PERSPECTIVES on Science and Christian Faith

JOURNAL OF THE AMERICAN SCIENTIFIC AFFILIATION

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"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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To avoid duplication potential authors *must* send the editor a one page outline. Manuscripts will undergo the usual review-revision process. Shorter papers on narrow themes — chaos or anthropic principle rather than cosmology or ecology — are preferred.

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In This Issue

It has long been argued that the classical notion of purpose in nature received a fatal blow with the work of Darwin. Robert M. Augros offers a scientific critique of this conclusion based on the inadequacies of Darwin's ideas in light of current work in paleontology, genetics, and molecular biology. The testimony of a diverse set of biologists, who view purpose as a distinguishing feature of the *living* from *nonliving*, buttresses his case.

Al Truesdale then sets forth a set of convictions basic to a Christian bioethetic — the value of humankind, individuality and social solidarity, and God and technology. Ignoring these convictions widens the range of the good life between the haves and have-nots, lessens the unitary nature of human life, and substitutes technological values for the relationship between God and man.

Harry Spaling and Annette Dekker argue that the cultural impact of traditional models of development often has destroyed a culture and, less frequently, has led to its revitalization. They elaborate a set of key principles framed by Christian considerations which can underpin a "cultural sustainable development" which values diversity and includes participation and final decision-making by the host culture.

In our closing paper, biochemist Gordon C. Mills considers three recent reports of DNA sequencing of plant and animal material in ancient fossils. He describes the techniques used in these studies and some of the challenges to the validity of particular experimental results and their interpretation. He concludes that these data cannot support either the Darwinian concept of evolution or the change aspect of the punctuated equilibria model of Eldredge and Gould. Rather, he finds these data consistent with a theistic model which he has described in previous issues of *PSCF*.

Richard Bube's *Communication* considers human uniqueness. The *Dialogue* section offers three more responses to the question, "Are evangelical scientists practical atheists?" A large selection of *Book Reviews* and three *Letters* conclude this issue.

Is Nature Purposeful?

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At the intersection of biology, philosophy, and theology stands the question of whether natural things apart from human intervention are purposeful. The author traces the dismissal of purpose from the biological sciences to Darwin. It is then argued that since neo-Darwinism itself is currently criticized from within biology that it is reasonable to reconsider the question of purpose on its own merits. Some evidence for purposefulness in nonliving things is briefly indicated from astronomy and astrophysics. The article concludes with a detailed discussion of the various ways purpose is used in the work of biologists when they account for living things.

Does nature act for an end? Is purposefulness found in natural things apart from human intervention? These are questions of major import for biology, philosophy, and theology. It makes a world of difference in the method of biology whether or not we can assign the purpose of a structure, a material, or a process. The question also has important repercussions for the philosophic investigation of nature. Plato argues that the good is a cause in natural things.[1] Aristotle devotes an entire chapter in his *Physics* to manifesting that nature acts for an end. He also discusses the question at length in his biological treatises.[2] There are implications for theology as well. Natural things acting for an end imply a Mind behind nature directing them to their goals. Thomas Aquinas' famous fifth proof for the existence for God uses the purposefulness of nature as a key premise:

> A fifth way is taken from the governance of things. For we see that some things lacking knowledge, namely natural bodies, act for the sake of a goal. This is clear from the fact that they act always or for the most part so that what results is best, whence it is obvious that it is not by chance but by intention that they reach the goal. But things which do not have knowledge do not tend toward a goal unless they are directed by something knowing and intelligent, as the arrow by the archer. Therefore, there exists an intelligence by which all natural things are ordered to a goal, and this intelligence we call God.[3]

Up to the middle of the nineteenth century, biologists took for granted the purposefulness of nature and adopted the natural theology that followed from it.[4] Since then, however, the purposefulness of living things is thought to have been overthrown by Darwin. Julian Huxley, for example, declares: "At first sight the biological sector seems full of purpose. Organisms are built as if purposefully designed, and work as if in purposeful pursuit of a conscious aim. But the truth lies in those two words 'as if.' As the genius of Darwin showed, the purpose is only an apparent one."[5] Darwin's friend, biologist T. H. Huxley, thought that "teleology ... received its death blow at Mr. Darwin's hands."[6]

This article will argue that nature acts for an end. The article falls into two main parts: the first is a scientific critique of the denial of purpose in biology based on Darwinian claims; and the second is a look at the positive evidence for purposefulness, first in nonliving things and then in living things.

Darwin's Failure to Refute Purpose

If the exclusion of purpose from modern biology relies on Darwin's theory of evolution, then any serious doubt about Darwinian theory will require a reexamination of the status of purpose in biology. However, key features of Neo-Darwinism, espe-

cially gradualism and natural selection, are under serious criticism currently, not from creationists but from within biology itself. I will indicate very briefly some of the difficulties for Darwin arising from paleontology, ecology, genetics, and molecular biology. Note well that the following critiques aim not at evolution as such but at the specific mechanisms Darwin proposed to account for evolution.

Paleontologists Stanley, Eldredge, and Raup, among others, point out that the fossil record contradicts the gradual shifting of one species to another required by Darwinian theory. The typical pattern is for new species to appear for the first time in the fossil record abruptly, without slow transition, and then to remain stable for long periods without significant change,[7] just the opposite of Darwin's predictions. Stanley declares, "The known fossil record is not, and never has been in accord with gradualism,"[8] a discrepancy that paleontologist Steven Gould calls the trade secret of paleontology.[9]

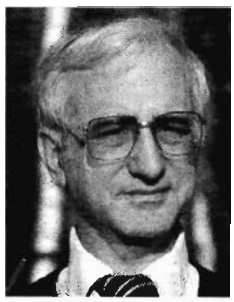
To this may be added the evidence of mass extinctions which have occurred on six occasions according to the fossil record, some of them destroying 90% of all things living at that time. If, as Newell points out, mass extinctions affected quite unrelated groups in different habitats,[10] then the majority of extinctions in the history of life have nothing to do with competition or adaptation as predicted by Darwin but are simply the result of global disasters.

Another central mechanism in Darwin's explanation is undermined by modern ecological studies. Ecologists Simberloff, Kormondy, Messenger, Ricklefs, and Colinvaux, basing their conclusions on hundreds of field studies, declare that in nature competition between species is rare to nonexistent.[11] Eldredge points to the many "ecologists skeptical of the very concept of competition between species ... who claim they simply cannot see any evidence for such raw battling going on nowadays in nature."[12] But if universal competition between species and between individuals is not factual, then Darwin's argument for natural selection fails. Ecological studies have also documented that species regulate their population size without recourse to disaster, predation, and disease as Darwin postulated.[13]

Further, thousands of genetic experiments with fruit flies subjected to X-ray treatments to increase their mutation rate up to 150 times the normal rate failed to confirm Darwin's assumption that the accumulation of small varietal differences will produce organisms differing in species. No new species emerged from any of these experiments.[14] Rather than the unlimited plasticity within each species that Darwin assumed, modern research in genetics indicates that random mutations are either insignificant or lethal.

From molecular biology comes further evidence that when DNA and protein sequences are compared none of the organisms conventionally thought to be transitional are in fact intermediaries. For example, since Darwin, amphibians have been thought to be transitional between fish and reptiles. However, in molecular terms, amphibians are equidistant from fish, reptiles, birds, and mammals. Biologist Michael Denton argues on molecular evidence that plant and animal species do not form a continuum as Darwin thought but are discrete, like the elements in the periodic table. Denton demonstrates that there is no biochemical foundation for claiming that certain extinct groups are ancestors of others. After reviewing the arguments on both sides, he concludes that "the Darwinian theory of evolution is no more or less than the great cosmogenic myth of the twentieth century."[15]

In addition to these difficulties, the Darwinian rejection of purpose falls into logical inconsistencies. Natural selection requires that the reproductive system of a species be functioning correctly, otherwise there would be no way to pass on advantages. But the reproductive system is itself clearly purposeful. Its organs, actions, and processes all aim at a definite goal: the production of new individuals of the spe-



Robert M. Augros received a Ph. D. in philosophy from Laval University in Quebec, Canada. For the past twenty-five years he has been teaching at St. Anselm College in Manchester, New Hampshire, where he is a tenured full professor. He is co-author of two books: The New Story of Science *and* The New Biology, *and many articles. Dr. Augros has given presentations at conferences all over the country on the connections between science and theology.*

cies. It seems, therefore, that natural selection cannot rule out all purposefulness from nature and still function as a mechanism of evolution.

The difficulties in Darwinian theory outlined above are not light or marginal. On the contrary, they attack the essence of the theory in its fundamental premises and in its necessary consequences. Nor can they be dismissed as the fulminations of a few cranks, coming as they do from leading biologists in several disciplines. On the other hand, this cursory review of the difficulties, in no way constitutes a refutation of natural selection.[16] It is offered merely as a sign that Neo-Darwinism is far from a conclusive and rigorous demonstration of the sufficiency of random chance in accounting for the origin and structure of living things. T. H. Huxley claimed, "Teleology ... received its death blow at Mr. Darwin's hands." If the criticisms just outlined are valid, it seems more likely that Darwin's theory may receive its death blow at the hands of modern paleontology, ecology, genetics, and molecular biology. Indeed, paleontologist Steven Jay Gould of Harvard has declared, "The synthetic theory [of evolution] ... as a general proposition, is effectively dead, despite its persistence as textbook orthodoxy."[17] My aim, however, is not to overthrow Darwin, but to open the issue of purpose. Thus, rather than banning purpose from nature on the authority of a theory now being called into question, it seems more reasonable to reconsider the evidence for purpose on its own merits.

Signs of Purpose in Nonliving Things

There is mounting evidence from sciences other than biology that the universe as a whole is purposeful. Contemporary physics and cosmology offer evidence that the universe is uniquely subordinated to the possibility of life. For example, astrophysicist Steven Hawking argues that the present rate of expansion of the universe is critically adjusted to what is needed to have a universe where life is possible.[18] Physicist John A. Wheeler in a similar way argues that the size of our universe had to be what it is in order for heavy elements to occur and hence for life to exist.[19] Astronomer Hugh Ross documents sixteen physical and astronomical features of our universe that appear uniquely designed for life and shows nineteen other delicately-balanced parameters of the planet earth that make it a hospitable environment for living things.[20] Astronomer John Barrow and physicist Frank Tipler, in a comprehensive study of purpose in science, argue that ours is a life-breeding universe.[21] Physicist Freeman Dyson points out that the forces within the nucleus of atoms had to lie within a very limited range to make life possible.[22] So on the small scale and on the very large scale, there is now much probable evidence from physics, chemistry, and cosmology that our universe, its history, and its material laws are uniquely subordinated to the possibility of life. This suggests, quite independently of any evolutionary considerations, the purposefulness of nature on the grandest scale.

Purpose in Living Things

The testimony of eminent biologists concerning purpose is clear and emphatic. Oparin declares that "The universal 'purposiveness' of the organization of living beings is an objective and self-evident fact which cannot be ignored by any thoughtful student of nature."[23] And Ayala agrees: "Teleological explanations cannot be dispensed with in biology, and are therefore distinctive of biology as a natural science."[24] Medawar writes: "Purposiveness is one of the distinguishing characteristics of living things. *Of course* birds build nests in order to house their young and, equally obviously, the enlargement of a second kidney when the first is removed comes about to allow one kidney to do the work formerly done by two." And he adds the example of the "body-wide monitoring system that exists in order to spy out and eradicate malignant variants of the body cells (immunological surveillance)."[25]

Monod compares the eye to a camera, arguing that both have the same purpose of recording images. He declares that purpose "is essential to the very definition of living beings."[26] Sinnott holds that "teleology, far from being unscientific, is implicit in the very nature of the organism."[27] Jacob contends "that structure is inseparable from its purpose."[28] Dobzhansky compares art to nature: "A living body ... is a work of art. Its beauty resides in its internal teleology. The beauty of human artistic creations is imposed by their makers; it is external teleology."[29]

Thorpe points out that purpose opens a line of inquiry unique to the life sciences: "We can ask of the structures in a living organism, just as we can ask of the structures in a man-made machine, what is this for? We can often give fairly exact and plausible answers."[30] Simpson argues that in biology "'What for?'— the dreadful teleological question — not only is legitimate but also must eventually be asked about every vital phenomenon."[31]

The above testimonies are a representative sampling of the majority opinion among eminent biolo-

gists: purpose is a necessary part of the method of biology.

The attempt to drive purpose from biology was encouraged in part by an overzealous desire to imitate the methods of physics. This desire was misguided because purpose is one of the features that distinguishes the life sciences from physics. Physicist Niels Bohr states: "A description of the internal functions of an organism and its reaction to external stimuli often requires the word purposeful, which is foreign to physics and chemistry."[32] Ethologist Niko Tinbergen echoes the same sentiment: "Whereas the physicist or the chemist is not intent on studying the purpose of the phenomena he studies, the biologist has to consider it."[33]

Purpose is a necessary part of the method of biology ... We do not understand a structure if we do not know its function.

On this basis the purposes apparent in living things cannot be dismissed as mere anthropomorphic impositions of the observer. First, we notice that the experts cited above insist that purpose is not an invention of the observer but is in the organisms themselves. They use such phrases as "essential to the very definition of living beings" and "implicit in the very nature of the organism." Second, even committed Darwinians do not deny that purpose *seems* to pervade every aspect of living things, and that the language of purpose is unavoidable in biology, as seen in the quotation from Julian Huxley at the beginning of this article. If, however, purpose were merely a part of the way the human mind must understand things, we should find purpose in every science. But we do not find it in every science. No one feels compelled to use the language of purpose in mathematics. Mathematicians do not strive to discover what prime numbers are *for*. They do not argue that triangles have three points to protect themselves against carnivorous squares. Mathematics is not plagued by an all-pervasive teleology. The same holds for physics and chemistry, as stated above. Therefore, the inevitability of purpose in biology comes not from the human mind but from the special subject matter of biology. Life incorporates genuine goals and purposes.

In biology we do not understand a structure if we do not know its function.[34] Ricklefs maintains that the flatness of leaves is much less intelligible if we do not see what purpose it serves: "Flatness makes the leaf an ideal organ to intercept light, the source of energy for the photosynthetic process of the tree, and for gas and heat exchange with the air. A flat object has a large surface and requires relatively little material for its construction."[35] The efficiency and usefulness of natural structures exemplify their purposefulness. The eggs of the guillemot, a cliff-dwelling sea bird, are pear-shaped. This can be understood most fully only by reference to purpose. Because of this shape, the eggs are incapable of rolling any distance in a straight line. Thus they do not roll off the flat cliff ledges on which the guillemot lays them without a nest.[36]

The best explanation *begins* with purpose. For example, the first thing a student should learn about lungs is that they are organs for breathing, that is, for assimilating oxygen and expelling carbon dioxide. Only then should the lungs' anatomy and physiology be studied, right down to the microstructures, respiratory pigments, and all the details of the necessary chemistry. These details make sense only in view of the purpose of lungs: respiration. Understanding the goal of respiration allows us to understand why the structures exist and why they are necessary.

A striking subordination to an end is found in the temporary structures of many organisms. Tinbergen speaks of the neck muscle in chicks, specially designed to help them hatch: "The chick's initial act in entering the world consists of pushing off the egg's 'lid' through a series of forceful stretching movements of the neck. The special muscle used for this shrinks after it has done its duty."[37] This precise timing makes it difficult to deny that the muscle is specifically designed for one activity. Ricklefs observes that reproductive capacity is delayed in many species until the individual animal has developed sufficient experience and hunting skills.[38] The benefit is obvious. Reproduction itself is also beautifully timed. Ethologist John Crook describes how the Stellar sea lion coordinates conception, implantation, and birth for the benefit of its young:

> The animals roam the oceans for most of the year, then congregate in early summer. Mating occurs soon after the cows have "hauled out" from their year's wanderings and given birth. This is convenient, since otherwise the males and females would have to seek each other over the trackless sea. But only eight months are needed for development of the embryo, and this would mean that births would occur at an unsuitable time [midwinter]. Seal cows "solve" the problem by carrying the fertilized egg within their bodies in a kind of suspended animation. Attachment of the egg to the

uterus — implantation — is delayed until eight months before the ideal time.[!][39]

Another striking subordination is found among molting birds. Ornithologist George Ruppell notes that among birds that must "remain capable of flight during molting, the primaries [flight feathers] are replaced one after another, in a specific sequence."[40] Among plants, many woodland seeds have mechanisms that require the seed "to be chilled for a long time, occasionally two cycles of chill and thaw [before it can germinate] ... Were it not for these mechanisms, a seed might sprout in the warm days of Indian summer or during a February thaw, only to be killed by the return of winter."[41] In all these examples, nature's elegant subordination of means to end is evident.

Purpose works only in and through material, structural, and mechanical causes.

Purpose is also illustrated in countless instances where human beings discover the best way to do something, only later to find that nature has been exploiting the same principle all along. This is particularly frequent in military inventions. Sonar was developed to locate submarines years before ethologist Donald Griffin discovered that bats direct themselves at night by a similar echolocation system. In the same way, helicopter pilots found that if they flew at the proper angle behind another helicopter, they could exploit the resulting updraft and get a more efficient ride. Only subsequently was it recognized that migrating birds have taken advantage of this principle for millions of years by flying in V formation. Again, after camouflage experiments during World War I, the United States Navy found the most concealing color to be omega gray, which has the same optical properties, wavelength, absorption, and reflection as the color of an Antarctic bird, the petrel.[42] This implies that human ingenuity could not have given the petrel a better color for camouflage than it has received from nature. In such instances art imitates nature, either deliberately or unwittingly. But human art is purposeful. Therefore, so is nature.

Acknowledging end or purpose in no way excludes the need to consider other causes. On the contrary, purpose works only in and through material, structural, and mechanical causes. Bohr comments: "The attitudes termed mechanistic and finalistic are not contradictory points of view, but rather exhibit a complementary relationship."[43] Lorenz says the same: "The fact that life processes are directed at aims or goals, and the realization of the other fact that they are, at the same time, determined by causality, not only do not preclude each other but they only make sense in combination."[44] In human actions this is obvious. The goal of the art of medicine is to produce health in the patient. Everything the doctor does is directed to this end. But this orientation to a purpose does not encourage the doctor to ignore the mechanics of health and disease. On the contrary, the more thoroughly he understands these, the more efficacious will be his treatment. With respect to the end, all other causes are means. It is the same in nature. An animal's desire for food would be futile if it did not set into motion activities in the animal that were likely to procure food. The desire is clearly a cause of the activities.

The cause of animal behavior is unintelligible without reference to a goal or purpose. For example, in the presence of a predator a nesting plover puts on a broken-wing display, strongly suggesting injury. In this way it lures the predator hundreds of meters away from the nest and then suddenly flies off, returning to its nest by an indirect route.[45] Although the animal is acting by instinct and does not understand why it acts the way is does; nevertheless, this is clearly goal-oriented behavior.

Other examples abound. Ricklefs explains that the elaborate courtship rituals in certain bird species are to identify a mate of the right species: "Reproductive isolation prevents the formation of unfit hybrids, which are a waste of both time and effort on the part of the parents."[46] Again a clear purpose is served. One sees here also nature's efficiency and economy. The female of the South American arrow poison frog, after bearing a live tadpole, induces it onto her back and then deposits it carefully into water trapped in a bromeliad (a plant related to the pineapple). She later returns to each "aquarium" to lay in it infertile eggs as food for the youngster until it can fend for itself. The spider's web, the beaver's dam, and all animal artifacts also serve evident purposes. In these instances and in countless others, animals clearly act for an end. But animals do not intellectually understand the end as such. They act out of instinct, not grasping the what or the why of things. Therefore, nature, in the cases of instinct, is acting for the sake of something.

The organs of plants and animals also manifest purpose. From simple inspection of the bills and feet of various species of birds, one can infer the special operations they perform to make a living.

No organ can be defined or understood without looking to its purpose, which is the activity it performs. Ayala insists that "a causal [exclusively mechanistic] account of the operation of the eye is satisfactory as far as it goes, but it does not tell all that is relevant about the eye, namely that it serves to see."[47] Tributsch describes a small tropical fish, *Anableps anableps,* that has two sets of eyes, one set specifically designed for seeing in air and the other for seeing underwater.[48] The fish swims along the surface with its upper eyes just out of the water. Thus it can observe simultaneously prey and predators above and below the surface. Hippopotamuses, frogs, and crocodiles can submerge their entire bodies except for their nostrils and eyes. In this way they are well hidden but can still smell and see what is going on around them. Even apparently insignificant features often serve important ends. Hertel points out that the thick hair covering the body of certain moths absorbs high-frequency sound waves so that the moths do not appear on bat sonar.[49] The resemblance, then, between human tools and animal tools is neither chance nor fancy. Biologist Andree Tetry concludes a book devoted to the study of animal tools with these words: "The natural tool bears witness to an incontestable purposefulness ... The tool always carries out ... a determinate and limited task; it attains an end."[50]

Geneticist Lucien Cuenot sums up the marvel of organic design:

> Birds that fly can do so because a thousand details converge: long wing and tail feathers, pneumatic bones, air sacs, breast bone and pectoral muscles, design of the ribs, neck, feet, spinal column, pelvis, automatic hooking of feather barbules, etc. Matisse thinks these features are joined together accidentally and that there is no need to wonder over the result, any more than over the properties of the oxygen or phosphorus atom, manifestations of a structure. I prefer to believe that the bird is made for flying.[51]

Some of the means that nature has invented are surprisingly ingenious. Ricklefs mentions that armadillos avoid inbreeding by giving birth in each litter only to identical quadruplets of the same sex![52] The cicada of North America live most of their lives underground. In the eastern half of the United States, the larvae emerge in adult form to reproduce only in seventeen-year cycles; in the southern states, the cycle is thirteen years. Thirteen and seventeen are prime numbers, so that no potential predator can coordinate its life cycle with the emergence of adult cicadas.[53] The squirting cucumber, through the buildup of internal pressure, can propel its seeds with an initial velocity of thirty-five miles per hour and up to a distance of forty feet.[54] This amazing mechanism guarantees optimal distribution of the seeds to an area where they will not compete with the parent plant for sunlight or nutrients.

Purpose is not present simply here and there in some organisms, it saturates the whole of life at every level.

Purposes abound in living things. Often we can distinguish two or more purposes served by the same organ. The tongue in the human species, for instance, serves for speaking, tasting, and eating. Tree roots absorb water and minerals, and also anchor the tree firmly in the ground. A whale's blubber serves three distinct ends: food storage, buoyancy, and insulation.[55] Energy is stored in the blubber for the whale's long migrations when food might not always be available. The blubber's superior buoyancy neutralizes the weight of the whale's bones and internal organs so that the animal is effectively floating free in the water. The blubber also insulates the whale so efficiently that when the animal is active it must operate a cooling system through its flippers to avoid overheating even in frigid waters. Whale blubber is a marvel of nature's simplicity, economy, and purposefulness. The slime on a fish's body also accomplishes three goals with extraordinary efficiency: it protects against parasites, makes the fish more difficult to seize by predators, and provides a laminar boundary layer around the fish's body, allowing it to move through the water with 45% less effort.[56]

Birds' feathers serve for flight, heat regulation, protection, and ornament. Ruppell writes: "Feathers are wonderfully light objects. Despite their lightness they are sturdy, flexible, and easy to care for; they provide a cushion, a thermal insulation, a water-repellent cover, and most importantly, they are replaceable."[57] Biologist William Montagna lists some of the many ends served by skin:

> It holds in the body's fluids and maintains its integrity by keeping out foreign substances and microorganisms. It acts to ward off the harsh ultraviolet rays of the sun. It incorporates mechanisms that cool the body when it is warm and retard the loss of heat when it is cold. It plays a major role in regulating blood pressure and directing the flow of blood. It embodies the sense of touch. It is the principal organ of sexual attraction. It identifies each individual, by shaping the facial and bodily contours as well as by distinctive marking such as fingerprints.[58]

Blood also has several functions. It transports nutrients to each cell and carries away metabolic wastes; it distributes oxygen throughout the body and transports carbon dioxide away; it repairs injuries and attacks bacterial and viral invaders; and it distributes hormones, the body's internal chemical messengers. The intensity of purpose in these and like instances is remarkable. Purpose is not present simply here and there in some organisms, it saturates the whole of life at every level.

Purpose is so much a part of organisms that it is rash to deny the efficiency of any structure or function in a living thing. For example, one textbook objects that the evaporation of water from tree leaves is excessive and useless. Because of evaporative loss to the atmosphere, a tree must take in 18 times more water than it needs for photosynthesis. The text concludes, "Here is a tremendous loss of water that apparently serves no function."[59]

Further investigation, however, reveals that the prodigious evaporation serves important purposes beyond providing the tree with water for photosynthesis. Evaporation permits leaves to avoid overheating and drying up in hot weather, operating in a way similar to evaporative cooling in animals.[60] As temperatures cool, evaporation automatically diminishes, and as they rise, it increases. Thus there is no excess at all, but a rather precise adjustment to the needs of the tree. Without evaporative cooling, a plant would become as hot as the hood of an automobile parked in the sun on a summer day. Also, if the ground water were never raised and recycled via evaporation in trees and other plants, huge amounts would become irretrievably locked underground. Hence, the evaporated water is not "lost" but, on the contrary, is regained. What at first glance seems to be useless turns out to be beautifully engineered for the benefit of both the tree and the whole ecology.

Considering the perfection of design in living things, it is not surprising that purpose is a principle of prediction and discovery in biology. Belief in purposefulness, writes Cuenot, "has shown a rare fecundity: it is because we thought that every instrument must have an end that we have discovered the roles of organs long considered enigmatic, such as internal secretionary glands."[61] One famous example of the predictive power of purpose was William Harvey's discovery of the circulation of the blood. Anatomical studies showed Harvey that the valves in veins all point in one direction. From his Aristotelian training, Harvey reasoned that nature does nothing without a purpose. Consequently, he hypothesized that the blood must circulate, a hypothesis he later confirmed by experiment and measurement.[62] In a similar way, when Crick and Watson discovered the molecular structure of DNA in 1953, they were able immediately to predict how it replicates.[63]

Conclusion

Purpose permeates every aspect of life. The metabolism of the cell is ordered to the needs of the organism. Growth aims at the completeness of form. The organ-tools of animals and plants, life's capacity for self-repair, and the efficiency of natural structures exemplify purpose. Matter is for the sake of form, and both are for the sake of function. The breadth and depth of evidence, the countless examples, and the testimony of biologists converge on the same conclusion: living things are ordered by purpose. The only thing holding some thinkers back from this conclusion and its theological implications appears to be Neo-Darwinism, a hypothesis itself under considerable criticism from within biology. ✶

Notes

[1]*Phaedo, 97c-99c.*
[2]*Physics II,* 8 and *On The Parts Of Animals I,* 2.
[3]*Summa Theologiae Ia Q.2 art. 3, corpus. My translation.*
[4]For a summary of the history of natural theology in Britain from Boyle to Paley, see *New Interactions Between Theology and Science* (Open University Press, Milton Keynes: 1975), 8-42.
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[12]Eldredge, 82.
[13]V. C. Wynne-Edwards, "Self-Regulating Systems in Populations of Animals," *Science* 147 (26 March 1965): 1543.
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[16]For more thorough argument and documentation of these points see *The New Biology*, Robert Augros and George Stanciu (Boston & London: Shambhala, 1987). For a cri-

tique of Richard Dawkins' arguments against purpose see two articles by Kenneth T. Gallagher: "Dawkins, Darwin, and Design," in *American Catholic Philosophical Quarterly* 47, no. 2; and "Dawkins in Biomorph Land," in *International Philosophical Quarterly* 32, no. 4 (Dec. 1992).

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[21]John D. Barrow and Frank J. Tipler, *The Anthropic Cosmological Principle* (New York: Oxford University Press, 1986), 21.

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[60]David M. Gates, "Heat Transfer in Plants," *Scientific American* 213 (December 1965): 76-84.

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Preface to Bioethics: Some Foundations for a Christian Approach to Bioethics

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Before we construct a Christian bioethic, we must identify Christian convictions that apply directly to the encounter between biotechnology and ethics. All Christians who work on this frontier — ethicists, members of the medical professions, research scientists, and developers of applied biotechnology — share equally in the responsibility to be faithful to those convictions. They share a common responsibility for the integrity and moral content of the Christian faith. In this article, the author discusses three of the many primary Christian convictions that can provide a foundation for a Christian bioethic: (1) the value of human life; (2) individuality and social solidarity; and (3) God and technology.

Christians whose work involves them directly in biotechnology share equally in the responsibility for the moral implications of their work. The ethic developed in response to biotechnology should show that Christians accept and exercise their responsibility. In this paper, I will discuss three primary Christian convictions that can guide us in formulating a Christian bioethic: (1) the value of human life; (2) individuality and social solidarity; and (3) God and technology.

Seldom has an event so challenged Christian ethics as has the emergence of biotechnology. The sheer diversity in the availability and application of biotechnology is daunting enough. Even more challenging is the complexity of the moral questions biotechnology has spawned. Perhaps as never before, Christian ethicists, scientists, and industrialists face a range of moral problems for which the Scriptures and Christian tradition have very few direct answers. Written in pretechnological and prescientific times, the Bible cannot be expected to address directly the thorny moral questions the new reproductive technologies, for example, are generating. However, the Bible is most instructive not as a catalog of answers to moral questions, but as the primary source to learn about God and his relationship to humankind and the rest of creation. By listening carefully to God's Word and being transformed by him, we form virtues that reflect the character of God and that help us think and act in ways that are distinctively Christian.[1]

As Christians we face the danger that our moral responses to biotechnology will not be distinctively Christian. While being morally defensible, our responses may result in little more than a philosophical ethic tinged with a religious flavor, not at all grounded in and informed by the faith we confess. A report of the Working Committee on Church and Society made to the World Council of Churches in 1981 warned against a Christian response to biotechnology that lacks a Christological center and unity. The report called for a bioethic that "makes sense of the claim that Christ is the unity of all life ..."[2] Christian ethicist James Gustafson lamented Christian ethicists who formulate responses to technology and the life sciences not as theologians but as moral philosophers who simply add a religious flavor.[3] To help Christians make sense of their faith in relationship to bioethical decisions, the bioethic must build on primary Christian convictions and then press the moral questions to their deepest levels and widest horizons.

**ASA Associate Member*

Although theologians and ethicists must do most of the theological and intellectual work, scientists and technologists who are Christians also bear responsibility for making clear the relationship between our moral response to biotechnology and our central theological convictions. All of us must give account of whether or not we do our work with clear reference to a Christian estimate of reality. Admittedly, the difficulties are often staggering, but for the sake of Christian integrity nothing less will be acceptable.

Gustafson, among others, has noted that the task for Christians is made more difficult because the problems arise and are defined without any reference to Christian faith. In science, the questions are technical and not theological in nature.[4] They arise in a pluralistic and secular world[5] where no single religion, including Christianity, provides normative answers. Instead, in the public arena the effort is to frame "an understanding of how a society will deport itself in conditions when one view of the good life, or of the nature of man, will not be imposed by force on all."[6] While Christians understand the secularity of the public arena, we also know that responding to biotechnology only as secularists is an unacceptable option.

