# PERSPECTIVES on Science and Christian Faith

JOURNAL OF THE AMERICAN SCIENTIFIC AFFILIATION

***In this issue . . .***



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

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*Perspectives on Science and Christian Faith*




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3. Use endnotes for all references. Each note must have a unique number. Follow *The Chicago Style Manual* (14th ed., sections 15.1 to 15.426).
4. While figures and diagrams may be embedded within the Word text file of the manuscript, authors are required to also send them as individual electronic files (JPEG or TIFF format). Figure captions should be provided as a list at the end of the manuscript text. Authors are encouraged also to submit a sample of graphic art that can be used to illustrate their manuscript.

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*The View from Shepherd's Knoll ...*

# "When Sickness Comes ... and Goes"

Recently, the editor was sick with coughing, hoarseness, mild fever, and a tight chest. My physician, confirming my personal diagnosis of bronchitis, prescribed an antibiotic, cough syrup, a bronchodilator inhalant, and several days of bed rest with minimal vocalization. (In lay-person terms, quaff up, rest up, and shut up!) How does a busy biology professor with classes to teach, research students to mentor, and numerous other responsibilities take such a hiatus from work? So against the advice of my physician and my good wife, I persevered on attempting to sustain school, editorial, church, and family responsibilities. What was the outcome? I experienced a prolonged bronchitis, which persisted even after a second round of antibiotics.

Why do we experience sickness? Is sickness a normal cyclic event of nature? Is it the consequence of Adam's sin? Is it a dietary consequence from a lack of vitamins and health food supplements? Is there Divine plan and purpose in the illnesses that we experience? Reflecting over the past weeks, I recognize some truths: (1) I am not invincible; sickness can bring me down and make me sputter. (2) Aging is not a friend to the recovery process. (3) The Great Physician, who is within beckoning distance, cares when I ache. (4) Finally, the world keeps on functioning even if I drop out of circulation for a few days. I am not indispensable. What humbling thoughts!

Maybe the purpose of my bronchitis lies in the words of the Psalmist: "Be still and know that I am God." Busyness, overcrowded schedules, and multiple responsibilities militate against stillness and meditation. However, lying in bed for a couple of days gives lots of time to reflect on the goodness of God, the joys of life, family, friends, church, and home. Withdrawal times, even when forced by illness, help one bring order to priorities.

In my childhood mind's ear, I heard my mother's clear soprano voice singing the words of the Methodist hymn writer, William Hunter, written in 1859:

> The great Physician now is near, the sympathizing Jesus;
> He speaks the drooping heart to cheer, O hear the voice of Jesus.
> Sweetest note in seraph son, sweetest name on mortal tongue,
> Sweetest carol ever sung, Jesus, blessed Jesus.
> And when to that bright world above we rise to see our Jesus;
> We'll sing around the throne of love His name, the name of Jesus.

The great Christian hope is that one day we will experience the continuous living presence of the Great Physician, where there is no pain, no sorrow, and no sickness.

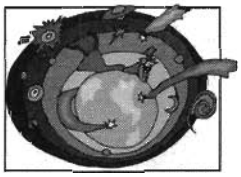
A recovering patient,
**Rornan J. Miller**, *Editor*

### In This Issue

If this issue of *PSCF* seems larger than normal, your perception is correct. Due to the generosity of an anonymous donor, the remaining journal issues in 2005 will be expanded by two sets of eight pages. Consequently instead of a standard 72-page journal issue, we will be printing 88-page journal issues in an attempt to publish more quickly a cluster of accepted manuscripts that have been awaiting entrance into our journal pages.

Two papers on origins occupy the Articles section. Writing for a popular audience, Perry Phillips describes the origin of the universe as the "Big Bang," and includes some thoughtful theological implications. Biologist Michael Buratovich discusses serial endosymbiosis, a theory of cellular origins, and links it with Intelligent Design theory. The Communications section relates the contributions of two contemporary scientists. Kevin Seybold assesses the integration work of John Stapylton Habgood, while Ben Carter analyzes the mindset of popular science writer Richard Dawkins.

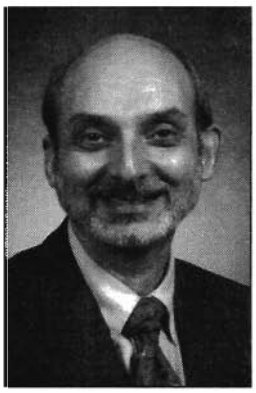
The News & Views section provides two reflections on life through the eyes of John Woodburn and Wayne Frair. Arlan Blodgett reports on the responses of surveyed archeologists to the Noahic flood. Finally, Glenn Morton provides current information on the global oil supply. A cluster of book reviews and several letters from readers on prior published material conclude the pages of this issue.





# The Thrice-Supported Big Bang

*Perry G. Phillips*



Perry G. Phillips

*"... A threefold cord is not quickly broken"* —Ecclesiastes 4:12.

*One cannot dismiss the Big Bang as "just a theory." Various lines of evidence confirm the "hot Big Bang" as the best model for the origin of the universe. The most widely known piece of evidence is Hubble's Law (galaxy redshifts), but the universal abundances of light elements and the cosmic microwave background radiation add convincing support to the hot Big Bang model. This paper discusses these three lines of evidence with emphasis on the last two.*

*Theological implications of the Big Bang are also discussed. Among ancient Near Eastern cosmologies, only the Bible presents the universe as having a beginning ex nihilo. Two historic alternatives to the Big Bang that avoid a beginning are presented and rejected. Finally, Gentry and Humphreys have proposed young-earth creationist models contrary to the Big Bang. We find their galactocentric cosmologies fail scientific and theological scrutiny.*

*The Big Bang is not "merely a theory." A number of cosmic observables are naturally explained only by Big Bang cosmology.*

The hot Big Bang is widely accepted as the standard explanation for the origin of the universe. According to this model, the universe began in an unimaginably hot, dense state that started to expand. In time, it cooled to the point where particles and atoms formed. Eventually, gravity organized this matter into galaxies and associated objects we observe today.

The Big Bang is not "merely a theory." A number of cosmic observables are naturally explained only by Big Bang cosmology. These observables are Hubble's Law (galaxy redshifts), the ratio of the abundances of light elements to hydrogen, and the cosmic microwave background radiation. These key pieces of evidence form the threefold cord of support for the Big Bang.

This article serves as an introduction and/or a review for those who have heard about the Big Bang but who have not had time to investigate supporting evidence for its validity.[1] In light of this evidence, we will see that opposing theories to the Big Bang—the steady state theory, oscillating universes, and recent young-earth proposals—lack scientific credibility. We also discuss theological implications of Big Bang cosmology.

**Perry Phillips**, *an ASA member, has a Ph.D. in astrophysics from Cornell University, an M.Div. from Biblical Theological Seminary in Hatfield, PA, and an M.A. in Hebrew from Jerusalem University College in Jerusalem, Israel. He taught astronomy, geology, mathematics, and biblical studies at Pinebrook Junior College, Coopersburg, PA, for thirteen years before winding up as a senior quality assurance engineer in the Boston area. Presently, he is teaching part-time at Gordon College. He and his wife live on Massachusetts' North Shore where he enjoys jogging through the woods and along the ocean. He can be reached by email at pgphillips@verizon.net.*

## First Key Evidence: Hubble's Law and the Expansion of the Universe

Of all evidence in support of the Big Bang, Hubble's Law—that distant galaxies are receding from us and that their recession speeds increase linearly with distance—is probably the best known. For decades, Hubble's Law was the foundational experimental evidence for Big Bang cosmology. Although this paper concentrates on the light element abundances and the cosmic microwave background radiation, completeness warrants a summary of Hubble's Law.

Until 1929, astronomers were convinced that the cosmos as a whole was static. They believed that the universe was infinite in extent with no beginning and no end. Stars and galaxies came and went, but the universe looked basically the same from all

locations for all time. No one expected a dynamic universe that changed size with time.

Suspicions that the universe might not be static were first raised in the 1920s by Georges Lemaître, Willem de Sitter, and Alexander Friedmann. These three formulated cosmological models that showed that a static universe was impossible. They based their models upon Albert Einstein's equations of General Relativity, which he developed in 1916.

To the discomfiture of many astronomers, most of their models indicated that the universe had a beginning! Before the work of Lemaître, de Sitter, and Friedmann, Einstein himself was aware that his equations led to non-static models, so he modified his equations with a term known as $\Lambda$ in order to keep the universe static. Even with $\Lambda$, however, solutions for universes that expand with time—implying a beginning—were soon found. Einstein ignored these solutions until 1929 when Edwin Hubble published his famous observations showing that the universe is expanding.[2]

Hubble showed that the speed of recession of a distant galaxy is proportional to its distance from earth. That is, the more distant the galaxy, the faster it is receding.[3] This observation confirmed the work of Lemaître, de Sitter, and Friedmann, and today remains one of the key evidences in favor of the Big Bang.

## Second Key Evidence: Abundances of Light Elements

The universe has an interesting chemistry; about 25% of the mass of atoms is helium and about one out of every 30,000 hydrogen atoms is deuterium. What accounts for these ratios, which are consistent on a cosmic scale? As we shall see, the Big Bang explains these universal abundances as a natural outcome of its early history.

In the 1940s, Ralph Alpher and Robert Hermann, in collaboration with George Gamow, realized that the early universe was hot enough to "cook" hydrogen into light elements, such as deuterium and helium.[4] To understand this process, however, we must first trace the thermal and the particle history of the universe for its first three minutes.

### *Planck Era*

The study of the universe requires the application of general relativity theory—which deals with space, time, and gravity—and of quantum mechanics, which describes the interaction of particles and photons. Unfortunately, neither of these theories applies to the universe before it was $10^{-43}$ seconds old. Before this time, known as the *Planck Era*, the very fabric of space-time was too chaotic to be described by known physical laws.[5] Hence, our description of the universe begins $10^{-43}$ seconds after its creation.

The temperature of the universe at the end of the Planck Era was an inconceivable $1.4 \times 10^{32}$ kelvins.[6] Only photons and neutrinos existed, for no stable particles could survive this high temperature.[7] The universe was not static; it began expanding and as it expanded, the temperature dropped.

### *Hadron Era*

One millisecond after the Big Bang, the universe "cooled" to $10^{13}$ kelvins. At this temperature the energy of photons equals the rest energy of quarks (the constituents of protons, neutrons, and certain mesons). Equilibrium existed between the creation and the destruction of quarks[8] as long as the temperature remained above $10^{13}$ kelvins, but once the temperature dropped below $10^{13}$ kelvins, quarks ceased to be created.

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*The universe has an interesting chemistry; about 25% of the mass of atoms is helium and about one out of every 30,000 hydrogen atoms is deuterium. What accounts for these ratios, which are consistent on a cosmic scale?*

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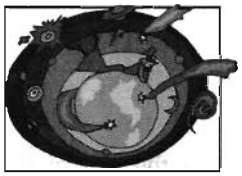
Think of the formation of quarks as a *phase change*. This is similar to what happens when steam turns to liquid water. That is, water can exist as steam at high temperature, but once the temperature cools enough, steam condenses into liquid water. Similarly, when the temperature dropped below $10^{13}$ kelvins, quarks "condensed out." The photons also cooled to the point where they no longer had the energy to create new quarks.

Quarks and antiquarks have identical rest mass; hence, one expects equal numbers of both particles to have condensed out when the temperature dropped below $10^{13}$ kelvins. But quarks and antiquarks annihilate each other when they meet, so once quark/antiquark pairs ceased to be created, total annihilation should have taken place. Only photons—the result of quark/antiquark annihilation—should exist today. This, however, is not the case; antiquarks were wiped out, but a small number of quarks survived along with the photons.

There are presently about two billion photons for every *baryon* (protons and neutrons are baryons). Three quarks comprise one baryon; this means that for every two billion quark/antiquark annihilations, three quarks remained



# Article

*The Thrice-Supported Big Bang*

*So how do the light elements give evidence for the Big Bang? ... If these abundances [of light elements] are observed throughout the cosmos, then there is very strong evidence that the Big Bang's early history matches theory.*

along with two billion photons. (These photons, as we shall see, reveal the structure and the future history of the universe.)

Apparently, an asymmetry[9] in the creation and/or the destruction of quarks prevented complete annihilation, thereby allowing quarks to dominate over antiquarks, and subsequently for matter to dominate over antimatter.[10] The remaining quarks quickly formed protons and neutrons that later built up the light elements. First, however, the temperature had to drop; otherwise, the photons would break up the nuclei of the elements as fast as they formed.

