

The Bible on Culture is the sixteenth book in the Faith and Culture Series published by Orbis. It is divided into three parts: (1) Israel and the Nations (the Old Testament); (2) The Cultural World of Jesus; and (3) Paul and Beyond. In this book, Legrand introduces the concept of "inculturation" in which the revelation of God's Word, the incarnation of Christ, and Christian faith are all seen to enter into a given cultural environment. He argues that through the entire Bible, God's revelation is intermingled with the various vicissitudes of people's lives. He sees the Bible as the outcome of an ongoing process of cultural exchange with the nations among whom the biblical writers lived. Legrand's basic thesis is that the writers were able to communicate God's message in ways appropriate to their culture at that time. The modern reader should understand that cultural background as a way of better understanding the relevance of the text for today.

Legrand argues that Israel came from the very Canaanite culture which it grew to oppose. He contends that Canaan stands as a symbol of what Israel rejected and at the same time is the milieu that nurtured its growth. He suggests that Israel's kings were sympathetic to the values and ideas of the surrounding nations, but this sympathy was counterbalanced by the prophets, who continually challenged Israel to remain uncontaminated by pagan influences and to remain true to their holy calling.

Legrand discusses at length the cultural and religious environments in which Jesus and Paul were raised and how these influences shaped their thinking. He considers Jesus to be a typical Jewish child. The adults who influenced him while he was growing up were probably the village Pharisees. Consequently, Jesus is comfortable in the Jewish environment and is able to critique the Jewish leaders as an insider. Legrand suggests that Jesus' critique is in the manner of the Old Testament prophets. For example, Jesus' attitude toward the temple resembled the criticism of Amos or Jeremiah. Another significant influence in Jesus' upbringing was his rural environment. Thus most of Jesus' teachings reflect agricultural ideas such as seeds and soils. Ultimately, Jesus was at home among the poor peasantry.

Legrand considers Paul to be truly Jewish, but comfortable within the Hellenistic world. Like Jesus, Paul also was able to criticize the Jewish leaders as an insider. But having been raised also in the Gentile world of Tarsus, Paul was able to comfortably move out into ministry to the Gentiles. As a way of applying his basic thesis, Legrand specifically analyzes in some detail selected texts such as Paul's sermon in the Areopagus in Acts 17. This proves effective. Legrand convincingly defends his thesis that the biblical writers were influenced by their cultural background and surrounding environment, and that understanding these influences sharpens our ability to interpret Scripture correctly.

Legrand also argues that the reason for the decline of Christianity in Europe can be seen as a failure to inculturate the Christian message in changing social and cultural circumstances. In this regard, the book is useful for North Americans who face the challenge of a society which increasingly views the Bible and the church as irrelevant. Legrand's approach is sound and could be helpful for all American Christians concerned about how to bring the Gospel to a pluralistic society.

Legrand's approach is compatible with a conservative view of revelation. Having studied at a conservative seminary myself, I would have found this book extremely helpful as a background text to all my courses on the Bible. Although Legrand is a Roman Catholic, *The Bible on Culture* is written for a Protestant audience as much as for a Catholic one. It is written at a Bible college or seminary level, but it is very readable for lay people as well. This book would be appreciated by missionaries, Bible scholars, and those who teach the Bible to adults.

Reviewed by Mark A. Strand, Medical Team Director, Shanxi Evergreen Service, 3330 Benton Street, Wheat Ridge, CO 80212.

JESUS OUTSIDE THE NEW TESTAMENT by Robert E. Van Voorst. Grand Rapids, MI: Eerdmans Publishing Co., 2000. 248 pages. Paperback; $22.00. ISBN: 0802843689.

Van Voorst, professor of New Testament at Western Theological Seminary, is the author of *Anthology of World Scriptures, The Ascents of James,* and *Building Your New Testament Greek Vocabulary.* In this present volume, he addresses the question of whether Jesus' existence can be verified based on evidence outside the New Testament. Is there extra-canonical evidence? Van Voorst puts forth writers from Roman, Jewish, pre-Christian, and post-Christian sources that mention Jesus. Using fresh translations of these relevant documents, Van Voorst extracts information from them to aid in reconstructing the historical Jesus.