The standard by which we ought to be judged is not by how successfully we address a pluralistic society, but by how coherently we apply Christian convictions to questions raised in the ever-expanding applications of biotechnology. James Gustafson sums it up well: "[All of us] must help Christians understand technology in the light of their religious faith and convictions."[7]

There are beacons that can guide us in exercising our shared responsibility. Let us identify some primary Christian convictions that help form the foundation for a Christian bioethic. I will state them in their dialectical form.

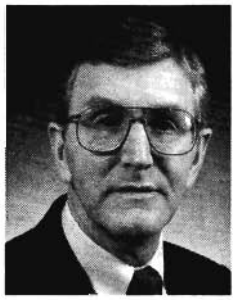
The Value of Human Life

The first Christian conviction is that all human life is of inviolable but not ultimate value. This conviction provides sentinels that guard against both the exploitation and idolization of persons.

Development of this conviction must be prefaced by a Christian affirmation regarding anthropology. For Christians, "human" is first of all a theological category — not a sociological, psychological, or economic one. As Christians our discussion of personhood begins with God who was incarnate in Jesus of Nazareth, the head of the new and true humanity. To be sure, political, biological, sociological, psychological, and economic factors figure prominently in our understanding of personhood. However, for Christians such elements are of lesser significance and must always be referenced to Christ, the ultimate anthropological axis. In *Anthropology of the Old Testament*, Hans Walter Wolff shows that personhood in the Old Testament is characteristically understood dialogically, or referentially. It originates and gains its significance in dialogue with God who is above all. "... man sees himself as called in question, searched out and thus not so much established for what he is as called to new things. Man as he is, is anything but the measure of all things."[8]

That which is uniquely human derives not from being "of the dust of the earth," but from a unique relationship to God who breathes into humankind's nostrils the breath of life. "It is only the breath produced by the Creator that makes [humankind] a living soul, which is to say, therefore, a living being, a living person, a living individual."[9]

While knowing in advance that our anthropological starting point will not satisfy secularist orthodoxy, Christians nevertheless reject the post-Enlightenment practice of defining humanity in autonomous and immanentalist terms.[10] The bioethic we develop must express a direct challenge



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to one founded on atheistic assumptions. We must be wise enough to know the difference.

Now let's turn more directly to the first conviction. The valuation of persons set forth in Scripture contrasts sharply with the valuation that issues from the Enlightenment and eighteenth century democratic philosophy. In the Bible, " ... the value of life is never independent or intrinsically cherishable by itself, for it always remains relative to the providential care and purposeful will of Yahweh."[11] Its value is bestowed, not intrinsic. Christ made known that everyone — despite accidental differences such as gender, race, and social status — is invited to enter the Kingdom by faith and to partake of all its riches. In continuity with the Old Testament, but reaching beyond it, Jesus reaffirmed the inviolable value God places on each person. Therefore, no person should reduce another to a "thing," an exploitable means to an end. Since each person has received inviolable value as God's gift, no one can disregard another's bestowed value without also disregarding the Divine giver. Alfred N. Whitehead referred to the Christian estimate of persons as humankind's "most precious instrument of progress."[12]

All human life is of inviolable but not ultimate value.

That human life is inviolable is the first part of the dialectic. The second part — that human life is not of ultimate significance — saves us from idolatry, a pervasive tendency in modern medicine and technology. In clear disagreement with Fredreich Nietzsche, Sidney Hook, et al., Christians believe that treating human life as autonomously valuable apart from theological considerations cheapens rather than elevates life. The modern worship of the individual as complete apart from God, Donald Shriver says, actually degrades personhood.[13]

From the first conviction, Christians can anticipate implications for bioethics. Because we know that our value before God doesn't depend on mutable circumstances, we can — under certain circumstances — willfully relinquish life without in any way jeopardizing our being valued by God. We don't have to hoard life. It is but one value set within constellations of other values that are also valued, and therefore secured, by God.

The first Christian conviction in its dialectical form will guard against two eminent dangers which face bioethics: (1) to devalue persons because society judges them undesirable, and (2) greedily to consume limited therapeutic resources when they could have a much greater salutary impact on others. Only those who treat human life as of ultimate value need exact its last morsel. Karl Barth stated both parts of the dialectic when he warned Christians against worshiping health even as he urged them to "improve, raise and perhaps radically transform the general living conditions of all men," perhaps even requiring "a new and quite different order of society, guaranteeing better living conditions for all."[14]

Because Christians place a value on human life that transcends the shifting valuations which arise from within mutable society, it saves us from debasing life through idolatrous self-worship. For Christians, both the preservation and surrender of life are transcendently anchored.[15]

Individuality and Social Solidarity

A second foundational Christian conviction is that in the Christian faith the individual is important, but individuality is always understood relationally. Hans Walter Wolff says that in the life of ancient Israel, the individual was always firmly integrated into the bonds of his family and thus of his people. "Wherever he is set apart or isolated, something unusual, if not something threatening, is happening, although it is also ultimately something essential if man is truly to become man."[16]

The second conviction was worked out systematically in Paul Ramsey's covenant-centered Christian ethic. According to Ramsey, God has made a covenant with people who therefore have an obligation to be faithful to that covenant by replicating it in all their relationships with each other. Fidelity to the covenant requires congruent fidelity between persons.[17] Throughout, the biblical narrative constructs a picture of human life as essentially personal and essentially relational. Its unitary quality entails both.

Many Christian theologians and ethicists have developed this central Christian theme. J. Robert Nelson has done so eloquently in *Human Life: A Biblical Perspective for Bioethics*. He explains the relationship between the personal (individual) and social (relational) poles of human existence with reference to the Christian doctrine of the image of God. "Personal relationship in love belongs to the very being of God, from which human community and love derive."[18] Nelson borrows from Karl Barth's Trinitarian idea that human beings constitute a parable of the divine nature itself, in the sense that authentic humanity requires complementarity among per-

sons. Even gender distinctions have importance that rise above mere biological reproduction. The division of sexes enables human beings to know the most intimate I-thou relationship, which is love. Viewed parabolically, "the personal relation of complementarity between men and women is eternally pre-figured in the communal nature of God, namely, in the mystery of the divine trinity."[19]

A characteristically Christian understanding of individuality is markedly different from the narcissistic and even solipsistic perception of individuality so characteristic of late- and post-modernity. In both the Old and New Testaments, the individual receives one's being *qua individual* only in relationship to others, to the community. As presented in the New Testament, the Christian understanding of the individual is intensely dialectical. The individual *is*, but *is not*, apart from the community. In the New Testament, the church is the creation of God and is far more than the sum of its parts; yet importantly, the *ecclesia* includes its many members, with Christ as its head. The church both *is*, and *is not*, apart from its members.

The Christian understanding of self as socially constituted and corporately united stands against all atomistic and anarchic estimates of selfhood. It fosters awareness of social solidarity and cultivates responsibility. It raises a strong counter voice against the almost unchecked egoism and nationalism that often creep into the development and consumption of biotechnology. A Christian understanding of personhood should incline Christians to think and act with global and neighborly interests that moderate individual ones. For example, Christians should raise a united voice against the maldistribution of medical resources and the inequality of access to health care that exists in developing countries and in the United States. Stewart Kingma explains:

> For vast portions of this part of the world [developing countries], 60-80% of the population do not have reasonable access to even minimal health services, while others in those same countries can readily get good care, including that of the very highest technology. Rural peoples in the developing world suffer from a host of preventable diseases and often cannot avail themselves of the simple techniques of preventive care; at the same time the urban people enjoy the presence of a concentration of doctors, clinics and hospitals. Even the provisions of meeting basic needs, safe water, sanitation, transportation and the like exhibit similar inequalities in distribution.[20]

Commitment to a Christian understanding of personhood should motivate Christians to rise above the egoism and nationalism Kingma describes. It should lead us to place our own claims upon costly and limited medical resources within the context of more universal needs, even to the point of self-sacrifice where necessary.

Lisa S. Cahill has drawn a series of moral correlations that lay out the implications of the second conviction. They stand in a dialectical relationship to each other:

Personal Pole	Corporate Pole
the dignity of the person	distributive justice
the sacredness of life	the common good
an equal respect for all	an option for the poor [the dispossessed]

Cahill thinks that Christians should observe these correlations when we contribute to the development of biotechnology, make bioethical decisions, or participate in shaping social policy.[21] In an appeal that bears directly on Cahill's third set of correlations, David Neff says that when Christians speak regarding bioethics, we must be alert to the special needs of those who cannot care or speak for themselves: the unborn, the catastrophically ill, and the aged and infirmed. "Approaches to bioethics that do not put first the needs of the weak and defenseless must be resisted."[22]

God and Technology

The third Christian conviction that should inform a Christian bioethic arises from what we believe about God's relationship to technology.[23] This conviction is actually a part of the larger topic of Christ and culture.

We cannot neatly summarize the Christian outlook on technology as either optimistic or pessimistic. Christians know as well as anyone that technology can be used for either salutary or destructive ends. We have witnessed too many abuses of technology, and the resultant tragedies, to be naively optimistic. More importantly, our doctrine of original sin predisposes us to be always alert to the likelihood that technology will be conscripted into evil's service. On the other hand, far from thinking of technology and the risks that come with it as inherently evil, the prevailing Christian posture holds that one important dimension of the *imago Dei* evidences itself in the imagination and creativity that research and technology express, although the Fall has negatively impacted that image.

Because we worship God alone and believe that he is creatively and governmentally present in his creation, and because the world for us has been demythologized, we are freed from both a crippling fear and a worship of technology.[24] Jack W. Moore puts it this way, "Humans can be co-workers with God's creative activity in maintaining and improving the patterns and processes of nature." This is, he says, both our right and responsibility.[25] Moore admits that placed against this positive evaluation of technology is a strain in Christian tradition that views the human being as a creature of the universe who should not tamper with its mysteries. God has designed the natural order and we must respect that order to preserve the structures of our humanity.[26] Nevertheless, Moore thinks it is consistently Christian to believe that through research and technology humankind can more richly exercise its stewardship over the creation.

In the Christian faith, the individual is important, but individuality is always understood relationally.

In the biblical sense, a steward must not only conserve what has been given to him or her but also must develop (*oikodomeo*, build further) it. The steward, an administrator who creatively expresses the will of the owner, should return to the master more than was entrusted to him or her.[27] The gains, however, must not occur at the expense of impoverishing the entrusted estate, but in a way that enhances the estate and shows respect for the owner.

For Christians, the lesson is clear. Along with increased technological powers and promise come increased risks and responsibilities. When technology slips away from its anchorage in transcendent values and becomes an end in itself, it repeats the sin of the tenant farmers Jesus described in Luke 20:9-16. They rejected the owner of the farm at harvest time and attempted by fraudulent means to take the estate for themselves. By contrast, as Christians we believe that the story can turn out differently. The steward can cultivate the farm in a way that honors the owner, respects the estate as belonging to someone else, and generates approval for the farmers.

Because we worship God alone and believe that human creativity is positively related to the creativity of God and to our role as stewards, we believe that technology can serve human, moral, and redemptive ends. On principle, biotechnology is governable by theological and moral standards. At the same time, because of the fallenness of humankind, technology will always be vulnerable to misuse. If Christians must come down on the side of either optimism or pessimism regarding technology, we should be guardedly optimistic, to the extent that we submit technology to regulation by transcendent values.

Paul Tillich's warning is worth recalling: while technological reason is a legitimate and divinely ordained dimension of reason, it must always be governed by ontological reason.[28] Admittedly, when it comes to applying this principle, Christians disagree sharply over how to achieve balance. One area of greatest controversy even among Christians is over the moral boundaries for employing the available array of reproductive technologies.[29]

Especially in the West, where technology always threatens to take on godlike qualities, once a particular form of biotechnology is available, it can bring subtle, powerful pressures to bear on moral reasoning and public policy. The current parliamentary debate in Great Britain over the use of fetal eggs for *in vitro* fertilization is a prime example. From another perspective, Andrew Simons has shown how the idolatry of technology can rule out all responses to suffering other than the technological one. It can powerfully erode a Christian understanding of suffering.[30] In Holland Richard Fenigsen has demonstrated how technology contributed to a subtle social coercion in favor of a national policy on euthanasia. Public pressure increased to a point where the "voluntariness" of euthanasia often became counterfeit and questionable.[31] Nevertheless, while the second Christian conviction entails moral vigilance at every point, it also fosters a creative stewardship of technology.

In each era, culture has presented to the church new opportunities for explaining what it means to say that Jesus is Lord. In each case Christians have had to demonstrate the integrity of the Christian faith. Today, biotechnology offers another challenge and opportunity.[32] ✶

Notes

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[3]James Gustafson, "Theology Confronts Technology and the Life Sciences," *On Moral Medicine: Theological Perspectives*

in Medical Ethics, Steven E. Lammers and Allen Verhey, eds. (Grand Rapids, MI: William B. Eerdmans Publishing Co., 1987), 35-41.

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[5]On the limits of a secularist medical ethic, see Allen Verhey and Steven E. Lammers, "Rediscovering Religious Traditions in Medical Ethics," *Theological Voices in Medical Ethics*, Allen Verhey and Steven E. Lammers, eds. (Grand Rapids, MI: William B. Eerdmans Publishing Co., 1993), 1-6.

[6]Englehardt H. Tristan, "Bioethics in Pluralistic Societies," *Perspectives in Biology and Medicine* 26 no. 1 (Autumn 1982): 64-77.

[7]Gustafson, 41.

[8]Hans Walter Wolff, *Anthropology of the Old Testament*, trans. Margaret Kohl (Philadelphia: Fortress Press, 1974), 3.

[9]Ibid., 22. In his study of Old Testament anthropology, Wolff raises questions that apply directly to biotechnology and to bioethics: "Why does the progress of science and technology not only penetrate into new light but also into new darkness? Why is the misuse of scientific and scholarly knowledge and methods assuming threatening form, not only in the practice of the natural sciences but even in the so-called humanities? Why is research designed for the use of man — in medicine, chemistry, pharmacology, sociology, psychology and theology — suddenly by-passing man altogether?" (ibid.). Attempts to know who man is by looking to the world alone has in the end led to the fundamental being of humankind becoming the most alien dimension of all. Wolff says that there exists an "elemental hunger" to know who a human being is beyond the naturalistic and reductionistic definitions secularity offers. The essence of personhood, he says, is to be found not in the thicket of clever plans and misguided impulses,"but in God's bond with man, and man's bond with God, the Other who enters human history and enquires anew of every fresh generation: 'man, where are you?' and before whom every fresh generation can ask yet again, 'what is man? Who am I?'" (ibid., 1-2).

[10]J. Robert Nelson, *Human Life: A Biblical Perspective for Bioethics* (Philadelphia: Fortress Press, 1984), 57-81. See also Karl Barth, *The Humanity of God* (Richmond, VA.: John Knox Press, 1969). Will Durant was one among many who clearly stated and embraced the secularist anthropology Christians reject: "We [Humanists] are content to be wholly a part of Nature — of the magnificent and impartial panorama that greets our senses and instruments" Will Durant, *The Humanist*, reprinted in *Humanist Ethics*, Morris B. Storer, ed. (Buffalo, NY: Prometheus Books, 1980), 6-9.

[11]Ibid., 66.

[12]Alfred N. Whitehead, *Adventures of Ideas* (New York: The MacMillan Company, 1936), 17.

[13]Donald Shriver, "Inter-relationships of Religion and Medicine," *On Moral Medicine: Theological Perspectives in Medical Ethics*, Steven E. Lammers and Allen Verhey, eds. (Grand Rapids, MI: William B. Eerdmans Publishing Co., 1987), 11.

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[16]Hans Walter Wolff, *Anthropology of the Old Testament*, trans. Margaret Kohl (Philadelphia: Fortress Press, 1974), 214.

[17]Paul Ramsey, *Basic Christian Ethics* (New York: Scribners, 1950).

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[19]Ibid.

[20]Stuart Kingma, "Biomedical Ethics: In Search of Touchstones for Tough Choices," *The Ecumenical Review* 32 no. 3 (July 1980): 273-280.

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[23]See Harman L. Smith and Paul A. Lewis, "A Protestant View of Reproductive Technologies," *Second Opinion* 14 (July 1990): 94-106.

[24]Ibid., 96. Hans Walter Wolff says that the Genesis creation accounts display or presuppose a demythologized world. "All and everything that is to be found in the world is revealed as being in God's creation; consequently, for the man who has grasped this, there is neither a divine earth, nor divine beasts, nor divine constellations, or any other divine spheres basically inaccessible to man. The whole demythologized world can become man's environment, his space for living, something which he can mould" (Wolff, *Anthropology of the Old Testament*, 162).

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[27]J. Goetzmann, "House, Build, Manage, Steward" [*Oikos* and its derivatives], *The New International Dictionary of New Testament Theology*, ed. Colin Brown, Vol. 2 (Grand Rapids, MI: Zondervan Publishing House, 1979), 247-56.

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[31]Richard Fenigsen, "A Case Against Dutch Euthanasia," *Hastings Center Report* 19 no. 1 (January/February 1989): 22-30.

[32]Ibid., 96. Hans Walter Wolff says that the Genesis creation accounts display or presuppose a demythologized world. "All and everything that is to be found in the world is revealed as being in God's creation; consequently, for the man who has grasped this, there is neither a divine earth, nor divine beasts, nor divine constellations, or any other divine spheres basically inaccessible to man. The whole demythologized world can become man's environment, his space for living, something which he can mould" (Wolff, *Anthropology of the Old Testament*, 162).

Cultural Sustainable Development: Concepts and Principles[1]

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All models of development result in cultural change, but culture has not been considered an integral component of mainstream development theory. This has resulted in the marginalization of culture and cultural disintegration. The multidimensional nature of sustainable development provides a framework within which to integrate the cultural dimension. Christian thought on development affirms the diversity of culture and advocates cultural contextualization. These constructs are used to formulate the idea of cultural sustainable development. This implies development that is shaped by — and takes into account its impact on — the shared ideas, beliefs, and values as well as the intellectual, moral, social, and aesthetic standards and practices of a community. Principles of diversity, change, holism, sovereignty, and relativism guide cultural sustainability.

The idea of sustainable development has challenged traditional approaches to development, particularly those based on growth economics. Besides the economic dimension, this idea incorporates environmental and, increasingly, social and political dimensions. Development theorists have embraced sustainable development as a means to collectively achieve the multiple goals of economic well-being, ecological sustainability, and social justice. Sustainable development has conceptual and popular appeal because it integrates various dimensions of development into a unified framework. It combines the notion of development as a process of directed change with the concept of sustaining the multidimensional conditions or forces which perpetuate this change.

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Practitioners of development are, by virtue of their interaction with people of different cultures, involved in the transformation of those cultures. Seemingly innocuous technologies, or ideas, have changed cultures in momentous and unforeseen ways. Changes that have caused cultural disintegration, as well as those that have revitalized a rich cultural heritage, challenge those involved in the process of development to recognize the cultural dimension and to explicitly consider the sustainability of culture.

This paper develops the concept of cultural sustainable development and describes key principles for cultural sustainability. Culture is defined broadly to include every aspect of the day-to-day life of a group of human beings that is transmitted from one

generation to another. Economic transactions, social customs and relationships, political ideologies, artistic expression, language, and religious practices reflect cultural values and behaviors. The focus is on nonwestern, traditional cultures common to people groups of the South, in particular the sustainability of these cultures as they experience intentional cultural intervention in some development effort by institutions of the North (e.g., government agencies, nongovernmental organizations, church mission boards). A basic premise is that development activities that do not respect, accord legitimacy to, or are not formed within the contextual reality of people groups are ultimately not sustainable. Cultural sustainable development implies development that is shaped by — and takes into account its impact on — the shared ideas, beliefs, and values as well as the intellectual, moral, and aesthetic standards of a community.[2]

Various theories of development (e.g., modernization, dependency, global reformism) and culture (e.g., functionalism, evolutionism, relativism) have been advanced. These have been reviewed elsewhere,[3] including criticism from a Christian perspective.[4] Their further appraisal is beyond the scope of this paper. Here we propose the idea of cultural sustainable development. This idea builds on the multidimensional nature of sustainable development which provides a framework to integrate the cultural dimension. It also incorporates constructs from Christian thought on development, particularly notions of cultural diversity and preservation, and cultural contextualization.

This paper contributes to an ongoing dialogue on development and culture among church-based nongovernmental organizations (NGOs). The discussion is aimed primarily at church agencies and other Christian organizations of the North engaged in development work.[5] These institutions often have been accused of elitism and contributing to cultural disintegration, generally more so than their secular counterparts. In addition to acting as agents of western culture, the biblical beliefs that motivate, guide, and accompany their development practice frequently differ fundamentally from beliefs indigenous to many host cultures. While acknowledging these differences and their historical impact on culture, Christian thought on development has long recognized the dimension of culture, and the importance of cultural contextualization. Church development workers often have been at the forefront in acquiring cross-cultural knowledge and skills essential to carrying out and sustaining development work. Christian development thought can contribute to, and also be informed by, the concept of cultural sustainable development.

This paper begins with a brief overview of key forces which are contributing to an increasing awareness of culture in contemporary development theory. Next we outline cultural changes attributable to different models of development. Then from the perspective of culture, we critique sustainable development and Christian thought on development. The final section describes five principles that shape the concept of cultural sustainability.

Culture: An Emerging Awareness

An increased sensitivity to cultural aspects within mainstream development theory can be attributed to the decline and disintegration of those cultures subjected to the forces of "westernization." The shortcomings of past development efforts have challenged development practitioners to broaden their focus to include culture. Besides the lessons of history, two broad forces have influenced the emerging awareness of culture in development thinking: postmodernism and cultural pluralism.

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In postmodern philosophy the focus is no longer on discovering absolutes, but on exploring the relationship between probabilities. Relativity rather than exclusive absolutism has become normative. Postmodern philosophy has pointed out that scientists (and others) are biased not only by their convictions about preferred theories and methods, but also by their metaphysical worldviews. This has led to greater understanding of the ways in which we "create our own realities." Since our interpretations, and the meanings which we attach to what we observe, are dependent on our worldview, it follows then that we cannot absolutize them as truth for all. Such a perspective legitimizes alternative perspectives and worldviews. It contributes directly to the notion of cultural relativity: "... the view that all cultures are of equal value and that its values and behaviors can only be judged using that culture as a frame of reference."[6]

There is much in postmodern relativism that challenges the Christian. Moral or ethical relativism argues that there is no final court of appeal that decides whether one basic moral perspective is better than any other. Christians agree that, humanly speaking, this may be the case, but point out that relativism ignores the absolute existence of God or God's perspective. This does not mean however that divine absolutes are to be identified with a particular cultural perspective or that they apply to every detail of moral life.[7] Relativism has served to sensitize Christians to the subjective realities of people from other cultures. Belief in the existence of a divine perspective thus takes on a less strident, judgmental tone and becomes a matter of dialogue in the search for basic truths and transcultural norms.

The cultural plurality of our global community has not always been affirmed. History is full of examples of cultural elitism in which one group made exclusive claims for itself and condemned others. Recent history has shaped the demand for a recognition and acceptance of pluralism. The world wars in the first half of this century resulted in a greater consciousness of the right of differing cultures and people groups to exist. More recently the struggle for justice of aboriginal peoples everywhere has made us poignantly aware of the power of solidarity in language and spirituality, and of the resilience of culture. Formal recognition of aboriginal peoples and their right to self-determination has supported the notion of cultural plurality.

Increased communication and transportation technology have removed the insulation and isolation of cultures. The existence of "other" cultures can no longer be ignored; surreal images of them are communicated daily and a day's travel can land one in the reality of many cultures quite different from one's own. Due to large migrations of people, western cultures have become increasingly heterogeneous. The multicultural reality of cities and towns makes cultural isolation virtually impossible today. Technological progress, the movement of peoples, and greater global consciousness have compelled individuals and groups to reevaluate their ethnocentric and exclusive stance.

In summary, postmodernism contributes new perspectives of knowledge, and thus also of culture, whereas the acknowledgment of pluralism affirms the value of cultural preservation and cultural diversity. For those involved in the day-to-day reality of development, the challenge is to alter the exclusivity of past paradigms and to create alternative perspectives and approaches that contribute to cultural sustainability.

Models of Development and Cultural Change

Central to the concept of cultural sustainability is an understanding of the process of change. Cultures evolve; and change is inherent in the life process. Cultural change often results from an introduction of new ideas or technology or from ecological or economic change. Cultures, like other systems, tend to seek regularity and equilibrium, but also are faced with contradictions and conflicts.[8] To resolve these, change takes place. Over the last five decades, the highly increased pace of change in most cultures around the world underscores the need to understand the change process.

Cultural change can result from many development approaches. Table 1 shows models of development that are invariably associated with some form of cultural change. These models represent a general historical progression, but all are evident to some degree in contemporary development practice. We will discuss three in detail: imperialism, charity, and institutional.

Imperialism imposes change on a culture (Table 1). The insidious nature of ethnocentrism and neocolonialism is far from outdated and continues to emerge in various forms today. Blatant examples include: a net dollar flow from countries of the South to those of the North, forced resettlement of indigenous people groups, commercial exploitation of rainforests upon which native peoples depend for livelihoods, and international marketing of substances banned in the country of origin (e.g., export

of hazardous wastes). "Colonialism is not just a matter of economic exploitation. It is the organised repression of the cultural life of a people to make them accept other values as superior."[9]

"Charity" no longer enjoys the positive connotations it once did (Table 1). It is now associated with a disdainful paternalism. Change in a culture is assumed, even expected, because of things given. The emphasis is on help in overcoming a deficiency, rather than a genuine response to an immediate need, and thus presumes some arrogance by the giver and shame for the receiver. While contemporary forms of charity (i.e., relief and humanitarian assistance) are justified, such as the distribution of food, clothes, and medicine in disaster relief (e.g., flood, famine, war), the risk is in delayed transition to self-help forms of development. Too frequently, charity creates dependencies and no longer really "helps."[10] This cynicism about charity is based on the harsh realities created by misguided giving. For example, some North American churches and Christian agencies regularly collect and freely donate used clothing to the poor in countries of the South, where it is most often sold by importers, merchants, and market vendors. This intervention based on charity has altered the traditional styles and codes of dress in many cultures, and reorganized subsistence economies dependent on local cloth manufacture.

Institutional development refers to the building and strengthening of indigenous organizations to carry out the development process (Table 1). It recognizes that beneficiaries have a right of determination in the development process. This model is the *modus-operandi* of most church-based development NGOs, and is considered a necessary condition for achieving sustainable development. However, institutional development can contribute to unintended cultural transformation. Western models of institutional development include: organizational structures which are hierarchical and compartmentalized; management systems based on resource allocation, performance indicators, and results; and decision making characterized by authority of position. Development workers may also convey the agency culture or internal values of their employing

Table 1. **Models of Development and Cultural Change**

Model	Type of Change	Example	Implications for Cultural Sustainability
Imperialism	change is imposed or forced	colonialism, conditional aid, militaristic peacemaking	coerced acculturation, cultural homogeneity, loss/extermination of indigenous values and social organization
Charity	change is a "given" because of things given	relief and humanitarian assistance	loss/destruction of indigenous adaptation strategies and increasing reliance on externally-dependent coping mechanisms
Modernization	change is planned *for* others for their supposed benefit	mega-projects, multinationalism, basic needs development projects	notions of progress as material well-being and individualism, problems of elitism and equitable distribution of benefits, culture is given secondary status
Institutional	change is controlled by participants but guided by western ideologies and values	local organizational development, partnership strategies	cultural transformation via transferral of worldviews and values through institution building
Indigenous	change from within, little interaction with the developed world	indigenous NGOs, bridging organizations, people movements	cultural preservation is valued, cultural change is indigenous, isolation from other cultures

institution: loyalty to the agency, codes of behavior, and relationships between individuals and units within the agency. This contrasts, for example, with indigenous structures in Africa that tend to be decentralized along tribal, village, and clan units; use communal and consensual approaches to decision making; and exhibit loyalty to clan/family relationships that often exceeds loyalty to nonindigenous institutions such as government, multinational corporations, and international NGOs.[11]

Whatever the model of development, interventions in another culture — whether or not they are accompanied by intentions to change the culture — inevitably result in cultural change.

It is important to recognize that institutional development is not a value-free or neutral process. It could be considered another "Trojan horse" of development: a way of importing western culture into another without seeming to.[12] However, if the values and worldviews of an agency engaged in institutional development are explicitly identified, these can be dealt with in the planning process and partnership strategies.

Whatever the model of development, interventions in another culture — whether or not they are accompanied by intentions to change the culture — inevitably result in cultural change. A challenge is to recognize the impact of development on culture, and to incorporate cultural preservation and the conscious planning of cultural change into development practice.

The Concept of Cultural Sustainable Development

This section develops a conceptual framework of cultural sustainable development. The framework builds on the multidimensional paradigm of sustainable development and views of culture derived from Christian thought on development.

Sustainable Development and Culture

Multiple dimensions characterize the paradigm of sustainable development. Early theoretical frameworks focused on the integration of economic and environmental dimensions.[13] More recently, development theorists have argued for the inclusion of other dimensions into the framework, particularly social and political.[14] Daly and Cobb[15] have made a notable contribution by integrating principles of economics, ecology, and community development.

Practitioners of sustainable development have generally focused on reconciling economic development with environmental conservation. The United Nations in particular has championed the cause of sustainable development through its World Commission on Environment and Development[16] and the Earth Summit in 1992. Government aid agencies have adopted environmental sustainability as a key policy objective of foreign assistance.[17] Nongovernmental organizations have strived to implement community development strategies based on sustainable resource management.[18] Church-based development agencies also have advocated environmental sustainability of development projects, usually within the context of environmental stewardship or earthkeeping.[19]

Given the inherent role of culture in defining, evaluating, and managing economic-environment interactions, the cultural dimension is notably absent from the paradigm of sustainable development. A plausible explanation is that contemporary, western views of sustainable development are still largely guided by modernization theory based on principles of neoclassical economics. This theory subscribes to preconceived western values of rationality, individualism, materialism, and social hierarchy.[20] It emphasizes the secular instead of the religious, the individual in place of community, urban rather than rural, and democratic decision making as opposed to consensus or hierarchical decision making.[21] Development approaches based on modernization frequently confront indigenous cultural values. The resulting degradation of cultures has been widely acknowledged:

> All over the planet, the cultural integrity and vitality of the different human groups find themselves threatened by development strategies which stress economic growth and institutional efficiency at all cost ... Too often the values of the Third World are irredeemably damaged by models of social change based on consumption, competition, acquisition and on the manipulation of human aspirations.[22]

The focus on economic change overrides consideration of the cultural dimension so that culture is marginalized, or even considered an obstacle to development. For example, the concept of private ownership of economic factors of production (e.g., land,

labor, capital) clashes with the notion of communal ownership of resources, pooled labor, and equitable sharing of production that is common to many indigenous societies. Modernization theory focuses on improvements to material well-being and relegates indigenous cultural values and beliefs to the periphery of the development process. The failures of this approach in preserving the cultural integrity of people groups have been well documented.[23]

In spite of almost twenty years of warnings from both indigenous people groups and development professionals, integrating the dimension of culture into the theory and practice of sustainable development is still a new concept. Writings on sustainable development give only fleeting recognition to cultural sustainability.[24] The cultural dimension can be incorporated into the sustainable development framework by recognizing a tripartite relationship among economic, environmental, and cultural dimensions. Within this integrative framework, cultural sustainability means that all people groups have the collective choice to maintain their cultures and, equally important, the collective choice to determine the nature and means of culture change.