## Lepton Era

About one second after the Big Bang, the temperature fell to 10 billion kelvins. This is a critical temperature. Photons at this temperature have the same energy as the rest mass of an electron/positron pair. (The positron is the antiparticle of the electron.) This means that photons freely generated electrons and positrons as long as the temperature was above this threshold. As the temperature dropped, however, electrons and positrons ceased to be created. They subsequently annihilated, but just as in the case of quarks, an asymmetry in the process left an excess of electrons over positrons. Since the number of positive and negative charges is always in balance, the universe did not wind up with an excess charge. This means that the number of electrons matched the number of protons.

The combination of a proton and an electron produces a neutron (and an antineutrino), so neutrons formed as long as the temperature remained above 10 billion kelvins and a prodigious number of electrons were around. The drop in temperature below 10 billion kelvins stopped electron/positron pair production. Most electrons annihilated with positrons, thereby dropping their number considerably. Cessation of electron production quenched further production of neutrons, which at this time numbered about one neutron for every five protons.[11]

## Nucleosynthesis

Protons and neutrons have a great affinity for each other, but at the end of the lepton era the temperature was too high for light elements to form through proton/neutron bonding. Any attempt to bond was thwarted by the photons, which had more than enough energy to destroy newly formed nuclei.

About one minute later, however, the temperature dropped to one billion kelvins. At this stage, protons and neutrons could bond without dissolution by energetic photons. In the next two minutes, neutrons and protons combined to form the light elements. When the neutrons were used up,[12] light element production ceased.

Table 1 summarizes the relevant factors leading to the production of light elements.

## Light Elements and the Big Bang

So how do the light elements give evidence for the Big Bang? Given the constraints discussed above, one can calculate the primordial abundance of light elements. If these abundances are observed throughout the

**Table 1. A Summary of the Early History of the Universe**

| Time since creation | Temperature of the universe (kelvins) | Major activity |
|---|---|---|
| < $10^{-43}$ second | > $10^{32}$ | *Planck Era.* Presently known physics cannot describe the universe at this time. |
| 1 millisecond | Ten trillion ($10^{13}$) | *Hadron Era.* Quarks and antiquarks form and annihilate leaving a residue of quarks to form protons and neutrons. |
| 1 second | Ten billion ($10^{10}$) | *Lepton Era.* Electrons and positrons form and annihilate leaving a residue of electrons. Neutron formation ceases. |
| 1–3 minutes | One billion ($10^{9}$) | *Nucleosynthesis.* Protons and neutrons combine to form light elements until neutrons are used up. Light element production ceases. |

cosmos, then there is very strong evidence that the Big Bang's early history matches theory.

One observational problem exists with this scenario. Many physical processes in the universe destroy deuterium; only the Big Bang created deuterium.[13] Hence, the amount of deuterium has been decreasing ever since its formation. Helium, on the other hand, is produced by stars, so its abundance has increased throughout the universe's history. Astronomers must, therefore, hunt down localities of deuterium and helium in which their primordial abundances have not changed.

Fortunately, such locales exist. High resolution observations of the absorption spectra of quasars reveal the presence of deuterium. The absorption lines originate in very distant clouds that lie between the quasars and us. The light producing these spectra has traveled billions of years to reach us. As such, the spectra reflect the chemical composition of the clouds billions of years ago before substantial changes could take place in their original elemental abundances. The observations are difficult to make, for only one deuterium atom is expected for every 30,000 hydrogen atoms, but the observations confirm theoretical calculations.[14]

Quasar absorption spectra also reveal primordial helium. In addition, one can observe helium in the atmosphere of stars that have very small metal abundances. These stars are very old and formed from material from an early age of the universe.[15] From quasar absorption spectra and from low metal stars we find that the ratio of helium to hydrogen conforms to the theoretical prediction of 25% by mass.[16]

All in all, primordial helium and deuterium abundances throughout the universe match expectations, thus forming the second key evidence of support for the Big Bang.

# Third Key Evidence: Cosmic Microwave Background Radiation

## *General Background Radiation*

The universe emits microwave radiation in whatever direction one observes. This radiation has a specific temperature and spectrum. What is its origin? Can any theory of the universe naturally account for it?

Alpher, Hermann, and Gamow, who predicted the cosmic light element abundances, theorized in the late 1940s that a remnant of the brilliant radiation in the early stages of the Big Bang should pervade the universe today. Their theory first received observational support in 1965 by Arno Penzias and Robert Wilson, who won the Nobel Prize for their achievement. Other observations ensued, culminating in observations by the COBE satellite in the early 1990s.

The cosmic microwave background radiation (CMBR) has all the requisites of *blackbody radiation* (also called *Planck radiation*). This is the kind of radiation emitted by objects that are in thermal equilibrium with their surroundings. Blackbody radiation has a unique spectrum for any temperature, and this is precisely the kind of radiation predicted by Alpher, Hermann, and Gamow. COBE detected CMBR characteristic of an object emitting blackbody radiation at 2.73 kelvins (Figure 1). Only the Big Bang naturally accounts for the origin, spectrum, and present temperature of the CMBR, thereby further substantiating the Big Bang view of the cosmos.

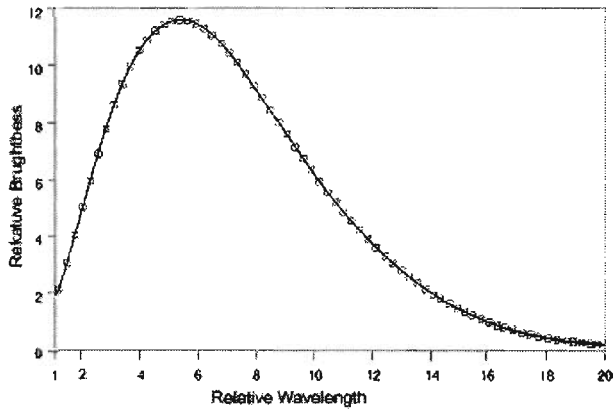



**Figure 1.** The solid curve represents the expected spectrum of blackbody radiation at a temperature of 2.73 kelvins. The COBE results, represented by the boxes, fit exactly on this curve, which is a pure blackbody spectrum as predicted by Alpher, Hermann, and Gamow. (NASA Goddard Space Flight Center and the COBE Science Working Group)

## *Anisotropies in the Background Radiation*

Superimposed upon the blackbody radiation, COBE also found that the CMBR intensity varies slightly from place to place across the sky. Specifically, patches of sky about seven degrees in diameter (roughly 14 times the diameter of the moon) are alternately slightly warmer or cooler than the average 2.73 kelvins background (Figure 2). These differences, which depend on the direction of observation, are called *anisotropies*. The temperature between patches varies about one part in $10^5$ from the mean background temperature.

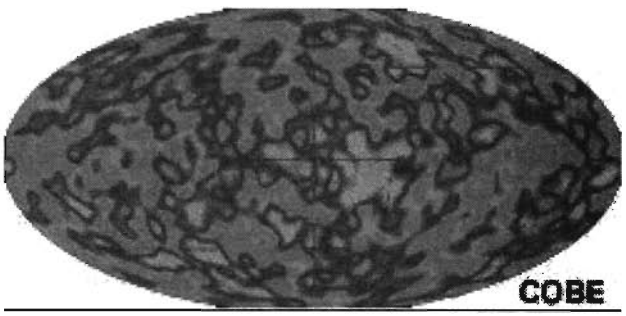
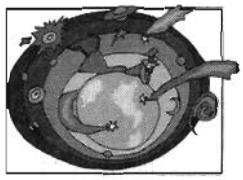



**Figure 2.** COBE anisotropy results. Various shades represent regions in space with slightly differing temperatures. (NASA Goddard Space Flight Center and the COBE Science Working Group)



# Article

*The Thrice-Supported Big Bang*

*What do the redshift, light element abundances, CMBR, dark matter, and dark energy have to do with the Big Bang? The answer is that* only *the hot Big Bang unifies these disparate observations into a coherent whole. Other cosmologies can be contrived to mimic some observations, but they fail miserably at other points.*

## Origin of the CMBR

Earlier we described the origin of quark/antiquark pairs and their eventual annihilation into photons, except for the few quarks that remained to form the baryons of today's universe. The photons emanating from the annihilation have become the CMBR. Of course, the expansion of the universe has highly redshifted the photons from the gamma ray to the microwave region of the spectrum.

We also described nucleosynthesis, which occurred at a temperature of about one billion degrees. At this temperature, the elements were *ionized*. Electrons could not bond with the nuclei to form neutral atoms. The atoms collided with such force that the electrons could not attach themselves to a single nucleus without being knocked away. Energetic photons also kept the electrons on the move through what is known as *Thompson scattering*. As such, the universe consisted of a mixture of protons and light element nuclei immersed in a sea of electrons and photons, thereby forming a *photon-baryon fluid*.

This condition lasted 380,000 years until the universe cooled to 3000 kelvins. At this temperature, neither collisions between atoms nor photons had enough energy to ionize the light elements to a great extent.[17] Electrons and nuclei formed neutral atoms. Since bound electrons do not interact with radiation as strongly as free electrons, the photons could now travel long distances unimpeded by the electrons. At this point, the radiation *decoupled* from the matter in the universe.

Photons from the *Decoupling Era* continue their flight through the cosmos to this day. These are the photons detected by COBE. The photon temperature, however, has decreased from 3000 kelvins to 2.73 kelvins because of the cooling effect of the universe's expansion.

As an aside, one does not require fancy equipment to detect the CMBR. It is possible to "see" it on a TV screen on a set that receives its signal from an antenna. Simply tune to a channel with no signal (where only "snow" appears). CMBR photons comprise a few percent of the snow. The picture will not win a prize, but it does show an echo of creation!

## CMBR Anisotropies

We have explained the origin and the nature of the CMBR, but how did its anisotropies originate? To answer this question, we must examine the properties of the universe soon after the Planck Era.

At the end of the Planck Era, the size of the universe was only as large as the distance light could travel in $10^{-43}$ seconds, which is on the order of $10^{-33}$ centimeters. Newtonian physics does not work on this scale. *Quantum physics*, on the other hand, can be used to describe the behavior of the universe at this stage. One of the principles of quantum physics is that no collection of particles, photons, or energy distribution is entirely uniform. This means that quantum density fluctuations existed throughout the early universe.

Quantum physics (specifically, quantum field theory) also predicts that between $10^{-35}$ and $10^{-33}$ seconds after the Big Bang the size of the universe increased enormously, some $10^{58}$ to $10^{60}$ times. This phenomenon, called *inflation*,[18] was first proposed by Alan Guth around 1980. Inflation took quantum induced density fluctuations and made them enormous, increasing their size by the same factor that the universe expanded. These density variations persisted until the decoupling era. Denser regions were more compressed, so they were a bit warmer than their surroundings. Photons emitted from these regions, therefore, were warmer than photons emitted by cooler regions, and this temperature difference gives rise to the COBE anisotropies.

In a sense, COBE reveals pre-inflationary quantum fluctuations that have grown to cosmic proportions!

## Acoustic Waves Anisotropies

Smaller angular-sized anisotropies than those measured by COBE overlie the CMBR. They arose from sound waves, or *acoustic waves*, which existed in the universe before the decoupling era. Acoustic waves also influenced the CMBR, and this influence can be detected today. These anisotropies argue strongly for the hot Big Bang, but before making this connection, we must understand how acoustic waves arose. We will also see how acoustic wave anisotropies provide information about the universe's

geometric structure, baryon density, and the amounts of dark matter and dark energy.

Before the decoupling era, the universe was a mixture of particles and photons, and this mixture acted like a fluid in which acoustic waves originated. They arose as follows: Quantum fluctuations created regions of greater density, and the stronger gravitational attraction in the denser regions attempted to compress the associated matter. The photons, however, were not so easy to compress; they exerted an outward pressure through their interaction with the free electrons, and this made the region expand. Thus, a tug of war ensued between the gravitational attraction and the photon repulsion. As such, oscillations developed, thus setting up acoustic waves that traveled throughout the universe.

As an illustration of this effect, consider Figure 3. The two balls represent particles that are being drawn by gravity toward the bottom of the bowl. The spring represents photons. As gravity pulls the balls together, the spring joining them is compressed and begins to exert an opposing force. Eventually, the spring's repulsive force exceeds the attractive gravitational force and the balls begin to move apart, only to be pulled back together again by gravity. Just as an oscillation develops in the ball/spring system, so an oscillation arises in the photon-baryon fluid from the competition between gravitational attraction and photon repulsion.