This volume is one in a series published by Eerdmans entitled "Studying the Historical Jesus." The idea that Jesus was a myth and not a historical figure has pretty much been invalidated by scholarship over the past several decades. This has come about due to intensive study of archaeology, ancient Judaism, Hellenistic literature,

and extra-biblical documents. The historical Jesus attracts interest not only as an important historical figure, but, more importantly, as the pivotal figure in Christian theology.

Van Voorst's evidence for Jesus' existence is divided into five sections: (1) outside the New Testament; (2) in classical writings; (3) in Jewish writings; (4) in the sources of the canonical Gospels; and (5) in Christian writings after the New Testament. His indices (of names, subjects, and Scriptures) and bibliography are valuable aids. After examining his material, Van Voorst concludes: "The non-Christian evidence uniformly treats Jesus as a historical person." After looking at the evidence, however, he says: "We are left for both the main lines and the details about Jesus' life and teaching with the New Testament. Our study of Jesus outside the New Testament points at the end of the day to Jesus inside the New Testament." To examine the extra-biblical evidence for yourself, buy this book.

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

LABYRINTH: A Search for the Hidden Meaning of Science by Peter Pesic. Cambridge: MIT Press, 2000. 186 pages. Hardcover; $21.95. ISBN: 0262161907.

Pesic has tried to write a book about "the hidden quest of science and its human meaning" (p. 1). As a musician, Pesic promises to breathe new insight into the pursuit of science, as one who considers himself "something of [an] 'outsider' as well as [an] 'insider'" (p. 7). Pesic is a tutor and Musician-in-Residence at St. John's College, Santa Fe, New Mexico.

Pesic waxes eloquently in his effort to follow the "labyrinth" and wrest great secrets from nature. "In musical terms, this book is a triple fugue, an interweaving of three distinct but finally interrelated themes concerning the character of the scientific enterprise and the deep effects it has on human character" (p. 3). Despite Pesic's undisputed excellence in prose, the book is fundamentally lacking in content. Pesic toys with images to try and illustrate how Bacon, Kepler, Newton, and Einstein have mentally wrestled with ideas that have led to their respective revolutionary theories. Newton's "self description as 'a boy playing on the sea shore' [shows that] Newton recognizes some crucial respect in which his discoveries seem to him shells from the depths, not the great ocean itself. His failure to plunge in was not ignorance, though the image of the boy suggests a kind of innocent disregard" (p. 128). And so the text continues, full of metaphors that say nothing.

Labyrinth confirms that a gulf exists between the academic realms of science and the humanities. Reclaiming some remnant of the renaissance ideal of a well-rounded intellect is a necessary element for integrating scholarship and Christianity. Pesic's desire to contribute to this ideal is laudable, although the several excellent books available are, in this reviewers' opinion, more profitable than following this "*Labyrinth*."

Reviewed by Fraser F. Fleming, Associate Professor of Chemistry, Duquesne University, Pittsburgh, PA 15282.

Letters

Creation Sequence of Birds and Humans

McIntyre is to be commended for his discussion of the introduction of Scripture into scientific controversy, "Repeating the Catholic's Galileo Error" (*PSCF* 52 [December 2000]: 255–9). This letter is to comment on the appendix to his article, "Resolution on Creation," items 1 and 3, pertaining to the question of historical accuracy and consistency of the Genesis chapter 1 and chapter 2 creation accounts.

In the Genesis 1 account, birds are created in the fifth day (1:20–22) and human beings, both genders, are created on the sixth day (1:26–27). In the Genesis 2 account, the creation sequence of birds and Adam is reversed. Adam is created first (2:7), then birds (2:9), and later Eve (2:22).