The cultural dimension can be incorporated into the sustainable development framework by recognizing a tripartite relationship among economic, environmental, and cultural dimensions.

Culture interacts with other dimensions of the framework. For example, culture-specific views about human-environment interactions determine the acceptability of economic development of natural resources, define tolerable levels of environmental change associated with this development, and guide human responses and adaptations to these economic and environmental changes. Change to any one dimension, or all of the dimensions, may be necessary to achieve cultural sustainable development.

This expanded framework has conceptual appeal, but there is always the risk that one dimension, particularly the economic, becomes predominant. Perhaps a lesson can be learned from the environmental dimension. Pollution, resource depletion, and environmental changes attributable to economic development resulted in procedures for environmental impact assessment of development projects.[25] Although these procedures have mitigated environmental concerns, they have not altered the dominant role of economics in development. Just as modern development responded procedurally to concerns about environmental impacts, it also responded to cultural issues by developing techniques for cultural appraisal.[26] These techniques focus on methodological tools to assess the impact of development on culture, and to access culture to maximize development goals. Cultural appraisal techniques are thus designed to increase sensitivity to cultural change associated with development projects and to ensure "more effective development work," but they do not alter the basic framework or process of development. Cultural sustainable development calls for the full integration of all dimensions in the development process.

Churches, Development, and Culture

Christian thought on development has long recognized that the development worker is a bearer of culture.[27] Views on the influence of church-based development on culture vary however. One view sees development work of church and para-church agencies as overt religious activity which imposes cultural change on indigenous peoples through transformation of their belief systems. This ethnocentric view, most prevalent among governments, international entrepreneurs, and mission agencies during the colonial era, results in the breakdown of indigenous culture and greater cultural homogeneity.[28] We can learn from colonial history by asking how development imposes ethnocentric views today. Are they reflected in conditional or selective aid that ensures a beneficial return to the donor? Is ethnocentrism evident in models of institutional development that pattern organizational structure and authority after western design?

Another perspective recognizes church-sponsored development work as a direct contributor to local economic development, but also an unintentional contributor to social and cultural inequalities. For example, case studies have shown that development projects may contribute to an elitist class of income earners, an influx of outside migrants who depend on the project for necessities (e.g., relief dependency), and aspirations for consumer goods and western gadgetry beyond local purchasing power.[29] Like secular development agencies, church-related NGOs have not always been aware of inequities and indirect cultural changes resulting from well-intentioned development efforts.

Still another viewpoint attributes economic and social benefits of development to direct changes in cultural values, beliefs, and behavior which result from religious change. This viewpoint recognizes the often critical role of belief change which may be necessary for sustained change in other dimensions. For example, Christian medical practice may confront cultures with fatalistic beliefs about illness which hinder primary health care programs. Similarly, cultures damaged by colonialism, or other forms of exploitation (e.g., tribalism, war), may regenerate because of development work which emphasizes individual dignity and self-worth, and communal responsibility based on biblical principles of love for God and fellow humans.[30]

Christian thought on development has contributed several ideas which have important implications for cultural sustainable development.

Through these divergent views and practices, Christian thought on development has contributed several ideas which have important implications for cultural sustainable development. First, there exists, in the basic truths of Scripture, a set of supracultural or universal norms for development that transcends all cultures. These include life sustenance, equity, justice, dignity and self-worth, freedom, and participation.[31] Cultural transformation is subject to these norms.

Second, the diversity of cultures is affirmed:

> It seems that, just as our Creator delights in a vast variety of colors and smells, just as he has brought millions of unique personalities into being, so he has ordained an amazingly wide spectrum of cultures. God has programmed into (people) a capacity for cultural variation that enables us to explore our potential in all its complexity, to increase the richness of his world.[32]

This recognition of cultural diversity implies that different cultures are worthy of preservation because of their created potential.

Third, Christian thought on development has incorporated the notion of cultural contextualization. This means that the host culture is valued and takes precedence over the home culture of the development agency. Every effort is made to minimize the introduction of western culture and to preserve the indigenous culture. This does not imply that church-based development work readily accepts or succumbs to every cultural context, but that its interventions are culturally determined by the active participation of people affected by it. In their search to provide an authentically contextual approach, church development workers have long been vanguards in understanding and successfully living in other cultures.

Toward Cultural Sustainability

In moving toward cultural sustainability, it is crucial to be conscious of five key principles that shape it: diversity, change, holism, sovereignty, and relativity.

Cultural Diversity

Inherent in the promotion of cultural sustainable development is the value of cultural diversity and therefore of cultural preservation. This is an affirmation of both the commonality and the uniqueness of people groups. "The basis of cultural diversity as a value is simply that the human potential is too rich to be expressed adequately in a single form."[33]

In contrast to this affirmation of diversity is the notion of a "global homogeneous culture." Universality, as expressed through such concepts as "one world" or "global village," minimizes diversity for the sake of equality or efficiency. "Whichever way one looks at it, the homogenization of the world is in full swing. A global monoculture spreads like an oil slick over the entire planet."[34]

Evidence of this is the fact that some languages are dying out. When a language dies, an entire culture vanishes, for every language contains its own structure for perceiving and explaining the world. It has often been suggested that linguistic plurality impedes development. A "development" that requires linguistic uniformity or a standardized blueprint for "progress" results in extinct cultures.

Cultural diversity needs to be preserved to enhance the global quality of life. Extinction of cultures and languages diminishes the perspectives on the mystery of God and the forms of relating in community. The loss of any one culture robs all others of sources of knowledge and meaning. Cultural diversity provides a variety of worldviews and information often critical to resolving problems in another culture. For example, the knowledge of

medicines and human-environment relationships apparent in nonwestern cultures has challenged western notions about treatment of disease and environmental management.

Cultural Change

Cultural change is inevitable. The dynamic nature of a culture means that it evolves over time. Change rises from within and also from exposure to the ideas and techniques of other groups. For most cultures around the world, the forces of modernization have increased the pace of change dramatically. The question becomes not whether change in a culture will occur, but how it occurs.

Cultural disintegration is a reality on this planet. All cultures, including our own, have been both enhanced and victimized by the ideas of progress and development. Disintegration, cultural identity crises, and spiritual alienation are as much a "western" phenomena as they are a "third world" one. The western mindset has confused "standard of living" with "quality of life."[35] Along with this debilitating confusion have been the economic injustices of western institutions. Alternatively, many cultures, especially aboriginal ones which are in the process of reclaiming their heritage and setting new directions and goals, are examples of the affirmative aspects of change.

Cultural sustainable development assumes that cultural change is not only inevitable, but also necessary and desirable. There are aspects of all cultures that are either destructive or oppressive, resulting in a lack of harmony between individuals and groups and the creation. Practices such as infanticide, slavery, pollution, and oppression are ultimately harmful and thus, from a universal standpoint, unethical. The recognition that some cultural values violate the integrity of people, groups, or the creation, and thus need to be changed, often provides the impetus for international governmental and nongovernmental action.

Cultural sustainable development recognizes that people groups, through collective choice, determine the nature and the means of cultural change. What is needed is a constructive process which identifies cultural change attributable to specific development models and activities before they are implemented, evaluates this change relative to the values and aspirations of the host culture, and preserves the collective choice of people groups to accept, adapt, or reject the interventions which stimulate the change.

Cultural Holism

Critical to understanding cultural sustainable development is the notion that cultures are holistic and have internal integrity. Cultures are "systems" made up of various parts or "subsystems": economic, political, language, religion, etc. These parts interact so that any change in one subsystem causes change in the others, and therefore alters the system as a whole.[36]

The western mindset has difficulty understanding holism. The tendency is to divide the whole into parts and to focus on them singularly. Modernization assumes that changes in the economic system can be neatly compartmentalized there and any further effect on any other part of the cultural system is negligible. The past focus on economic status of others prevents a recognition of the effects of development on a culture's integrity and vitality as a whole. The segmentation of reality, and the global diffusion of western culture, can result in resistance to narrowly focused development approaches by cultures determined to maintain their unique identity. Cultural holism rejects the singular focus of modernization theory.

Cultural sustainable development recognizes that people groups, through collective choice, determine the nature and the means of cultural change.

Confronted with the consequences of having focused past development efforts almost exclusively along one dimension (i.e., economic), western culture is now faced with the challenge of integrating — and creating harmony among — the multiple dimensions which contribute to sustainable livelihoods among the poor.

Cultural Sovereignty

Cultural sustainable development requires a valuing of the sovereignty or the right to self-determination of people groups and individuals. "It is each people's own culture that must decide what, for them, is a 'good life.' It is culture that instills its rhythm on the life of a community and gives it its direction."[37]

No people should have imposed on them a culture that is alien. Each people group has the collec-

tive choice to determine its own rate of cultural change and to control the process. It also has the right to decide what it wishes to preserve, to change, to adapt, or to transform. If stripped of the right and responsibility to do so, a culture resists in active or passive forms. When resistance is overrun by dominant forces, a culture becomes disoriented and alienated from itself. Still, the intergenerational resilience and survival mechanisms of cultures long oppressed, should arouse awe and respect for the phenomena of culture.

Cultural Relativity

The presence of cultural differences has often resulted in ethnocentrism which leads people to make judgments according to their own cultural standards. The tendency is to see one's own cultural ways and views as "right" and others as "wrong." Cultural relativism suggests that we can understand and evaluate the behavior of others only in the context of their own culture.[38]

Cultural relativity is compared to universal and evolutionary views of culture in Table 2. A universal view holds that cultures are more similar than diverse. Although cultural groups express themselves differently, the commonality of human beings results in a basic homogeneity among cultures. Global community action (e.g., United Nations, Earth Summit, World Council of Churches) is possible under this view. An evolutionary view assumes that cultures evolve through successive stages of development. Cultural diversity is recognized but ranked according to its developmental stage. Ranking of nation states by their quality of life and differentiating stages of institutional development reflects evolutionary views. Cultural relativity holds that while cultures are different they are also equal. Therefore, cultures can be understood but not evaluated outside their own context. Cultural relativity presumes pluralism and contextualization which, for example, have produced multicultural policies, and self-government for aboriginal peoples.

It is important to distinguish between cultural relativity and ethical principles. The realities of life do not allow humans to live in a moral vacuum. Cultural relativity is grounded in the biblical tenets of justice, peace, compassion, freedom, and dignity, and their corresponding rights and responsibilities. These tenets provide a normative framework for each culture to pursue its right to self-determination, and to promote harmony among its people, and people of other cultures.

Conclusion

The concept of cultural sustainable development builds on theoretical constructs derived from the paradigm of sustainable development and Christian thought on development. The multidimensional nature of sustainable development provides a framework to integrate the cultural dimension. Culture is an integral component of human-environment interactions and, thus, also can support the achievement of economic and environmental sustainability. Christian development thought acknowledges a set of supracultural norms rooted in Scripture, affirms the diversity and preservation of cultures, and recognizes the importance of cultural contextualization. Collectively, these constructs constitute the essence of cultural sustainable development.

All models of development inevitably result in cultural change because development is ultimately perceived, defined, and carried out from a culturally-determined worldview. It is incumbent for development practitioners to understand the cultural viewpoint which characterizes their prevailing de-

Table 2. **Three Views of Culture**[39]

	Universalism	Evolutionism	Relativism
Attribute	Cultures are more alike than different. Homogeneity among cultures allows common action.	Cultures evolve from stage to stage. Evaluation of cultures according to an ideal "end" stage.	Cultures are different but equal. Cultures are evaluated within their own context only.
Example	United Nations, Earth Summit, World Council of Churches	United Nations ranking of states; Stages of institutional development	Multi-cultural policy; Aboriginal self-government
Difficulty	Dealing with tension arising from cultural diversity	Ethnocentrism or cultural bias in defining the ideal "end" stage	Lack of normative framework to resolve inter-cultural tensions

velopment model, and to be aware of the cultural changes associated with this model. The missionary tradition of gaining cross-cultural knowledge and skills can help to identify, analyze, and assess cultural changes attributable to various development models.

Development workers can strive for cultural sustainable development by fully integrating cultural sustainability into the goals and processes of development. Cultural sustainability needs to be steadfastly owned by, and explicitly stated as a goal of, Christian development institutions. Because the development process is a major determinant of cultural sustainability, relevant mechanisms of interaction among cultures must be found. These mechanisms must be based on equality of cultures, and the right of each to define and direct change within it. Cultural interaction must follow a model of reciprocity.[40] This presupposes a mutual willingness to entrust one's own culture to the same process of change that one encourages in another.

Christian development thought acknowledges a set of supracultural norms rooted in Scripture, affirms the diversity and preservation of cultures, and recognizes the importance of cultural contextualization.

Cultural sustainable development is guided by the principles of cultural diversity, cultural change, cultural holism, cultural sovereignty, and cultural relativism. These principles are more than simply a cultural appraisal technique focused on individual projects. They need to guide the selection of the development approach. Their implementation may lead to fundamental alterations of development practice to foster certain cultural changes, or to reject approaches associated with undesirable changes.

Tensions and paradoxes among the principles of cultural sustainable development confront the development practitioner. How can one hold that both the preservation of culture and cultural change are valuable? Can one respect the sovereignty of a culture and still be committed to biblical norms of equity and justice? Inevitably, a challenge exists in deciding which specific cultural values are changed to achieve a development goal. For example, it is generally assumed that altering culturally-defined roles of women is acceptable in promoting sustainable forms of economic development. Equality of women is a western value espoused by many development agencies, but it is not shared among all cultures. Similarly, participatory decision making at the grassroots level is presumed to result in sustainable institution building at the community and regional levels, though this type of decision making may be foreign to the host culture. A process is needed to identify cultural attributes and values subject to change and those essential to cultural preservation. This process must include the participation of host cultures and, preferably, final decision-making by that culture.

By incorporating cultural sustainability into development practice, Christian development agencies will learn from lessons of the past and refocus the future. They will also address the sometimes justified accusations of critics, and be in the forefront of development theory and practice. Most importantly, they will contribute to the vitality and integrity of other cultures, and their own. ✶

Notes

[1]This paper is based on the authors' report *Cultural Sustainable Development* (April, 1993) prepared for the "Churches and Development Consultation," NGO Division, Canadian International Development Agency (CIDA), Ottawa. We thank CIDA for permission to prepare this paper.

[2]The definition of culture is adapted from R. Schwader and R. Levine, eds., *Culture Theory: Essays in Mind, Theory and Emotion* (Cambridge: Cambridge University Press, 1984), 67.

[3]See, e.g., D. Butz, S. Lonergan, & B. Smit, "Why International Development Neglects Indigenous Social Reality," *Canadian Journal of Development Studies* 12 (1991): 143-157; C. Geertz, *Interpretation of Cultures* (New York: Basic Books, 1973); R. A. LeVine, "Properties of Culture: An Ethnographic View," in R. Schwader and R. Levine, eds., *Culture Theory: Essays in Mind, Theory and Emotion* (Cambridge: Cambridge University Press, 1984), 67-87; and W. Sachs, *The Development Dictionary: a Guide to Knowledge as Power* (London: Zed Books, 1992).

[4]See, e.g., M. Adeney, "Culture and Planned Change," in V. Samuel & C. Sugden, eds., *The Church in Response to Human Need* (Grand Rapids: Eerdmans, 1987), 62-84; W. Bragg, "From Development to Transformation," in V. Samuel and C. Sugden, eds., *The Church in Response to Human Need* (Grand Rapids: Eerdmans, 1987), 20-51; and D. Kennard, "A Christian Critique of Development Perspectives: Modernization and Dependency," *Journal of the American Scientific Affiliation* 36 (1984): 162-168.

[5]The discussion is also relevant to church agencies and parachurch NGOs of the South (i.e., less developed countries), but the emphasis is on Christian institutions of the North (i.e., more developed countries) because of the historical

influence of western culture on and through these institutions.

[6]W. Gudykunst and Y. Kim, *Communicating with Strangers: An Approach to Intercultural Communication* (Reading, MA: Addison-Wesley, 1984), 97.

[7]R. Mouw, *Distorted Truth: What Every Christian Needs to Know about the Battle for the Mind* (New York: Harper and Row, 1989).

[8]C. Geertz, *Interpretation of Cultures* (New York: Basic Books, 1973) and R. A. LeVine, "Properties of Culture: An Ethnographic View," in R. Schwader and R. Levine, eds., *Culture Theory: Essays in Mind, Theory and Emotion* (Cambridge: Cambridge University Press, 1984), 67-87.

[9]Ashis Nandy in S. J. Samartha, *One Christ — Many Religions: Toward a Revised Christology* (New York: Orbis Books, 1991), 3.

[10]M. Gronemyer, "Helping," in W. Sachs, *The Development Dictionary: A Guide to Knowledge as Power* (London: Zed Books, 1992), 63-69.

[11]D. Leonard, "The Political Realities of African Management," *World Development* 15 (1987): 899-910.

[12]W. Sachs, "Development: A Guide to the Ruins," *The New Internationalist* 232 (1992): 4-27.

[13]See, e.g., E. Barbier, "The Concept of Sustainable Economic Development," *Environmental Conservation* 14 (1987): 101-110 and P. Bartelmas, *Environment and Development* (Boston: Allen and Unwin, 1986).

[14]See, e.g., S. Lélé, "Sustainable Development: A Critical Review," *World Development* 19 (1991): 607-621 and M. Redclift, "The Multiple Dimensions of Sustainable Development," *Geography* 76 (1991): 36-42.

[15]H. Daly and J. Cobb, *For the Common Good: Redirecting the Economy Toward Community, the Environment, and a Sustainable Future* (Boston: Beacon Press, 1989).

[16]WCED (World Commission on Environment and Development), *Our Common Future* (Oxford: Oxford University Press, 1987).

[17]For example, CIDA (Canadian International Development Agency), *CIDA's Policy for Environmental Sustainability* (Ottawa: CIDA, Department of External Affairs, 1992).

[18]For example, N. Yap, "NGOs and Sustainable Development," *International Journal* 45 (1989): 75-105.

[19]For example, G. Prance and C. DeWitt, *Missionary Earthkeeping* (Macon, GA: Mercer University Press, 1992).

[20]D. Kennard, "A Christian Critique of Development Perspectives: Modernization and Dependency," *Journal of the American Scientific Affiliation* 36 (1984): 162-168.

[21]H. Daly and J. Cobb, *For the Common Good: Redirecting the Economy Toward Community, the Environment, and a Sustainable Future* (Boston: Beacon Press, 1989); W. Sachs, *The Development Dictionary: a Guide to Knowledge as Power* (London: Zed Books, 1992); W. Sachs, "Development: A Guide to the Ruins," *The New Internationalist* 232 (1992): 4-27; and T. Verhelst, *No Life Without Roots* (London: Zed Books, 1987).

[22]T. Verhelst, *No Life Without Roots* (London: Zed Books, 1987), 19.

[23]For example, D. Butz, S. Lonergan, and B. Smit, "Why International Development Neglects Indigenous Social Reality," *Canadian Journal of Development Studies* 12 (1991): 143-157; D. Goulet, *The Cruel Choice: a New Concept in the Theory of Development* (New York: Atheneum, 1973); W. Sachs, "Development: A Guide to the Ruins," *The New Internationalist* 232 (1992): 4-27; and T. Verhelst, *No Life Without Roots* (London: Zed Books, 1987).

[24]For example, R. Norgaard, "Sustainable Development: A Co-Evolutionary View," *Futures* 20 (1988): 606-620 and S. Lélé, "Sustainable Development: A Critical Review," *World Development* 19 (1991): 607-621.

[25]For example, A. K. Biswas and Q. Geping, *Environmental Impact Assessment for Developing Countries* (London: United Nations University (Tycooly International), 1987).

[26]For example, G. Cochrane, *The Cultural Appraisal of Development Projects* (New York: Praeger, 1979).

[27]J. Bavinck, *An Introduction to the Science of Missions* (Grand Rapids: Baker, 1960) and V. Samuel and C. Sugden, eds., *The Church in Response to Human Need* (Grand Rapids: Eerdmans, 1987).

[28]For example, A. Dachs, "Missionary Imperialism — The Case of Bechuanaland," *Journal of African History* 13 (1972): 647-658.

[29]L. Weissling, "The Effects of a Religious Mission on Rural Development: A Case Study in Lwawu, Northwest Province, Zambia," *Canadian Journal of African Studies* 24 (1990): 75-96.

[30]For example, L. Goldin and B. Metz, "An Expression of Cultural Change: Invisible Converts to Protestantism among Highland Guatemala Mayas," *Ethnology* 29 (1990): 325-338.

[31]For example, W. Bragg, "From Development to Transformation," in V. Samuel and C. Sugden, eds., *The Church in Response to Human Need* (Grand Rapids: Eerdmans, 1987), 20-51.

[32]M. Adeney, "Culture and Planned Change," in V. Samuel & C. Sugden, eds., *The Church in Response to Human Need* (Grand Rapids: Eerdmans, 1987), 92.

[33]D. Goulet, *The Cruel Choice: a New Concept in the Theory of Development* (New York: Atheneum, 1973), 264.

[34]W. Sachs, *The Development Dictionary: a Guide to Knowledge as Power* (London: Zed Books, 1992), 102.

[35]W. Sachs, "Development: A Guide to the Ruins," *The New Internationalist* 232 (1992): 4-27.

[36]D. Geertz, *Interpretation of Cultures* (New York: Basic Books, 1973).

[37]T. Verhelst, *No Life Without Roots* (London: Zed Books, 1987), 161.

[38]C. Geertz, *Interpretation of Cultures* (New York: Basic Books, 1973) and R. A. LeVine, "Properties of Culture: An Ethnographic View," in R. Schwader and R. Levine, eds., *Culture Theory: Essays in Mind, Theory and Emotion* (Cambridge: Cambridge University Press, 1984), 67-87.

[39]D. Augsberger, *Pastoral Counselling across Cultures* (Philadelphia: Westminster Press, 1986).

[40]This model of reciprocity is developed in a forthcoming paper.

DNA Sequences in Miocene and Oligo-Miocene Fossils: Their Significance to Evolutionary Theory

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Three reports of sequencing DNA isolated from ancient fossils have recently been published. Two of these reports describe sequences of DNA from plant chloroplasts in 17-20 million-year-old fossils found in Miocene sediments in Clarkia, Idaho. The third report provides a sequence for a DNA segment from a 25-30 million-year-old termite imbedded in amber. The DNAs of the fossil plants code for a subunit of an important chloroplast enzyme and the DNA of the fossil termite codes for a portion of a ribosomal RNA. In this paper, the author critiques the chemical and biological value of these studies and their significance to Darwinian evolutionary theory, the theory of punctuated equilibria, and his theory of theistic evolution.

In the early 1990s, some studies on DNA sequences in 17-20 million-year-old fossils received considerable media attention. Fairly long segments of DNA were isolated from chloroplasts of leaves of a magnolia and a bald cypress found in Miocene sediments at Clarkia, Idaho.[1,2] Since then, DNA has been isolated from a fossil termite imbedded in Oligo-Miocene amber from the Dominican Republic.[3] The latter is believed to be 25-30 million years old. In this case, DNA isolated from the termite was somewhat shorter. In both cases, the DNA was informational, coding for a chloroplast enzyme in the two fossil tree leaves (magnolia and bald cypress), and coding for ribosomal RNA in the fossil termite.

Since these findings extend the age of previously studied DNA a thousandfold or more, we should carefully evaluate their significance. Preservation of undamaged DNA in ancient fossils is an extremely unusual occurrence.[4] However, the environmental conditions necessary for preservation appear to have occurred in Clarkia, Idaho sedimentary deposits and in amber trapping of insects. In both cases, differences in DNA sequence of fossil DNA compared to DNA in closely related living species were extremely small. Does this sequencing of fossil DNA provide, as Gould notes "... a striking illustration of the best kind of evidence that we can produce for the factuality of evolution itself"?[5] Or are there other possible interpretations for the significance of these fossil DNA sequencing studies?

When Gould uses the word "evolution," he is referring to it in a fully naturalistic sense, i.e., one where only chance events are considered. I recently proposed a theory of theistic evolution, which suggests a possible mode of action for divine agency that accounts for macroevolutionary change in organisms. This theory points to the need for a provision of *new genetic information* in major processes of change in organisms. I argued strongly that this theory will in no way interfere with scientific investigation and indeed will provide new insight into possible areas of future research.[6] In proposing this theory of theistic evolution, I do *not* wish to limit God's sovereignty or governance over all of his creation. God's sovereignty still extends over all of the physical laws of the created world, including those

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events that I have spoken previously of as being a consequence of chance.

In this paper, I will consider the relationship of fossil DNA research to this theory of theistic evolution as well as to naturalistic theories. I will examine the fossil DNA data carefully, and will make an evaluation of the possible significance of these studies. I will also consider several unanswered questions that should give us cause to avoid unmerited speculation.

Age of Fossils

As a biochemist and molecular biologist, I do not consider myself qualified to assess the accuracy of dating the Miocene Clarkia fossil beds where the magnolia and bald cypress leaves were found or the Oligo-Miocene amber with its imbedded fossil termite. The age of deposits at the Clarkia fossil beds is reported by Golenberg, et al. to be 17-20 million years,[7] and that of Dominican amber by DeSalle, et al. to be 25-30 million years.[8] The papers cited herein give some consideration to evidence for the validity of those dates for the fossils, but I will leave it to others to seriously critique the dates they provide. However, I have used the above ranges of dates in some of my calculations, and results of those calculations would be affected if there are serious errors in dating the fossils.

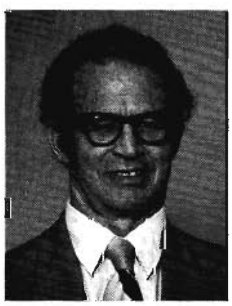
The Significance of Chloroplasts

A few characteristics of chloroplasts merit careful consideration. In earlier examinations of leaves in the Clarkia fossil beds, scientists found that chloroplasts were the best preserved structural component in the leaf cells with over 90% of cells containing intact chloroplasts. From the standpoint of possible DNA isolation, there are thousands of copies of chloroplast genes in each cell, so this would make these genes a much more favorable target for study than nuclear genes. The chloroplast is the organelle within plant cells that is primarily responsible for photosynthesis. In this process, solar energy is trapped and utilized in fixation of carbon dioxide from air into various organic carbon compounds. Like mitochondria, chloroplasts have their own DNA, although the DNA of the plant cell nucleus codes the majority of chloroplast proteins. Chloroplasts of all plants appear to be quite similar.

Ohyama, et al. have sequenced the entire chloroplast DNA of the liverwort *Marchanti polymorpha*.[9] Liverwort chloroplast DNA contains 121,024 nucleotide base pairs. They detected 128 possible genes in the DNA, including genes for four kinds of ribosomal RNA, 32 species of transfer RNA genes, and 55 possible genes for proteins. Clearly, a chloroplast is still extremely complex. Zurawski, et al. note that most of the genetic components of a chloroplast are extremely resistant to change. They estimate that the average rate of change of chloroplast DNA is about one-hundredth that of mitochondrial DNA.[10] Among the genes in chloroplast DNA is the rbcL gene, which codes for the larger subunit of the enzyme ribulose-bis-phosphate carboxylase. This enzyme catalyzes fixation of carbon dioxide and is therefore a very important component in the photosynthetic pathway of plants. The rbcL gene has been sequenced from a variety of plants. It is approximately 1400 nucleotide base pairs in length and is the gene that was isolated and sequenced from fossil leaves of magnolia and bald cypress.

Application of New Techniques — The Polymerase Chain Reaction

The data on the rbcL gene of these two fossil plants are taken from studies of Golenberg et al. for the magnolia,[11] and of Soltis, et al. for the bald cypress.[12] These authors deserve great credit for their careful and painstaking work, first in isolating the chloroplast DNA and in the subsequent sequencing work. However, use of the polymerase chain reaction (PCR), which was developed by others, was essential to this type of study. PCR amplifies an extremely tiny amount of fossil DNA into an amount



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suitable for sequence studies.[13] The starting position of DNA for amplification is selected by using a synthetic nucleotide primer (usually about 30 nucleotides in length) that has a known sequence identical to a segment from a known rbcL gene. This provides a means of selecting only the desired gene for amplification from all other genes in the fossil chloroplast DNA. Using the PCR procedure, the amount of DNA is doubled (presumably with perfectly sequential copies) at each cycle. When twenty or thirty cycles are carried out automatically over a period of several hours, it produces an amount of DNA a millionfold or more greater than the starting material. This amplified DNA is then used for the actual DNA sequencing. In these studies both strands of the initial fossil DNA were amplified by the PCR procedure. This provides an important check on the validity of these studies because the complementary strand would always have a different base in any position than that in the primary strand. The complementary strand also proceeds in the opposite direction and requires a different primer to initiate amplification.

Fossil Gene Sequencing — Are the Results Valid?

One extremely important question regarding the significance of fossil DNA sequence studies is the question of the validity of the studies. Could DNA possibly survive for millions of years without undergoing extensive damage? Initially, this damage might be a consequence of dying tissues, or possibly damage by bacteria or other organisms. Subsequently, damage would be predominantly of a chemical nature and would be dependent upon many environmental conditions such as pH, temperature, presence or lack of water and oxygen, etc. Golenberg, et al. note that the fossil leaves were generally intact and that natural dehydration before abcission may have contributed to preservation. They suggest that the leaves fell into water and sank to colder layers prior to covering with sediment.[14] The most likely types of chemical damage would include cleavages in the DNA chain, removal of individual purines (purine-deoxyribose linkages are particularly sensitive to acid conditions), or modification of adenine, cytosine, or guanine by deamination.

Because I have worked extensively with the various components of DNA, I would be among the first to question whether sequencing of 17-20 million-year-old fossil DNA could possibly give meaningful results. In fact, several papers (e.g., Paabo and Wilson[15] and Lindahl[16]) have challenged the validity of the sequencing studies. In both cases, the challenges were based on the known susceptibility of DNA to chemical modification. The authors postulated certain environmental conditions during the millions of years. After extrapolation of the data, they insisted that no DNA could possibly have survived in the fossil leaves for 17-20 million years. However, as noted by Golenberg, empirical confirmation must take precedence over theoretical objections since the actual environmental conditions during the 17-20 million-year period are not known.[17] Neither Paabo and Wilson nor Lindahl critically evaluated the fossil DNA sequence data.

Use of a 30-base DNA primer in the isolation technique assures the selection of the desired chloroplast gene and eliminates the possibility of contamination by bacterial genes.