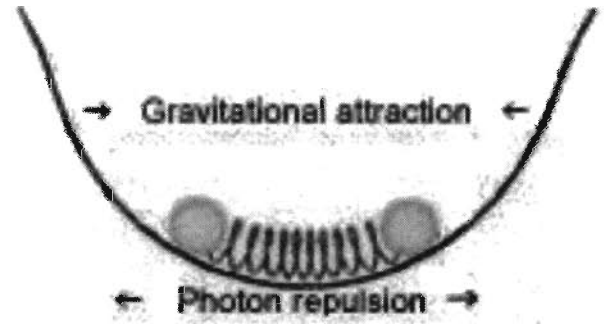



**Figure 3.** Illustration of gravitational attraction and photon repulsion that give rise to acoustic waves before the decoupling era. (Adapted from Wayne Hu, http://background.uchicago.edu/)

The contest between gravity and the photons continued until the decoupling era. At that time, free electrons became bound to form neutral atoms. Bound electrons do not scatter photons easily. The photons were now free to roam the universe, but they had a "memory" of the compressed and rarified regions from which they originated. Here's why: As the acoustic waves traveled through the universe, they alternately compressed and rarified the matter through which they passed. The compressed matter heated up, which in turn heated the photons interacting with hotter free electrons. At the moment of decoupling, the photons from the compressed regions were somewhat warmer than average, while those from the rarified regions were somewhat cooler. Since the photons no longer interacted with electrons, they traveled unimpeded from the time of decoupling to the present. The expansion of the universe has lowered their initial temperature difference to a few millionths of a kelvin, but they still carry a temperature imprint of the acoustic waves from what is called *the surface of last scattering*.[19]

A map of acoustic wave anisotropies appears in Figure 4. It is similar to the map from COBE, except that the scale of the anisotropies is on the order of one degree. (One degree is twice the angle subtended by the moon.) As we shall see, the angular scale of these anisotropies turns out to be one of the most accurate measures of the geometrical structure of the universe.

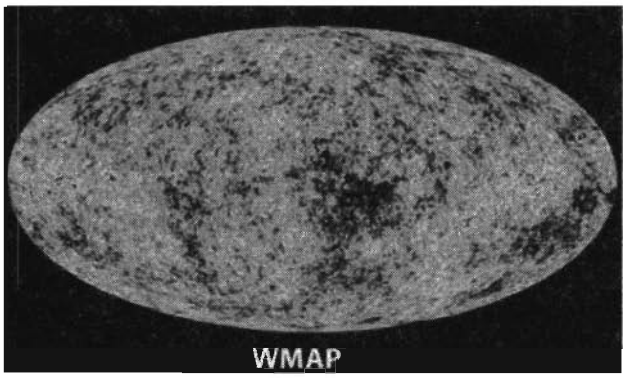


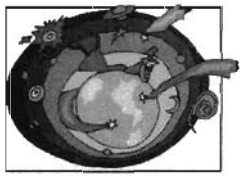

**Figure 4.** Composite map for the Wilkinson Microwave Anisotropy Probe (WMAP). WMAP displays finer detail than COBE. The angular separation of the anisotropies is on the order of one degree. The map reveals the minute temperature differences from the surface of last scattering. Light patches are warmer than dark ones. Compare these results to those of COBE in figure 2. (NASA/WMAP Science Team)

## Geometry of the Universe

One question of supreme interest to cosmologists is whether the universe will expand forever or eventually collapse upon itself. The outcome depends on the average density of the universe.[20]

General relativity connects the geometry of the universe to its density. At the *critical density* ($10^{-29}$ grams/cubic centimeter, or about five hydrogen atoms per cubic meter), the universe is *flat*. This means that if one were to draw a (very) large triangle across the universe—say hundreds of millions of light years on a side—the sum of its angles would be 180 degrees. This is what we expect when we draw a triangle on a flat sheet of paper. A flat universe is also called a *critical* universe.

On the other hand, if the density is greater than critical, the mutual gravitational force between all segments of the universe is able to "bend" the universe so its geometry resembles that of a sphere. On a sphere, the sum of the angles of a triangle adds up to more than 180 degrees. This kind of universe has *positive curvature* and is called *closed*.



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Conversely, if the density is less than critical, the geometry resembles that of a saddle. The sum of the angles of a triangle drawn upon a saddle is less than 180 degrees. A saddle has *negative curvature*, and such a universe is called *open* (Figure 5).

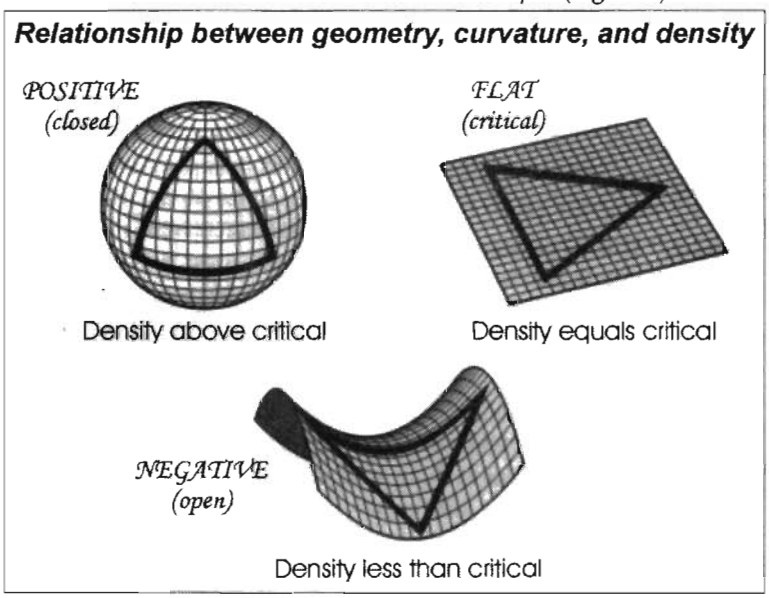


**Figure 5.** The geometry of the universe and its correlation to the critical density.

## Using the CMBR to Determine the Geometry of the Universe

Cosmologists can calculate the length of the acoustic waves at the decoupling era and predict their presently observable angular size. This angle should be about one degree *if the universe is flat.*[21] On the other hand, if the universe is closed, then the anisotropies will appear larger than one degree. Conversely, for an open universe, they will appear smaller than one degree (Figure 6).

Figure 7 shows an angular size "power spectrum" of acoustic anisotropies. That is, the graph correlates temperature differences across the sky for varying angular sizes. The main peak near one degree matches what has been calculated for a flat universe.

A flat universe substantiates a major prediction of the inflationary scenario. As an analogy why this is so, think of a sphere that expands $10^{58}$ to $10^{60}$ times. Regardless of its initial curvature, for all practical purposes the surface of the sphere will appear flat after expanding. The same holds for the universe.

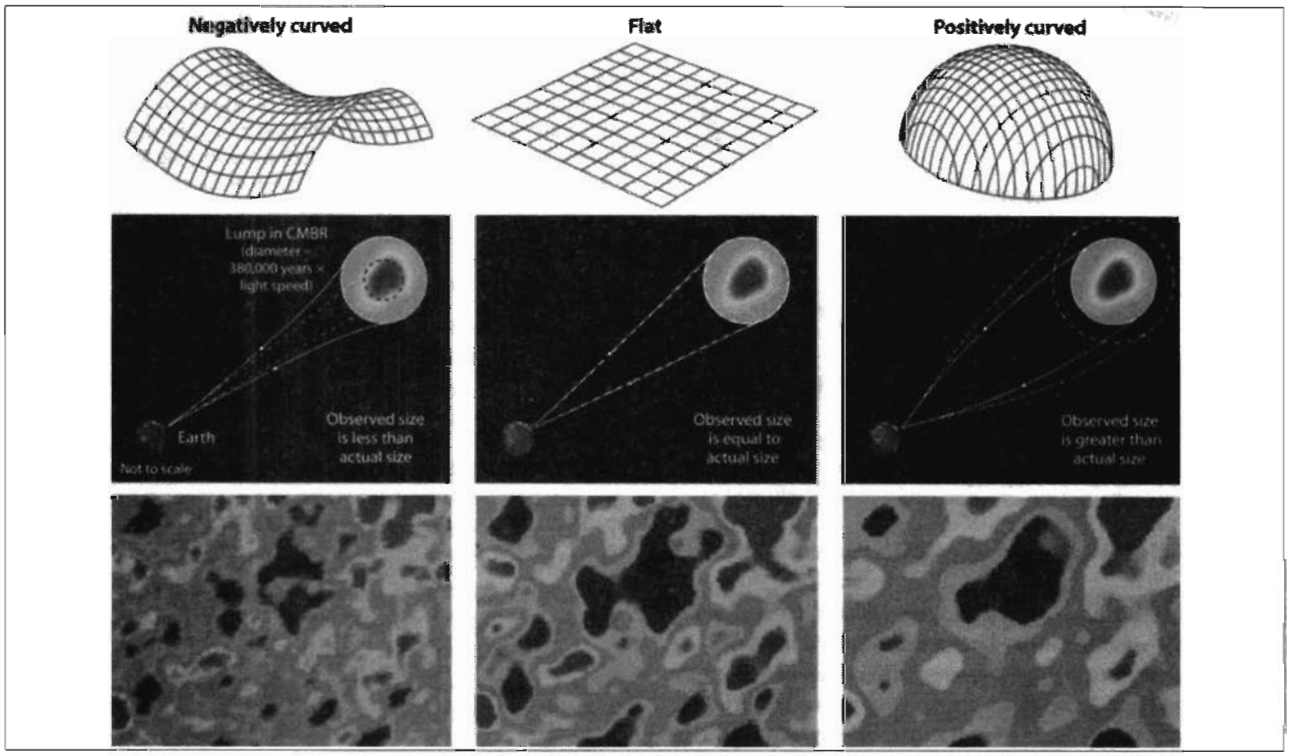


**Figure 6.** Sounding out the shape of space. *Top row*: On scales comparable to our visible universe, space can exhibit negative curvature (left column), no curvature (middle column), or positive curvature (right column). *Middle row*: This curvature determines the angular diameter of the baby universe's largest sound waves as seen on today's microwave sky. *Bottom row*: These false-color images show hypothetical maps of the CMBR. As it turns out, WMAP and several earthbound instruments all agree that the visible universe is flat—strongly supporting the inflation theory of the universe's origin. They have determined that the microwave sky is lumpiest on scales between ½° and 1°, as predicted for a flat universe, which is one with a critical cosmological density. (Graphics and caption from Wendy L. Freedman and Michael S. Turner, "Cosmology in the New Millennium," *Sky & Telescope* [October 2003]. Copyright © 2003 by Sky Publishing Corp., reproduced with permission of the publisher.)

Acoustic anisotropy data reveal that our universe will expand forever; never will it collapse upon itself and rise again from the ashes like the proverbial Phoenix!

Finally, we note that the size of galaxy superclusters matches the linear dimensions of the acoustic anisotropies in the CMBR.[22] This is not coincidental; the correspondence provides good evidence that acoustic waves gave rise to superclusters. Again, another observable in the universe is nicely explained by Big Bang cosmology.

## Baryon Loading

Notice that Figure 7 has a second peak at about one-third of a degree. This peak is also significant, for it shows the baryon density of the universe. Baryons are massive compared to electrons, so they do not respond as quickly to the compression and expansion phases of passing acoustic waves. Their relative immobility—called *baryon loading*—causes harmonics in the main acoustic wave. The baryon loading harmonic appears as a second peak in Figure 7.

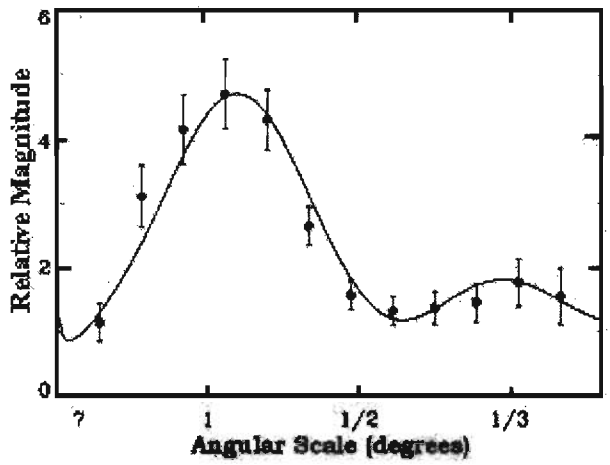


**Figure 7.** Temperature anisotropy and subtended angular diameter. The vertical scale is a measure of the temperature differences. The curve represents the best fit to the observed points. The vertical bars extending from the data points are the observational errors in the measurements. Notice the clear peak around one degree, which indicates a flat universe. The importance of the second peak is discussed below. (Adapted from BOOMERANG balloon data.)