Several attempts have been made by apologists for biblical inerrancy and literalist interpretation to account for this apparent discrepancy. Geisler and Howe state that Genesis 1 is in "chronological order" and Genesis 2 is in "topical order," which they explain with regard to land animals.[1] Since land animals and humans were created during the same Genesis 1 day (the sixth), this explanation may work for the animals but is nonresponsive regarding birds. Archer states that Genesis 2 presupposes that the events of Genesis 1 had already happened, and is merely fleshing out the details of the creation of human beings.[2] Archer ignores the fact that birds, according to Genesis 1, were created the day before humans.

Ross acknowledges that there is an apparent problem here.[3] His explanation is that the verb tense of "formed" in the original Hebrew (2:19) is nonspecific with regard to the relative creation sequence and indicates only that the events described had occurred at some time in the past. He dismisses the contradiction as being an artifact of "faulty scholarship." The verb tense may be nonspecific, but there are other factors that indicate that the Adam-bird-Eve sequence was intended in Genesis 2. First, a temporal sequence is implicit in the order in which the events are listed, i.e., Adam, then birds, then Eve. Sec-

ond, 2:18 and 2:20 both explicitly state that one of the reasons for creating animals and birds was to address Adam's need for a helper or partner.

Seely has convincingly argued that "flying creatures" in 1:20 could include flying insects but could not be construed as excluding birds.[4] However, I have yet to see an adequate reconciliation of the bird-Adam creation sequence with a literal Genesis interpretation.

Notes

[1]Norman Geisler and Thomas Howe, *When Critics Ask* (Grand Rapids: Baker Books, 1992), 35.
[2]Gleason Archer, *Encyclopedia of Bible Difficulties* (Grand Rapids: Zondervan, 1982), 68–9.
[3]Hugh Ross, *The Genesis Question* (Colorado Springs: NavPress, 1998), 73–4.
[4]Paul Seeley, "Genesis Revisted or Revised?" *PSCF* 52, no. 2 (June 2000): 77–8.

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Noah, From Whence Art Thou?

While my views can be validly criticized on several grounds, they can not be criticized for the reasons listed by Carol Hill's article, "A Time and Place for Noah" (*PSCF* 53 [March 2001]: 24-40). On page 38, the article claims my hypothesis cannot be true by saying, "Not even hominids existed in the Late Miocene (~10-6 million years ago), let alone a man who had the technology to build a boat the size of the ark." My views are based on the observation that the hominids (modern humans are also hominids) behaved in a very characteristically human manner several million years ago, and I hypothesize that Adam, Eve, and the flood were that long ago. This would mean that the anthropological record was the repopulation of the earth after the flood's devastation. So, if Hill's claim that hominids did not exist is true, then obviously that would be detrimental to these views. But Hill's claim is factually false on several grounds.

First, since the mid 1980s the genetic data has clearly shown that apes and hominids split between five and seven million years ago.[1] Secondly, the fossil evidence has shown that hominids existed that long ago. The 1965 find of a hominid mandible at Lothagam has been dated to between five and six million years ago.[2] Finally, in a discovery that Hill could not have been aware of at the time of writing, a new hominid called Millennium Ancestor but scientifically named *Orrorin tugenensis*, has been discovered.[3] This creature is six million years old, is morphologically closer to us than any of the younger australopithecines, and has a more humanlike body size than that of an australopithecine. Thus, the claims that hominids did not exist simply is not true.

Notes

[1]Bernard G. Campbell and James D. Loy, *Humankind Emerging* (New York: HarperCollins, 1996), 165.
[2]Andrew Hill, et al., "Anatomy and Age of the Lothagam Mandible," *Journal of Human Evolution* 22 (1992): 439–51; Donald Johanson and Blake Edgar, *From Lucy to Language* (New York: Simon and Schuster, 1997), 39–40.
[3]Claire Ainsworth, "The Oldest Strider in Town," *New Scientist* (Dec. 16, 2000): 5.