With sequencing of the second fossil DNA from a bald cypress,[18] it appears that most of the critics have been silenced. In this case, the fossil bald cypress gene differed by only 11 bases out of 1320 from the corresponding gene of a closely related modern species. None of these 11 bases would produce a change in amino acids of the corresponding rbcL protein. It is very difficult to postulate that results such as these could be due to an artifact. Artifactual changes would be equally likely to affect each of the three codon positions in DNA. In the bald cypress, all differences occurred in the third position of codons. It is probably true that much of the fossil chloroplast DNA has been damaged or modified over the 17-20 million year period since the leaves were formed, but some undamaged DNA molecules have apparently survived in fossil bald cypress and magnolia leaves. Use of modern isolation and amplification techniques has permitted selection of undamaged molecules for sequencing studies. Use of a 30-base DNA primer in the isolation technique assures the selection of the desired chloroplast gene and eliminates the possibility of contamination by bacterial genes. To be sure, there is still a question whether these techniques may be applied at other paleontological sites, since preservation conditions were unique at the Clarkia, Idaho site. Soltis, et al.[19] and Golenberg[20] indicate, however, that rbcL genes from several other plants have been isolated for study from Clarkia fossil beds.

One type of artifactual change would be deamination of individual bases of fossil DNA since one pyrimidine (cytosine) and both purines (adenine and guanine) have amino groups. However, deamination events at any particular site on a DNA strand would only occur at that site on one of the two strands. For example, if cytosine at a given position was deaminated to form uracil in one strand, the base paired guanine at that position on the other strand would likely be intact. Sequencing of the other strand would show guanine in the base-paired position of that strand. Since the strands go in opposite directions, the base-paired nucleotides in each of the two DNA strands would have different numbers in the linear sequence. One may estimate that up to 25% deamination at a given position on a DNA chain would probably be required before a deamination artifact would be evident. Even then there would be an indication on the sequencing gels of a possible artifact.

A careful study of the data has convinced me that sequenced fossil chloroplast DNA does actually represent the DNA sequence of the fossil leaves when they were first formed.

It is more difficult to predict the consequences of a depurination artifact (loss of adenine or guanine) on the fossil DNA chain, but it seems likely that the effect might be similar to that suggested for deamination. Depurination at any site on one of the chains would not necessarily cause a break in that DNA chain, since the backbone on DNA is made up of alternating phosphate and deoxyribose groups, with the purines and pyrimidines extending inward in the double stranded DNA helix. Depurination appears to make phosphate-deoxyribose linkages more susceptible to breakage, however. The procedures used in isolating DNA for study remove most DNA that is extensively broken. Since purines are always base paired with pyrimidines, the complementary strand of DNA would always have a correct base at any given position. It seems likely that depurination would have to be fairly extensive before errors, such as finding two different bases at a single position on the amplified DNA, would be evident. Golenberg has provided a careful evaluation of criticisms of fossil DNA sequencing studies and has outlined various controls utilized to assure that results are valid.[21] A careful study of the data has convinced me that sequenced fossil chloroplast DNA does actually represent the DNA sequence of the fossil leaves when they were first formed.

Results of Magnolia and Bald Cypress DNA Sequence Studies

Golenberg, et al. sequenced the 759 base segment of the rbcL gene from chloroplasts of a fossil magnolia (*Magnolia latahensis*).[22] This is slightly over 50% of the coding sequence of the larger subunit of the gene for ribulose-bis-phosphate carboxylase (rbcL gene). The above authors compared this DNA sequence with that of the corresponding gene from the most closely related modern species (*Magnolia macrophylla*) and several other related species (*Persea americana* and *Liriodendron tulipifera*). A comparison of the fossil magnolia gene (*M. latahensis*) with the corresponding gene from *M. macrophylla* indicated 17 base differences in the 759 base DNA segment (2.2% difference). Of the 17 differences, 11 were transitions (purine-purine or pyrimidine-pyrimidine) and six were transversions (purine-pyrimidine or pyrimidine-purine). There were no insertions or deletions. Thirteen of the base differences were in the third position of codons and would cause no change in amino acid sequence of the expressed protein. They, therefore, would be called synonymous differences. The other four differences were in the first or second position of codons and would cause amino acid changes in the expressed protein (i.e., they were nonsynonymous differences). Of the four amino acid differences, only one at codon 91, alanine-proline, might be classed as a radical difference. The other differences at codons 95, 97, and 255 respectively were: asparagine-serine, tyrosine-phenylalanine, and valine-isoleucine with the amino acid for the fossil protein listed first. Three of the nonsynonymous differences were grouped closely (codons 91, 95, and 97). They appear to be in a region of the gene that is seen to be quite variable when the same gene is examined in other plant species.[23,24] Therefore, there is a possibility that these nonsynonymous differences might represent a single gene conversion event rather than three separate mutational events.

Soltis, et al. sequenced the 1320 base segment of the rbcL gene from chloroplasts of a fossil bald cypress and from the same species of a living bald cypress (*Taxodium distichum*).[25] This sequence constitutes about 92% of the entire coding sequence for this gene. For comparison, they also sequenced the same gene from another related modern species (*Metasequoia glyptostroboides*). In this case, the DNA sequence of the fossil rbcL gene from the bald cypress

differed from that of the modern gene of the same species in only 11 positions (0.83%). There were no insertions or deletions, and the 11 differences were all transitions in third positions of codons (synonymous differences). Therefore, the proteins expressed by rbcL genes of living and fossil bald cypress would have identical amino acid sequences. For comparison, the fossil bald cypress gene and that of the modern bald cypress both differ from the corresponding *M. glyptostroboides* gene in 38 positions (2.9%). Seven of these base differences would cause amino acid differences in the expressed protein.

The proteins expressed by rbcL genes of living and fossil bald cypress would have identical amino acid sequences.

If we assume — for the purpose of making calculations — that the fossil bald cypress, *T. distichum*, has an ancestral relationship to the corresponding living species, we may calculate a value for the rate of change in nucleotide sequence of the rbcL gene. Likewise, the fossil magnolia species, *M. latahensis*, and the closely related sister species, *M. macrophylla*, may be considered to share a common ancestor, and be separated by a minimum of 17-20 million years. Consequently, we may calculate a maximum value for the rate of change in nucleotide sequence for the rbcL gene of this species. For the bald cypress, we obtain an average change rate for the rbcL gene of 0.4-0.5 synonymous changes per nucleotide site per billion years. For the magnolia, the corresponding maximal value for synonymous changes would be 0.8-1.0 per nucleotide site per billion years. For nonsynonymous changes, the change rate for the bald cypress rbcL gene would be zero, and for the magnolia, a maximal value of 0.3 changes per nucleotide site per billion years.

The data of Zurawski, et al. provide some figures for comparison.[26] They reported 47 synonymous differences and 25 nonsynonymous differences in rbcL genes (1279 bases) of barley and maize. They estimate a divergence date for these two plant species of 50-65 million years. If we assume that half of the synonymous base changes were in the line from the common plant ancestor to maize and the other half were in the line from the common plant ancestor to barley, we obtain an average change rate for the rbcL gene of 0.3-0.4 synonymous nucleotide differences per site per billion years. If we make similar calculations for nonsynonymous changes, the value obtained is 0.15-0.2. None of the above calculated values are corrected for multiple substitutions. It is interesting that the rate of DNA sequence changes based on comparisons of the fossil DNAs with living plant chloroplast DNAs are of the same order of magnitude as the estimates of average change rates calculated from comparisons of DNA sequences in the rbcL genes of maize and barley.

Neither Golenberg, et al.[27] nor Soltis, et al.[28] studied the 5'-noncoding region of the rbcL gene. Most of the short nucleotide sequences that control the expression of genes lie in adjacent noncoding regions. In studies of 5'-noncoding regions of rbcL genes in chloroplasts of barley and maize, Zurawski, et al. noted that insertion/deletion differences were often seen in these gene regions when making comparisons. They noted that other types of changes (single base differences, for example) were less evident in 5'-noncoding regions of these genes than in the third position of codons in coding regions.[29] If we were to study these same 5'-noncoding regions of rbcL genes of fossil cypress and magnolia leaves and their living counterparts, we might learn whether the control regions of these genes were as stable for 17-20 million years as their coding regions.

Studies with Fossil Termite DNA

DeSalle, et al. isolated some DNA from genes that code for ribosomal RNA from both cell nuclei and mitochondria of a 25-30 million-year-old fossil termite (*Mastotermes electrodominicus*) imbedded in amber.[30] This would be informational DNA since these nuclear and mitochondrial DNAs code for nucleotide sequences in RNA used in ribosomal particles of cells. However, the actual function of this ribosomal RNA during translation is not known. After amplification of the isolated fossil termite DNA using the PCR procedure, the amplified DNA was sequenced. The authors provide nucleotide sequences for two fragments of the nuclear gene, designated 18SA (116 bases long) and 18SC (121 bases long), and one fragment of a mitochondrial gene designated 16S (94 bases long). The length of these segments contrasts sharply with the 759 and 1320 bases found for fossil chloroplast genes in leaves of magnolia and bald cypress. DeSalle and coworkers compared the nuclear DNA sequences with that of a closely related living termite (*Mastotermes darwiniensis*) and also with comparable sequences of several other species of termites and related insects (cockroach, mantid, grasshopper, stone fly and fruit fly). The primary thrust of their paper was in providing molecular evidence for phylogenetic relationships of these organisms.

Although the means of preservation of the termite in amber is entirely different from that of the fossil leaves, DeSalle and coworkers note that trapping and encapsulation of an insect in the resinous sap of *Hymenaea* would result in fairly rapid dehydration as isoprene components of the sap polymerize. They also note that bactericidal action of terpenes gives amber its natural embalming characteristics. The authors selected genes coding for ribosomal RNA from both the cell nucleus and mitochondria for study because of the high copy numbers of these genes in each cell. Other workers had previously studied these genes and their work had indicated a high degree of likelihood that useful information could be obtained by sequencing these particular types of DNA.

Clearly, the DNA of the particular nuclear ribosomal gene segment studied ... is very highly conserved.

In their paper, DeSalle and coworkers do not consider the types of artifactual chemical modification of DNA that might have occurred in amber fossils. However, they do very carefully consider the possibility of contamination by bacteria during processing of fossil DNA and in the subsequent amplification of fossil DNA by the PCR procedure.

They also indicate that *M. darwiniensis* appears to be one of the most primitive of 2000 or more described species of termites, and is the only living species of the family *Mastotermitidae*. Other species of the genus *Mastotermes* are extinct and the best preserved fossils are found in amber (e.g., *M. electromexicus*). When the two nuclear gene fragments (18SA and 18SC) of the fossil termite (*M. electrodominicus*) are compared with corresponding fragments of the closely related living termite (*M. darwiniensis*), the DNA sequence differs in only three positions out of a total of 237 (1.3% difference). Using the same type of comparisons, nuclear DNA of the fossil termite differed from two other termites of other genera (*Nasutotermes costalis* and *Zootermopsis nevadensis*) by 3.4% and 4.2%; from a cockroach (*Blaberus sp.*) by 3.8%; from a mantid (*Mantis religiosa*) by 3.8%; from a stone fly (*Pteronarcys sp.*) by 5.5%; from a grasshopper (*Warramaba picta*) by 6.3%; and from a fruit fly (*Drosophila melanogaster*) by 14.3%.

Since the fossil termite, *M. electrodominicus*, and the living termite, *M. darwiniensis*, are closely related sister groups, they may be considered to share a common ancestor. Consequently, the three nucleotide differences in nuclear ribosomal DNA segments may represent the change in 237 bases for this type of DNA for a minimum period of 25-30 million years. Since the genus *Mastotermes* occurs as early as 40 million years ago, the time separating these two species could be even longer. Consequently, the maximum value for the average change per nucleotide site would be 0.4-0.5 per billion years. The value for the termite is not too different from the average nucleotide changes for the rbcL gene of the fossil leaves: a maximal value of 1.1-1.3 per site per billion years for the magnolia, and a value 0.4-0.5 per site per billion years for the bald cypress. Clearly the DNA of the particular nuclear ribosomal gene segment studied by DeSalle and coworkers is very highly conserved.

The relatively small sequence differences in nuclear ribosomal DNA of other closely related insects (based on morphological comparisons) also show that this segment of nuclear ribosomal DNA is highly conserved. In contrast, the mitochondrial ribosomal DNA segment studied in four of the organisms showed much greater differences in DNA sequence. The larger number of differences in mitochondrial ribosomal DNA between the fossil and living termite makes it difficult to provide an assessment of their evolutionary significance. This is due partially to the short length of the DNA sequence studied and partially because the DNA sequence could not be related to any specific ribosomal function. Why should ribosomal DNA that is repeatedly replicated in mitochondria change much more rapidly than that which is replicated in the nucleus? Is it related in some manner to functions of RNA molecules transcribed from mitochondrial DNA genes? Or is it related in some manner to repair mechanisms that prevent modification of nucleotide sequences in genes? The answers to these questions are not evident at the present time.

Significance of Fossil DNA Studies to Evolutionary Theory

DNA sequence studies with these two tree leaf fossils provide very good evidence of the ancestral descent of living bald cypress (*T. distichum*) from the fossil bald cypress (*T. distichum*) that lived 17-20 million years ago. The studies also provide reasonable evidence that the modern magnolia (*M. macrophylla*) and the fossil magnolia (*M. latahensis*) are closely related sister groups that may be considered to share a common ancestor that lived at least 17-20 million years ago. Likewise, the living termite (*M.*

darwiniensis) and the fossil termite (*M. electrodominicus*) are closely related sister groups that share a common ancestor that lived at least 25-30 million years ago.

The ancestral descent that we are dealing with in these cases is clearly of a very limited nature. In the bald cypress, it is ancestral descent within a particular species. In the other two instances (magnolia and termite), it is ancestral descent within a particular genus. After reviewing the data on the bald cypress, Gould notes "... in this case we may be looking at an unbroken and unbranched evolutionary sequence — a true continuity over 20 million years — and the smaller percentage of changes, with no alterations at all in amino acids may record the actual architecture of evolutionary stability."[31] I would agree perfectly with Gould's conclusion to this point.[32] One might even use this case to illustrate the stasis of Eldredge and Gould's punctuated equilibria theory of evolution.[33] Gould then goes on to say, however, that the data represents the "... best kind of evidence that we can produce for the factuality of evolution itself."[34] Can Gould really illustrate the dramatic change aspect of punctuated equilibrium by citing cases of stasis? I believe not.

The fossil DNA studies provide the first direct evidence of average rates of change for some types of DNA within very closely related organisms.

If these studies cannot be interpreted as providing real support for either the Darwinian concept of evolution or the change aspect of the punctuated equilibria concept of Eldredge and Gould, what is their real significance? It is simply that the fossil DNA studies provide the first direct evidence of average rates of change for some types of DNA within very closely related organisms. The studies are important because they provide a new and independent approach. Previous values of average rates of change were dependent upon estimations of organismal relationships and on divergence dates of related species, both of which were often uncertain. It is important to realize that all of the nucleotide differences noted in this study between DNA of fossil organisms and DNA of living species may be explained by point mutations. There is no indication that any of these differences could account for any change in function, particularly when considering the changes in the gene coding for the chloroplast enzyme. At this point in our knowledge of evolutionary biology, the possibility of even minor changes at the species level is far more likely to be a consequence of more extensive changes in an organismal genome (gene crossovers, gene conversions, gene duplications, etc.), than they are to be due to point mutations.

In a recent review of the molecular clock hypothesis,[35] I provided evidence that there is no constant rate of change in the incorporation of mutations into specific proteins of organisms. In that paper, I discussed the types of changes in organismal genomes that may occur because of chance events. Of particular interest are those events that may involve a transfer of genetic information, both within an organism (intraspecies transfer) and from one species to another (interspecies transfer). Within a particular cell, the intraspecies transfer might be a consequence of gene conversions, gene crossovers, gene duplications, etc. In interspecies transfer, movement of plasmid DNA between bacterial cells appears to be fairly common. This transfer process is termed conjugation. In contrast, transfer of genetic information between different species of higher organisms is rare, but there is increasing evidence that it does occur. Usually a viral vector is involved as a carrier of the transferred gene. Also, a number of organisms at various taxonomic levels use symbiont organisms (usually bacteria) in their metabolic processes. These organisms most commonly function extracellularly but sometimes they do act intracellularly. There seems to be no proof that these symbiont organisms transfer their DNA into the host cell genome, however. The transfer of genetic information, either intra- or interspecies, does not produce new genetic information. The types of genetic changes described above are all very likely a consequence of chance events. Indeed they may have a major role in speciation events (microevolution), but it seems very unlikely that they could account for any macroevolutionary events.

Recently I proposed the following theory of theistic evolution to account for macroevolutionary changes: "that in the history of the origin and development of living organisms, at various levels of organization, there has been a continuing provision of new genetic information by an intelligent cause."[36] What is meant by *new* genetic information, how the theory would be related to theories of common ancestry, punctuated equilibria, etc., are considered in some detail in that paper.

It would appear that *developmental* genes would have to be involved in macroevolutionary changes that might account for large morphologic change

in an organism. These developmental genes control the migration and positioning of cells in the formation of various morphologic structures, and the length of time that they act during embryogenesis is under tight control. Some of these genes have a broad specificity and act in a wide variety of organisms while others appear to have very limited specificity. Although some developmental genes might be retained throughout evolutionary history, it appears likely that the provision of new genetic information in these developmental genes would be essential to account for major macroevolutionary change.

Possibilities for Future Research Involving Fossil Genes

Although developmental genes would appear to have the highest potential for involvement in evolutionary change, it seems very unlikely that these particular genes could ever be isolated from fossil leaves or fossilized insects. Only if these developmental genes were present in organelles such as chloroplasts or ribosomes, where many copies of the gene are present per cell, would their isolation from fossils seem possible.

One type of fossil gene study of evolutionary significance that would appear to be possible is to search for genes or gene segments added or lost to the chloroplast genome ...

One type of fossil gene study of evolutionary significance that would appear to be possible is to search for genes or gene segments added or lost to the chloroplast genome in the millions of years separating the fossil DNA from its present day counterpart. Noting an *absent* gene or gene segment in chloroplast DNA of living organisms would not be too difficult to establish, particularly if DNA regions adjacent to the gene or gene segment were sequenced. It would be more difficult to establish whether the absent gene may have been transferred to another position on the chloroplast DNA. Similarly, an *added* gene or gene segment could be established in the same manner, i.e., by sequencing DNA regions at both the 5'- and 3'-ends of a particular coding region. These searches for gain or loss of DNA would provide very important information regarding the extent of transfer of DNA into and out of particular DNA regions of the chloroplast genome during the millions of years separating the fossil leaves from living organisms. This type of study would have more evolutionary significance than a study of possible point mutations in coding regions of genes. Either of the proposed studies involving addition or loss of genes would require the isolation and sequencing of fairly large segments of chloroplast DNA, both the fossil DNA and corresponding DNA of similar living plants. Although the isolation and sequencing of very large fossil chloroplast DNA segments is unlikely, sequencing of overlapping smaller segments could provide the same information regarding the genes.

It would be much more difficult to carry out the types of studies that I have suggested for fossil chloroplast DNA on fossil ribosomal DNA of insects. The reasons for the increased difficulty are: (1) there is a distinct advantage to studying DNA that codes for a functional protein because effects of changes in triplet codes can be more readily assessed; (2) at the present time, fossil nuclear ribosomal DNA segments that have been isolated are much shorter than the isolated fossil chloroplast DNA segments; and (3) possible bacterial contamination of the insect fossils imbedded in amber is a much greater problem since both bacteria and insects have ribosomal DNA.

Theological Implications

Brooke, in his book *Science and Religion: Some Historical Perspectives*, has reviewed attempts by scientists such as T. H. Huxley and Ernst Haeckel to interpret Darwinian evolution in such a manner that there was no longer any need for God. Brooke also reviews carefully views of those who held strongly to a Christian belief and who tried to modify evolutionary theory to make it compatible with their beliefs. He notes that others, both scientists and theologians, rejected Darwinian evolution entirely, particularly after hearing the extreme interpretations of Huxley and Haeckel.[37] A. H. Dupree and F. Gregory, in their chapters in *God and Nature: Historical Essays on the Encounter between Christianity and Science*, also provide insight into views of scientists and theologians of the nineteenth century. They deal particularly with issues such as design, purpose, order, natural law, etc.[38,39]

In this paper, I note that there is no problem in interpreting the fossil DNA studies as being consistent with my proposed theory of theistic evolution. The fossil DNA data provide little support, however, for the gradualism inherent in views of traditional Darwinian evolution, but are consistent with the stasis aspect of Eldredge and Gould's the-

ory of punctuated equilibria. Continuation of studies of fossil DNA of the types described earlier in this paper, in conjunction with studies of corresponding DNA from related living organisms, could provide much valuable information. This information might be consistent with the theory that I have proposed or it might suggest the need for modifications. There are many other possible studies that might indicate whether this theory of theistic evolution will continue to be consistent with experimental evidence, or whether the theory might need to be modified or even rejected.

The fossil DNA studies call attention again to questions regarding resistance of DNA in an organism to change with time. Why do genes for some types of proteins (e.g., fibrinopeptides) appear to change so rapidly, and others, such as chloroplast genes, somatic genes for cytochrome c,[40] and especially genes for histones change so slowly? To what extent do functional constraints of specific proteins have a role in preventing change in the DNA coding for that particular protein? Or do DNA repair mechanisms built into the design of various cells serve as the primary constraint against change in DNA? Does not the information encoded in all genes of living organisms suggest the need for an intelligent designer? Previously I presented arguments that God is involved in some manner as an intelligent cause behind all of life.[41,42] For many of the questions posed above, we have no clear answers at present, but the questions surely merit careful consideration. ✶

Notes

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Communications

Is "Man" Unique?

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A fundamental question that touches on a wide variety of disciplines in science and theology is the simple question, "Is 'man' unique?" There are several ways that this question might be interpreted. Two of these, concerned with life elsewhere in the universe, may be stated: (1) Is there human life elsewhere in the universe? or (2) Is there any kind of intelligent life elsewhere in the universe? These are questions of fact, for which we do not presently have the answer, but concerning which an answer is, in principle, obtainable. If we never encounter human or intelligent life forms from elsewhere in the universe, then our only possible answer to these questions is, "We don't know"; in this case some may choose to add, "For a variety of reasons, we don't think so." If we do encounter such life forms, then our answer is a simple, "Yes." Of course the effect of finding other life forms in the universe with respect to the question, "Is 'man' unique?" depends on the specific meaning we associate with "man" and "unique."

These are not, however, the questions being considered in this communication. Here we focus our attention on the characteristics of the human race on earth, and ask again, "Is 'man' unique?" Or are there other forms, now known or imaginable, that can so closely reproduce the characteristics of the "human race" that it becomes impossible to distinguish between them? The question being addressed is clear to anyone who has watched the android Data on the TV program, *Star Trek: The New Generation*. It is posited that Data is an artificial creature, made by a scientist from lights, switches, and connections, so that to all intents and purposes Data has most of the characteristics of a "human being," although he is lacking in a few of the more emotion-oriented ones. (We get the impression that these could be added if knowledge and desire were great enough.) Creative plots have centered on whether Data should be treated as having "human responsibility" or "human rights," or like a nonhuman machine without moral consequences.

How should we think about the human race? Is it unique for some reasons, and if so what are these reasons? Our answers to these questions can profoundly affect a whole host of genetic and bioethical decisions, as well as fundamental social and theological issues. They are related to the creative activity of God in bringing each life form into being. Our answers also depend in a critical way on the basic definitions we assign to some of the most fundamental words involved in describing the human race, such words as "living," "human," "being," "person," "soul," and "spirit," which are far too often used in a thoughtless and confusing manner. Biological life characterizes all living creatures, human life describes living human beings, personal life describes the characteristics of human life when the individual is capable of exhibiting the properties attributed to selfhood, and spiritual life describes the characteristics of human, personal life when considered in terms of transcendence and its relationship with God. Practical definitions of these concepts have been suggested previously.[1]

Definitions

If we are going to address the question, "Is 'man' unique?" it is essential for us to be clear on what

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we mean by "man" and what we mean by "unique?" We do not attempt here to give an exhaustive philosophical analysis of terms, but to indicate practical definitions consistent with experience that we can use in proceeding with our discussion. By "man" we mean the "human race," that collection of creatures that share a common membership in the species *Homo Sapiens*, whose overall identity is associated with a particular biological type of genetic material. Here the term "human" is an adjective defining the biological identity of the noun it describes, e.g., a human ovum, a human fetus, a human body, a human corpse. A creature is "human" if it is based on "human" genetic material; it is not "human" if it is not.

In common usage, a member of the "human race" is also called "a human being"; this term is often too ambiguous, and the more specific "a human person" is used instead to describe the full characteristics of a living, functioning member of the "human race." Again in keeping with contemporary medical and scientific understanding, as well as insights gained from the Bible, it is common to think of three aspects of a living "human person": (1) those bodily and biological aspects associated with biological structure and genetics, (2) those self-identifying, mental aspects involved in self-consciousness, interpersonal relationships, emotion etc. that are commonly considered as "soulful" characteristics, and finally (3) those spiritual aspects involving relationship with God and the transcendent that are commonly considered as "spiritual" characteristics. Although in many traditional usages, these three aspects have been thought of as three separate entities, it is much more likely that they should be viewed as hierarchical descriptions of different characteristics of a whole human person, a *pneumopsychosomatic* whole. To ask whether "man" is unique is therefore to ask whether the general bodily, soulful, and spiritual properties of a "human person" can be achieved in any other way than the common biologically-based ones of our experience to date.

Possible Alternative

In all of the following cases, it is assumed theologically that any creature produced by one of these alternatives is produced through the creative activity of God, either in a standard or a nonstandard way, rather than by a procedure that rules out the creative activity of God.

(1) To be "unique" might imply that the normal process of fertilization of a human ovum by a human sperm followed by implantation and growth in a human womb is the only possible process by which "man" can be produced.

(2) The concept might be broadened to include any means of reproduction involving a human ovum and sperm, such as *in vitro* fertilization, or *in vitro* fertilization followed by maturing in another womb than that of the mother, or even in a synthetic womb. All of these variations would preserve the basic biological identity of the fetus, defined in the [ovum + sperm] form, and one conclusion would be that the claims that "man is unique" means that "man" can be reproduced in a variety of ways, as long as the biological processes are preserved.

(3) One step away from this would be to consider the case where a human ovum is fertilized by a synthetic sperm, i.e., a sperm "manufactured" in the laboratory from nonliving material, or where a sperm is used to fertilize a synthetic ovum. If it is assumed, as part of the conditions, that the synthetic sperm or the synthetic ovum are ultimately indistinguishable biologically from the naturally-occurring sperm and ovum, it might be concluded that success in bringing a human person into the world in this way would not violate the uniqueness of "man."

(4) This variation can be generalized still further to suppose that it were possible for a scientist to go into the laboratory, and, using "ordinary chemicals" off the shelf, to construct a creature in *exactly* the same way that a mature human person is constructed. In the previous case, we were still relying on "natural" processes to carry forth the fertilization and development of an ovum, whereas in this case we eliminate all traditional processes in achieving our goal, but hypothesize that we are successfully able to produce ultimately a living creature that is biologically indistinguishable from a creature produced in the ordinary way. Does the "uniqueness" of "man" exclude this possibility? Or is it more consistent to view the creature produced in this way as having all the normal human characteristics of bodily biology, soulful identity, and spiritual awareness? Could not this creature indeed be a real "human person" for whom Christ died?

(5) The final step in this consideration is now before us. We assume a major difference in that the creature being constructed in the laboratory is being constructed from a different set of materials and structures. The creature is clearly not a member of *Homo Sapiens* and therefore is not

"human," and has no biological relationship to our usual concept of "man." The question is: "Does our normal concept of soulfulness and spirituality require the involvement of human biological material and structure of a particular kind, or can the same characteristics of the whole being be obtained by the appropriate use of alternative materials and structures?" Is it possible to construct a nonbiological, nonhuman "person" that could be appropriately described in terms of body, soul, and spirit (with meanings similar to those of the usual human biological person)? Could such a nonhuman, nonbiological "person" also be characterized as sinful and in need of a Savior?

Consideration of Cases

Cases (1) and (2) both contain no inputs to the formation of a creature other than the biological fertilization of human ovum by human sperm. No matter what variations are performed on this, and quite independent of the desirability or lack thereof of using any of these specific variations, we may conclude that the mature product of this activity is to be considered without question a "human person."

Cases (3) and (4) include more or less synthetic activity in the formation of the biological entities that then give rise to the final living creature. In both cases, however, and regardless of how unlikely they are to be actually achieved because of the technical difficulties involved, the underlying assumption is that the synthetic entities produced have *exactly* the same biological materials and structure as a "human person" produced by the techniques of (1) and (2). (Of course, if this "*exactly*" does not hold, the conclusion is nullified.) In the belief that the properties of the "person" are the same if the same materials and structures are present, even if the processes used to arrive at these same materials and structures deviate markedly from the "normal" ones, we conclude that the mature product of this activity is also to be considered a "human person."

Case (5) is critically different in that not only are the production techniques radically different from the "normal" ones, but the final product is also radically different from the normal "human person." We are left with the central question: "Is it possible to produce a nonhuman entity using nonbiological material and structures, which exhibits the same personal characteristics as a normal human creature consisting of the standard biological materials and structures?" At the present time, we do not know the answer to this question. If forced to make a conclusion based on current evidence and experience, we might tend to be traditional and give a negative reply: we find it difficult to believe that such a creature can be synthesized that will then possess and exhibit all of the characteristics of a member of the human race, but we cannot be certain.

Identity and Value

Once the issue of identity has been resolved, either in fact or by agreement, there remains an additional issue concerning "value" or "rights." Within the framework of Christian theology, "value" and "rights" are the consequence of the creative intention and act of God in bringing the creature into existence. If it is agreed that a particular creature corresponding to the five cases above is indeed a "human person" by identity, then it follows that the creature should be ascribed the "value" due to a "human person," and "rights" appropriate to a "human person." On the other hand, if it is agreed that a particular creature described above is not a "human person" by identity, it does not follow then that we need ascribe no "value" or "rights" to that creature.

There are other cases where a creature has the potential to become a "human person" but has not yet done this, where a creature was in the past a "human person" but now is one no longer, or where a creature displays so many of the characteristics of a "human person," that it becomes at least socially, and perhaps morally as well, essential to ascribe to it at least most of the "value" and "rights" of an actual human person even though it is not one in terms of some ultimate identity criteria.

Examples of these three types of possibilities may be given as follows. Although a fetus is both alive and human at conception, it requires a process over time (the neocortex, essential for "personal" existence, begins to function only several weeks after birth) for the fetus to become a "human person"; because of the *potential* of the fetus, however, the "value" and "rights" of a "person" are ascribed to it and are honored except in such cases as the "value" and "rights" of an actual "person" may come into legitimate conflict with those of the fetus. Although "personal life" has ceased when a "human person" dies, the resulting human corpse is still treated with an assessment of "value" and "rights" consistent with the memory of the living "human person" it had previously expressed. In both cases failure to attribute at least some measure of "value" and "rights" to the "nonpersonal" mode of existence would threaten treatment of the corresponding future or previous mode of "personal" existence.