Baryon loading depends upon the relative density of baryons to other kinds of matter in the universe. *The greater the density of baryons, the smaller is the size of the second peak relative to the first, and vice-versa.* Present measurements indicate that the baryon density of the universe is a little over 5%.[23]

## Dark Matter

Astronomers have known for a long time that the universe contains far more matter than revealed by visible light. This statement holds true even when all available forms of radiation are examined across the entire spectrum—from gamma rays to radio waves. One may ask, therefore, if this *dark matter* (also called *cold dark matter*) cannot be observed, how do we know it is there?[24]

Dark matter reveals itself through its gravitational attraction. For example, when we observe galaxy clusters, we find that some galaxies are moving so fast that they would have escaped from their parent cluster if a stronger gravitational field were not keeping them bound—a stronger field than inherent simply in the cluster's visible matter. Dark matter keeps the galaxies at home in the cluster.

Additionally, material in the outer regions of our own galaxy is rotating too rapidly about the galactic center to be contained by the gravitational force produced solely by our galaxy's visible matter. In other words, if the galaxy did not contain more matter than what is visible, its outer regions would have spun off by now. We find the same phenomenon exhibited by other galaxies, as well.

Dark matter does not interact directly with photons; its only interaction with other forms of matter is through its gravitational field. Nevertheless, dark matter influenced the CMBR anisotropies. Dark matter's gravity modulated the acoustic wave oscillations in the decoupling era, and this modulation shows up as another peak in the CMBR anisotropy data. The amount of dark matter determines the height of the third peak (Figure 8).

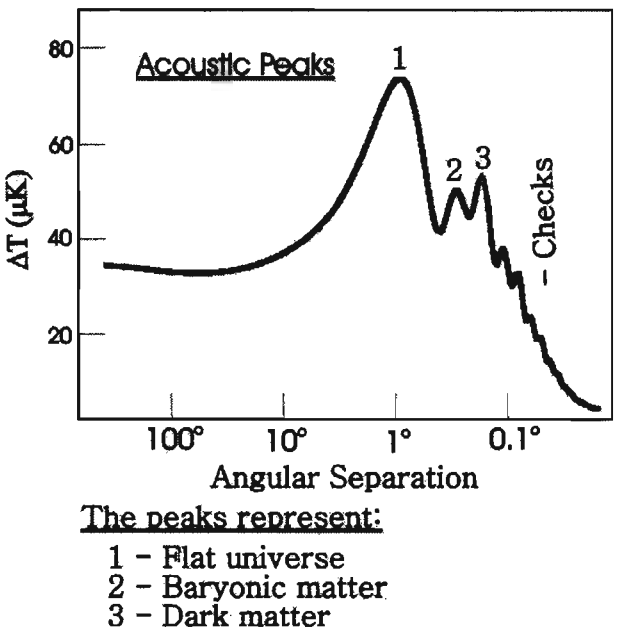


**Figure 8.** This diagram is an extension of Figure 7 and shows the harmonic peaks caused by *baryon loading* (labeled *baryonic matter* in the diagram) and by *dark matter*. The portion of the diagram marked *checks* are other harmonic peaks that can corroborate the calculations giving rise to the first three peaks. Discussion of the "checks" is beyond the scope of this paper. (Adapted from Wayne Hu, http://background.uchicago.edu/.)

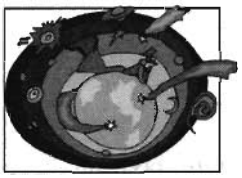

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Figure 9 presents the combined results from numerous CMBR observations as of this writing. The height of the third peak near 0.2 degrees corresponds to dark matter that makes up about 25% of the total content of the universe. We still do not know what comprises cold dark matter, yet there is five times more of it than the matter we are made of!

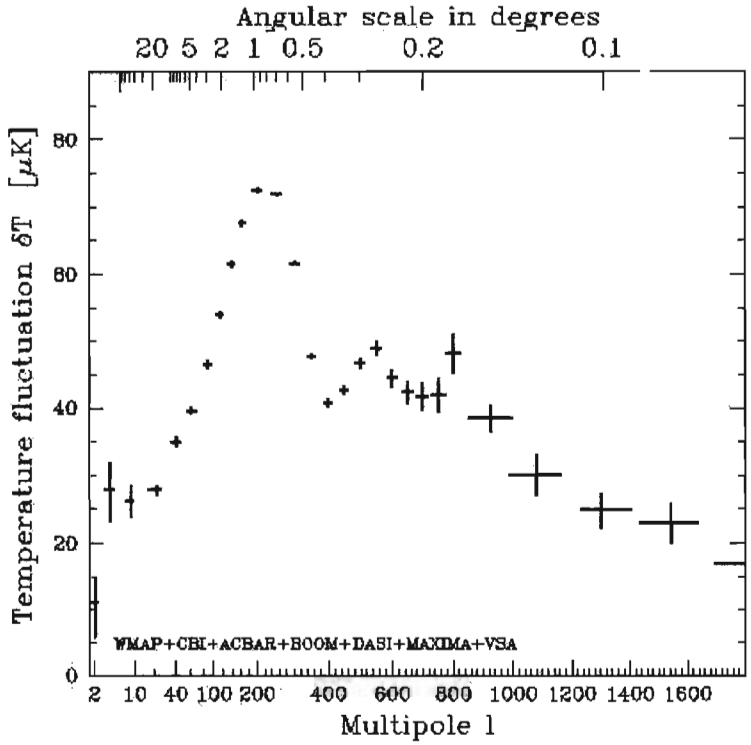



**Figure 9.** Latest observational results from various experimental groups (listed at bottom left of graph). The points average the measurements to show the prominence of the peaks. (Adapted from Tegmark. See Max Tegmark's web site at www.hep.upenn.edu/ ~max/cmb/experiments.html for continuous updates of this diagram.)

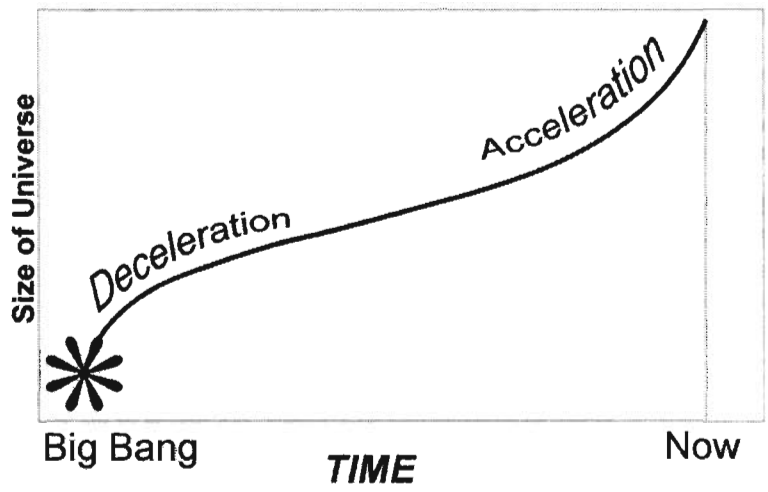



**Figure 10.** Gravitational attraction slowed the universe's expansion at first, but now a mysterious *dark energy* is causing the universe's expansion rate to increase.

## Polarization

The final aspect of our discussion of the CMBR deals with *polarization*. Polarization refers to the orientation of the electric field of the photons. Light reflected from flat surfaces, such as a pool of water, is polarized, which is why polarized sunglasses are able to eliminate most of the reflection.

Under most circumstances, one expects blackbody radiation to be unpolarized. A slight polarization in the CMBR is anticipated, however, from the scattering of photons by electrons that have not yet formed neutral atoms toward the end of the decoupling era.[25]

One also expects polarization of starlight from the first stars created after the decoupling era. These stars would ionize neutral hydrogen, and the electrons formed by ionization would polarize the starlight scattering off of them. Since this process occurred soon after the decoupling era, the polarized starlight would be redshifted into the microwave region.

Whatever the process, polarization of the CMBR was predicted, and now this prediction has been observed by the Degree Angular Scale Interferometer, or DASI.[26] CMBR polarization becomes yet another piece of evidence in favor of the Big Bang.

## Dark Energy

Astronomers are able to measure the distance to a galaxy and to correlate that distance with its recession speed. This gives rise to Hubble's Law. In the last few years, however, astronomers have discovered that distant galaxies are farther away than expected by the Hubble relationship. This effect reveals itself in the objects used to measure distances—Type Ia supernovas.

Supernovas are exploding stars. Their explosive energy is so immense that for a couple of weeks a supernova can outshine an entire galaxy. Since they are exceedingly bright, they can be seen for great distances and thus be used as distance indicators.[27]

The recession speed of a supernova is readily measured, and by Hubble's Law its "Hubble distance" can be inferred. The problem, however, is that at great distances Type Ia supernovas appear dimmer than expected. The best explanation for this phe-

nomenon is that their dimness results from their being more distant than their recession speed and Hubble's Law indicate. The simplest way to interpret this effect is that the universe's expansion rate has begun to accelerate. This has taken the supernovas farther away than expected, which makes them appear dimmer than anticipated. Figure 10 illustrates this phenomenon.[28]

The accelerating expansion was totally unexpected. Some kind of *dark energy* exists that is causing this behavior, but its makeup is unknown.[29] Moreover, dark energy turns out to be the major component of the universe, as illustrated in Figure 11.

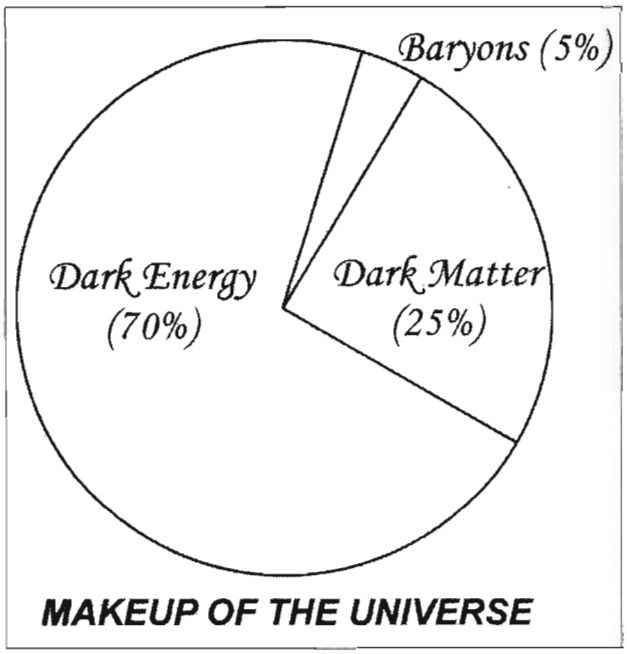



**Figure 11.** Component makeup of the universe. Notice that most of the universe is made up of non-baryonic matter. The combined mass/energy equivalence of all components of the universe points to a flat universe. These proportions are based upon WMAP and SDSS data. (See http://map.gsfc.nasa.gov and www.sdss.org for details.)

So strange are the results for the makeup of the universe from studying the CMBR and Type Ia supernovas that one can legitimately ask, "Can we trust these results? Is there an independent method one can use to measure the makeup of the universe?"

The answer to both of these questions is a resounding "Yes!" Surveys of tens of thousands of galaxies reveal that the universe resembles a collection of soap bubbles with large voids surrounded by thin walls of galaxies. The Sloan Digital Sky Survey (SDSS) has observed over *two hundred fifty thousand* galaxies, and the density of the constituents of the universe that produce the observed structure conform, within a couple percent, to those inferred from WMAP.[30]

### *Dark Energy, Geometry, and Future of the Universe*

Before the discovery of dark energy, cosmologists correlated the future of the universe to its geometry. To wit, without dark energy, a closed universe expands up to a point and then collapses upon itself. This is because a closed universe has a high enough density for the gravitational field to slow down and to reverse the expansion. Eventually, everything in a closed universe slams together in a "Big Crunch."

Critical universes, on the other hand, are on the exact boundary between continuous expansion and eventual collapse. Open universes expand at a faster rate than critical. Critical and open universes expand forever.

With dark energy, however, the geometry of the universe does not determine its future. Dark energy acts as a cosmic repulsive force providing a continuous expansion for all universes, regardless of their curvature. Since our universe has a large dark energy component, it will expand forever.[31]

In spite of the weirdness of dark matter and of dark energy, the combined mass/energy of the universe adds up to the critical density. This is further evidence for a flat, critical universe predicted by inflation.

### *Tying It All Together*

So what do we make of all this? What do the redshift, light element abundances, CMBR, dark matter, and dark energy have to do with the Big Bang? The answer is that *only* the hot Big Bang unifies these disparate observations into a coherent whole. Other cosmologies can be contrived to mimic some observations, but they fail miserably at other points.

The conclusion is clear: The threefold cord of support for Big Bang cosmology consists of solid evidential fiber!