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A Response to Morton's Critical Review of *Creation, Evolution, and Modern Science*

Glenn Morton offered a review of the book, *Creation, Evolution, and Modern Science* (*PSCF* 53 [March 2001]: 63–4), which I edited and wrote most of the chapters. Even a cursory reading of the book itself will allow most to realize that Morton's negative and hostile review fails to reflect accurately the book's intent, content, and audience. I offer a few rebuttals and will let the reader decide how to interpret Morton's other comments. It seems clear to me that Morton expects any book dealing with scientific issues to be written on a scientific scholarly level. My experience has been that this approach turns the scientific novice away, therefore defeating the purpose of education. First, I will address Morton's factual charges and then answer his concern of the level of scholarship.

Morton chides me for not quoting from Cambrian explosion authority Simon Conway Morris's 1998 book, *The Crucible of Creation: The Burgess Shale and the Rise of Animals* (Oxford University Press), in the chapter on the Cambrian explosion. Morton leaves the impression that if I had, I would not have represented the Cambrian as exhibiting the first example of all but one animal phylum. Morton says: "Nowhere does Bohlin acknowledge the fact that five phyla are now found in the pre-Cambrian including sponges, molluscs, worms, jellyfish, and arthropods." The reason I did not acknowledge this "fact" is that it is not a fact but an opinion, and a controversial one at that. Let's let Conway Morris speak for himself.

Referring to the resemblance of the Ediacaran fauna to jellyfish (cnidarians) and worms, Conway Morris says:

> For many years paleontologists have been busy comparing Ediacaran fossils to supposed modern-day equivalents, such as jelly-fish or worms. A more careful scrutiny reveals, however, some significant problems. Certainly there are similarities, but they are worryingly imprecise" (*The Crucible of Creation*, p. 28).

Later, Conway Morris admits that it is his opinion that many of the Ediacaran fossils are cnidarians. He says: "In my opinion not only are the frond-like Ediacaran fossils cnidarians, but so too are many of the other fossils. What appears to be an intriguing absence from the Ediacaran faunas, however, are the sponges."

Conway Morris goes on to cite a recent find of sponges (porifera) in the Ediacaran of Australia by Gehling and Rigby. But even the UC Berkeley website, usually more up-to-date than print media, lists this find as a "probable" sponge (www.ucmp.berkeley.edu/porifera/poriferafr.html) and still lists sponges as first appearing in the Cambrian (www.ucmp.berkeley.edu/phlya/metazoafr.html). What emerges is that sponges are found unequivocally in the Cambrian, and their presence earlier in the fossil record is controversial. This hardly qualifies as fact.

In turning his attention away from sponges and cnidarians, Conway Morris curiously remarks that they are primitive and can be considered evolutionary dead-ends. In a note, he states:

> Sponges and cnidarians are so different that it is difficult to imagine how the transitions between them, or between cnidarians and the platyhelminthes were achieved. Most probably this is because the intermediate forms are now extinct, leaving only speculation. The bulk of evidence certainly suggests that metazoans are monophyletic; but the possibility that the sponges and cnidarians had independent origins from separate protistan an alternative, albeit unpopular, possibility (*The Crucible of Creation*, pp. 35–6).

So, even if scientific opinion unites behind the presence of sponges and cnidarians appearing in the Precambrian, that may not help resolve the riddle of the Cambrian explosion.

Next Conway Morris addresses possible precursors of annelids and arthropods in the Precambrian, which Morton also labels as firmly established.

> What about the more advanced groups that must have given rise to the bulk of the Cambrian faunas? Can they be identified amongst the Ediacaran fossils? There are some candidates. These fossils, which show a variety of forms, have clear bilateral symmetry, often with a well-defined anterior end. In addition, some types may show transverse segmentation. These fossils are probably on the route leading to groups such as arthropods and annelids. Their exact place in the scheme of metazoan phylogeny is nevertheless still controversial.

In a figure legend on page 27, Conway Morris admits that the relationships of *Dickinsonia costata* to known groups are uncertain and that its segmentation only "suggests that *Dickinsonia costata* may be related to groups such as the annelids." Use of such terms as "candidates," "probably," "controversial," "uncertain," and "suggest" do not constitute a fact in anyone's lexicon.