If we now consider the third case above, we may well be led to conclude that even if a living creature cannot be considered to be a "human person," still it may be socially and morally incumbent upon us to treat such a creature concerning "value" and "rights" as completely as possible as if "it" were a "human person." This does not mean necessarily that we accept the claim that this living creature "really is identical to a human person," but that any action on our part to withhold "value" or "rights" from this creature would be inconsistent with the observable characteristics of the "nonhuman person," and would necessarily endanger our stand toward the "value" and "rights" of those whom we do accept as "human persons."

Conclusion

We have argued that the specific nonstandard processes that may be involved in the formation of a living creature with all of the body/soul/spirit characteristics of a normal "human person" does not affect identity as a "human person."

We have had to remain open on the question of whether a creature can be formed from totally nonhuman, nonbiological structures, and still possess the characteristics of a "human person," although we are inclined to consider it unlikely.

In a sense we have resolved the dilemma of how to treat a "nonhuman" creature who displays all (or most of) the attributes of a "human person." Even without being able to resolve the dilemma of what category the "nonhuman" creature fits into, we conclude that the more a creature behaves like a "human person," the more we should ascribe to that creature the "value" and "rights" of a "human person." We do this for the sake of the creature, but even more so for the sake of all the other actual "human persons" whose "value" and "rights" would be called into danger if we did not. ✶

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Dialogue

A Credible Faith

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Western culture is undergoing a fundamental ideological transformation. Historically based on Judeo-Christian ideology, scientific methodology, and critical reasoning, it is now migrating toward a culture based on far less reliable guides. Social scientists refer to this trend as "postmodernism."

Modern western societies have advanced technologically far beyond all historical precedents. Advances in medicine, engineering, and agriculture have produced higher standards of living for more individuals than ever before. Scientific methodology has played a critical role in this success, and is thus highly esteemed in western cultures. This esteem is so high that scientific opinions are often more highly regarded than "Judeo-Christian" ones, even among people of faith. And why not? Science has put a man on the moon, split the atom, given us the telephone, television, computer, genetic engineering, and promises to eventually cure all of our medical ills — even to reverse the aging process. Who needs God? Judeo-Christian ideology has given us irrational, intolerant radicals who lead violent crusades, teach that the Earth is flat, deny the existence of dinosaurs, and try to make us feel guilty about everything. Despite its apparent failures, conservative historians correctly argue that the Judeo-Christian ethic has played an essential role in the success of Western culture.[1] Nevertheless, the preference for science over faith is so much a part of our society's structure that the argument carries little sway.

Although the situation is changing, I have been convinced that the preference for science over faith is more prevalent in western culture than many people recognize. One obvious consequence of this preference is the widespread notion that science and religion are fundamentally in conflict, to the degree that it is difficult to reconcile how a person can be both a scientist and a devoted person of faith. Although I find this notion preposterous, it is somewhat understandable given the behavior of scientists and religious leaders.

On the one hand, the general public does not understand what science is, due in large part to the deteriorating state of modern education. The situation is aggravated by scientists who do not consider the listener when making scientific statements. That is, the average listener understands scientists to be sources of objective, absolute facts. He doesn't realize that when a scientist says that he has "proven something," he is really saying, "based on this set of assumptions and this set of data, this explanation is the most probable one offered to date."

On the other hand, we must recognize that some scientists have behaved poorly. Scientists, too, are human. Too many scientists have abused their credibility, making stronger claims than are justified by their data without qualifying them accordingly. They have *presented as fact* conclusions which flow from personal biases rather than from objective data: "expert" witnesses are paid substantially for scientific testimony which incidentally bolsters the client's case, and researchers perform "objective" stud-

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ies which conveniently justify the social/economic agenda of their political/industrial sponsor. The situation has so deteriorated in recent years that scientific societies are now publishing guidelines on ethical scientific behavior and establishing courts to enforce them. Some universities now include a required course on ethical scientific behavior in their curriculum. This situation has not gone unnoticed by the general public, and the credibility of science is lower today than it has been for decades.

As a result, postmodernism is on the rise. Increasingly, individuals are looking to nontraditional means to obtain "truth," such as intuition, mysticism, or psychic phenomena.[2] Sadly, the organized church and practitioners of science have so violated the public trust that they have lost credibility, and society is now obsessing on their failures. Traditional approaches are viewed as inept in the face of persistent problems such as crime, violence, and disease. Cultural relativism, political correctness, revisionist history, pathological science,[3] and alternative medicine are clear symptoms of this postmodernist trend. Although the trend may persist for only a few decades, the long-term consequences of *reimagining*[4] one's faith or reinventing history will be significant. Generations of minds will be ungrounded in rational thought, and the practice of more reliable methodologies will diminish. I don't know how long this damaging trend will persist, but I don't like the view from here.

I personally embrace a paradigm based on Judeo-Christian and scientific foundations, where both are rooted in analytical reasoning and are complementary, yet equally reliable means of knowing. This does not mean that I am not open to new discoveries and ideas; only that I will not assimilate them until they have passed through the same rigorous analytical filters which I have found to be the most reliable. In this synthesis, I evaluate new ideas in the context of history and against the most successful prior paradigms. The rigorous combination of scientific methodology and Christian ideology is not new. Science finds its origins in Christianity. Modern science was born in an environment in which the rigorous pursuit of truth and knowledge was fostered by the church. Unfortunately, the organized church failed then, and persists in mishandling scientific results today. However, foolish behavior by churches does not make Christianity foolish. Likewise, foolish behavior by some scientists does not invalidate the scientific method.

In my personal paradigm, science and Christianity are more than just compatible, they are complementary and mutually supporting. One discipline does not supplant the other, but faith provides the *why* and science the *how.* Albert Einstein also expressed this conviction, writing, "*Science without religion is lame, religion without science is blind.*"[5] Because scientific methodology *presupposes* a physical explanation for all phenomena, scientists who deny the existence of God are actually practicing the *religious* philosophy of Naturalism. Ironically, it is actually more objective to allow for the possibility of supernatural phenomena than not. Conversely, persons of faith who deny empirical conclusions deny that "*the universe is full of logic,*"[6] and require a "God of the gaps" mentality to account for God's constant intervention in physical reality. Thus, when natural explanations are found for events originally considered "miraculous," superstition is exposed and the need for God appears diminished.

Combining faith and science in this way allows each discipline to embellish the other, affecting the other's motivation, not methodology. Thus, I experience the spiritual joy of wonderment when I explore a natural phenomenon with scientific eyes, free to explore *how* nature behaves, undistracted by *why*. The wonderment leads to a sense of humility, which experience has shown is the best way to approach scientific questions. I am then free both to explore *and* appreciate nature. Copernicus expressed this elegantly:

> To know the mighty works of God; to comprehend His wisdom and majesty and power; to appreciate, in degree, the wonderful working of His Laws, surely all this must be a pleasing and acceptable mode of worship to the Most High, to whom ignorance cannot be more grateful than knowledge.[7]

Admittedly, this paradigm is traditional and conservative. It is anchored in critical reasoning, objective observation, and 4000 years of collected history and wisdom. But it is not antiquated. For of what use is a faith that cannot withstand one's own scrutiny? ✶

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Al Eterno Enthusiasmo

Faith, Enthusiasm, and Botany

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"And I attribute that to your faith," said Dan, my department chairman. My enthusiasm for plants and botanical research linked to my faith? I fumbled some hasty response attributing this to a personality trait more than my Christian faith. Dan knew my faith as well as my often irrational excitement about plants. According to him, this enthusiasm had not wavered in the almost quarter century we have been colleagues. Dan saw a link between my botanical zeal and my Christian faith that I didn't.

At a botanical symposium in Cordoba, Spain, just a few weeks earlier, I was presented with the *Al eterno entusiasmo* award. Honored by the recognition, I had failed to see any interplay between enthusiasm and faith. I did not appreciate Dan's comment nor did I see its connection with the Cordoba award until I read the editorial in the June issue of *Perspectives on Science and Christian Faith* (48/2:73) titled, "Are evangelical and scientists practical atheists?" In it, we were challenged to consider "... the question of how ... Christian faith plays a role in ... scientific work."

Okay, I confess. Until recently, I have been operating as a practical atheist. As Mark Noll painfully reminded us is in *Scandal of the Evangelical Mind*, many evangelicals are good, even notable, scientists but few explore the link between their faith and their practice of science. Reasons for that hiatus are many and would be a worthwhile study on their own. Opposition to a personal God, embarrassment by well-meaning, but often ignorant, supporters of a "young earth," and a pervasive mechanistic philosophy are some of the reasons. We all bring our tenets of belief into our science consciously or unconsciously. For me, one outcome of my belief system is enthusiasm.

Embarrassed that I had never considered the question before caused me to ponder it carefully, "What *is* the link between faith and enthusiasm?" At its simplest, I believe my unabashed enthusiasm for plants is because I know, *really* know in my heart of hearts, that these wonderful organisms have been designed by a skillful Creator! And I know that Creator in the person of Jesus Christ! He has given me the opportunity to spend a career engaged with plants, studying their beauty, diversity, and utility.

As an ethnobotanist, I am awed at how plants are used in a multitude of ways by people around the world. My own thrill of discovery has involved research on the bizarre *Hydnora* along the Nile and Sudan that is totally subterranean except for flowers that break through the cracked clay. Also in Africa, I am researching the witchweed of the genus *Striga* that are some of the most refractory problems in subsistence agriculture in the African Sahel. Even after two decades, I am still amazed at their parasitic behavior. Closer to home, I am working with an engaging group of furtive fern allies, *Isoetes*, abundant in parts of the Southeast, yet so poorly known that new species are being discovered. It has been exhilarating to have the responsibility to maintain and restore the northern most stand of longleaf pine. I could go on — and usually do — but the bottom line is that I find something intrinsically interesting in each plant, population, and community. And behind it all, I see the Creator.

Are there biblical patterns for this deep appreciation of plants? Certainly. Although not one of

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the best known biblical characters, Jotham is one of my heroes. Like myself, he lectured on Mount Gerazim. He was addressing a political question; I was a Fulbright Professor at An Najah National University located on the same mountain. In Judges 9:8-15, Jotham outlines the salient features of important plants. To do this, Jotham had to have a knowledge of plants and the enthusiasm to lecture on them.

The greatest student of natural history in the Bible is Solomon. He had a profound appreciation of plants, perhaps inherited from his shepherd father who wrote worshipful psalms about creation. More plants are mentioned in connection with Solomon than anywhere else in the Bible. "He (Solomon) described (Hebrew *dabar*, Greek equivalent is *logos*) plant life, from the Cedar of Lebanon to the hyssop that grows out of the wall" (1 Kings 4:33). *Dabar* implies more than verbal description, it incorporates the idea of speaking with authority and, I would suggest, enthusiasm.

The Lord Jesus spoke about plants and linked them with Solomon. In Luke 12:27, Jesus says that one of the common "lilies" (likely *Anemone coronaria*) was more resplendent than Solomon in *all* his glory! And Solomon was the most glorious king recorded in all of Scripture! Doesn't this imply an appreciation and enthusiasm for this strikingly beautiful but common wildflower?

Ultimately, enthusiasm for the creation leads to worship of the Creator. This is the paramount *eterno entusiasmo*! I am thankful to have been reminded of this and jolted into considering the connection between my faith and the practice of science. ✶

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The Scientist as Christian or Atheist

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No doubt Christians sometimes function as practicing atheists in their work, but there is nothing inherent in the scientific enterprise which requires this. According to Hooykaas, modern science developed as the handmaid of Christian stewardship.[1] Science helped humankind to carry out the religious duty of caring for the creation through better understanding of the world's workings. Along the way some things have gone wrong, however. Today, many believe that science and Christian faith are incompatible. I disagree! God, who reveals himself at many times and in many ways, has left his imprint on all creation and invites us to study it and learn of him.[2] He also calls us to be stewards of creation. Such stewardship is a responsibility which can best be guided by a broad knowledge of creation.

In the discussion which follows, we will consider the role of world views and basic assumptions, ways of knowing, the nature of truth, and the limitations of science. Examples will be taken mainly from psychology since that is the discipline I know best.

Sadly, scientific theory is often confused with the world view of the scientist. This confusion is fostered on many fronts. First, many scientists pass off their world views (or religions) as a part of their science. *Beyond Freedom and Dignity* by B. F. Skinner is a prominent example.[3] Second, many are not well informed about the nature of science, or about the parallels in theology.[4] Third, Satan, the father of lies, has much at stake in encouraging this confusion.

Everyone has a world view. All human intellectual activities, including scientific and theological inquiry, occur in a world view context. World views address the basic questions of life, including what exits (ontology), how it is known (epistemology), who we are as persons (anthropology), and the meaning and purpose of life (theology). All world views are essentially religious.[5] Some make science meaningless.

World views vary in many ways, but can be divided roughly into two groups. The first acknowledges the God of Scripture and is informed to greater or lesser degrees by Christian theology. The second group is alienated from or hostile to God, whether knowingly or not. All scientists and theologians approach their work from a world view. Christians are legitimately concerned about the accuracy or truth of ideas gathered in the context of non-Christian world views. World views are like sand at a picnic — they get into everything.

In some ways modern science is complex. However, the basic elements of science are assumptions, observations, and interpretations. Assumptions are those things believed to be true from the outset. Often unstated, they may not be readily recognized because they are so embedded in the person's world view that he/she is not consciously aware of them. Observations are the data which scientists gather; the scientific method emphasizes precautions to enhance objectivity and minimize risk that data are flawed. In principle there should be agreement about the observations. But to be meaningful, data must be interpreted. Interpretations make sense of data in light of assumptions. While data can be relatively independent of any particular set of assumptions, even data are influenced by theory.[6] Conclusions, interpretations, or theories are profoundly affected by assumptions. Most conflicts about interpretations result from disagreements about assumptions. The emotional intensity surrounding differing interpretations reflects these deeply and dearly held beliefs.

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Theology develops in similar ways. Theologians, too, approach their task with certain assumptions. Scripture, and in some cases other data as well, are interpreted in light of those assumptions. Theological disagreements, which are numerous, reflect subtle to substantial differences in assumptions, differences in the data which the theologians consider, and the resulting differences in conclusions.

Common assumptions among scientists include the assumptions of materialism, naturalist, determinism, evolution, reductionism, and uniformitarianism. Christians object to many of these, proposing assumptions such as creation, free will, and spirituality. However, the assumptions essential to actually do science are much more modest: (1) the world exists and can be known, (2) the world is orderly, predictable or lawful, (3) the methods of science are a suitable approach to knowing the world. On these assumptions there is wide, but not universal, agreement.[7]

Experience, reason, and the scientific method are widely accepted as legitimate ways of knowing, although many in our culture accord science a special place, almost to the denial of experience and reason. More controversial, but affirmed by Christians, is that revelation is also a legitimate source of knowledge. Christians believe there are, in principle, no inherent conflicts among these ways of knowing. Rather, they are complementary and inextricably intertwined. Experience is the beginning point of all human knowing. Reason helps us to organize and make sense of our experience. Science is a formalized method for gathering and interpreting data more carefully and systematically than with ordinary experience. The goal of science is to produce sounder inferences and conclusions that are possible through reasoned exploration of experience alone, though the precise dividing point between experience and science is somewhat arbitrary. Finally, we use reason and hermeneutic principles (a counterpart to the scientific method) to interpret revelation.

All approaches to knowing are concerned with discovering truth. Truth is complicated. Jesus' claim, "I am ... the truth" suggests that truth is person. Truth involves knowing, being, doing, relating, and experiencing. It involves both propositional consistency and coherence, and righteousness and integrity in relationships. To walk in the truth (cf. 3 John 3, 4), as called by God, we must practice truth in all these ways.

We cannot grasp truth fully. All truth as known by humans is limited by God's discretion in revelation and is tainted by the effects of the fall on human knowing. World views inevitably "color" our grasp of truth. Now we "see through a glass darkly" (1 Cor. 13:12). Still, truth may be grasped by Christian and non-Christian alike.[8]

Another complication is that science is based on the logical fallacy of affirming the consequent, thus logical proof is not possible. Rather, science provides probable conclusions. Two kinds of errors are possible: misses and false positives. Misses occur when a relationship or condition is true, but we fail to discover it. False positives involve wrongly concluding that a particular condition or relationship is true. Statistics can be used to limit the risk of false positive conclusions about relationships in our samples, but we can never examine every possible instance of a given sort — past, present, and future. More troublesome, our strategies for limiting false positives increase misses to an unknown degree.

Clearly, Christians may practice science within a Christian world view. Naturally, a Christian world view affects the approaches taken and the conclusions reached. This effect is sometime subtle and other times profound. But truth may be found in the research and theories of non-Christians. Precautions must be taken to avoid accepting conclusions, interpretations, or theories which are untrue, or more precisely, less true — or in the words of C. S. Lewis, "bent." Such precautions must be taken when examining the work of Christian and non-Christian alike, but may understandably be taken more carefully when the person is known to be non-Christian. Comparison with Christian theology, analysis by reason, re-examination of the data, and evaluation with human wisdom are practical strategies for doing so. Humility in the face of our own fallenness and proneness to error is also appropriate in drawing all conclusions! ✶

Notes

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Book Reviews

GOD, THE BIG BANG, AND STEPHEN HAWKING: An Exploration into Origins by David Wilkinson. Crowborough, England: Monarch, 1996 (2nd edition). 176 pages, index. Paperback; £5.99.

Wilkinson, who has his doctorate in Theoretical Astrophysics and is a fellow of the Royal Astronomical Society and a Methodist minister, has written a very accessible book for a popular audience (with helpful charts and humorous illustrations) about cosmology and its relationship to theism. The book assumes that the reader has "little background in science or religion" (p. 11) and is written in light of the issues raised in Stephen Hawking's best-seller, *A Brief History of Time*, such as the universe's origin, the place of a Creator in light of current physics, and the search for a grand unified theory.

The first part of the book offers an excellent, well-summarized outline of developments in scientific thought regarding the universe's origin: how the universe has evolved over 15 billion years, general and special relativity, quantum mechanics, Many Worlds Hypotheses and their problems, chaos theory, the anthropic principle, and much more. This part is fairly noncontroversial.

On the other hand, the latter part of the book, which examines "what the Christian view of God both gives and receives in relation to the scientific view" (p. 22), offers mixed blessings. On the positive side, Wilkinson provides some incisive critiques of Hawking's imaginary time (in which spatial and temporal distinctions are blurred), his "no-boundary condition" (in which there is no beginning in time for the universe), and his attempts at a theory of everything (which turn out to be insufficient to explain *why* the universe is the way it is). Because of the speculative nature of some of Hawking's theories and their lack of wide acceptance, Wilkinson rightly urges caution about taking Hawking as supplying the definitive view on origins and a theory of everything.

He, furthermore, criticizes Hawking for simply *assuming* the universe's intelligibility; for attacking a straw man (or straw God!) — namely, that of deism; and for presupposing an inevitable clash between science and religion (pp. 97-8). However, Wilkinson clearly appreciates much of what Hawking has attempted to do and cites him as being open to the existence of a supreme being (pp. 101, 159).

On the negative side (and all within a few pages!), Wilkinson, first, appears to wrongly attribute to Aquinas a cosmological argument against an uncaused infinite *temporal* regress of events rather than a *simultaneous* series (pp. 91-92). Nor is Wilkinson convinced that we can "prove God" by some cosmological argument (p. 97) or that we can infer God's causing the universe via the Big Bang. Surprisingly, Wilkinson fails to make reference to the persuasive *kalam*-style approach which argues against the existence of an actually infinite series of past events. Although "proofs for God" — a phrase which implies a mathematical certainty — is generally not used by theistic philosophers, I believe it can at least be said that certain versions of the cosmological argument and of the design argument (e.g., regarding the delicately balanced life-permitting conditions of the universe) do render God's existence *much more plausible* than many of the feeble naturalistic attempts to bypass divine creation and design.

Second, Wilkinson oddly sides with Kant when he considers cause and effect to be applicable "within the universe" only (p. 93). But this seems arbitrary, especially for a theist. (What of the creation of angelic beings, for instance?) Moreover, he asserts (again with Kant) that to speak of causes (i.e., efficient ones) "in some way beyond this universe is highly questionable" (p. 93) since causality allegedly implies temporality. But this assumes a *physicalist* approach to causality. Although Wilkinson is correct to argue that the universe was created *with* time (not *in* time), he seems to overlook the fact that a timeless personal agent who is *causally* — not temporally — prior to the space-time order could bring about the first moment.

Third, Wilkinson cedes too much to Hume and Russell on the limits of causality (p. 93), and his question "Why should God be self-explanatory when the universe is not?" (p. 94) is a category mistake. God by definition is necessary and self-sufficient whereas this being so of the universe is hardly obvious. Our universe did not have to exist of necessity (i.e., there are possible worlds in which it doesn't) whereas God necessarily exists in all possible worlds.

In the appendix, Wilkinson refers to some of the difficulties with young-earth creationism: its approach to Genesis 1 overlooks clearly figurative elements in the text, which should not be taken strictly scientifically; that God would create an ostensibly "mature," well-worn-looking universe essentially makes *him* into a deceiver; it wrongly supposes that God must create instantaneously rather than over billions of years; and it denies the work of both Christian and non-Christian scientists. Wilkinson also proposes a level-headed literary, theological (rather than a scientific textbook) approach to Genesis 1 in the face of the many figurative elements in the text itself.

Although Wilkinson's book is problematic in some ways, it reveals an excellent grasp of technical material and is a useful introduction to cosmology, to Hawking's main ideas, and to Christianity's relationship to science (and, more specifically, origins).

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COSMOLOGY: Science and the Meaning of the Universe by John McLeish. North Pomfret, VT: Trafalgar Square (Distributors), 1993. 212 pages, index. $39.95.

Reading how McLeish talks about God and the Bible hurts. The personality, behavior, and talk of Yahweh in the Old Testament horrify McLeish (p. 187). He said that the God portrayed by Christ was different, not a malicious and bad-tempered old man. He also says that Christ's followers were wrong. The story about the tables of law is the quintessence of anthropomorphism (p. 190). Ironically, he refers to Ex. 33:17-23, where the Lord tells Moses that he will not show himself to Moses. Moses may only see his goodness. At the end of the chapter, McLeish tells how God should be.

McLeish tells the story of what "really" happened. "At this stage, the only authority was truth itself, whose credibility was judged by the ordinary person, and by social consensus" (p. 7). It is still the norm in some aboriginal societies, McLeish claims. The history of the sixteenth to eighteenth centuries is very incomplete. What McLeish writes about Jesuits on page 27 is not true for all Jesuits. Sometimes their missionary activity consisted of having heretics killed.

The index is incomplete. For example, the writer refers to the apostle Paul three times, but Paul is not in the index. Occasionally I like to check sources, but due to the lack of references and bibliography that would be a major undertaking.

Because of its anti-Christian bias, I would not use it as a cosmology textbook. I do not recommend this book.

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EINSTEIN'S GREATEST BLUNDER? by Donald Goldsmith. Cambridge, MA: Harvard University Press, 1995. 216 pages with index. Hardcover; $22.95.

Einstein called his introduction of a "cosmological term" into his gravitational equations his "greatest blunder." Donald Goldsmith, astrophysicist and author of popular books on astronomical topics, starts from there to give a different twist to this survey of cosmology. Several nontechnical books cover basic cosmological topics: historical development, general relativity, discoveries of the extragalactic character of nebulae and their recession, the microwave background, nucleogenesis, inflationary theories, age problems, and dark matter. Goldsmith presents these topics well and gives some insight into the nature of cosmology as a science. The book's novel feature is described in its subtitle: "The cosmological constant and other fudge factors in the physics of the universe."

The first chapter describes the interplay between theory and observation. Most scientists are familiar with "fudge factors," which Goldsmith defines as "features introduced into a theory ... in order to resolve a pressing problem with the theory in an acceptable but aesthetically unsatisfying way." He notes that these are not always bad, and that their introduction may turn out to be correct.

Various "dark matter" theories, discussed in later chapters, are in the fudge factor category today. Here there are a couple of "pressing problems." First, galaxies and clusters of galaxies do not contain enough luminous matter to hold them together gravitationally. Second, inflationary cosmologies require the universe to be spatially flat and thus barely bound, but the observed density of matter is too small to make this happen. Various types of nonluminous matter have been invoked to resolve the discrepancy. The task is complicated by the fact that the mass needed to solve the first problem is not enough to solve the second. As often happens, one has a choice of fudge factors. The hope is that eventually observation will rule out all but one, which can be incorporated into a satisfying theory.

Einstein's constant is the prototypical cosmic fudge factor. If positive, it results in a repulsive component of gravitation at great distances. Einstein introduced it to make a static universe solve his gravitational field equations when everyone thought the universe *was* static. When this was found not to be so, he disavowed the cosmological constant.

But once unleashed, such things take on a life of their own, and can't be controlled by their inventor. New ways of thinking about an initially fudgy factor may be discovered. Einstein himself, before discarding the term, tried to relate it to the Poincaré stresses of classical electron theory, an idea having some connection with the appearance of such a term in quantum field theories. Eddington, impressed by the fact that the cosmological constant introduces a natural scale of length, insisted that before he would give it up, he would go back to Newtonian theory. And some unified field theories, such as Schrödinger's, require a non-zero value for the constant. Today, a positive value for the cosmological constant provides a way of resolving the problem that the ages of some stars seem greater than the time since the big bang *if* no cosmic repulsion has been at work.

Goldsmith refers briefly (pp. 188-190) to "God" language in discussions of scientific cosmology, as with notorious "face of God" comments about confirmation of temperature variations in the microwave background. Emboldened by problems about ages and missing mass in cosmology, some Christians may be tempted to appeal to a classic fudge factor, the God of the Gaps. The use of God language by others may be an attempt to ward off serious theology: if a satellite shows us "the face of God," why do we need Christ?

Goldsmith does not explore those issues at the science-theology interface deeply. His book will, however, provide helpful orientation to current issues in cosmology and, perhaps even more important, to the way cosmologists go about their task. The interest of the topic extends

to other disciplines as well. Cosmologists are not the only people who use fudge factors.

Reviewed by George L. Murphy, Pastor, St. Mark Lutheran Church, Tallmadge OH 44278.

THE FIRE IN THE EQUATIONS: Science, Religion, and the Search for God by Kitty Ferguson. Grand Rapids, MI: Eerdmans Publishing Co., 1995. 320 pages, notes, bibliography, index. Hardcover; $25.00.

The author of this book has had an unusual career. A graduate of the Juilliard School of Music, she was for many years a professional singer and conductor. After a period of residence at Cambridge University in England, she entered into a full-time writing career on science. In this book she applies an unusually patterned style to discuss most of the major issues relating modern science and religious faith. The book is warmly endorsed on the jacket by such outstanding figures as John Polkinghome at Cambridge: "Ferguson weaves together science, philosophy, and theology with verve and clarity"; and John A. Wheeler at Princeton University: "A delightful, up-to-date, and accurate account of the most active frontiers of physical science in language equally pleasant to read at age thirteen or eighty-three, laced with puzzles, poems, people, and science and with much of the delicious accompaniment that goes on in the search." The *New Scientist* comments that "Ferguson ... concludes that 'God, though perhaps not ruled in, is certainly not ruled out.'"

The book consists of eight chapters with the titles, "They Buried Him in Westminster Abbey," "Seeing Things," "Almost Objective," "Romancing the Creation," "The Elusive Mind of God," "The God of Abraham and Jesus," "Inadmissible Evidence," and "Theory of Everything ... Mind of God."

Overall this book presents an informed and meaningful comparison between science and religion, arriving at the final conclusion that science can neither establish nor contradict the existence of God. Along the way a number of basic statements are made that are important for such a discussion. It is pointed out that science doesn't claim to discover the ultimate truth about anything, and that in science nothing can ever be really "proved." Or again in a discussion of evolution, "... the arguments which show that evolution would have been a clever and almost foolproof way for God to set things up do not prove that there is a God who did this. They only show that we can't use the process of evolution to prove that there is no such God." Or again, "We've shown that science can't prove that a physical explanation is *the* complete explanation;" or "... the bottom line would seem to be that at present we have no scientific way of proving or falsifying either of them (i.e., God or Mathematical and Logical Consistency as First Cause candidates), nor are we likely ever to determine the answer by means of the scientific method. To vote for either candidate is a matter of faith;" or "The failure of the God of the Gaps doesn't prove there isn't a God." These repeated statements on "proving the existence or non-existence of God," the first from p. 26 and the last from p. 205, illustrate one of the features of the book that was self-defeating for this reviewer: a style that may be literarily elegant, but is repetitive and rambling, a style that does not match the subject, at least for this reviewer.

Fanciful language tends to run away with the subject when it comes to the meaning of quantum mechanics. It is argued that existence as an independent entity demands that it have a definite location and a definite motion, and that "it seems that when an atom isn't being observed it lapses into a state that can be described as ghostlike with no concrete reality to it all. ... To put it bluntly, the observer seems to create reality by observing it." Now, because of the literary style, we have a hard time deciding whether the author is really advancing these views herself, or whether she is being dramatic with a recitation of the viewpoints of others. This gets intensified further when she asks, "Can God exist without believers?"

Another troubling aspect of the book for this reviewer was the frequent use of such concepts as "God intervening in the world," "events governed by the laws of nature," "breaking the laws of nature," "violating the laws of nature," "setting aside the physical laws" etc., without ever really giving a definitive treatment of what was meant by these critical terms, "laws of nature," "governing," and "intervening." Now it may be that phrases like, "In the beginning, God created everything ... as well as the laws that directed that outcome," are really only literary expressions.

There are many readers who may really enjoy reading this book as an experience in good literature, but those looking for recognizable resolutions of fundamental issues in a brief space may be frustrated. Perhaps the only way to find out which group you belong to is to get hold of a copy and give it a careful reading. You will certainly be informed about many aspects of modern science that you may not otherwise encounter.

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

THE DEMON-HAUNTED WORLD: Science as a Candle in the Dark by Carl Sagan. New York: Random House, 1995. 457 pages, extensive references, index. Hardcover; $25.95.

Sagan is the David Duncan Professor of Astronomy and Space Sciences at Cornell University. He is author of many best sellers, including *Cosmos*, which became the most widely read science book ever published in the English language.

In this book Sagan discusses the claims of the paranormal and fringe-science. For instance, he examines

closely such issues as astrology (p. 303), crop circles (p. 75), channelers (pp. 203-206), UFO abductees (pp. 185-186), faith-healing fakes (p. 229), and witch-hunting (p. 119). Readers of *The Skeptical Inquirer* will notice that Sagan's approach is very similar.