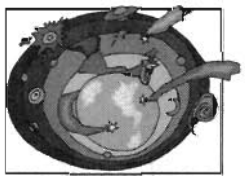
## Theological Implications

### *Creation ex nihilo*

Historically, Judeo-Christian theology has interpreted the first verse of the Bible as meaning that God, through his sovereign will, created the entire universe out of nothing (creation *ex nihilo*). Unlike ancient Near East or Hellenistic cosmologies, the God of the Bible did not begin with pre-existing matter.[32]

The Big Bang fits in well with creation *ex nihilo*. In the words of Robert Jastrow:

> Now we see how the astronomical evidence leads to a biblical view of the origin of the world. The details differ, but the essential elements in the astronomical and biblical accounts of Genesis are the same: the





*Historically, Judeo-Christian theology has interpreted the first verse of the Bible as meaning that God, through his sovereign will, created the entire universe out of nothing (creation* ex nihilo*). ... The Big Bang fits in well with creation* ex nihilo.

> chain of events leading to man commenced suddenly and sharply at a definite moment in time, in a flash of light and energy.[33]

A classic attempt to circumvent a beginning was made in 1948 by Fred Hoyle, Herman Bondi, and Thomas Gold. They proposed their "Steady State" universe based on the "Perfect Cosmological Principle."[34] A consequence of the perfect cosmological principle for an expanding universe is that matter has to be created continuously to make up for its decreasing density over time. In other words, matter has to pop into existence and form galaxies at the same rate as they disappear beyond the universe's horizon. As such, Steady State cosmology was dubbed "continuous creation" cosmology.[35]

Steady State cosmology, however, has no mechanism for producing the CMBR and its anisotropies, or the universal light element abundances. As such, this theory is studied for its historical interest rather than as a viable alternative to the Big Bang.[36]

Another attempt to avoid a beginning is the oscillating universe, which became popular in the mid-twentieth century and was advocated by Carl Sagan in his PBS *Cosmos* series. Basically, the universe is like an accordion that expands and contracts in the course of several hundred billion years. The universe expands to its maximum extent and then collapses upon itself in a "big crunch," out of which it begins anew with another big bang. This cycle of "bang" to "crunch" repeats forever.

Historically, oscillating universes had three major problems.[37] First, thermodynamic considerations predict that subsequent universes will have proportionately greater ratios of radiation to matter, and this leads to longer cycling times for each oscillation. If we are the result of an infinite number of past cycles, then our universe should be a radiation-only universe. Clearly this is not the case, which means that our universe, at best, is only a few cycles old.

Second, we have no theory as to how a big crunch turns into a big bang. One requires a quantum theory of gravity to attempt to solve this problem, and even with such a theory there is no guarantee that a mechanism exists.

Third, recent data that the universe's expansion rate is accelerating drives the final nail in the coffin of the oscillating universe. Dark energy will prevent the universe from collapsing upon itself. As such, oscillating universes are not seriously considered today, although they are hailed as "scientific evidence" in support of Hindu cosmology by some adherents of Hinduism.[38]

For now, the standard hot Big Bang remains the best explanation for the creation of the universe.[39] Future theories may elucidate further the moment of creation, but in the words of Joseph Silk:

> If a better theory of the universe is forthcoming, there seems little doubt that it will incorporate the big bang theory as an appropriate description of the observable universe ... in the same way that Einstein's theory of gravitation encompassed and generalized the concepts of Newtonian gravitation.[40]

## The Big Bang and Young-Earth Creationism

In many Christian circles, Big Bang cosmology is denied, ignored, or reviled, especially by those who do not accept that the universe is billions of years old. Some have attempted to reformulate the Big Bang in a young-earth framework, while others have resorted to nonconventional theories to explain the cosmological redshift—as though the validity of the Big Bang rests solely on the redshift.[41]

One of the latest attempts to reinterpret the Big Bang in a young-earth framework is that of Robert V. Gentry's Cosmic Center Universe (CCU), which has evolved from his earlier New Redshift Interpretation.[42] Basically, Gentry sets up a universe centered upon our own galaxy. He adds a "non-zero vacuum energy density" that causes the galaxies to recede from the Milky Way in such a way as to give Hubble's Law of recession. Unlike Friedmann-Lemaître models, however, the galaxies are not fleeing because of expanding space; rather, the galaxies are moving *through* space at speeds that vary with distance so as to give the Hubble Law for small distances.[43]

Gentry's model also invokes a spherical shell of galaxies at roughly the Hubble distance from the center.[44] This shell is massive

enough to cause a gravitational redshift of its emitted radiation such that its initial temperature drops to 2.73 kelvins by the time it reaches earth. Inhomogeneities in this shell account for the anisotropies in the CMBR.

Gentry's CCU is ingenious, but it is totally contrived. Whereas Big Bang cosmology gives rise in a natural fashion to the present temperature of the CMBR, Gentry has to set the temperature of the radiation emitted by his galactic shell to match what is seen at earth after it has been gravitationally redshifted. Gentry also has to set up the speeds of the receding galaxies to match what naturally occurs in an expanding universe.

Second, based upon principles of nucleosynthesis, Big Bang cosmology correctly predicts the universally observed abundances of the light elements helium, deuterium, and lithium. Gentry's theory has no mechanism for generating these abundances; thus, their observed amounts occur simply by chance. For these and other reasons,[45] Gentry's theory is not a serious contender to Big Bang cosmology.

### *Reversing Copernicus*

Finally, a few words should be said concerning recent attempts to bring the earth close to the center of the universe.[46] Not only is Gentry's CCU "galactocentric," so is a new proposal by D. Russell Humphreys. Humphreys points to the bunching up of galaxy redshifts into regularly spaced intervals as indicating that the galaxies are laid out in concentric, spherical shells that are evenly spaced around the Milky Way.[47]

Humphreys's galactocentric universe fits in with his theology. Earth is central to God's redemptive plans, and earth's physical position in the universe reflects its theological centrality. Humphreys, therefore, rejects the "Copernican Principle," which states that there is no preferred location or center in the universe.

The Copernican principle leads to the conviction that the universe—on a very large scale—is homogeneous and isotropic. Homogeneity and isotropy are foundational to Big Bang cosmology. As such, Humphreys also rejects the Big Bang in favor of his spherical, onion-layered universe.

Unfortunately, Humphreys errs at several critical junctures. First, his theological predilection is a throwback to pre-Copernican thinking. Christians have long realized that the Bible does not insist that the earth be the center of the universe for it to be central to God's plans.[48] Humphreys has substituted a new, supposedly biblically-based galactocentrism for the old, errant, supposedly biblically-based geocentrism.

Second, Humphrey's presumed quantized redshifts are based on obsolete datasets. The recent and ongoing Two-Degree Field Galaxy Redshift Survey (2dFGRS) and the Sloan Digital Sky Survey (SDSS) show not a shred of the redshift quantization claimed by Humphreys.[49] Apparently, the supposed quantizations were largely the result of improper data analysis or too small a sample to be legitimate. This is not surprising; many factors distort the true motion of galaxies in the universe. These distortions affect determining the correct value for the redshift of a galaxy.[50]

In summary, Big Bang cosmology indicates that the universe had a beginning, and this fits in with traditional Judeo-Christian doctrine of creation *ex nihilo*. Attempts to avoid a beginning, such as the Steady State Theory or an oscillating universe, are unsupported by the scientific evidence.

As for two contemporary young-earth creationist alternatives to the Big Bang, we find that Gentry's CCU and Humphreys's "quantized redshift" galactocentric universes fail scientific and theological scrutiny. The hot Big Bang remains the best model of the universe.

## Conclusions

We have made great progress in understanding the overall structure and history of the universe. Our universe began in the finite past. Its density is critical (i.e., it is geometrically flat), and it contains far more dark matter and dark energy than baryons, even though baryons comprise the matter most familiar to us. The universe will expand forever. Dark energy guarantees that it will never collapse upon itself to be reborn sometime in the future.

Our understanding of the very large (general relativity) and the very small (quantum mechanics) has revealed secrets of the universe hidden since creation. Hubble's Law, the abundances of the light elements, and the CMBR show that the Big Bang model of the universe is essentially correct. To this writer, the evidence is so overwhelming that arguing against the Big Bang is akin to arguing for a flat earth.

*"It is the*
*glory of God*
*to conceal a thing,*
*but the*
*glory of kings*
*(and cosmologists?)*
*to search out a matter"*

—Proverbs 25:2.

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## Notes

[1]I have attempted to strike a balance between articles that are too short to do justice to the evidence and book length works that deluge the reader with piles of data. The annotated bibliography at the end points to helpful works for those who wish to pursue the topic further.

[2]When Einstein learned of Hubble's results, he said that putting $\Lambda$ into his equations was the biggest blunder of his life. For an enjoyable history of this period, see Robert Jastrow, *God and the Astronomers* (New York: Warner Books Edition, 1978). Today, $\Lambda$ has come back into the picture in a big way, as I bring out below.

[3]This is true for distances of hundreds of millions of light years. At smaller distances, the random motions of galaxies overwhelm the Hubble effect. Since galaxies are receding from us, light emitted by them is shifted to longer wavelengths, which for visible light is the red end of the spectrum. Hence, astronomers refer to the Hubble relationship as the cosmic redshift effect.

[4]Other light elements formed during this period were tritium, helium-3, and lithium-7, where the number represents the mass number (the sum of the number of protons and neutrons). I will discuss only deuterium and helium-4 in this paper.

[5]Physicists are currently seeking to understand the nature of gravity and particle behavior during the Planck Era. Theories based upon strings, quantum loops, branes, and super-symmetry have been formulated, but their success is limited.

[6]The kelvin temperature scale is zero at absolute zero and positive from there on. Zero degrees centigrade (or Celsius) is 273 degrees kelvin, and one degree change in the centigrade scale is the same on the kelvin scale. Also note that rather than use the term "degrees kelvin," most scientists just say "kelvins." For a rough conversion of high kelvin temperatures to equivalent Fahrenheit temperatures, multiply the kelvin temperature by 1.8.

[7]Actually, "virtual" particles of all sorts existed. If photons have enough energy, then by Einstein's famous equation $e = mc^2$, the photons can spontaneously form pairs of particles each of whose "rest mass" equals half the energy of the photons. Hence, quantum mechanics allows for particles to be created from energetic pho-

tons, but they are immediately destroyed by mutual annihilation or by other photons. Thus, the early universe is home to zillions of photons and particles that are in a continuous process of creation and annihilation.

[8]In reality, both quarks and *antiquarks* appeared and disappeared, but here I have lumped both species into the generic term "quarks." Antiquarks are the *antimatter* form of quarks. Quarks and antiquarks annihilate when they come into contact, releasing gamma rays.

[9]We do not have a clear understanding of the asymmetry, but suffice it to say that without it we would not exist!

[10]Minute quantities of antimatter can be created in particle accelerators and by high energy cosmic rays, but for all practical purposes, the observable universe is devoid of antimatter.

[11]The difference in the rest masses between protons and neutrons fixes this ratio. See Joseph Silk, *The Big Bang*, 3rd ed. (New York: W. H. Freeman, 2001), 422; and Barbara Ryden, *Introduction to Cosmology* (San Francisco: Addison Wesley, 2003), 182.

[12]Neutrons have a mean lifetime of eleven minutes, so some neutrons decayed before being captured by protons. This dropped the neutron/proton ratio from 0.2 to 0.15. This ratio has remained constant since the end of cosmic nucleosynthesis.

[13]Nuclear reactions in stars also produce deuterium, but this deuterium quickly converts to helium and is not released into the interstellar medium. In the Big Bang, however, the temperature dropped fast enough to allow some deuterium to survive. (Deuterium requires a high temperature to fuse into helium.)

[14]David Kirkman, et al., "The Cosmological Baryon Density from the Deuterium to Hydrogen Ratio towards QSO Absorption Systems: D/H Towards Q1243+3047," *Astrophysical Journal Supplement Series* 149, no. 1 (2003). Online at http://arxiv.org/ PS_cache/ astro-ph/pdf/0302/0302006.pdf.

[15]Metals are generated in the last stages of a supernova explosion. The explosion spreads the metals into the surrounding medium from which later stars form. They, in turn, have a higher metal abundance than the stars that preceded them. When these stars become supernovas, metals enrich the surrounding medium even more. In this way successive generations of stars contain more metals than previous generations. Since stars spend most of their lives converting hydrogen to helium, supernovas also add helium to the mix, so its abundance also increases with progressive generations of stars. Astronomers seek metal poor stars to measure the helium abundance because they know these stars are older and less "polluted" by non-primordial helium.