And regarding the fifth taxon in which I am accused of getting my facts wrong, the molluscs, a recent news article in *Science* (Vol. 291 [23 March 2001]: 2292), shows I am at least in good company. Writing for *Science*, Erik Stokstad reports on the first example of an aplacophoran (shell-less molluscs inhabiting today's sea-floor that are thought to resemble the first molluscs). He states: "Yet none had been found in the fossil record of mollusks, which stretches back more than 500 million years to the early Cambrian—until now." The "until now" refers to a specimen found *not* in the Precambrian, but the Silurian from Herefordshire, England.

Morton also chastises me for claiming the Cambrian only lasted for 5-10 million years. I did not. The five to ten million-year time frame referred only to the Cambrian explosion, not the Cambrian period in its entirety. I corrected Morton on this, but he apparently did not believe me. Morton is confused here too, since he states in his abstract from his article on page 42 of the same *PSCF* issue that "evidence arises indicating that the Cambrian explosion was not very explosive. In contradiction to many apologetical claims, it occupied a period of nearly 100 million years." Yet according to Morton's acknowledged authority, Conway Morris says:

> The term "explosion" should not be taken too literally, but in terms of evolution it is still very dramatic. What it means is the rapid diversification of animal life. "Rapid" in this case means a few million years, rather than the tens or even hundreds of millions of years that are more typical when we consider evolution in the fossil record (*Crucible of Creation*, pp. 31–2).

Now I know that Morton did not mean to say that the Cambrian explosion lasted nearly 100 million years, but that is what he appears to have said.

Also, Morton says there are at least thirteen phyla that make their appearance after the Cambrian. While Morton does not list them in the review, he does in his article (*PSCF* 53, no. 1 [March 2001]: 44). Morton knows these are nearly all plant phyla because I corrected him on this too. Some are not even phyla, but sub-phyla and classes. Plants are never considered part of the Cambrian explosion and I explicitly state animal phyla in the book. The one from Morton's list of thirteen that is not a plant taxon, the Bryozoa, is the one I mention as an exception in the book. Why this charge remains in his review I can only guess.

From what I have been able to glean, it is Morton who has his facts wrong. However, one may rightly ask the reason why all of this detail is not found in *Creation, Evolution, and Modern Science*. It is that I am *not* writing in *Science, Nature*, or the *Journal of Paleontology*. *Creation, Evolution, and Modern Science* is *not* written to the scientific community. I made this point to Morton when he graciously allowed me a preview of his review. Obviously Morton was not impressed. I believe my statements regarding the Cambrian are accurate though perhaps not as precise as Morton would prefer. It is a longstanding tension in writing on science for the public.

While I found much to disagree with Carl Sagan's world view, I admired his gift of communication. Yet, many of his colleagues in science felt he simplified to such an extent as to be inaccurate. Sagan was frequently imprecise, but usually accurate. Science writing for the general public is a difficult task, constantly balancing accuracy and comprehension. I have been guilty in the past of being so accurate and precise in lectures and articles for

the public that people become impressed, but come away having learned nothing. Obviously Morton believes I have sacrificed accuracy for readability. I disagree.

This also explains why I did not use more references from the scientific literature, which Morton also declares unscholarly. Specifically he derides my extensive use of a cover story from *Time* (December 4, 1995) on the Cambrian explosion. Like it or not, science is rapidly becoming second only to law as a somewhat disreputable profession in the general public. They unfortunately have no interest or inclination to read *Science*, *Nature*, or any other scientific publication. Scholarly precision that leaves the eyes glazed over only exacerbates the problem. I used the *Time* article precisely because people were likely to actually have read it or at least have access to it if they had not. The *Time* piece also committed many of the errors of communicating about evolution to the public that I wanted to discuss and it quoted many scientists more candidly than scientific literature ordinarily does.