Sagan writes:

> The Committee for the Scientific Investigation of Claims of the Paranormal is an organization of scientists, academics, magicians, and others dedicated to skeptical scrutiny of emerging or full-blown pseudo-sciences. It was founded by the University of Buffalo philosopher Paul Kurtz in 1976. I've been affiliated with it since its beginning. Its acronym, CSICOP, is pronounced "sci-cop" — as if it's an organization of scientists performing a police function ... CSICOP publishes a bimonthly periodical called "The Skeptical Inquirer." On the day it arrives, I take it home from the office and pore through its pages, wondering what new misunderstandings will be revealed (p. 299).

Sagan points out that in 1991 two pranksters in England admitted that they had been making crop figures for 15 years. They flattened the wheat with a heavy steel bar. Later on they used planks and ropes, but the media paid brief attention to the confession of these hoaxers. Why? Sagan concludes, "Demons sell; hoaxers are boring and in bad taste" (p. 76).

Christians must admire Sagan's commitment to critical thinking, logic, and freedom of thought. He takes on many subjects in this book, and the vast majority of his analysis is exceptional. However, his opinions on religious matters are affected by his devotion to scientism. Sagan believes only that which can be proved by science is true. He disputes psychologist Charles Tart's assertion that scientism is "dehumanizing, despiritualizing" (p. 267). Sagan comments, "There is very little doubt that, in the everyday world, matter (and energy) exist. The evidence is all around us. In contrast, as I've mentioned earlier the evidence for something non-material called 'spirit' or 'soul' is very much in doubt" (p. 267).

Science can only prove things about the physical world, and it cannot prove anything about the spiritual world. Does that mean that the mind and soul don't exist? Of course not! First, we must realize that science is not the only way to truth. Even Sagan must admit that he must justify values like "be objective" or "report data honestly." Where do those values come from? They came from outside science, but they must be in place for science to work.

Sagan gives an illustration that contrasts physics and metaphysics. He shows that the physicist's idea will have to be discarded if tests fail in the laboratory. Therefore, the main difference between physics and metaphysics is that the metaphysicist has no laboratory. This is a cute story, but can science answer the basic questions that underline all knowledge? Metaphysics is necessary for science to take place. It is not true that science is superior to metaphysics like Sagan would have us believe. The presuppositions of science can only be validated by philosophy. J. P. Moreland has correctly said, "The validation of science is a philosophical issue, not a scientific one, and any claim to the contrary will be a self-refuting philosophical claim" (*Scaling the Secular City*, p. 197).

Second, the absence of scientific evidence for the soul does not mean the soul does not exist. Sagan himself states, "Absence of evidence is not evidence of absence" (p. 213).

I was impressed with the way Sagan put his inner thoughts on the table. For instance, he comments, "Plainly, there's something within me that's ready to believe in life after death ... If some good evidence for life after death was announced, I'd be eager to examine it; but it would have to be real scientific data, not mere anecdote" (pp. 203-204). What kind of evidence is Sagan looking for? It certainly is not vague prophecies. He states, "Think of how many religions attempt to validate themselves with prophecy. Think of how many people rely on these prophecies, however vague, however unfulfilled, to support or prop up their beliefs. Yet has there ever been a religion with the prophetic accuracy and reliability of science?" (p. 30). The answer to that question is "yes." Christianity can point to very clear passages such as Isaiah 53 and Daniel 11 written hundreds of years before the events occurred.

While comparing science to religion, Sagan comments, "Science is far from a perfect instrument of knowledge. It's just the best we have" (pp. 27-28). Here Sagan is only half right. Science is imperfect, but it is not better than the Bible.

The Demon-Haunted World is a thought-provoking book that I thoroughly enjoyed. Some of Sagan's anti-Christian views come through, but on the whole, this book uses critical thinking and logic and applies them to the claims of the paranormal and fringe-science of our day.

Reviewed by Everette Hatcher III, P.O. Box 23416, Little Rock, AR 72221.

ATTITUDES TO NATURE by Jean Holm and John Bowker, Eds. New York: Pinter Publishers, 1994. 172 pages, index, footnotes. Paperback.

Attitudes to Nature is the tenth volume in the *Themes in Religious Studies* series. This series focuses on the way eight religious traditions view important issues of the day. The groups covered are Buddhism, Christianity, Hinduism, Islam, Judaism, Sikhism, Chinese religions, and Japanese religions. Each religion covers one chapter. Holm has spent her career teaching mainly Judaism and Hinduism, most recently as Principal Lecturer in Religious Studies at Homerton College in Cambridge University. Bowker, Professor of Divinity at Gresham College in London, is interested in anthropological and sociological approaches to the study of religions. Neither editor contributed to this volume.

In the series Preface, Holm notes the danger and widespread tendency to stereotype beliefs and practices of re-

ligions. In this regard, she writes, "We need to bracket out, temporarily, our own beliefs and assumptions, and 'listen in' to a religion's account of what *it* regards as significant." This book, and presumably the other books in the series, is a useful tool in understanding the views of the major religious groups of the world from their own perspective, rather than from a Christian's perspective on their views. The contributors introduce scriptural teaching and religious practices which relate to their view of the origins and meaning of the natural world. It became quickly obvious that even the meaning of the word *nature* varies greatly among different religious groups.

The essays differ in style and depth of treatment. The essay on Sikhism was simple and personal. It was full of Sikh scripture references followed by commentary on how these apply to their view of nature, much like a simple homily. On the other hand, the essay on Japanese religions was a Japanese defense against western accusations of Japanese as eco-terrorists, whale killers, and callous capitalists. The authors on Japanese religions appeared to have an agenda which transcends the scope of the book itself. However, both the Sikh and Japanese essays are effective and enjoyable reading in their own right. Christianity and Buddhism, seldom found to have anything in common are noted to share a fundamental denial of the world and a tendency to escape from it. The material in the chapter on Islam is surprisingly similar to a Christian view of reality, emphasizing how creation points beyond itself to God the Creator. For example, the authors write, "Everything in the heaven and earth bows to God in worship. However, many humans do not and deserve punishment." However, the authors also mention how Muslims tend to view western science as secular and profane and completely void of any theistic focus. This is a good reminder to ASA members who must strive to adequately integrate faith and science.

This book introduces some conclusions held by religious people. For example, in the essay on Judaism, the author highlights the Hebrew Scriptures' preoccupation with keeping each species of life distinct. Animals were not to be cross-bred and Noah was careful to take all animals, even unclean animals, on the ark. This was to show that Judaism has defended biodiversity from antiquity. Looking at the same Scriptures, would Christians draw this conclusion?

The essays say little about how their respective beliefs about nature work themselves out in real situations, or how their ancient scriptures help them deal with modern problems like global warming, over-population, radioactive waste management, or species extinction. The tendency is to see the principles in the religious systems as the basis from which to ask the right questions about modern issues rather than indicate how they should be dealt with. Consequently, there are several ways a given religion might deal with environmental issues.

Attitudes to Nature meant more to me as a book to further my understanding of these religions than as a book on nature or ecology. I think it would be more appropriately used in a course on world religions (college level) than in a course on nature or ecology. (An exception might be the essay on Japanese religions.) Living in China, I found the essay on Chinese religions helpful to better understand Taoism. But when I learned that they view humans as one with nature, I was even more confused about why Chinese are so unconcerned about the environment, both personally and as a nation. As with many of the essays, I still asked, "How does their behavior relate to their religious background?" In defense of the essays, their purpose is not to tackle popular environmental issues or apply their teaching to life, but I was frustrated at times with inadequate discussion of how and why the religious groups fall sort of the glory of their teachings on the natural world.

The nine contributors to this volume have varied academic credentials. Some essays were at a popular level (Sikhism and Japanese Religions), while others were more academic (Buddhism and Hinduism). Each chapter ended with a Suggested Reading list. Only books were mentioned (no journal articles) and many of the books were quite dated (1970s). Each author is intimately involved in work or research directly related to the topic they have addressed in the book. If my reading of the ethnic background of their names is correct, they all come from the religious or cultural background which they address, adding an element of authenticity and personalness to their respective essays.

Being interested in religions and cultures, as well as living overseas, I found this book interesting and beneficial. ASAers with a similar interest would likewise enjoy it. For those who work with internationals or work in science overseas, it would be a useful reference tool.

Review by Mark A. Strand, Medical Team Director, Evergreen Family Friendship Service, Taiyuan, Shanxi Province, China, 030002.

CREATION AND EVOLUTION by Alan Hayward. Minneapolis, MN: Bethany House Publishers, 1995. 232 pages, Name Index and Subject Index. Paperback.

Hayward, a physicist and a Christian, retired from a position of principle scientific officer at a British government research laboratory in 1977, in order to devote time to writing. This book is a recently revised edition a work originally published in London, in 1985. He has published several other books, including: *Planet Earth's Last Hope, God's Truth* and *Does God Exist? Science Says Yes!*

Hayward's purpose for this book is to present the case for ancient creationism. In his words, "my aim is to produce a kind of Plain Man's Guide to what is going on" in the creation-evolution debate. He begins in an introduction by defining terms with particular emphasis on "succession," "evolution," and "Darwinism." Hayward presents a very useful "Logic Diagram."

The book is divided into three parts. In Part I, "The Genuine Scientific Objections to Darwinism," Hayward presents arguments and quotations exclusively from the writings of evolutionists who oppose Darwinism. He finds that American and British biologists have acquired the curious and incorrect notion that practically everybody accepts Darwinism, but biologists outside England and the U.S. are not so accepting and would rather say "we don't know how things could have evolved, then pretend that a bad theory is a good one." Prominent European biologists find that Darwin's theory cannot be made to fit the fact no matter how much the theory is modified.

Part II, "The Age of the Earth" is Hayward's attempt to summarize the evidence that the earth is very old. While he makes some good points, my impression of this part is that it is more an attempt to discredit young earth creationists and Flood Geology than to present the scientific evidence. I find that several recent books, for example, *The Creator and the Cosmos* and *Creation and Time*, both by Hugh Ross, are much more extensive and helpful on this subject.

In Part III, "Bible Teaching and Creation," the focus is on the Bible with an attempt to see what Genesis and other parts of Scripture really say about creation. Hayward discusses the five "well-known" theories about the days of creation: (1) Literal Days of Recent Creation, (2) Literal Days of Re-Creation, (3) Days equal Geological Age, (4) Intermittent Days of Creation, (5) Days of Revelation.

Then he presents a more extensive discussion of what he thinks is the most appealing but neglected theory, Days of Divine Fiat. Hayward suggests seven advantages of this theory with the last and most important being that it "makes it easier to understand why the New Testament is so insistent that Genesis 1 is a prophecy of Christ." In the twelfth (and next to last) chapter, "Some Biblical Objections to Theistic Evolution," Hayward distinguishes between the liberal and conservative versions of theistic evolution. Liberal evolutionists modified Darwin in the same "cavalier fashion as they reassessed the Biblical writers." He concludes that when the Fall of Adam is treated as religious fiction we strike at the very heart of the Christian Gospel and that the blend of fact and fiction made by liberals is a flimsy foundation on which to build a doctrine of eternal life. Hayward argues that quite a formidable case against any kind of theistic evolution can be mounted on Genesis. "If we let the Bible speak for itself there appears to be only one natural way to read Gen. 2:7, the verse informs us that God miraculously created Adam from non-living matter." "The theistic evolutionist appears to fall between two stools, when he reasons that God inspired Moses to compile a mixture of history and myth, and then left it to us to sort out for ourselves which is which." To make Genesis fit the evolutionary view, Hayward concludes that the conservative theory of theistic evolution must abandon most of the historical details of the Fall, although it considers the Fall to be a historical event.

In the concluding chapter, Hayward suggests two simple questions to help anyone reach some decision in the creation-evolution debate: (1) Do the experts agree among themselves? (2) Can simple but convincing experimental proof be provided?

He believes that the answer to both questions is "no" where evolution is concerned, that all the evidence seems to show that large-scale evolution did not and cannot occur. As to the question of age of the earth, the answers to both questions is "yes," there is abundant evidence on the age of the earth and all the experts are in agreement.

Overall, I found Hayward's book to be worth my time and have gained some new insights into the creation-evolution debate. The book is written for the lay person and is a popular presentation with almost no technical language. I am pleased to recommend this book to ASA members.

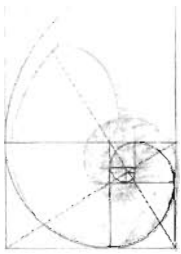
Reviewed by Bernard J. Piersma, Professor of Chemistry, Houghton College, Houghton, NY 14744.

TELLING LIES FOR GOD: Reason vs. Creationism by Ian Plimer. Random House, Australia Pty Ltd., 1994. 303 pages. Paperback; $14.95.

In Australia, as in America, too little heed has been given to F. F. Bruce, who in his biblical scholar's advice to the Victoria Institute in 1954, urged the "mathematician or natural scientist" not to interpret early Genesis with either the "exact literalism" that leads to hasty dismissal or to spend "needless toil" in reconciling scientific knowledge with language which called for no such reconciliation (*Journal of the Transactions of the Victoria Institute* 86 [1954]: 77).

Unhappily, "exact literalism" and scientific knowledge have met head on, since some still seek to compress earth's earliest ages into six literal days and deluge the geological column. A blunt riposte was bound to follow. Now, Ian Plimer, Professor of Geology at the University of Melbourne, well known for his research on metallic ore deposits, confronts "Creation Science" before the law courts.

The case may be moot, but its outlines seem clear in *Telling Lies*. Concerned with erosion of faith, some rethink their Christian options, others claim "equal time," promote "Christian schools," or launch protests. Regrettably, no ASA-like position appears to have mediated the extremes. Admittedly, the Foreword by Peter Hollingsworth, Anglican Archbishop of Brisbane, begins with a soft answer, but its pointed queries raise "the real question" of truth,



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and its proper pursuit. What of thoughtful youth whose "Literalist Fundamentalism" often yields to the persuasive "general concept of evolution" with its consequent (but unnecessary) discard of Christian faith? Urging that minds be opened to "see all of creation" as part of God's domain, Hollingsworth leans toward Plimer's view, whereas Robyn Williams, ABC National Science Unit, pulls no Aussie punches in his trenchant Preface. Citing discrepancies between an astronomer's public lectures and his "Young Earth" credo, he underscores the disconcerting sting in *Telling Lies*.

When Plimer steps directly into the fray, he invokes Papal authority to claim that physical evolution is irrelevant to faith, and turns his ire on the "scientific" claims of the "Creation Research" movement. Hopefully, the casual reader will not confuse this with the essential Christian doctrine of creation and recourse to commentaries should eliminate ideas of four-footed "fowls" and "turtles" (turtledoves?) that give voice (p. 17). Still, it's not Plimer's biblical understanding that's at issue here: it's his more pertinent geology.

Conceding scientific qualifications to at least some "Creationists," Plimer highlights alleged distinctions between self-corrective "Science" and "dogma." There's real umbrage in his reaction to "abuse": abuse of "democratic" voting power, selective presentations of data to a public which (given the nature of science) can scarcely comprehend context or appropriate qualification, abuse of time-consuming quotes and misquotes, and failure to explore either the awkward ramifications or the scrupulous cross-checking inherent in an integrated science. And especially the portrayal of science as vacillating betwixt Evolution and Creation, between an earth billions, or only 6,000, years old — each a "mere theory."

The mix of indignation and mockery continues for all 300 pages. Chapter 2 moves from "biblical" to scientific methods of determining earth-age, with an ironical challenge to confirm alleged changes in the speed of light. Chapter 3 turns to "scientific fraud," giving decidedly personal attention to views expressed by some "creationists." Chapter 4, "the great flood of absurdities," is followed by "bearing false witness" in Chapter 5, which claims to probe the personal, academic, and fiscal backgrounds of some, issuing in insinuations of media manipulation, and raising questions regarding appeals for education and "Ark-eology." Chapters 6 and 7 respectively touch on "doublespeak" and "gishing for God," not without self-congratulatory accounts of debates, and sharply-drawn contrasts between Creationists' contributions to scientific journals, and the implications of their Young Earth "cult."

The closing Chapter, "Why all the fuss?" only seems less strident. Plimer's wonderment at the coincidences of earth's history are matched with puzzlement that some intelligent folk accept "creation" — though not, presumably, in forms that expunge geology from youthful minds. Dismissing Creation Research as lacking either theological or scientific credibility, he notes its significant absence from "mainline" churches. His final musings on a scientist's hopes and fears have Christian counterparts, and — maybe — a saner appreciation of science and Scripture might yet emerge.

Reviewed by Gordon R. Lewthwaite, Professor Emeritus, Geography, California State University, Northridge, Northridge, CA 91330-8249

AT HOME IN THE UNIVERSE by Stuart Kauffman. New York: Oxford University Press, 1995. 321 pages, bibliography, index. Hardcover; $25.

This book's contents are called a major scientific revolution, a new paradigm in evolution theory, rivaling Darwin's theory in importance. Kauffman, the leading thinker of self-organization and the science of complexity, uses common properties of complex systems to show that self-organization is inevitable. He is a biologist at the Santa Fe Institute. This text, written for the general audience, follows his *The Origins of Order*, written for specialists. All technical words and concepts in biology, chemistry, physics, and mathematics are properly described in non-technical terms. The reader needs good analytical/mathematical reasoning ability to understand the computer algorithms which underlie this research.

His book is well written and well organized with good introductions for each chapter. In the first chapter, Kauffman subtly hints at a desire to find meaning in his existence. He is uncomfortable with the Darwinian concept of man as simply the result of a chain of accidental mutations. Kauffman is still a Darwinian and his new theory is a marriage of chance and necessity.

The second chapter describes the total failure of previous theories to understand the origin of life — even to the extent that no plausible story-line could even be conceptualized for the beginning of life on Earth. Kauffman presents this chapter as an entrepreneur with a new product, showing that all existing products on the market are unsatisfactory.

Chapter three presents computer simulations which show a chemical soup held in a localized region with a supply of energy and a sufficiently diverse supply of molecules which will crystallize into a complex "autocatalytic" system. Kauffman shows that such an autocatalytic system can reproduce and is capable of heritable variation. The beauty of his models is its simplicity and few basic assumptions. The only inputs are variable values for the number and diversity of molecules, the number of possible chemical reactions and the average probabilities that any molecule can catalyze (speed-up) any reaction. No details such as specific types of molecules or reactions are considered.

Chapters 4 through 6 use chaos theory, again with no details and only basic properties to show that cells and ecosystems are likely to be near the boundary between subcritical and supracritical behavior. One of the successful outputs of the theory is that the number of human

cell types is approximately the square root of the number of genes.

In chapters 8-10, he incorporates standard Darwinian evolution to ecosystems, giving plausible explanations for the Cambrian explosion 550 million years ago and for the Permian extinction 245 million years ago. Finally, in the later chapters he introduces his models to the understanding of economic, political, and cultural systems.

I enjoyed this book. I like the marriage of chance and necessity which, as a physicist, I see throughout the natural order. I see evidence for Design and the anthropic principle in Kauffman's model. Kauffman realizes his model is not yet a fully developed theory and acknowledges its limitations. At the same time, his upbeatness, excitement, and anticipation are contagious. There is a good possibility experiments will be performed to test his model. This is the way science should work and makes any experimental scientist envious of what lies ahead.

Reviewed by William R. Wharton, Physics Department, Wheaton College, Wheaton, IL 60187.

AN ETHOS OF COMPASSION: The Integrity of Creation by Brian J. Walsh, Hendrik Hart, and Robert E. VanderVennen, Eds. Lanham, MD: University Press of America, 1995. 230 pages. Paperback.

When I saw this title in the "Books Available for Review" section, I thought that it would be a book about how Christians should deal with the environment. The book, however, is on that subject and more. It is a record of the proceedings of a symposium held in 1992 in Toronto, on the twenty-fifth anniversary of the Institute for Christian Studies. The book began as if it had nothing to do with the environment. After an introductory chapter, the talk by J. Richard Middleton, the designated devotional speaker, appears. It is subtitled "Opening Meditations For a Creation-Order Tradition." There isn't really an explanation of what that means. Since the conference was apparently attended mostly by persons in that tradition, there was probably no need for such an explanation. I gathered that a Creation-Order Tradition isn't only, or even mostly, about Christian stewardship of the environment. I think Creation-Order Tradition is like a Natural Law Tradition.

Other chapters include: "Creation Order: A Historical Look at Our Heritage" by Albert Wolters, "Creation Order and Transcendental Philosophy" by Sander Griffoen, "The Doctrine of Creation: Judging Law and Transforming Vision" by Carroll Guen Hart, and "Points of Unease With Creation Order" by Nicholas Wolterstorff. My reaction to all these is that those in the Reformed Tradition should read them for their own evaluation.

There are several reasons why I think this book is important. First, it is clear that the book was written by, and apparently for, what are mostly called political liberals. That doesn't make them wrong (or right, of course), and those who are called political conservatives aren't always right (or wrong) either. What evidence do I have for this leaning? One of the authors said exactly that. Another took Reagan, Bush, and Quale [sic] to task. There are occasions when the oppressed are listed. Such oppressed are the poor, the nonwhite, females, and homosexuals. Unborn fetuses (abortion is given a passing reference) aren't even mentioned in the book, let alone described as oppressed. Conservatives probably would have included them, and perhaps not all the others.

Secondly, the book is of note because the longest chapter, "Creation Order in our Philosophical Tradition: Critique and Refinement" by Hart, who is an employee of the Institute, was disturbing. I quote:

> If the Bible is not obviously a book of doctrines and moral absolutes anchored in a known and unchanging order, but speaks to us more clearly as narrative of divine guidance in history, the traditional message of Scripture changes considerably (p. 68).

Yes. And Hart makes it clear that he wants to make this change.

> ... Christians should acknowledge that we already play God when we participate in dealing with abortion and euthanasia, with *in-vitro* fertilization and extending life beyond its livable margins, with the ozone and the Amazon, with nuclear arms and genetic engineering. Why should we shrink back when, for example, it comes to redefining sexual morality? Why should we not view homosexual relations in the light of Jesus rather than in the context of the specific understanding of a culture that is no longer ours? Why should intimate relations be normed by preserving antecedently known eternal rules? ... To reclaim the world as creation, we must acknowledge God's authority in *all* creation and learn to regard *all* rules, also the ones we now think we make ourselves, as human responsibility in the *presence of God* (emphasis in original, p. 73).

The Hart paper was important enough that there were three printed responses to it. One by John E. Hare entitled "Too Far the Pendulum Swings" says:

> My main point in this response is to deny that an ethos of compassion is inconsistent with the evaluative framework within which there is a central core of human needs which stay the same. That is, compassion does not require a framework within which the assessment of what constitute core human needs changes over time (p. 104).

Another response is entitled "Portrayal of Reformation Philosophy Seems Unfair," by Johan van der Hoeven. The title speaks for itself.

In the third place, this book *did* have quite a bit about homosexuality. There is a chapter, "When Is Sex Against Nature?" by James Olthuis, that examines the Scriptures which are used to bolster the evangelical view that the only proper sex is between married heterosexuals. It comes to the conclusion that the evangelical view isn't nearly as firmly based on Scripture as evangelicals usually think it is. This chapter deserves careful reading, and also deserves careful examination by Bible scholars.

In the fourth place, Allen D. Verhey, in "Biblical Hermeneutics and a Medical Ethos of Compassion," writes about something that has troubled me. I don't have much difficulty finding a scriptural basis for environmental ethics, but I do have a lot of trouble finding one for medical ethics. Verhey explains that, in his view, there *isn't* such a basis. (He is not arguing against the existence of a medical ethic, of course. He is just saying that it is not possible to find a scriptural basis for it.) He says some other things of importance in this paper, including that he isn't completely happy with the idea of compassion, because some stupid, and even evil, things have been done in its name.

In the fifth place, the book does have some environmental ethics. Calvin B. DeWitt has a pretty straightforward chapter on environmental ethics and puts forward seven principles which can be, and are, used by non-Christians, and gives biblical support for each.

There are some important, and disturbing, ideas here, and serious Christians can't ignore them.

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

HOW MANY PEOPLE CAN THE EARTH SUPPORT? by Joel E. Cohen. New York: W. W. Norton and Company, 1995. 506 pages, index, bibliography. Hardcover; $30.00.

Cohen is head of the Laboratory of Populations at Rockefeller University. He writes with relaxed authority concerning the demographic issues needed to address the title question. His relaxed tone does not mask the urgency he feels concerning the issues being developed. He has been a prolific writer on population issues and a range of other topics.

Background for this subject is developed as three subtopics. First is a review of the history of human population. Cohen describes various attempts at discerning and modeling patterns in human population growth from the beginning of history to the current time. Next a series of projections addressing where the earth's population may be headed is reviewed. Finally the concept of the earth's carrying capacity appropriately occupies the largest portion of the book. Pitfalls in defining a specific capacity are brought to light. The multifaceted issues are complexly intertwined. Though potentially highly disruptive indicators are observed, how they interact in any timely way to make policy choices is stymieing.

When technical and statistical materials are developed, the author's personal, straight-forward, and sometimes entertaining style make for comfortable reading. Clarifying analogies are frequently introduced. The analogy of a large truck on a changeable mountain road with a significant part of six billion passengers pumping at the brakes and accelerator or grabbing for the steering is as terrifying as it is clarifying. Actually, most of the passengers are probably making music with Nero and have little regard to coming curves.

Appropriate mathematics are introduced in a clear and friendly manner, without diminishing the difficulties innate to the work of gathering and analyzing population data. The author develops nuances of the issues involved in an accessible, yet intellectually legitimate manner. He discusses where significantly weak assumptions have lessened the usefulness of some attempts at understanding changing demographics. He exposes weaknesses with understanding, not iconoclastic vigor.

The book is peppered with clear, supportive charts and graphs. The section delineating mathematical models that have been tried (unsuccessfully) as fits to population data is well supported graphically. There are abundant, helpful notes and a thorough, relevant bibliography.

There is not a theistic perspective to any of the material. There are a couple comments about Hutterites being obstinately pro generative. After a thorough discussion of Catholics, the conclusion is that organized religion's impact on rates of fertility is minimal. A reference to Adam and Eve is included in an illustration about linear population growth. If, throughout history, population had increased linearly at the 1994 rate, then Adam and Eve would have been created in 1936. They also would have had to have 90,000,000 offspring that year. (Tim Stafford in *Christianity Today* 10/2/94 writes with great clarity about population issues as a theologian.)

Cohen speaks politely of respect for various values and cultures. He cites Al Gore and others who call for action in education, especially for women, and in providing ubiquitous contraception, which he believes is especially needed for teens. He says that he would eschew coercive policies as ineffective, but apparently believes some centralized initiative is needed.

This book provides excellent documentation. It is an exceptional source for gaining perspective — a view from some high ground on population issues. The information contained in Cohen's book will serve a range of readers. It is a good place to gain an exposure to population issues. It is an insightful and extensive compilation of ideas for those already involved.

There are fluctuations of populations on all scales, spatially and temporally, as well as the wide swinging fluctuations in the projections of experts. This would suggest that both population change and modeling population change are complex phenomena. Cohen proposes that greater investment be made in gathering data. If we had better accounting of many things, then more discerning judgments would be possible. Should not a demographer solve problems with more demography? Could it be that such a complex system does not allow analysis that can be made significantly faster than real time? Consider the multitude of contributing factors and the amount of data that needed to be gathered and integrated. Successful prediction may be limited as in meteorology, where predictions by the best models are reliable for only a few weeks. In comparison, demographic projections have proven of little value within one year to a decade.

Human population will either fluctuate widely, or it will gently approach equilibrium. (Read chapters 5 and 6 for information that should dispel any notion of the possibility of perpetual growth.) Intuitive reactions are generally empty of real problem solving. In fact, they may tend to support callous policies, reflecting Scrooge's comment about reducing the excess population. Such heartlessness has been a repeated theme for millennia. Tertullian in 200 A.D. wrote, "In truth, plague, famine, wars, and earthquakes must be regarded as a blessing to civilization, since they prune away the luxuriant growth of the human race." To too large an extent, western attitudes toward Third World disasters display this callousness. We need to understand what is actually happening. *How Many People Can the Earth Support?* provides an excellent opportunity to become better informed.

Reviewed by Douglas Franks, Physics, Christopher Dock Mennonite High School, Lansdale, PA 19446

CREATION AT RISK? Religion, Science and Environmentalism by Michael Cromartie, Ed. Grand Rapids: Eerdmans, 1995. 166 pages. Paperback; $15.00.

According to the flyer advertising this book, *Creation at Risk?* "is a collection of essays in which ten scholars and activists explore — and clash over — some of the scientific, religious, moral, philosophical, economic, and political claims proposed by contemporary environmentalists." The concept behind the book is an excellent one, based on a symposium held in 1994 by the Ethics and Public Policy Center's Evangelical Studies Project that brought together a diversity of people to discuss the relationships among the topics included in the title. Unfortunately, the chapters and responses are uneven in their scholarship and writing, making for a volume that suffers from an evident lack of cohesiveness.

There are five chapters: "Managing the Planet," "The Climate Change Debacle," "Here Comes the Sun," "The Challenge of Biocentrism," and "Can Markets or Government do More for the Environment?" Each chapter is followed by a response, followed in turn by comments of various symposium participants. Andrew Kimball wrote the response to the first chapter and one of his comments applies to several parts of the book: "An unseemly snideness marks much of the criticism of environmentalism, especially from the right." Kimball's chapter is one of the best in the book, although I disagree with several of his principles. "The Climate Change Debacle" seems out of place in this book. It deals with specific aspects of global warming. Other aspects of global environmental concerns are not given even treatment.

"The Challenge of Biocentrism" will be of interest to readers of *PSCF* because it addresses the accusations that biblically based Christianity is to blame for at least some of the present environmental mess. I read the last chapter, "Can Markets or Government do More for the Environment?" while on a field trip to Alaska. Surrounded by the pervasive wilderness and the stunning splendor of Denali National Park, I trembled at the thought of such God-given resources managed by the private sector. Sure, bus tours and bookstores can be privatized but the overall maintenance of natural areas of national importance benefit from being government run.

It is difficult for me to identify the audience for this book. It could be used in a public policy course dealing with the environment but only if other books were ignored. It is too light on either theology or ecology to be used in those courses. One bright spot is the cost. At fifteen dollars, it is sort of an endangered species in the book market.

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INVESTIGATING THE BIOLOGICAL FOUNDATIONS OF HUMAN MORALITY by James P. Hurd, Ed. Lewiston, NY: The Edwin Mellen Press, 1996. 249 pages. $89.95.

This book addresses one of the pivotal questions of our time: "To what extent is evolutionary biology a nec-

essary and sufficient explanation for human morality?" (p. ii). It is pivotal because our answer will have, indeed has begun to have, a major effect on how we order our lives and societies. While you might not guess it from the title and main question, this book is particularly valuable for those interested in a Christian perspective on biology and morality. This is not surprising given the editor and publisher. James Hurd is Professor of Anthropology at Bethel College, and active in the Network of Christian Anthropologists. Likewise, the Edwin Mellen Press is a household name in religious studies.