[16]Gary Steigman, "BBN and the Primordial Abundances," http://arxiv.org/PS_cache/astro-ph/pdf/0501/0501591.pdf. Helium abundance measurements are lower than predicted, but as Steigman points out: "The culprit may be the astrophysics [measurements] rather than the cosmology." If, however, WMAP observations of baryon density are believed, then observed helium abundances correspond to Big Bang nucleosynthesis theory. See Richard H. Cyburt, et al., "New BBN Limits on Physics beyond the Standard Model from 4-He," http://arxiv.org/PS_cache/astro-ph/pdf/0408/0408033.pdf.

[17]At 3000 kelvins, some photons have enough energy to ionize hydrogen, but their number is not sufficient to alter what follows.

[18]These are high-end values for inflation. For a sense of scale, if two objects were one inch apart before inflation, they would be two million trillion trillion trillion *light years* apart after inflation! Of course, the universe was far smaller than one inch when inflation began, but these numbers give a sense of the magnitude of the expansion. Some propose an expansion of "merely" $10^{22}$ to $10^{30}$ times. Whatever value one chooses, the inflationary growth of the universe is mind-boggling.

[19]We emphasize here that the acoustic wave anisotropies are different than the inflation induced anisotropies discussed earlier and detected by COBE.

[20]"Density" does not refer only to baryons; it includes dark matter and dark energy, both of which are discussed below.

[21]For a mathematical derivation, see Ryden, *Introduction to Cosmology*, 161–5.

[22]Ron Cowen, "Repulsive Astronomy: Strengthening the Case for Dark Energy," *Science News* 164, no. 5 (August 2003): 67; Ryden, *Introduction to Cosmology*, 162; and Ron Cowen, "Modern Echoes of the Early Universe," *Science News* 167 (January 15, 2005): 35; Govert Schilling and Joshua Roth, "Galaxy Maps Reveal Long-Sought Waves" *Sky and Telescope* 109, no. 5 (May 2005): 8; "The Cosmic Yardstick—Sloan Digital Sky Survey Astronomers Measure Role of Dark Matter, Dark Energy and Gravity in the Distribution of Galaxies," www.sdss.org/news/releases/20050111.yardstick.html; and Daniel Eisenstein, et al., "Detection of the Baryon Acoustic Peak in the Large-Scale Correlation Function of SDSS Luminous Red Galaxies," http://arxiv.org/abs/astro-ph/0501171.

[23]Max Tegmark, et al., "Cosmological Parameters from SDSS and WMAP," available at http://arxiv.org/abs/astro-ph/0310723. We only "see" about one-third of the total baryonic matter in the universe in the form of galaxies and their associated, visible components (stars, planets, bright and dark nebulas, etc.). Two-thirds is in the form of large conglomerations of intergalactic hydrogen, which is detected by its absorption of radiation emitted by distant quasars. See Ron Cowen, "Visible Matter: Once Lost But Now Found," *Science News* 162, no. 6 (10 August 2002): 83.

[24]*Cold dark matter* is not to be confused with dark *baryonic* matter. The latter is made up of baryons. We do not know what constitutes the former.

[25]This effect was first discussed by Martin Rees, "Polarization and Spectrum of the Primeval Radiation in an Anisotropic Universe," *The Astrophysical Journal* 153 (July 1968): L1–L5. His paper is online at http://adsabs.harvard.edu/journals_service.html. A polarization "primer" by Wayne Hu and Martin White is available at http://xxx.lanl.gov/abs/astro-ph/9706147.

[26]Joshua Roth, "Polarized Microwaves Bolster New Cosmology," *Sky & Telescope* 104, no. 6 (December 2002): 20–1. The most recent evidence points to the second reason for the polarization by stars that formed about 200 million years after the Big Bang. See Bertram Schwarzschild, "WMAP Spacecraft Maps the Entire Cosmic Microwave Sky with Unprecedented Precision," *Physics Today* 56, no. 4 (April 2003): 21–4. More information about DASI is available at http://astro.uchicago.edu/dasi/.

[27]Type Ia supernovas have a well-defined intrinsic brightness that can be compared with their observed brightness to infer their distance. See Saul Perlmutter, "Supernovae, Dark Energy, and the Accelerating Universe," *Physics Today* 56, no. 4 (April 2003): 53–60.

[28]Type Ia supernovas are not the only indicators of an accelerating expansion. Correlations between galaxy clustering and the CMBR show the same effect. See Ron Cowan, "Repulsive Astronomy: Strengthening the Case for Dark Energy," *Science News* 164, no. 5 (2 August 2003): 67.

[29]A readable discussion of dark energy is Sean Carroll's "Dark Energy and the Preposterous Universe," *Sky and Telescope* 109, no. 3 (March 2005): 32–9. Many associate dark energy with Einstein's famous "cosmological constant" lambda ($\Lambda$) that he added to his field equations but later disowned. Lambda acts as a cosmic repulsive force that accelerates the expansion of the universe. See Silk, *The Big Bang*, 23, 24, 100–1. For a thorough discussion of the cosmological constant, see Sean M. Carroll, "The Cosmological Constant," *Living Reviews in Relativity*, 4 (2001): 1–80. Also online at http://arxiv.org/PS_cache/astro-ph/pdf/0004/0004075.pdf. This article requires some knowledge of general relativity.

[30]Max Tegmark, et al., "Cosmological Parameters from SDSS and WMAP."

[31]We note here that if dark energy were attractive, then all universes would end in a big crunch, regardless of their curvature. For details, see Ryden, *Introduction to Cosmology*, 91–4.

[32]Whether the Bible teaches creation *ex nihilo* depends upon the interpretation of Gen. 1:1. For a review of whether Genesis 1:1 should be translated as an independent clause (implying creation *ex nihilo*) or a dependent clause (implying God used previously

existing material), see John J. Davis, "Genesis 1:1 and Big Bang Cosmology," in *The Frontiers of Science & Faith: Examining Questions from the Big Bang to the End of the Universe* (Downers Grove, IL: InterVarsity Press, 2002), 11–25. I accept the historical and the grammatical evidence that the clause is independent.

[33]Robert Jastrow, *God and the Astronomers* (New York: Warner Books Edition, 1978), 3–4. Jastrow reached this conclusion a quarter of a century ago, and it is valid today. Jastrow's comment is particularly interesting since he declares himself an agnostic in this book. Jastrow also shows various scientists' troubled reactions to the evidence that the universe had a beginning.

[34]The "Cosmological Principle" states that on a large enough scale (about 300 million light years), the universe is homogeneous and isotropic. The "Perfect Cosmological Principle" extends homogeneity and isotropy into the dimension of time. That is, the physical characteristics of the universe have remained constant throughout eternity.

[35]When Thomas Gold was confronted with objections to continuous creation because it violated the law of conservation of mass/energy, he would remind his critics that the same is true for big bang cosmology. The only difference is that the Big Bang violated mass/energy conservation all at once while continuous creation does this in small steps. As he would say, "The difference is one big miracle versus a bunch of tiny miracles." (This is a figure of speech; Gold did not believe in miracles.)

[36]A good summary of the history of and the problems with the steady state theory appears in George Smoot and Keay Davidson, *Wrinkles in Time* (New York: Wm. Morrow & Co., 1993), 66–86. For personal reflections on the motivation for proposing the steady state theory, see Herman Bondi, "The Cosmological Scene 1945–1952," in *Modern Cosmology in Retrospect*, ed. B. Bertotti, R. Balbinot, S. Bergia, and A. Messina (Cambridge: Cambridge University Press, 1990), 189–96. Hoyle continued to rail against the Big Bang to his dying day despite the evidence that his objections were wrong. Unfortunately, young-earth creationists still refer to Hoyle (along with his colleagues Burbridge and Narlikar) for evidence against the Big Bang. (For example, see Henry M. Morris, "The Cosmic Bubbleland," in *Back to Genesis* 150 [June 2001], a–b. Also available online at: www.icr.org/pubs/btg-a/btg-150a.htm).

[37]John D. Barrow, *The Origin of the Universe* (New York: Basic Books, 1994), 29–31; and P. J. E. Peebles, *Principles of Physical Cosmology* (Princeton: Princeton University Press, 1993), 367–8.

[38]E.g., www.atributetohinduism.com/Hindu_Culture.htm. "Hinduism is the only religion that propounds the idea of life-cycles of the universe. It suggests that the universe undergoes an infinite number of deaths and rebirths. Hinduism, according to Carl Sagan:

> ... is the only religion in which the time scales correspond ... to those of modern scientific cosmology. Its cycles run from our ordinary day and night to a day and night of the Brahma, 8.64 billion years long, longer than the age of the Earth or the Sun and about half the time since the Big Bang."

[39]For other alternatives to the hot Big Bang besides those discussed here, along with their problems, see Silk, *The Big Bang*, 385–401, and Davis, *Frontiers*, 25–36.

[40]Silk, *The Big Bang*, 407.

[41]See, for example, the hypothesis for a cosmic time slowdown advanced by D. Russell Humphreys, *Starlight and Time: Solving the Puzzle of Distant Starlight in a Young Universe* (Colorado Springs: Master Books, 1994). His arguments have been thoroughly refuted, albeit he refuses to acknowledge this. Readers can follow the exchange between Humphreys and his critics and decide for themselves: P. G. Phillips, "D. Russell Humphreys's Cosmology and the 'Timothy Test,'" *Creation Ex Nihilo Technical Journal* 11, part 2 (1997): 189–94; J. D. Sarfati, "D. Russell Humphreys's Cosmology and the 'Timothy Test' A Reply," *Creation Ex Nihilo Technical Journal* 11, part 2 (1997): 195–8; and D. R. Humphreys, "Timothy Tests Theistic Evolutionism," *Creation Ex Nihilo Technical Journal* 11, part 2 (1997): 199–201. For a rejoinder to the last two articles, see P. G. Phillips, "Rejoinder to Humphreys and Sarfati Responses," at www.ibri.org/Papers/Timothy_Test/Timtest_Rejoinder.htm. Also see Samuel R. Conner and Don N. Page, "*Starlight and Time* Is the Big Bang," *Creation Ex Nihilo Technical Journal* 12, no. 2 (1998): 174–94. A list of articles that challenge Humphreys's thesis, along with attempted responses to his critics, appears at www.trueorigin.org/ca_rh_03.asp.

[42]Robert V. Gentry, *Modern Physics Letters A* 12, no. 37 (1997): 2919. Also online at http://arxiv.org/abs/astro-ph/9806280. Gentry's other publications on this subject are online at www.orionfdn.org/papers/other-papers.htm.

[43]That is, for cosmological redshifts with $z < 1$. For small velocities, z is the ratio of the galaxy's velocity to that of light.

[44]The Hubble distance is the distance light travels during the age of the universe. It is about 14 billion light years.

[45]See Ryan Scranton's "Debunking Robert Gentry's 'New Redshift Interpretation' Cosmology" for details at www.talkorigins.org/faqs/nri.html. Note that Scranton wrote his piece when Gentry had a shell of hot hydrogen gas rather than a shell of galaxies at the Hubble distance. Even so, a shell of galaxies will also be unstable. Also see the debate between J. Brian Pitts and Gentry on the latter's view of energy conservation in Big Bang cosmology in *Perspectives on Science and Christian Faith* 56, no. 4 (December 2004): 260–84. Pitts points out the deficiencies in Gentry's position.

[46]This is not geocentrism, but "galactocentrism." That is, our galactic center is the center of the universe. The position of the solar system in our galaxy is accepted as a necessary condition for life to exist on earth.

[47]A summary of Humphreys's thesis is found in "The Battle for a Cosmic Center," *Impact* 350 (August 2002), which is also available online at www.icr.org/pubs/imp/imp-350.htm. His extended article is "Our Galaxy is the Center of the Universe, 'Quantized' Redshifts Show," *Ex Nihilo Technical Journal* 16, no. 2 (2002): 95–104. Quantized redshifts are discussed by William G. Tifft and W. John Cocke of the University of Arizona. They summarize their work in "Quantized Galaxy Redshifts," *Sky & Telescope* (January 1987): 19–21.

[48]See the helpful discussion by Daniel Danielson, "Copernicus and the Tale of the Pale Blue Dot" at www.english.ubc.ca/%7Eddaniels.

[49]E. Hawkins, S. J. Maddox, and M. R. Merrifield, "No Periodicities in 2dFGRS Redshift Survey Data," *Monthly Notices of the Royal Astronomical Society* 336, no. 1 (October 2002): L13. SDSS results appear at http://arxiv.org/abs/astro-ph/0310725. Since the universe resembles a collection of soap bubbles with large voids, observing galaxy populations in any direction will reveal galaxy distances bunched in multiples of the diameter of the voids. The voids are approximately 300 million light years across. This correlates to a redshift $z = 0.024$, which is 100 times greater than the presumed periodicity upon which Humphreys bases his conclusions.