Finally, what left me most perplexed about Morton's review was the last sentence. "Unfortunately, as Bohlin told me, a bad review here may help his sales, I fear he is correct." Morton implies I am more interested in sales than in truth. I want to assure the readers of *PSCF* that while I did make the comment to Morton, it was fully intended as a joke. That Morton would represent this good-natured statement as a serious reflection of my attitude was extremely disappointing, as was the entire review.

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On Natural Explanations

In Arthur Hill's denunciation of theistic evolution and its proponents (*PSCF* 53 [March 2001]: 5-6), he criticizes Christians who, when publishing in secular contexts, discuss evolution in terms of natural (Darwinian) mechanisms that make no reference to God. It is instructive to consider the absurdity that results if this view is taken to its logical end. I know several Christian atmospheric scientists. Are they lacking "Christian integrity" when they describe rain in purely natural terms, despite Scripture's teaching (Matt. 5:45) that rain is God's doing? Since God created the stars (Gen. 1:16), shall we disown astronomers who explain star formation in terms of the godless processes of gravity and nuclear physics?

On the issues of rain and star formation, even many opponents of evolution appreciate God's sovereignty over nature and recognize that "natural" scientific descriptions do not entail the absence of God. Yet, when the issue is the development of life, this healthy theology is often discarded and replaced by a semi-deism (what I call the Dawkins/Johnson view) that considers God to be absent unless some gaps are found in which to insert him. This results in misguided efforts to oppose science in order to find room for God. Hill thinks those who work at reconciling science and Christian theology do a poor job of advocating the claims of Christ. While we all could do better in that regard, he should appreciate that many will not even consider the Gospel as long as key stumbling blocks (such as those created by the "God of the Gaps" theology that lurks beneath most Christian anti-evolutionism) remain in the way.

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Response to Lahti's Critique of an Inverted Retina

In reference to David Lahti's comments on my retina paper (*PSCF* 52 [March 2000]: 18–30), I cited only a few of the many reasons why the inverted retina is a superior design compared to the verted retina. Many other examples exist, which space limitations prohibited discussing. Furthermore, the literature clearly shows that Lahti's argument that the existing retina is not the optimal design is incorrect from a theoretical standpoint; in fact, it is the optimal design, both in theory and in fact, given the needs of humans.

To prove that humans do not have an intelligent creator, prominent scientists like Dawkins, Williams, and Diamond use a reverse theological design argument to argue that the verted eye is an excellent example of poor design. Dawkins[1] states that "evidence of telling imperfections" (p. 91) in design is important evidence that no designer (God) exists. His examples include the inverted retina and others such as the flatfish. He concludes that "no sensible designer would have conceived [them]" and that "Octopus eyes are ... more 'sensibly' designed" (pp. 92, 95). Intelligent design theorists use examples of excellent design to prove a designer. Theorists, such as Dawkins, use what they consider poor design to suggest that there could not be an intelligent designer.

The neurologists, ophthalmology researchers, and others that I consulted all mentioned that they thought that the arguments used by Dawkins, Williams, et al. were based on an appalling lack of knowledge about how the human eye functions. I was not able to locate a single qualified retina neurologist who agreed with the claims of poor design—all such statements were made only by evolutionary biologists in an effort to defend their "blind watchmaker" argument.

Lahti's argument that "no one has postulated that eye functionality would improve" if the human eye was verted is not true. Claims made by evolutionary biologists on this matter are not ambiguous. Dawkins et al. have postulated that the inverted retina is inferior, and if it were verted, it would be superior because the putative problems that he has elucidated would not exist. In contrast, it is clear from what is known now that if we had evolved a

verted eye, our vision would *not* be more efficient but less so, as is apparent when the literature on pigment epithelium is reviewed.

As to Lahti's claim that Darwinists "claim that the natural world was designed," design in the common use refers to intelligent design. Of course, Darwinists believe the Earth was "designed" by natural selection, selecting the mutations and genetic variety that maximize survival and reproduction success. Actually, to use the expression natural selection "designed" is like calling the wind blowing around paint an "artist." The phrase "the world was designed by mutations (copying errors)" includes a number of contradictory ideas. Also, contrary to Lahti's statement, biologists have said much about both the purpose and the agent of this design in a metaphysical sense.