The book's origins can be traced to the Conference on Biology and Morality held at Bethel in 1992. Fortunately, it is not just a long-delayed printing of conference papers; at least some of the articles have since evolved. Most of the papers are quite original, and as the authors come from a range of fields, they have aimed their work at each other, not just fellow specialists. Among them are two anthropologists: William Irons and James Hurd (who offers a preface but not an article); three psychologists: Linda Mealy, Carole Young, and Lucie Johnson; four biologists: Gregg Johnson, Jeffrey Schloss, Timothy Shaw, and Elving Anderson (the last two are ASA members); one geochemist and social historian: Alfred Kracher; two theologians: Garrett Paul and Gary Simpson; and two philosophers: Bruce Reichenbach and James Fetzer.

This volume clearly moves us forward in our understanding of biology and morality. But I think it is also fair to say it is like a room full of explorers describing disparate plans and discoveries. Contributors' answers differ substantially on the main question, though the view that biology is both necessary and sufficient for explaining morality is clearly in the minority. Likewise, it is far from uniform as a Christian response to sociobiology. Indeed, several authors (Irons, Mealy, and Young) make no direct reference to religion. All of this reflects the state of the field.

Although I cannot summarize each piece, a few examples may give a sense of the work. In "The Selection of Moral Behavior by its Consequences," Carole Young brings together sociobiology and behaviorism. Someone like B. F. Skinner, she argues, would agree with much of the sociobiological explanation of altruism "except for the characterization of human behavior as anticipatory" (p. 68). But she finds the behaviorist alternative, that we act in certain ways because past behavior is reinforced, to be compatible with, and to improve upon, sociobiology.

It is characteristic of sociobiology to argue that altruistic acts are really selfish, but Gregg Johnson ("Inadequacies of Sociobiological Explanations of Altruism") shows that humans engage in genuinely nonselfish acts, and do so both frequently and cross-culturally. This is not genetically adaptive for the individual and so "cannot be accounted for by sociobiological explanations." Yet, it does seem adaptive for the species overall.

Jeffrey Schloss ("Sociobiological Explanations of Altruistic Ethics: Necessary, Sufficient, or Irrelevant?") asks: "When we speak of unselfish behavior, are we speaking of genetic consequences or personal motivations?" (p. 111), and proposes an account that affirms true altruism but yet is consistent with sociobiology. If radical sacrificialism exists, he states: "Either we admit to non-Darwinian agency, or we find that the most truly unilateral acts of human sacrifice, while altruistic in motivation, are not fitness-reducing in consequence" (p. 127). It is just possible, in other words, "that a strategy of authentic generosity and honest concern for others could do equally well or better than one of manipulative exploitation" (p. 129).

Geneticist V. Elving Anderson and philosopher Bruce Reichenbach collaborate in the "Implications of the Human Genome Project for Views of Morality," which is exceptional for its imagination and clarity. They point out that the "effect of individual genes must be described in terms of probabilities rather than rigorously determined outcomes" (p. 167) and go on to argue "that the effect of genes upon behavior, including moral behavior, cannot be understood without considering the development and function of the brain and the role of trait-relevant environmental factors (both internal and external)" (pp. 171-172).

Finally, in "Ethics and Evolution" James Fetzer shows that we do not always act morally, and that behaviors consistent with kin selection or even reciprocal altruism are not always good. This will prove to be a key point. But, as Fetzer observes, it raises the problem of how we decide what is morally good in the first place. Thus, while his objection to Robert Richards' model is that some evolved behaviors "appear to qualify as immoral" (p. 225), this does not mean Richards is wrong. What it does mean is that if we accept Richards' view we will need to *greatly* change our ideas about which behaviors are right or wrong. My guess is that there are many who would willingly, even gleefully, do just that if required (or even just excused) by their view of biology and morality.

We usually assume there are only three sources of moral standards — religious, objective moral axioms, and genetically-based rules of conduct (p. 231). But, Fetzer points out, we also have moral theorizing "in which notions that are vague and ambiguous ... are subject to critical scrutiny in an effort to clarify and illuminate their meaning" (p. 231). With our minds, we can contribute to improving our own culture (p. 233). Indeed, he even suggests "that morality may have originated with criticism" (p. 232). Our capacity for critical thought is not mere chemistry; it has a measure of autonomy, and a great influence on what we do. Fetzer goes on to build an evolutionary ethic that accounts for this capacity, concluding that the emphasis in sociobiology on survival of the species as the basic good, as the fundamental goal of morality, will inevitably render evolutionary theories of morality incomplete. He believes they must "be supplemented by deontological commitments to the equal worth of every human being" (p. 233).

I agree. I think he is also correct that this is a truth which cannot come from biology. But can it come from critical thought alone? Suppose a sociobiologist becomes insistent (I'm speaking hypothetically, but it just could

happen) and says: "If critical thought (if *modern, Western* critical thought) leads to a view of right and wrong different from evolutionary morality, that's tough. I still prefer my model, which has the weight of biology behind it. What evidence do you have that our critical thinking has not simply misled us about morality?"

How would we answer? I do not think Fetzer has solved the problem. But he does have some very good ideas which will help. I urge you to read the article for yourself, for there is more to his case than I have presented here. That goes for the rest of the book as well.

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THE NINE LIVES OF POPULATION CONTROL by Michael J. Cromartie, Ed. Grand Rapids, MI: Eerdmans Publishing Co., 1995. 160 pages, notes and index. Paperback; $14.00.

In 1993 scholars, activists, and religious leaders came together at a conference on "World Population Growth," sponsored by the Ethics and Public Policy Center. This book presents the results of this meeting and also a paper assessing the significance of the 1994 population conference in Cairo.

The nature of the "population problem" has seemed fairly straightforward to me. (1) If the birthrate exceeds the replacement rate, the population will grow until something stops it. (2) World population will not grow without limit, but will reach some maximum value. (3) If we do nothing about it, this maximum value will come about either (a) naturally and benignly, requiring no or little attention, or (b) with increased human suffering, requiring major human attention to avoid. (4) If (3)(b) is accepted, then the required attention is (a) primarily educational, financial, and motivational, or (b) coercive, political, and authoritative. I have favored principally (4)(a), and perhaps this is a major perspective of this book, but a clear exposition of these choices and issues is hard to find.

In the first chapter with the same title as the book, Midge Decter, social critic and writer, concludes that "there is only one way" to get people to have "only as many children as they can feed and house and bring up benignly." This one way is to "help them, even just permit them to attain to a bit of wealth." She dismisses the suggestion that limitation on natural resources may be a crucial factor: "The problem is not the resources at all which wealth, in fact, helps to preserve and protect."

Nicholas Eberstadt, visiting scholar at the American Enterprise Institute and at the Harvard Center for Population and Development Studies, writes on "The Premises of Population Policy: A Reexamination." Noting that "Dire results have been just as assuredly ascribed to population slowdown or decline," as to its growth, he concludes that "nothing like a generalized understanding of the socioeconomic causes or effects of population change can be found today, nor does such a thing appear to be in the offing." Not only that, but "there is no workable demographic definition of 'overpopulation.'" Finally, the author offers the critique that "much of the current discourse on the 'population problem' seems to assume that preventing the birth of poor people will help to eliminate poverty. This appears to be a fundamental error."

Robert Engelman of Population Action International responds to Eberstadt. Engelman views population policies, not as "an intrusion or restriction on human freedom," but "as precisely the reverse: a community public-health service that expands freedom and personal options — especially for women, who need it most." He challenges the thesis that growth in population in the past decade has acted in any country to raise the overall economic situation. He points out the basic fact that "over the past forty years ... three billion people have been added to a world that took from the dawn of human time to 1960 to acquire the first three billion," and reminds us that "Eberstadt ignores the critical question of balance between the earth's physical and biological systems and human population." Finally in one of the places in the book where the issue is clearly stated, Engelman points out:

> Unless you believe that the capacity of the earth's resources and waste sinks, as modified perhaps by human imagination and work is absolutely without limit, you are forced to agree that there is some level of human occupation of the planet at which well-being would decrease with further additions.

In the following chapter on "How Population Growth Affects Human Progress" by Julian Simon, who teaches business administration at the University of Maryland, and Karl Zinsmeister, the editor of *The American Enterprise*, the battle is rejoined: "Many Americans believe that population growth inevitably slows economic development, increases global poverty, reduces the food supply, and degrades the environment. The reason for this wide-spread mistaken belief is not hard to find." It is all the result of a concerted plot by international institutions and environmental organizations. After all, "the contributions people make to knowledge are great enough to overcome all the costs of population growth." And if you like unlimited optimism: "The standard of living has risen along with the size of the world's population since the beginning of recorded time. There is no convincing economic reason why this trend toward a better life should not continue indefinitely."

A response by Rodolfo A. Bulatao, a senior demographer with the Population and Human Resources Department of the Word Bank, seeks to establish a responsible middle ground, and concludes: "What I have argued, then, is this: (1) that hundreds of millions have chosen to limit their fertility, and hundreds of millions more are motivated to do so but need assistance; (2) that, to promote their welfare, it makes sense to provide them with assistance."

In one of the final two chapters, "Population: Delusion and Reality," Amartya Sen, Lamont University Professor and professor of economics and philosophy at Harvard

University, argues against a confrontation between "apocalyptic pessimism," on the one hand, and "dismissive smugness" on the other. After his own assessment of the problems and issues, he concludes: "There is no imminent emergency that calls for a breathless response. What is called for is systematic support for people's own decisions to reduce family size through expanding education and health care, and through economic and social development."

Finally George Weigel, president of the Ethics and Public Policy Center, gives a critique of the population conference at Cairo, "What Really Happened at Cairo and Why" with a ringing denunciation of "the U. N. bureaucrats, Scandinavian politicos, Clinton administration 'global affairs' mavens, radical environmentalists, feminists, and population-controllers."

In an Afterword, "The Meaning of the Presence of Children," Gilbert Meilaender, professor of religion at Oberlin College, presents a warm and understanding assessment of the Christian attitude toward children, but the relevance of this discussion to the issue of overpopulation is not clear.

Although the reader can certainly gain a much clearer perspective on the differences between advocates on both sides in the "population debate" from this book, it is likely that the reader will leave with the same original problems. Advocates of population control see it as a humanistic attempt to provide the motivation for people to have fewer children, whereas opponents of population control see it as coerced abortion. The flagrant disagreements and denunciations of one another are reminders of how much more complex the field of social interactions is compared to the field of physical science.

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LIFE ON A MODERN PLANET: A Manifesto for Progress by Richard D. North. Manchester: Manchester University Press, 1995. 326 pages, index. Hardcover.

North brings twenty years of environmental writing to this book. The book displays two major interests: the "debunking" of most of the "hot button" environmental issues in Parts I and II (pp. 2-186) and the rejection of some of the major attitudes and presuppositions of the environmental movement in Part III (pp. 187-309). In all topics, North gives a balanced presentation of scientific and other empirical evidence.

North's major accomplishment in dealing with the "hot button" issues is that he shows that the issues have two sides. On issues as far ranging as global warming, oil spills, and chlorine pollution, he repeatedly points out that, while the environmental problems are real and demand serious attention, there are cogent arguments that things are not as bad as the environmentalists maintain.

Some specific examples follow. North points out that the often predicted food crisis has not occurred, and that when it has seemed to occur it has really been the product of other more specific causes rather than over-population or environmental degradation. There are negatives in food production, but the debate has two sides (pp. 35-62).

North is equally optimistic concerning the energy crisis, citing such facts as the following: We can now produce oil in algae ponds at a rate of a barrel per acre per week. When the return reaches five barrels per acre, the technology will be feasible (p. 75). Photovoltaic production of hydrogen for fuel is nearing feasibility (pp. 77-78). Energy efficiency can produce even further great savings in energy consumption (pp. 79-80). For North, nuclear power is not the energy villain. He points to the natural formation at Oklo in Africa to argue both that nuclear fission is a normal natural process and also that safe storage of nuclear by-products is possible (p. 84).

North discusses the dangers of chlorine usage (pp. 123-163). He mentions such disasters as its use as a poison gas in World War I (p. 129), its indirect role in the Bhopal tragedy (pp. 129-130), and the DDT pesticide disaster (pp. 141-142). These negatives have led to efforts to ban any usage of chlorine. North responds that there is a necessary and proper usage of chlorine products. The issue should not be banning a useful chemical, but should be the wise, responsible usage of a necessary resource. North insists that there is a way of dealing with the dangers which is both friendly to the environment and friendly to the human race.

He gives some examples in Part III, in which he argues for more general changes in attitude. He notes in Chapter 10, "Wilderness and the Manscape," that some human impact even on designated wilderness areas is unavoidable. Therefore, wilderness maintenance is always relative (p. 208), a fact which has not always been acknowledged by devout environmentalists. Chapter 11 (pp. 250-275) seems to make the point that the Green movement has failed the practicality test and thus reduced itself to practical impotence. Chapter 12 may be summarized by North's praise of the IIED's work in "combining economic growth in poor countries with the ecological needs which underpin it" (p. 276). Again, the general theme is that ecological issues are serious, but that some compromise with human need and practicality is needed in dealing with these issues.

Overall North achieves a good balance between recognizing the reality of ecological problems and the need for practical common sense in dealing with those problems. However, while I generally agree with North on details, two "doomsday" issues will illustrate North's major weakness. First, it is true that population has been sustainable far beyond early doomsday predictions. But that does not mean that indefinite growth is sustainable. Even if the world could sustain a population of 100 billion rather than North's ten billion, population growth must still cease at some point. Second, although North recognizes the dangers of global warming. and notes that "'insurance' action is worth taking" (p. 74), this reaction does

not match the gravity of a doomsday threat. Both of these are issues in which some believe that the possibility of disastrous though improbable environmental consequences could demand very drastic "insurance."

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BIOETHICS AND THE FUTURE OF MEDICINE: A Christian Appraisal by John F. Kilner, Nigel M. S. de Cameron, and David L. Schiedermayer, Eds. Grand Rapids, MI: Eerdmans, 1995. 313 pages. Paperback; $18.99.

This is the first volume in the *Horizon in Bioethics* series, produced by the staff of The Center for Bioethics and Human Dignity in the suburb of Chicago. The series is intended to be a serious engagement about bioethical issues from the Christian-Hippocratic tradition. The twenty-three essays in this volume emerged from the inaugural conference on bioethics held at the Center in collaboration with Trinity International University and the Christian Medical and Dental Society.

These essays are divided into four parts. Part one "The Practice of Medicine" has six articles. "The Christian Stake in Bioethics" by Nigel Cameron sets the tone for the book. He points out that there is a need for Christian bioethics in this progressively secularized, post-Christian, post-modern society. "The Medical Profession in Modern Society" by H. Jochemsen et al., attacks the pseudo-religion of science and medicine, and asks the medical profession to set its own limits in the taking of human life in abortion and euthanasia, and in reconstructing a new order through genetic engineering. "Daniel versus Saul: Toward a Distinctly Christian Biomedical Ethics" by Loreen Herwaldt is a personal testimony by a physician about being a virtuous doctor. "Physician Values and Value Neutrality" by John Peppin explains the impossibility of being value neutral as a Christian doctor and encourages a disclosure up-front of one's belief and values. "Study of Religion and Health" by David Larson and Mary Greenwold points out that religion is a neglected or mismeasured variable in health research and summarizes the beneficial association of religion and health. "The Ethics of Physician Income" by David Schiedermayer defends the high salary of physicians and encourages Christian youth to enter medical careers.

Part two "The Ethical Underpinnings of Medicine" also has six articles. "Luther's 'Freedom' and a Patient's Autonomy" by Allen Verhey points out that quest for freedom is a distinct character of the Protestant movement, and enumerates the difference between this Christian freedom and secular autonomy. "Quality of Life Criteria" by Jerome Wernow says that quality of life consideration is consistent with a sanctity of life position in dealing with terminal illness. "Bioethics in the Shadow of Nietzsche" by Stephen Williams considers Nietzsche's influence in autonomy and egotism. "Bioethics and the Church" by Ben Mitchell delineates the role of the church in the world and in the life of the believer and encourages the church to speak the Christian truth to the world and teach it to the believer. "Decision-making in Clinical Ethics" by Robert Orr gives four factors to be considered in decision-making: medical indications, patient preference, quality of life, and contextual features; and contrasts secular and Christian thinking in medical ethics. "Christian Ethics, Pastoral Care, and Public Policy" by Dennis Hollinger differentiates these three as foundation of right and wrong, application with compassion and grace, and dialogue in the pluralistic secular public square.

Part three "The Evolving Abortion Crisis" has five articles. "Post-Abortion Syndrome" by Stephanie Smith summarizes a report from a British private commission of inquiry into the consequences of the abortion and indicates that further long-term investigation and better measurements are needed. "Abortifacient Vaccines" by Lawrence Roberge discusses the recent research in this area for very early stage first trimester abortion and possible impact on the abortion scene, the vaccine recipient, and the pro-life movement. "Legal Focus in the Abortion Debate" by Francis Beckwith tries to refute the argument put forward by Judith Jarvis Thomson about women's right of refusing to be a good Samaritan. "Abortion and the 'Image of God'" by Donal O'Mathuna briefly summarizes different interpretations of the image of God, uses the metaphor of God as our protector to remind us to act as protectors for the unborn, and asks us to show the grace and love of God in dealing with people of different persuasions. "Abortion: Responsibility and Moral Betrayal" by Christine Pohl points out that the abortion is an escape of responsibility — not just by the woman, but also by the male participant, extended family, church, and the community, and also a betrayal of self and the unborn child by partners, parents, and society.

Part four "The Expanding Bioethics Agenda" has six chapters. "Commercial Surrogate Motherhood" by Scott Rae discusses the issue and concludes that it is the equivalent of baby-selling, therefore morally objectionable. "Clones, Chimeras, and Barthian Bioethics" by Geoffrey Brown deplores the human creative genetic engineering of the clone, the specialized human mutant and the chimera through Karl Barth's treatment of *Imago Dei*. "Advance Directives: The Case for Greater Dialogue" by Peter L. Jaggard points out the need for more dialogue between physicians and patients in terminal illness, but rejects assisted suicide and voluntary euthanasia. "The Right to Die" by Daryl Charles argues that the right-to-die movement is inconsistent with the thoughts of America's founding fathers, and it is a perversion of moral discourse — by transforming questions of right and good into questions of individual preference. "Christian Care for the Dying" by Greg Rutecki decries neglect of the dying in the hospital and redefinition of death to increase the supply of organs, and praises the hospice movement. "Rationing and Health Care Reform" by John Kilner explains the inevitability of rationing, and proposes that Christians should develop rationing criteria that do not put marginalized persons at risk.

Overall this book is a good beginning for conservative Christians to enter into dialogue about bioethics. Some

articles have fallen into the mentality of cultural war and tend to be judgmental. Some take mediate positions such as the fetus may not be an image of God from the moment of conception, or Scripture may not forbid genetic surrogacy in which the surrogate contributes both the egg and the womb. Many areas are touched upon only superficially, such as new reproductive technologies, human genetics, health care reform, health policy, and experimentation on human subjects. I hope some in-depth treatises will be written in the future, grounded in Scripture and theology, fully informed about the medical and scientific issues, to provide clear analysis of Christian options. These will be welcome by the church and will provide Christian education material for adults. To convince the secular public to return to the Judeo-Christian-Hippocratic tradition ultimately depends on the testimony of the Christian community, as well as their evangelism, dialogue, and caring.

Reviewed by T. Timothy Chen, National Cancer Institute, Bethesda, MD 20892.

COMPETING GOSPELS: Public Theology and Economic Theory by Robert G. Simons. Alexandria NSW, Australia: E. Dwyer (Australia) Pty. Ltd. (distributed in the U.S.A. by Morehouse Publishing, Ridgefield CT), 1995. 231 pages, bibliography, name, and topic index. Paperback; $14.95.

Every Christian should read this book. It shows how economic theories guide governments. The author says in the Preface that the subtitle might have been: "The struggle for a minority opinion." Simons mentions four reasons supporting the need for a minority opinion. First: "The radical need to move from viewing social relationships as embedded in an existing economy, to holding economic systems accountable to already existing sets of human relationships and communities." Second: "An opportunity to place the anthropologies assumed by economists from both capitalist and socialist backgrounds in critical dialogue with a more sensitive communitarian vision of the human person derived from key Christian doctrinal perspectives." Third: "The need for the voice of Christian churches on economic issues to become even more public and credible." Fourth: "To suggest strategies to the Church for alternative ways of communicating and witnessing the relevance of its wisdom in the realm of economic organization."

The writer shows his Roman Catholicism. He only treats as a Protestant economic theory the theory of the "invisible hand" of Adam Smith. Simons thinks that Smith derived his theory from the Protestant doctrine of Original Sin. Simons does not mention Protestant economists who criticize the economic and political scene. One example is De Lange and Goudzwaard, who wrote *Beyond Poverty and Affluence* (University of Toronto Press, 1995).

The author knows that politicians (and others) in the "First" world will not receive his book well, since the First world increases its wealth by keeping the "Third" and "Fourth" worlds dependent (p. 139). Goudzwaard says it even more strongly, namely that the rich in Western society are becoming richer at the cost of the poor, including the poor in their own countries. Simons warns against the thought that Christian norms only apply to personal morality (p. 162).

Some people may disagree with certain ideas in this book, but the basic points need to be considered: mankind is destroying our planet; the rich trample the poor, often unknowingly; churches have to stand together and fight the secular, worldly economic systems. Modern society must hear that message. I recommend the book for critical reading.

Reviewed by Jan de Koning, Instructor of Mathematics, Box 168, St. Michael's College (University of Toronto), 81 St. Mary Street, Toronto, Ont., M5S 1J4, Canada.

GOD OWES US NOTHING: A Brief Remark on Pascal's Religion and on the Spirit of Jansenism by Leszek Kolakowski. Chicago: University of Chicago Press, 1995. 238 pages. Hardcover.

"God owes us nothing"; this statement is by no means universally accepted even within Christianity. But what is God supposed to owe us? Life, eternal life, life in eternal happiness. Does he really? From the standpoint of the Almighty, the Creator of all, nothing is owed to anyone; everything is a matter of divine grace. From the standpoint of man the answer is not so obvious. If God owes us nothing, then our actions have no bearing on the afterlife, on eternal happiness. We cannot in any way earn the entrance to God's presence; this entrance is bestowed only by God's grace. And this is a position of Augustine. On the other hand, as Pelagius maintained, man can earn the afterlife, thus God owes it to man. A middle course is called semi-Pelagianism according to which man's action counts since man cooperated with God's grace. Thus God owes us, if only a little bit.

Although discussions concerning which position is correct are as old as Christianity, they have risen to the height they reached in seventeenth century France. Theological aspects of these discussions are brilliantly presented by Kolakowski. The author concentrates on the core discussions between Jansenism and the doctrine of the Molinists, on the problem of human freedom versus God's grace. On the theological level the question is whether man can add anything to God's grace, and the Augustinian-Jansenist answer was negative, which amounted to espousing the doctrine of predestination. The positive answer of the Molinists stresses human freedom and partnership with God, whose reward can be won by appropriate actions. There was also a practical side to the issue. Jansenists called for total commitment to a godly life. This attitude led Pascal's renunciation of scientific pursuits. The Molinists emphasized acts as the path leading to God, which led to indulgences and the like. The problem was that the Jesuits wanted to retain influence of the higher strata of the society, which was impossible to do in the Jansenist

spirit: "The Augustinian moral stringency and inflexibility were simply not for ballrooms or comedy-goers" (p. 57).

The Molinists prevailed in the Catholic Church and, as Kolakowski sees it, this fact had an overall positive effect since "it may well have played a liberating role in the history of modern Europe" because of Molinists' emphasis on human freedom. The Jansenist's accentuation of total humanity's dependence on God could justify "the oppressive and potentially totalitarian idea." Neither side was free from degeneration, thus "no idea, however attractive ... is invulnerable to the infiltration of evil and cannot become prey to the dark side of human nature" (pp. 184-5).

Reviewed by Adam Drozdek, Duquesne University, Pittsburgh, PA 15282.

THE GOD OF FAITH AND REASON by Robert Sokolowski. Washington, DC: The Catholic University of America Press, 1995. 153 pages, appendices, index. Paper; $14.95.

Monsignor Robert Sokolowski is a priest in the Diocese of Hartford and professor of philosophy at The Catholic University of America. He has written extensively in the areas of philosophy and Catholic doctrine. This book is a reprint of a work that was originally published in 1982. The current version is unchanged from the original except for the addition of a preface in which Sokotowski attempts to clarify his approach to theology. Although the book is the result of his students' questions, it is not intended as a text; however, it could be used a supplement in a course on Christian doctrine or ethics.

The purpose of this book, according to the preface to the original edition, is to provide the needed theological foundation for believing that the Christian doctrines are real. For Sokolowski the needed theology is the view of St. Anselm, namely that the Christian God is totally transcendent to the world. Specifically God does not depend on the world in any way for his existence but would be just as good and great as he is, even if he had never created the world.

After presenting and elaborating on St. Anselm's theology, Sokolowski applies his theology to several areas: creation, the incarnation, virtue, the Scriptures, Christian experience, and the sacraments. The Christian response to creation is intense gratitude for such a gift "brought about by a generosity that has no parallel in what we experience in the world" (p. 19). The incarnate Christ can be separately truly man and truly God: "it was not necessary that the human nature of Jesus be diminished and replaced in part by the divine" (p. 35). Sokolowski agrees with Aristotle that there are good people, either through virtue or self-control; however, this natural virtue does not lead to salvation. Salvation must be the work of God: "no action of ours, no matter how virtuous or generous, can bring about our life with God" (p. 73). If human beings could initiate the life of God within them, "then that divine life would be something achievable within the powers of nature and the world, and God would not be distinguished from the world in the way Christian faith understands him to be" (p. 37). The Scriptures must be read in light of God's transcendence: "If this is not done, the salvation promised in the Scriptures is almost bound to be distorted" (p. 122). Not all religious experience is Christian: "all Christian experience must blend natural feeling, sentiment, and insight with what is believed in faith"(p. 140). Furthermore, "it requires careful attention to the integrity of doctrine to keep the Christian distinction intact and alive and in control of the natural religious instinct, not in the service of it" (p. 138). Finally, if God were not separate from the world, there would be no sacraments: "sacrament can occur only when there is a need for actions and events in regard to the God who is not part of the world" (p. 147).

The book contains twelve chapters and three appendices. In the appendices Sokolowski cites recent formulations on Aristotlean ethics, discusses John Wippel's interpretation of St. Thomas' argument for the existence of God, and critiques of the political philosophy of Leo Strauss. Although crediting Strauss for being the only contemporary to write on religion and politics, Sokolowski faults him for failing to properly distinguish the natural and the supernatural.

The theme of the book is an important one for all Christians. However, understanding Sokolowski's applications requires a strong background in Roman Catholicism. There were several places where I had to ask my Roman Catholic husband for clarification. This is an aspect which I believe limits the book's value to the majority of the ASA membership.

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

THE DISAPPEARANCE OF GOD by Richard Elliott Friedman. Boston, MA: Little, Brown and Company, 1995. 335 pages, bibliography, index. Hardcover; $24.95.

Friedman is a professor of Hebrew and Comparative Literature at the University of California in San Diego. His previous book was *Who Wrote the Bible?* His present book is intended for a general audience. It contains useful notes, a bibliography, and an index.

My interest in this book was stimulated by hearing Friedman on a local PBS talk show. I called in and gave some general thoughts without having read the book but was stimulated to read it. I found the author's thesis interesting and well defended.

The book is in three parts, presented as three mysteries. The first mystery, the disappearance of God in the Bible, is argued brilliantly from the biblical data. The second mystery deals with Nietzsche's death of God theme — seen by Friedman as an outgrowth of the disappearance of God. The last mystery is an attempt to relate all of this and Big Bang cosmology to the Kabbalah (Jewish mysticism of the Middle Ages).

Friedman, in presenting the first mystery, argues that if one looks at the Hebrew Bible, one observes the gradual disappearance of God from the world, and a shift in power from God to man. That is, in the early stages of human development, God reveals himself to everyone. Examples are the flood of Noah, the plagues in Egypt, and the Exodus event. These public displays of God become more rare with the passage of time until we end up with the last public event, the bringing down of fire (several times) and the resurrection of the dead by Elijah's prayers. After this, God's relationship with his people is by his prophets, who experience God privately, in dreams and visions. Again, Moses sees God's backside in Ex. 33:17-34:8 and the last person to "see" God is Solomon (1 Kings 9:2). Finally, in the last three books of the Hebrew Bible, Ezra, Nehemiah, and Esther, God is not visibly active except by his Torah. Strikingly, Friedman argues that this is what God said he would do all along and he quotes, Deut. 31:17, 32:20 and other texts (Isa. 45:15, Pss. 10:10, 44:25 etc.) in which God says he will hide his face from them.

This development is provocative from a number of view points. A reader with a critical knowledge of the Scriptures wonders how he would relate it to JEDP theory. Since it doesn't fit convincingly with this approach, this section is poorly developed. Most of us are already vaguely familiar with this idea, mainly through the 400 years of silence between the Old and New Testaments. His conclusion is "that the placement of God in history, inevitably meant departure" (p. 89).

The second mystery is the mystery of Nietzsche's struggle with the death of God, centering at Turin. In a provocative manner, the author suggests that, for Nietzsche, this means that God was alive, and that in a mighty struggle — a struggle so severe that it drove Nietzsche to insanity — Nietzsche brought about the death of God. This death results in "all is permitted" and the chaos that moderns find themselves in.

While some treatment of the New Testament is given, it is only about 10 pages, with an emphasis on the idea that God is incarnate in Jesus whom humans kill. Here the basic pitch is that Christianity provides salvation and, like Judaism's Torah, an ethic for living.

The conclusion of the first two mysteries is that we are in a profound moral void. "Nothing has come to replace the direction and security that a more widespread reliance on God once provided" (p. 255).

Friedman then goes on to argue that Big Bang Cosmology and the Kabbalah offer an answer. They do this by asserting that we are all part of creation and that we therefore resonate with natural law. This is tied in with a Kabbalistic cycle of creation and consummation. The Kabbalah speaks of creation, beginning from a point and a "shattering of the vessels" that in some ways is like broken symmetry from which we are all derived. But morality is in all of us since we are all part of the same stuff. This section was weak with respect to answers.

I found much that was stimulating and much with which I disagreed. The Christian sees Friedman's thesis as implying that we need to use all of our intelligence to solve our problems and that if we don't, God will allow us to do what we will. He has given us enough information to solve our spiritual problems. God is our Father, and after a period of human infancy and growth, we have been taught by God, and are now, in many ways on our own. Just as our earthly parents give us ever greater freedom as we mature, so God treats humanity.

Reviewed by Fred Jappe, Professor of Chemistry and New Testament, retired, Mesa College, San Diego, CA 91911.

A KINDER AND GENTLER TYRANNY: Illusions of a New World Order by D. Michael Rivage-Seul and Marguerite K. Rivage-Seul. Westport, CT: Praeger Publishers, 1995. 161 pages, index. Hardcover; $49.95.