[50]Dr. John Huchra, Harvard-Smithsonian Center for Astrophysics, in a personal communication (25 October 2003) says:

> First, it is hard to define a "velocity" for a galaxy at better than a few km/s. That is because different components of the galaxy often have slightly different centers-of-mass (e.g., in spiral galaxies, most of the neutral hydrogen is in the disk and not the central bulge or nucleus, and the nucleus can be moving with respect to the center of mass of the whole galaxy with a small velocity as is probably the case in our own Milky Way). It's also often the case that measurements of different features in a galaxy or quasars will give different velocities (different spectral features, that is) because of internal motions, infall, outflow, etc. There are well-known offsets of several hundred km/s between the quantum mechanically permitted and forbidden emission lines in active galactic nuclei because of source geometry.

Dr. Huchra has completed many galaxy surveys and is an expert in the observational difficulties.

# *Book of Life*

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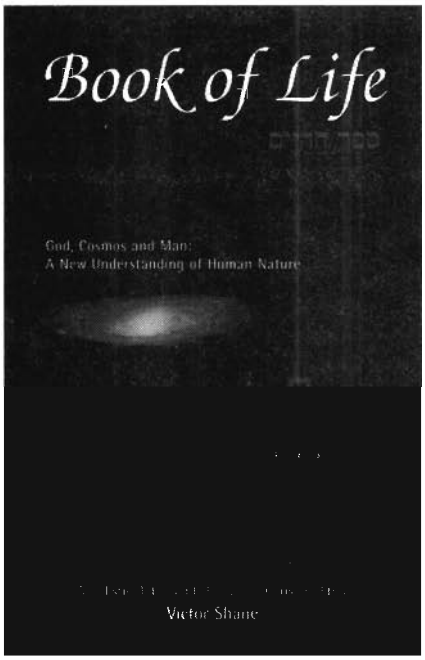


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# The Serial Endosymbiosis Theory: Cellular Origins and Intelligent Design Theory

*Michael Buratovich*

Michael Buratovich

*Even though the origin of cells remains largely unresolved, the serial endosymbiont theory is widely accepted as the means by which two organelles, mitochondria and chloroplasts, came to be. The serial endosymbiont theory hypothesizes that mitochondria and chloroplasts were derived from ancient bacteria that were engulfed by an ancient, nucleated cell and took up residence in the cytoplasm of the nucleated cell, until over time these internalized cells became organelles. Several lines of evidence support the serial endosymbiont theory and associations between several species of insects and various microbes also provide convincing examples of intermediates in the process by which a microorganism becomes an organelle. The pervasiveness of endosymbiosis in nature suggests that organisms have a tendency to form mutually beneficial relationships. This tendency to form such relationships reflects the goodness that God imparted to creation and is somewhat antithetical to traditional Neo-Darwinism. Alternatively, the data suggest that more purposeful forces or principles might guide the formation and subsequent maturation of such relationships.*

*Since [Lynn Margulis gave the serial endosymbiosis theory (SET) its modern expression, it] has received nearly universal acceptance as an explanation for the origin of mitochondria and chloroplasts.*

The origin of cells is a subject of intense debate within biology, but most creationists and intelligent design theorists find the formation of any cell from nonliving molecules simply impossible.[1] Nevertheless there is substantial agreement, at least among the majority of mainstream scientists, on the origin of two subcellular structures within some cells.

According to contemporary evolutionary thinking, two compartments inside cells, mitochondria and chloroplasts, are descended from bacteria that were engulfed by ancient cells and took up residence inside their hosts. Normally the predatory cell would digest the bacteria as food, but for some reason the invaders were not digested this time. The two cells began a mutually beneficial relationship in which the hitchhiking bacterium gave chemical energy to the host and the host protected the tiny interloper. Over time, this relationship grew into one of mutual dependence until the bacterial invader became recognizable only as an organelle, or miniature organ, within a host cell that depended heavily upon the activity of the newly-minted organelle for its survival.

The idea outlined above is called the serial endosymbiosis theory (SET). A. F. W. Schimper first proposed this idea in 1883,[2] but Lynn Margulis gave it its modern expression.[3] Since then, the endosymbiont theory has received nearly universal acceptance as an explanation for the origin of mitochondria and chloroplasts. Even though the evidence used to support the endosymbiont theory is deep and broad, this theory proposes that mutually beneficial associations between organisms is a major driving force behind the formation of new species.[4] Such an evolutionary mechanism is somewhat non-Darwinian, and even represents a challenge to modern neo-Darwinian thought.[5]

It is the goal of this article to present the data used to support the endosymbiont theory, especially the flood of new sequence data. However, the data that corroborates the endosymbiont theory also show that

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mitochondria and chloroplasts contain features that are not easily explained by contemporary neo-Darwinism. In fact, some aspects of the origins of these organelles might be better described by an appeal to a less orthodox explanation that requires purposeful, but not necessarily supernatural forces at work. Furthermore, SET supports a tendency for organisms to form interdependent and mutually beneficial relationships, which is not predicted by Darwin's theory of evolution via natural selection. Thus, even though creation contains cruel and harsh elements, it also features organisms working together rather than against each other.[6] In this way, creation displays how people should work together in humility and mutual dependence, acknowledging our differential giftedness.[7]

## Endosymbiosis and Creation

In *The Origin of Species*, Darwin issued this challenge to his readers:

> Natural selection cannot possibly produce any modification in any one species exclusively for the good of another species; though throughout nature one species incessantly takes advantage of, and profits by, the structure of another ... If it could be proved that any part of the structure of any species had been formed for the exclusive good of another species, it would annihilate my theory, for such could not have been produced through natural selection.[8]

The selfish character of natural selection seems to contradict the way cooperative associations between very different organisms can mutually benefit each other. Certainly natural selection can account for the establishment of some mutualistic relationships,[9] but the extent to which we observe endosymbiotic relationships in nature may cause one to ask if some other principle is at work. Normally bacterial cells are food for single-celled, nucleated organisms. Why would an organism form a metabolic bond with an organism it normally views as food?

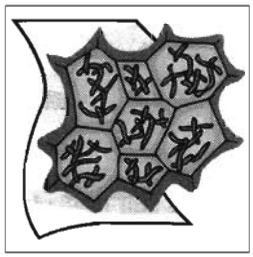
Despite the pain and suffering in our world, it still declares the glory of God the Creator.[10] It displays the power of God, which in the words of theologian John Rankin, is "the power to give."[11] This power to give is part of our being made in the image of God, since we can procreate or give life to another and give of ourselves to others. We show the ability to work cooperatively with mutual interdependence, which, in theory, is most clearly demonstrated in the church. Likewise nonhuman creation, or "nature," is endowed with the power to give, but it also displays the power to take and to destroy human life. Nevertheless, these same organisms still show the power to associate and form mutually beneficial relationships and this is, in an important way, a reflection of the glory of their Creator.

If evolutionary theory has taught theology anything, it is that death is usually necessary to make life possible.[12] This principle even applied in Eden, where, even if vegetarian diets were the rule, Adam and Eve still needed to eat plants, which required the death of part of the plant. This principle seems to work spiritually as well, since the skin of a dead animal was required to cover the naked bodies of Adam and Eve after they sinned.[13] Likewise the death of Jesus provides the free option of eternal life for all who embrace his call.[14] Since organisms are able to work together for their own mutual benefit without necessarily killing one another, endosymbiosis seems to be an alternative to the principle of life for one organism arising from the death from another.

*Since organisms are able to work together for their own mutual benefit without necessarily killing one another, endosymbiosis seems to be an alternative to the principle of life for one organism arising from the death from another.*

Despite the explanatory power of natural selection and the successes it has had in explaining animal and human behavior, there are elements of human and nonhuman behavior that presently are inexplicable by natural selection alone.[15] There are clear examples of human self-sacrifice that fly in the face of selectionist explanations, since, as sociobiologist Michael Ghiselin claims, if natural selection were true and sufficient as an explanation for human behavior, then there should be no genuinely disinterested behavior.[16] Symbiosis is a major force that drives biodiversity, both presently and in the past.[17] Could it be that the tendency for organisms to associate for each other's mutual benefit is another reflection of design in our world? Testing such a hypothesis would be difficult, but is worth pursuing.

Nature is a reflection of the Creator, even if it sometimes seems a cruel and unforgiving world. The ability of our world to make beauty and goodness from death and suffering is itself an illustration of the grace of God. We can do no less than embrace the good and fight the evil as stewards of the Gospel. We can also do no less to search for his ways within the world, even when they are hidden from plain view.



# Article

*The Serial Endosymbiosis Theory: Cellular Origins and Intelligent Design Theory*

*All living things are composed of cells and all cells come from pre-existing cells. This simple but elegant statement constitutes the cell theory ... [which] remains a foundational concept of contemporary cell biology.*

## Background

All living things are composed of cells and all cells come from pre-existing cells. This simple but elegant statement constitutes the cell theory. It is the culmination of the work of Robert Hooke (1635–1703), who first described microscopic cell remnants from a slice of cork in his popular 1665 book *Micrographia;* Antony van Leeuwenhoek (1632–1723), who described the first observations of living microorganisms using a simple microscope; Matthias Schleiden (1804–1881), who showed that different plant structures were made of cells in 1838; Theodor Schwann, (1810–1882) who extended Scheiden's observations to animals and embryos in 1839; and Rudolph Virchow (1821–1902), who demonstrated in 1858 that all cells come from previously existing cells. The cell theory remains a foundational concept of contemporary cell biology.

Modern organisms are composed of two distinct cell types. The prokaryotic cell type is a relatively simple cell that lacks internal compartments and contains a chromosome devoid of extensive secondary structure. Prokaryotes are well represented today by bacteria. The eukaryotic cell type contains an array of internal, membrane-bound compartments dedicated to specific functions. Because of their specialization, these compartments are called organelles.[18] Eukaryotic cells compose all vertebrate and invertebrate animals, land plants, algae, fungi, and protozoans.

One particular compartment in eukaryotic cells, the nucleus, houses the cell's genetic information. Cells store genetic information in the form of a molecule called deoxyribonucleic acid or DNA, which is assembled into compact, linear macromolecular structures called chromosomes (Figure 1A). The entire complement of genes contained within the nuclei of the cells of an organism is called the genome and a branch of genetics called genomics entails the study of the entire genome of an organism. With the advent of high-throughput automated sequencing, we can determine the sequence of the entire genome of organisms. Today we have the completed sequence for the genomes of over 160 microorganisms and almost twenty-five multicellular organisms, ranging from fungi to humans.[19]

Accessing the genetic information stored in DNA requires the synthesis of an informational intermediate molecule called ribonucleic acid (RNA). The DNA molecule serves as a template or pattern for the synthesis of RNA molecules, and RNA synthesis requires a large protein complex called RNA polymerase (Figure 1B). Some RNA molecules called messenger RNAs (mRNAs) are used to make proteins, but RNAs can also perform other tasks.

To make proteins, mRNAs are transported from the nucleus and come into contact with a structure called a ribosome. Ribosomes are the protein-synthesizing machines of the cell and are an assembly of proteins and special RNA molecules called ribosomal RNAs (rRNAs). The ribosomes of eukaryotic cells are distinct from those of bacteria. Herein lies the reason why we can treat diseases with certain antibiotics like erythromycin, tetracycline, and streptomycin that inhibit protein synthesis in bacteria but not in people—ribosomes from bacteria are susceptible to these antibiotics, but such drugs do not affect our own ribosomes.[20]

Ribosomes cannot make protein by themselves. Instead, they must have an mRNA to direct the synthesis of the protein, and without the mRNA, the ribosome is impotent to work. The sequence of the mRNA is a copy of one of the strands of the DNA molecule, and the ribosome uses this sequence to construct the protein. To make the protein, the ribosome needs the building blocks of proteins called amino acids. Small RNA molecules called transfer RNAs or tRNAs ferry the amino acids to the ribosome. Each specific tRNA carries a particular amino acid and the tRNA-amino acid conjugate comes to the ribosome when the ribosome has engaged a particular three-base sequence or codon in the mRNA. If the three-base codon corresponds to the sequence to which the tRNA can bind, then the tRNA delivers its amino acid payload to the ribosome and the ribosome attaches it to the growing protein (Figure 1C).