I have located hundreds of quotes by prominent evolutionists that make it quite clear that they believe evolution has proved that the Universe has no ultimate purpose, is pointless, and were evolution to occur a thousand times again, it likely never would produce anything like humans or dinosaurs. Furthermore, the agent of this "design" is clearly mutations coupled with natural selection, proving that an intelligent designer does not exist. In my thirty years of reading thousands of books and articles by various evolutionists, I have found that their beliefs and conclusions vary widely, but many, and especially the most prominent evolutionists, quite clearly teach that life has no ultimate purpose except survival and reproduction success.

Although, as Lahti notes, Darwinists generally believe that the extant organisms are the tips of long branches and that no morphological structure on one tip is inherited from that of another, transitional forms would be expected to connect the organisms located on the lower parts of the tree. Furthermore, the primary information we have of what these transition forms might be like comes from extant organisms. As Lahti correctly notes, we have no evidence that the inverted retina evolved from the verted retina, but we also have no evidence that the retina evolved from *any other type of eye* or *pre-eye structure*. In spite of this fact, the many types of eyes that now exist—from the eye spot to the human eye—are lined up hierarchically to support some hypothetical eye evolution (such as that proposed by Dawkins).

Relative to Lahti's claim that the eye evolved numerous times, it often is suggested by evolutionists that the eye evolved approximately thirty separate times—an idea which, although widely held, has faced serious problems as a result of the discovery that the genes coding for the structures that allegedly evolved *separately* often have an extremely high level of homology, thus creating in the minds of some researchers problems with the idea of convergent evolution of the eye and its various structures.

Lahti's statement that "there is absolutely no disagreement in evolutionary biology about these particulars" is quickly shown to be false under the weight of extensive reading. There exists enormous disagreement over *most* of the central ideas in Darwinism. It is therefore difficult to make statements about what "evolutionists believe," because so much disagreement exists among them over even the basic ideas of Darwinism.[2]

Notes

[1]Richard Dawkins, *The Blind Watchmaker* (New York: Norton, 1986).

[2]Kim Sterelny, *Dawkins vs. Gould: Survival of the Fittest* (New York: Totem Books, 2001).

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Relooking at Soul

I would like to thank David Siemens for his remarks (*PSCF* 53 [March 2001]: 69) on my paper "The Salvation of Your Souls" (*PSCF* 52 [December 2000]: 242–54). I agree that when referring to the soul, I should have used the noun *psuche* rather than the verb *psucho*. I note the error is pervasive and I regret it. Nevertheless, it seems plain enough from Siemens' own remarks that *psucho* as to breathe and *psuche* as breath are related, and he himself suggests in the fourth paragraph of his letter that *psuche* derives from *psucho*. In fact, by making that point, he seems to be making mine. Therefore, I fail to see how the detail he raises, important though it is, alters my argument in the least.

Secondly, I do not disagree with Siemens' discussion of Aristotle, but most of what Siemens says is not germane to the argument I construct. Thus I am a bit baffled by his claim that the situation with Aristotle is not quite as I present it. As to whether or not Aristotle said what I claim he said, the passage is peppered with footnotes that interested readers are welcomed to consult.

Thirdly, Siemens argues Aquinas did not originate the notion that there is only one soul in a person, instead he got it from Aristotle. I never claimed that the idea originated with Aquinas. Instead I pointed out in several places that Aquinas borrowed heavily from Augustine (Aquinas is very explicit about this) and that both men viewed the soul as a single thing. As for Aristotle's view of the soul's unity, I do not deny that. When discussing Aristotle's concept of the soul, I use the singular exclusively. However, Aristotle need not be interpreted that way, and many Scholastics imagined the forms of the soul as though they were independent powers.

Again, I thank Siemens for his comments. They were informative, and I think that I and other *PSCF* readers learned something from them.

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