The end of the Cold War eliminated familiar signposts for nuclear strategists, Kremlinologists, and peace activists alike. Berea College professors D. Michael Rivage-Seul and Marguerite K. Rivage-Seul argue in *A Kinder and Gentler Tyranny* that peace activists and educators must now turn their attention to "World War III," a one-sided conflict being waged by the First World against the Third World even as leaders in the former tout a "New World Order."

The global struggle between rich and poor began five hundred years ago when Europeans began to spread not only their political dominion but their economic ideas as well. Central to the Rivage-Seuls' analysis are the evils of free-market capitalism, a system that they contend "has failed miserably" from the perspective of two-thirds of the world's people. Furthermore, capitalism is doomed to failure because, in the absence of the kind of regulation that most advocates of "free enterprise" reject, it inevitably produces massive unemployment, vast income disparities, and destruction of the environment.

Much of the Rivage-Seuls' analysis of the New World Order is based on the work of liberation theologian Franz Hinkelammert and other Latin American intellectuals. Hinkelammert, whose forward endorses the Rivage-Seuls' work, taught at the Free University of Berlin until 1965 when he moved to Chile to work with the Christian Democrats and, ultimately, the government of Salvador Allende. As one might expect from someone whose efforts to implement the tenets of liberation theology were interrupted by the CIA-sponsored overthrow of Allende, Hinkelammert has nothing positive to say about multinational corporations (MNCs), capitalism, or U.S. foreign policy. Neither do the Rivage-Seuls.

The authors' critique of free-market capitalism and its central role in the New World Order is organized into a discussion of six illusions. At the outset, the Rivage-Seuls point out that it is an illusion to think that "everyone is better off without the Soviet." Instead, the triumph of capitalism means the poor "have lost their staunchest ally" (p. 3) and find themselves at the mercy of a system that requires their poverty and threatens an environmental holocaust that has its most significant effects in the Third World.

The second illusion, that "the poor are to blame" for their condition, stems from misperceptions held by most people in the First World concerning the causes of overpopulation, hunger, and poverty in the Third World. Land use policies geared toward the production of goods (including food) for export, foreign investments that benefit MNCs rather than the people of the host country, low-wage jobs, economic pressures for people to crowd into urban areas, and a variety of other factors implicate an internationalized free market as the root cause of the Third World's problems. The attack on the next illusion, that the "market is the solution, not the problem," flows from this analysis. It is in this context that the authors examine the devastating impact of Third World debt and environmental degradation on the world's poor.

The fourth and fifth illusions concern the belief systems that the Rivage-Seuls believe to be at the root of the world's present problems. The analysis of the last five hundred years of Western intellectual development in Chapter 4 is intended to persuade the reader that the world's social, economic, and environmental ills all flow from an erroneous effort to universalize the experience and viewpoint of one particular class. Like many postmodern analyses, this one is remarkable for both its boldness and its oversimplification.

Of particular interest to the readers of this journal is the theological discussion in Chapter 5. Here the authors argue that Judeo-Christian ethics have been inverted to justify an economic system that amounts to human sacrifice. Instead of requiring the payment of debt and delaying punishment and reward until the afterlife, God is "subversive," always identifying with the downtrodden in their struggle against the ruling class. Like other liberation theologians, the Rivage-Seuls identify the Exodus as the central event in Scripture. "In a real sense," they write, "everything else in the Bible is commentary on that event, meant to illuminate that experience and to reinterpret it in various historical circumstances" (p. 91). The problem, from this perspective, is that the Judeo-Christian system "has routinely been set on its head — made to serve the interest of empire and become an enslaving rather than a liberating force" (p. 112).

Many readers will no doubt be put off by the radical nature of the critique the Rivage-Seuls present in this book. It is, after all, a critique that labels free-market capitalism a form of totalitarianism, explicitly linking it with Stalin's communism and Hitler's national socialism. But the authors make no pretense about the nature and implications of their critique. In the conclusion, they argue that we must decide whether we are liberals, "who think the world's needed changes can take place within existing political and socioeconomic frameworks" or radicals, "who, on the basis of deep historical, structural, and spiritual analyses have decided that the leaders of the world's rich nations, like the system they serve, are pathogenic" (p. 135). What must be done is to subject the market to controls, forgive Third World debts, pay economic reparations to the Third World, and, in general, put human needs first. Christians can hardly argue against putting human needs above the demands of the market, but some will be reluctant to accept the implications of doing so.

Reviewed by Robert E. Williams, Associate Professor of Political Science, Pepperdine University, Malibu, CA 90263.

THE SACRED CODE by David L. Teuling. Privately printed, 1993. 106 pages. Paperback.

This book is intended to strengthen faith by showing that "Someone is seeking to communicate with us" (Preface). To this end, the author presents data from the solar system, ancient structures, and numerology. One must be exceedingly naive to find trust in the Almighty bolstered by these "evidences." For example, he argues that a square drawn around the earth has a perimeter of 31,680 miles. If one draws a circle with a diameter equal to the sum of the diameters of the earth and moon, it has a circumference of 31,680 miles. This is a special number because the number of feet in a mile multiplied by six also equals 31,680 (pp. 1-10). The obvious first question is why any of these numbers has any relevance. The second considers the derivation of these numbers. Teuling rounds off the 1964 IUGG value from 7919.77, and the moon's mean diameter from 2160.3, and uses 22/7 for pi. A later, better value for the earth's mean semi-diameter is 6371.315 + 0.437 Km (*CRC Handbook of Chemistry and Physics*, 76th ed., 1995), giving about 7917.88 miles for the diameter. If this is God's message, either he is ignorant of the value of pi or unable to make things correctly. How does this produce faith in him?

On pages 35-51, Teuling dabbles in gematria based on the numerology of the Jewish cabalists, but applied to Greek. They do it so much better that anyone interested in the esoteric will do well to follow them instead. Of course, their interpretations are thoroughly Jewish, a problem for even the quasi-Christian. In his exposition, he ignores the fundamental underlying principle of the Cabala, that the overt language must be abandoned as irrelevant or worthless and the true mystical message derived from the cryptic numbers. In this connection, he derives the number of "Lord Jesus Christ" (3168) from the Astronomical Unit, 93 million miles, reduced to inches and divided by the speed of light in miles per second, dropping zeros. Accurate values, known to eight or more places, give 3161694 ... Is the deity incompetent, or the author in error? The very text of the New Testament appears to undermine gematria. One of the most ancient texts, the fourth-century Codex Sinaiticus, spells out the numerals in John 21:6. (See *The New Westminster Dictionary of the Bible* [1970], 116.) The sole support for numerology is the number of the beast (Rev. 13:18), in a book whose apocalyptic symbolism has produced many incompatible interpretations.

Why is the English mile the standard? The only justification I find is that the foot is based on human proportions (p. 9). But which foot? The Spanish, about 11 inches? The ancient Roman, about 11 2/3 inches? The

ancient Greek, about 12.14 inches? The French, about 12.8 inches? One of the others that has been standard someplace? Why not the Roman mile of about 4860 English feet? It alone has biblical authority (Matt. 5:41). Why the English furlong of 660 feet (p. 13) rather than the biblical *stadion* of about 606 feet? The answer seems to be that Teuling feels free to make anything fit. For example, he makes the 29.53059 day lunar orbit 28 days (p. 19) to match his combination of four seven-pointed stars in a circular pattern for the New Jerusalem. That he thereby contradicts the inspired declaration that the city is square (Rev. 21:16) does not disturb his "faith-inspiring" demonstration. Can he think that he has the divine blueprint and John got it wrong?

Among other errors are the confusion of the medieval frame for holy figures, *vesica pisces* (fish bladder), with the much earlier Christian fish symbol (p. 23). In addition, he consistently makes the fish bladder into a pitch (*pices*) bladder or blister (see also p. 55). He apparently confuses the five- and six-atom rings of the purines, pyrimidines, and sugars of DNA and RNA with the structure of geodesic domes or buckminsterfullerenes (p. 31). Any similarity apparently means identity to him. In explaining "encrypting" he ties the term to "grave," a derived meaning, rather than to "secret" or "hidden" (p. 35). Presumably he does not believe in consulting dictionaries, but spins meanings as freely as "truths." But even such egregious errors can hardly detract further from the misguided content of the work.

The book has a single value: demonstrating the degree to which one may deviate from rationality by not accepting the plain message of the Bible. The bibliography is replete with works from the "occult and metaphysics" bookstore shelves. All this is unfortunate, for the fellow writes well and describes himself as an evangelist.

Reviewed by David F. Siemens, Jr., 2703 E. Kenwood St., Mesa, AZ 85213-2384.

AUTHENTIC CHRISTIANITY: From The Writings of John Stott by Timothy Dudley-Smith, Ed. Downers Grove, IL: InterVarsity Press, 1996. 405 pages, index. Hardcover, $22.99.

The editor of this volume has created a wonderful book for those who love Christian truth in general, and the writings of John Stott in particular. He has given us an anthology of the best from the writings of Stott, arranged topically.

Christian researchers looking for good quotations on a particular Christian subject will find much gold in this work. Over 900 selections from Stott are presented, coveting the full range of Christian doctrine. Topics include God, Jesus Christ, the Holy Spirit, Scripture, becoming a Christian, the church, social issues, and more.

John Stott is one of the great evangelical pastor/theologians of our day. For many years he served as rector of All Souls Church in London. He is an outstanding expository preacher. Anyone not familiar with his works would do well to begin with this volume, and then move on to the many books written by this giant of the faith.

Pastors would be especially interested in this book as it would enable them to spice up their sermons with thoughtful and timely quotes from Stott. The topical arrangement would facilitate their search.

While the book is difficult to review in terms of content because of its nature, I highly recommend it to all who like to immerse themselves in Christian truth.

Reviewed by Richard M. Bowman, Director of Research and publications, Disciple Heritage Fellowship, P.O. Box 109, Lovington, IL 61937.

GOD: A Biography by Jack Miles. New York: Alfred Knopf, 1995. 446 pages, index. Hardcover.

The author is a former Jesuit and currently noted journalist with a penchant for events in the Middle East, past and present. Although his book has received some acclaim, it has come more through the novelty of his perspective than through substantive content. Rather than drawing on more traditional historical and theological sources and interpretations, Miles relies almost exclusively on the forms and methods of literary criticism. For him, God becomes the protagonist in a cosmic play. He explains in the Prelude that the God of Scripture should be treated much the same as a Shakespearean character. Just as Shakespeare's characters take on a reality of personality development beyond mere words on paper or actors in dialogue when the play is actually performed, so God experiences progressive character development through interaction with his "imaged creation" as portrayed in Scripture. (Shakespeare is much better at this.)

Miles's God is a "comedy of errors" on a quest of self-discovery, having "no life other than the one he lives through mankind." Though almost omnipotent, he is strangely, severely myopic, being continually surprised and frustrated with the direction his prized creation takes:

> After each of his [God's] major actions, he discovers that he has not done quite what he thought he was doing, or has done something he never intended to do. He did not realize when he told mankind to "be fruitful and increase" that he was creating an image of himself that was also a rival creator ... He did not realize when he gave them the law that where there is law, there can be transgression and that, therefore, he himself had turned an implicitly unbreakable covenant into an explicitly breakable one. He did not realize when he began to withdraw from his alliance with Israel, after Israel's first, minor infidelities, that the aftermath would be the rise of a king, David, whose charisma would draw the Lord almost despite himself into a quasi-parental relationship with his semiabandoned ally (p. 250).

For the author, it is not appropriate to try and explain God's character through metaphor, allegory, or anthropomorphisms. Anger, jealousy, regret, fear, and, much

later in his turbulent relationship with mankind, love are all accurate explanations for the divine attitudes. Following the tripartite division of the Hebrew Scriptures (to which he limits his biography), the Tanakh, (Law, Prophecy, Writings), he portrays God progressively from turbulent teen, to mature adult (at last learning to love), to retiring grandfather. After the age of Prophecy, God becomes strangely quiet, less talking than talked about. In fact, things became so confused for God, that Miles would have us understand that the cosmic comedy was very nearly a tragedy. Job, the first of the Writings, whose strength of character and righteous defense "out-Gods God" so clearly that God very nearly gave up on himself: "Knowing himself to be what Job teaches him that he is, the Lord should find it impossible to go on; and this is almost what happens" (p. 405). What happens in the remaining books of the Writings is nothing less than the "saving" of God from himself, from oblivion; however, he no longer takes as active a part in the play, being retired to the grandfatherly status of a "motivating force," where he evidently remains forever.

Jack Miles is knowledgeable about literary criticism and Old Testament theology, and he writes well, weaving his literary analysis skillfully within the fabric of the Hebrew Scriptures. He does, however, distort both literary criticism and theology by attempting to keep them far more separated than a fair scholarly analysis would allow, and in so doing, misses the main point of Scripture. The Tanakh is not cosmic theater. Jack is nimble, Jack is quick, but Jack has mistaken a candlestick for Light. Candlesticks are much easier to jump over.

Reviewed by Wes Harrison, Professor of History/Political Science, Alderson-Broaddus College, Philippi, WV 26416.

REASON AND RELIGIOUS FAITH by Terence Penelhum. Boulder, CO: Westview Press, 1995. 166 pages, extensive references, appendix, bibliography, index. Paperback; $15.95.

Penelhum is professor emeritus of religious studies at the University of Calgary. He is author of many books and articles on the history of philosophy and the philosophy of religion, including *Religion and Rationality. Reason and Religious Faith* has five chapters: "Faith and Western Philosophy," "Belief and the Will," "Faith, Certainty, and Anxiety," "Faith and Rationality," and "Faith and Ambiguity."

In the preface, Penelhum states: "This book is intended to clarify and explore some of the special problems that religious faith raises for philosophy." Although Penelhum demonstrates an excellent grasp of the classical arguments given by the major philosophers of the past, he does not have a proper understanding of biblical faith. The Bible presents faith in a positive light, and one is told "that without faith it is impossible to please God" (Heb. 11:6). Therefore, faith must be something that is good to have. Penelhum states: "We all know that many people believe things that they lack sufficient grounds for; but it is the task of philosophical thought to put them on their guard against doing so as far as possible. Yet not only does faith appear to combine these things; it also seems to make a virtue of the combination" (p. 6).

Penelhum describes faith as something one believes when all reason says not to believe it. Why would any rational person be interested in something like that? Jesus said, "Love the Lord your God with all your heart and with all your soul and with all your mind" (Matt. 22:37). Our mind is important to God. "'Come now, let us reason together,' says the Lord" (Isa. 1:18). Biblical faith is a faith that by its very nature must go with the facts. Biblical faith is not something to be guarded against.

Penelhum approaches the Bible with a rationalistic viewpoint, and he questions the historicity of biblical miracles (p. 133). Furthermore, he has several disagreements with what Saint Paul wrote. However, it is not fair to say, "that is just Paul's opinion." 2 Peter 1:20-21 makes it clear that the authors of Scripture did not write out of their own personal opinions. In fact, Paul himself in Gal. 1:12 states: "I did not receive it from any man, nor was I taught it; rather, I received it by revelation from Jesus Christ." Penelhum's disagreement is not with Paul, but with Paul's Lord.

Penelhum is very critical of the passage Rom. 1:18-32. He strongly objects to the view "that belief in God is an universal endowment and its apparent absence is the result of its sinful suppression" (p. 105). This passage of Scripture teaches that unbelievers have rejected God even though God gave them evidence that he exists. Both the internal evidence in their conscience and the external evidence in the creation around them are clearly understood "so that men are without excuse" (Rom. 1:20). Yet Penelhum still objects. He states: "If the revelation is true, the signs of its truth have not been convincing to more than a minority" (p. 6). It is clear from comments like this that Penelhum does not understand what the Bible has to say about the sinful condition of man.

Nevertheless, I did appreciate the considerable attention Penelhum gave to Pascal's Wager in the section called "Prudential Belief." Penelhum concludes this section by stating: "I suggest that the case for prudential apologetics has considerable strength in a religiously ambiguous world. It does not merit the hasty dismissal that it commonly provokes" (p. 92). It is true that the ornery agnostic will not be challenged by Pascal's Wager because this kind of unbeliever will always move from one objection to the next. However, Jesus promised to reveal himself to the honest doubter who is willing to obey (John 7:17; 17:6-8). Pascal suggested that the unbeliever pray and attend church. Certainly these activities could not hurt, and possibly faith will come. Indeed, it is the prudent course of action for a truth seeker. There is nothing to lose; and if Christian theism proves true, he gains a great deal. This section on prudential apologetics is very strong in an otherwise weak book.

Reviewed by Everette Hatcher III, P.O. Box 23416, Little Rock, AR 72221.

Letters

Response On Murphy

I enjoyed George L. Murphy's discussion on the influence biblical beliefs have upon physics. However, I believe he missed one of the most important interactions between faith and study: thanksgiving and worship. One's faith and study need not and should not remain independent or interact merely to give each other meaning. As we discover the vast and intricate wisdom with which God designed the universe, we should see all the more plainly that God has eternal, dynamic power and a transcendent, divine nature (Rom. 1:20). This knowledge of God's power and nature should prompt the physicist (or any other scientist) to worship and give thanks to the Lord who has condescended to come near to us.

A biblical analogy should help make this responsibility (and privilege) to worship even more plain. Not all those who helped build the first temple under Solomon believed in Yahweh as the Most High God. However, some of these pagans probably had a good knowledge of how the temple was built and the designs that were in the temple. They could build even though they didn't believe.

Later, the upper orders of priests in Jerusalem continued to go through the worship routines with technical precision. However, the ark of the Lord was not there, and Ezekiel had already had a vision of the glory of the Lord departing from the temple. The science of sacrifice continued, but the point of the activity was missed: to worship and give thanks to God. In the same way, scientists are engaged in a practical idolatry if they fail to pray for wisdom in how to interpret the data and to thank God for creating and for showing his glory to us.

May God be praised in the heavens and the earth,

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Response to Winder

G. Gordon Winder's letter (Sept. 1996, p. 211) argues that ASA should revise its Statement of Faith to include a statement that science and religion are "compatible." He points to Christians as unique among religionists in expecting debate between "science and religion." Yet debate is vigorous within science, between religions, and within any religion with enough intellectual content to support theological reflection. Why should debate not occur when Christianity interacts with science?

In publishing *Teaching Science in a Climate of Controversy*, ASA has made at least one effort to "pursue compromise and conciliation to initiate resolution," as urged by Winder. Responses to that publication from hard-nosed atheists in the scientific community indicated that for ASA to "declare compatibility" would have no more influence on the real situation than the U.S. declaration of victory had in the Vietnam War. To some scientists, endorsing any statement of Christian faith was enough to demonstrate that the ASA authors could not be "real scientists."

By signing the ASA statement, thousands of scientists provide abundant evidence that science and Christianity do meet harmoniously in individual lives. Within the ASA "forum," I find the debates more often between two ways of interpreting scientific data, or two ways of drawing theological conclusions, than between "science and Christianity." Besides sharpening our ideas, debates within ASA make our unity in Jesus Christ all the more obvious: they give us opportunities to show love for those with whom we disagree.

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Functional Integrity and God's Interaction with His Creation

In the June 1995 issue of *PSCF*, Howard Van Till summarizes his views on "evolutionary creation" and "functional integrity."[1] Critiques of those views are presented by Gordon Mills in the same issue of *PSCF* and also in the *Christian Scholar's Review*.[2] In his *PSCF* paper, Mills notes similar views of those of Van Till that are held by two British scientist-theologians, Arthur Peacocke and John Polkinghorne. Since they have expressed their current views in a dialogue in *Science & Christian Belief*, it appeared of interest to compare some of the views of Peacocke and Polkinghorne with those of Van Till, Michael Corey,[3] and Mills.

Peacocke's view includes God unfolding by chance exploration the potentialities of matter that he gave to it. The overall mechanism involves both chance and law in the origin and development of living organisms. The "law" portion of this mechanism involves the analogy of nonlinear systems which, in a far from equilibrium thermodynamic state, form ordered "dissipative structures," and which, under certain conditions, fluctuate to a new ordered

state. The above phenomenon is denoted as "order-through-fluctuations," and because of it Arthur Peacocke believes that the "emergence of ordered self-reproducing molecular structures — that is, of living systems" is highly probable. It further is the basis for a model involving a "hierarchy of dissipative structures." Arthur Peacocke sees this hierarchical model as being analogous with "the early stages of biogenesis and the subsequent evolution to higher forms" wherein the emergence of life is inevitable.

This view is based primarily upon works of Ilya Prigogine and Manfred Eigen. It is a scientific view, but there is little reason to regard Peacocke's conclusions regarding the significance of these studies as correct. Thaxton, Bradley, and Olsen have discussed Prigogine's nonlinear thermodynamics and its possible application to the origin-of-life question. They note: "Prigogine, et al., Eigen, and others have suggested that a similar self-organization ... can potentially account for the highly complex macromolecules essential for living systems. But such analogies have scant relevance to the origin-of-life question. A major reason is that they fail to distinguish between order and complexity."[5]

Polkinghorne's view involves God giving away "active information" to his creation by either "willed intentionality" or "holistic laws of nature" which supposedly cause "the universe to evolve greater degrees of complexity." Although Polkinghorne's theoretical framework appears to be fairly reasonable, any real significance with biologically relevant molecules has not been demonstrated. Polkinghorne also notes: "... it seems to me that agency through 'active information' may well be the way that God providentially interacts with the world as well as the way in which we ourselves are agents."[6] Also, "divine action will always be hidden, contained within the cloudiness of unpredictable process."[7]

In his response to Polkinghorne, Peacocke notes: "Polkinghorne rightly draws attention to our common suggestion of the usefulness of the notion of information in our attempts to model God's interaction with the world ... I refer to God's interaction with the world as a whole as the flow, or 'input,' of information and he to 'active information' — and we both point out that this is distinct from an input of energy from God, which would indeed by 'intervention.'"[8] Thus, both Polkinghorne and Peacocke appear to recognize the necessity of some type of flow of information from God to his creation. To what extent Van Till agrees with their position is not entirely clear.

Although Van Till argues strongly for his view that the Creator has equipped his creation so that "... molecules and organisms have in fact accomplished the changes envisioned in the macroevolutionary paradigm simply by employing their own resident capacities," he does note that "... every one of these processes and every connective pathway in the possibility space of viable creatures is a mindfully designed provision from a Creator possessing unfathomable intelligence."[9] The only apparent way of reconciling these two statements of Van Till is to suggest, as do Peacocke and Polkinghorne, that God's interaction with the world involves an "input" of information, particularly in regard to exploring possibilities.

Although Peacocke and Polkinghorne use the term "information," rather than "genetic information," it would appear that Polkinghorne's and Peacocke's views on information are not necessarily in conflict with Mills' statement: "... that in the history of the origin and development of living organisms, at various levels of organization, there has been a continuing provision of new genetic information by an intelligent cause." For Mills, a "provision of genetic information" involves the incorporation of information containing aperiodic polymers of DNA of a *specified* sequence and this provision might indeed require an input of energy.[10] If Peacocke's and Polkinghorne's "input" of information "to the world-as-a-whole" is a secondary causational level physical transfer of a communication involving either particle or wave phenomena, then an input of energy might also be required for this physical transfer to be achieved. Moreover, note that Rolf Landauer states that "Information is inevitably tied to a physical representation ... [and in accordance with] ... the laws of physics ... [it is proper to ask] ... whether there are minimal energy dissipation requirements associated with information handling."[11]

Michael Corey, whose views in many respects are similar to those of Peacocke, Polkinghorne and Van Till, is much more explicit when he speaks of genetic information. He notes: " ... the *a priori* existence of a complex set of genetic instructions specifying the future development of all life on earth would itself demand the existence of some type of genetic programmer, which, in all probability, would turn out to be the Creator Himself."[12] Corey is even more explicit when he notes: " ... there is no *a priori* reason why the very first life form couldn't have contained all the genetic information for the evolutionary development of the entire biosphere. Or alternatively, there is no *a priori* reason why some external source couldn't have infused the proper genetic instructions into the genome at the appropriate time in evolutionary history."[13] This second alternative is very similar to the proposal of Mills. Corey clearly espouses the view that a Creator has infused, in some manner, genetic information into living organisms. Also he considers this view not to contradict his previous statement that " ... God seems to act almost exclusively through the use of natural cause-and-effect processes — which he himself designed into matter ..."[14]

In their critique of Polkinghorne's and Peacocke's views, Doye, et al. note: "... we might wonder whether we can reasonably expect to demarcate the bounds of and reasons for the acts of the almighty Creator ...".[15] We wonder whether the distinction between "interaction" and "intervention" based on energy input is as clear as has been suggested by Peacocke and Polkinghorne.

In closing this letter, another comment of Polkinghorne is pertinent in regard to God's interaction: "All of us currently working in this area are seeking to find some account of divine action which is consistent and continuous in character, reflecting that unyielding steadfastness which is part of the divine nature."[16]

Notes

[1]Howard Van Till, "Special Creationism in Designer Clothing: A Response to *The Creation Hypothesis*," *Perspectives on Science and Christian Faith* 47, No. 2 (1995): 123-131.

[2]Gordon Mills, "A Theory of Theistic Evolution as an Alternative to the Naturalistic Theory," *PSCF* 47, No. 2 (1995): 112-122 and Gordon Mills, "Theistic Evolution: A Design Theory at the Level of Genetic Information," *Christian Scholar's Review* 24 (1995): 444-458.

[3]J. C. Polkinghorne, "*Creatio Continua* and Divine Action," *Science & Christian Belief* 7 (1995): 101-108; J. C. Polkinghorne, "Theological Notions of Creation and Divine Causality," In *Science and Theology: Questions at the Interface*, M. Rae, H. Regan and J. Stenhouse, eds., (Grand Rapids: Eerdmans, 1994), 225-237; A. R. Peacocke, "A Response to Polkinghorne," *Science & Christian Belief* 7 (1995): 109-115; A. R. Peacocke, *God and the New Biology*, (San Francisco: Harper & Row, 1986), especially pp. 62-64 and 97-99. Other works of Peacocke and Polkinghorne are cited in *Science & Christian Belief* 7.

[4]M. A. Corey, *Back to Darwin* (Lanham, MD: University Press of America, 1994).

[5]C. B. Thaxton, W. L. Bradley, and R. L. Olsen, *The Mystery of Life's Origin*, (Dallas: Lewis & Stanley [second printing], 1992), 151.

[6]J. C. Polkinghorne, "Theological Notions of Creation and Divine Causality," In *Science and Theology: Questions at the Interface*, M. Rae, H. Regan and J. Stenhouse, eds., (Grand Rapids: Eerdmans, 1994), 236.

[7]Ibid.

[8]A. R. Peacocke, "A Response to Polkinghorne," *Science & Christian Belief* 7 (1995): 113.

[9]H. T. Van Till, "God and Evolution: An Exchange" *First Things* (June/July 1993): 32-41, quotes, p. 34 and p. 38; see also H. J. Van Till, "Is Special Creationism a Heresy?" *Christian Scholar's Review* 22, (1993): 380-395.

[10]For the "provision of new genetic information" with more details see Gordon Mills, "Theistic Evolution: A Design Theory at the Level of Genetic Information," *Christian Scholar's Review* 24 (1995): 448-450 and C. B. Thaxton, et al., *The Mystery of Life's Origin*, (Dallas: Lewis & Stanley [second printing], 1992), 128-143 and 151-165.

[11]See Rolf Landauer, "Minimal Energy Requirements in Communication," *Science* 272 (28 June 1996): 1914-1918 at 1914.

[12]M. A. Corey, *Back to Darwin* (Lanham, MD: University Press of America, 1994), 287.

[13]Ibid., 288.

[14]Ibid., 4.

[15]J. Doye, I. Goldby, C. Line, et al.,"Contemporary Perspectives on Chance, Providence and Free Will," *Science & Christian Belief* 7 (1995): 117-139.

[16]J. C. Polkinghorne, "*Creatio Continua* and Divine Action," *Science & Christian Belief* 7 (1995): 108.

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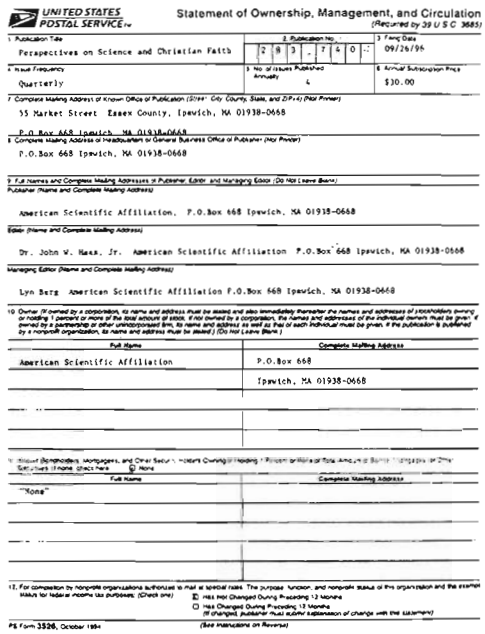

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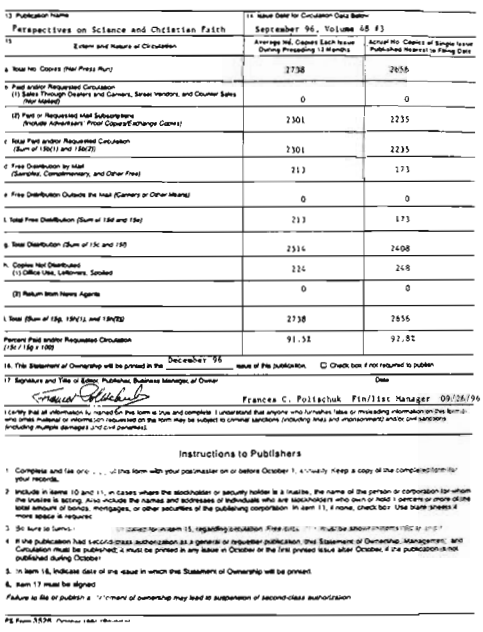

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The American Scientific Affiliation (ASA) is a fellowship of men and women of science and disciplines that can relate to science who share a common fidelity to the Word of God and a commitment to integrity in the practice of science. ASA was founded in 1941 and has grown significantly since that time. The stated purposes of the ASA are "to investigate any area relating Christian faith and science" and "to make known the results of such investigations for comment and criticism by the Christian community and by the scientific community."

Science has brought about enormous changes in our world. Christians have often reacted as though science threatened the very foundations of Christian faith. ASA's unique mission is to integrate, communicate, and facilitate properly researched science and biblical theology in service to the Church and the scientific community. ASA members have confidence that such integration is not only possible but necessary to an adequate understanding of God and His creation. Our total allegiance is to our Creator. We acknowledge our debt to Him for the whole natural order and for the development of science as a way of knowing that order in detail. We also acknowledge our debt to Him for the Scriptures, which give us "the wisdom that leads to salvation through faith in Jesus Christ." We believe that honest and open study of God's dual revelation, in nature and in the Bible, must eventually lead to understanding of its inherent harmony.

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

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