Ribosomes also receive assistance from some accessory proteins during the process of protein synthesis. One group of accessory proteins called initiation factors help the ribosome begin protein synthesis. A second

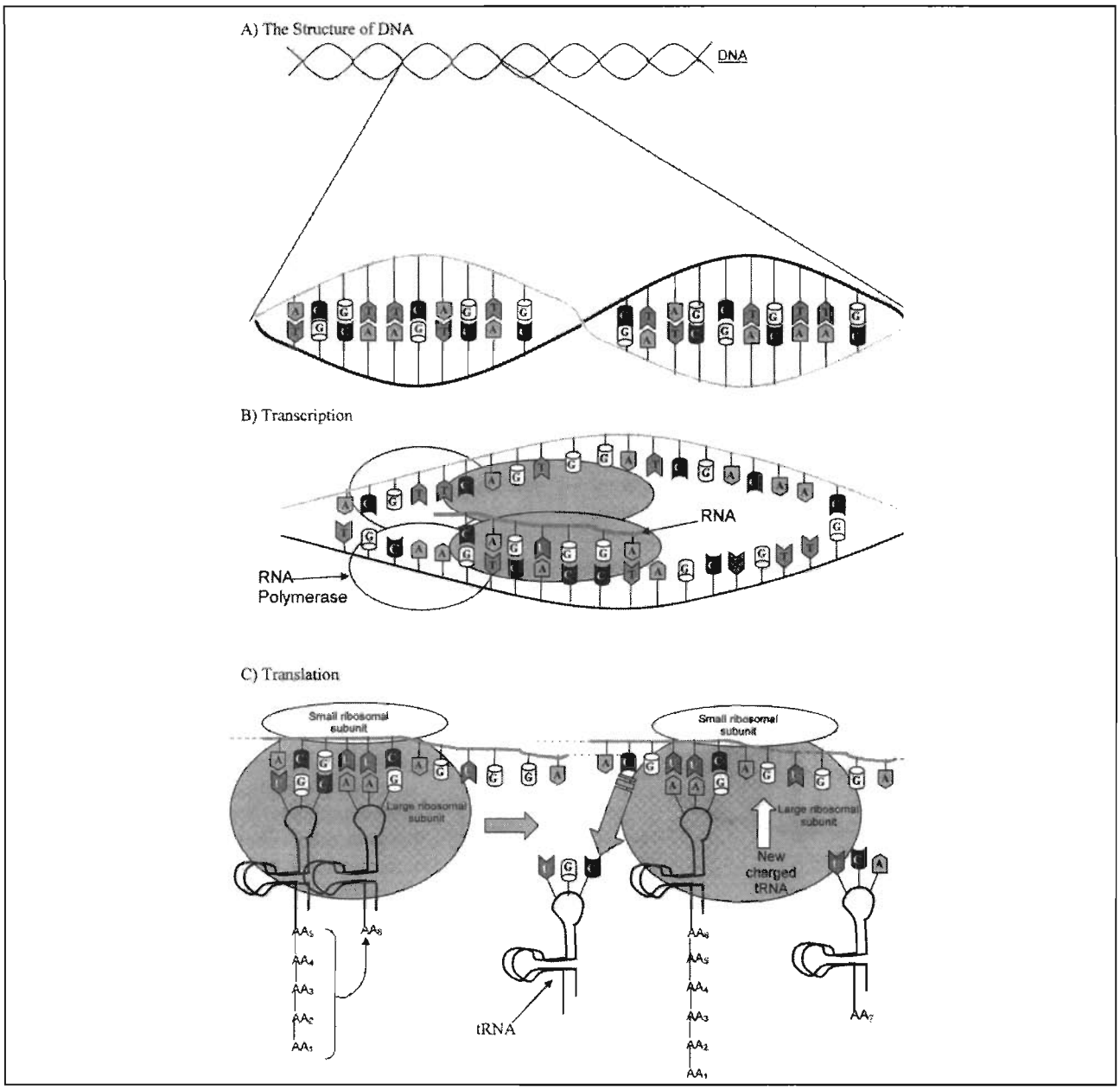
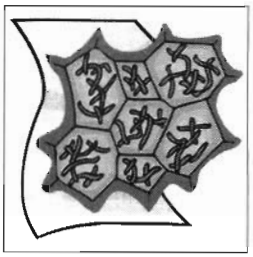



**Figure 1. The Flow of Genetic Information.** These three figures illustrate the basic elements of molecular biology and how genetic information is stored and accessed by the cell. **(A)** ***A DNA or deoxyribonucleic acid molecule.*** DNA is a polynucleotide molecule, which is to say that it is composed of a repeating chain of nucleotides. Nucleotides consist of three chemical entities; a phosphate, sugar, and nitrogenous base. The bases of DNA also show extremely specific rules of interaction; the base adenine always pairs with a thymine and cytosine always pairs with guanine on the opposing strand. Exceptions to these rules occur at the ends of some linear chromosomes. **(B)** ***Transcription or the synthesis of RNA from DNA.*** DNA is used as the pattern for RNA synthesis. The enzyme RNA polymerase synthesizes RNA from DNA and the enzyme must unwind the double helix before it can synthesize RNA. RNA polymerase uses the bases of DNA to synthesize an RNA molecule that is matched to one of the strands of the DNA molecule. RNA polymerase accesses the DNA at specific sequences called promoter sequences, which act as entry points for RNA polymerase. RNA is typically a single-stranded molecule. **(C)** ***Translation or the synthesis of protein from an RNA molecule by a ribosome.*** Most RNA molecules are messenger RNA molecules, which are used as a pattern for protein synthesis, although some RNAs play structural or regulatory roles. The protein synthesis machines of the cell are ribosomes, which are composed of two subunits, a small and large subunit. The ribosome "reads" the RNA three bases at a time and carrier molecules called tRNAs bring amino acids, the building blocks of proteins, to the ribosome, and the ribosome links these amino acids together to make a protein. Each messenger RNA has a distinct sequence, and from this sequence the ribosome makes a protein with a specific amino acid sequence. How does the ribosome know which amino acid should be added next? The tRNAs that carry the amino acids have a loop at the front of the molecule with a three-base sequence (anticodon). This front-loaded three-base sequence must match the three-base sequence (codon) of the messenger RNA at the ribosome. If it does not match, then the tRNA cannot bind to the ribosome. If it does, then the tRNA binds and its amino acid is added to the growing protein chain. Specific tRNAs with specific three-base sequences in their front loop carry specific amino acids, which means that only the amino acid coded for by the mRNA gets added to the growing protein. The ribosome also gets help during protein synthesis from a cloud of proteins that help start (initiation factors), maintain (elongation factors) and terminate (termination factors) translation. Also specific enzymes called aminoacyl-tRNA synthetases link the amino acids to their specific tRNAs.





group called elongation factors help the ribosome execute the actual synthesis of proteins, and a third group known as termination factors help end the process of protein synthesis. Finally proteins called aminoacyl-tRNA synthetases attach the amino acids to the tRNAs for use in protein synthesis. All of these accessory proteins play crucial roles in carrying out and regulating protein synthesis. After proper translation of the mRNA, the protein is potentially ready to perform its function.

## The Endosymbiont Theory and Its Evidence

Mitochondria and chloroplasts are two organelles in modern eukaryotic cells that are thought to have originated from bacteria that entered a proto-eukaryotic host cell and became part of it. Mitochondria are found inside almost all eukaryotic cells, and they appear as small sacs surrounded by two membranes. Mitochondria are the powerhouses of the cell, since they make the bulk of the chemical energy required by the cell for its life-sustaining processes (Figure 2A). Chloroplasts, on the other hand, are only found in plants and algae. Green plants contain the pigment chlorophyll, which they use for the process of photosynthesis, and the green, tubular organelles called chloroplasts house chlorophyll and the photosynthetic machinery (Figure 2B). Without chloroplasts plants are unable to carry out photosynthesis and lose their green coloration.

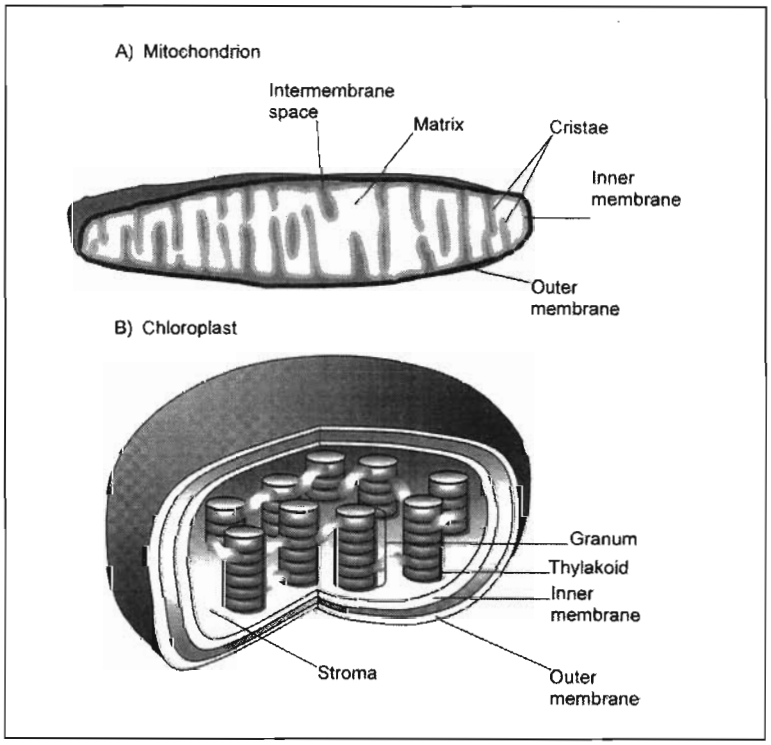



**Figure 2. The internal organization of mitochondria and chloroplasts. (A) *The internal structure of a mitochondrion.*** The central core region, or matrix, is surrounded by two membranes, a selectively permeable inner membrane and a relatively permeable outer membrane. The matrix contains the enzymes of the Krebs cycle and the mitochondrial genome. The components of the electron transport chain that are used for oxidative phosphorylation are embedded in the inner membrane, and this membrane is highly infolded in creases called cristae to increase its surface area. **(B) *The internal structure of a chloroplast.*** Like the mitochondrion, chloroplasts are surrounded by two membranes, but the inner membrane is not folded. The space surrounded by the inner membrane, the stroma, contains enclosed sacs called thylakoid membranes that are organized into stacks called grana. The stroma contains the enzymes of the Calvin cycle and the chloroplast genome. The thylakoid membranes contain the photosynthetic machinery and the electron transport chains that allow photophosphorylation.

If mitochondria and chloroplasts in modern cells descended from bacteria that came into larger cells and stayed, then these organelles should show similarities to bacteria. Dyer and Obar outline six specific criteria that should be met if chloroplasts and mitochondria descend from bacteria. First, the proteins and enzymes from mitochondria and chloroplasts should be more similar to those from bacteria than any other eukaryote. Second, we would expect these organelles to have retained their own genome and these genomes, including the genes they encode and their mechanisms of gene expression should be more like those of bacteria than eukaryotes. Third, the inheritance patterns of mitochondria and chloroplasts should be separate and distinct from the inheritance pattern of the nuclear genome. Fourth, the RNAs used by each organelle—the rRNAs, tRNAs, and mRNAs—should resemble those from bacteria more than they do those from eukaryotes. In the case of rRNAs, which are the essential structural and catalytic elements of ribosomes, the ribosomes of mitochondria and chloroplasts and their accessory proteins should also more closely resemble those from bacteria in size, structure, and function than those of eukaryotic cells. Fifth, we should be able to find a living bacterium that genetically resembles each organelle. Finally, we should be able to find evidence of organisms that have secondarily lost these organelles.[21]

Proteins are composed of chains of amino acids. By comparing the amino acid sequence of one protein to another, we can quantitatively determine the similarities between two proteins. With the aid of computers, we can compare the amino acid sequence

similarities between groups of proteins and such comparisons can tell us a great deal about evolutionary relationships between organisms.[22] If we use this approach to compare the amino acid sequences of proteins from mitochondria, with a variety of other extant organisms, the greatest similarities are found with proteins from a specific group of bacteria called the α-proteobacteria, particularly the *Rickettsia* subdivision of the α-proteobacteria.[23] Similar comparisons with proteins from chloroplasts show that the most similar proteins are found in a photosynthetic group of bacteria called the cyanobacteria.[24] Thus, the amino acid sequences of mitochondrial and chloroplast proteins are most similar to those from specific groups of bacteria.

Mitochondria and chloroplasts also contain their own genomes, and these genomes are every bit as important to the cell as that of the nucleus.[25] In fact, the DNA chromosomes found in the majority of chloroplasts and mitochondria consist of circular DNA molecules, much like the chromosomes of most bacteria,[26] although the size and gene content of mitochondrial and chloroplast genomes vary tremendously (Table 1).[27]

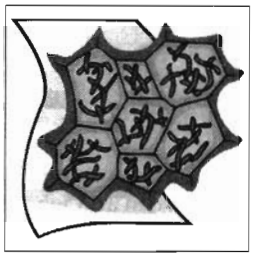
In many cases, the genes encoded by the DNA chromosomes of mitochondria and chloroplasts are arranged in the same order as those found in bacteria.[28] Several molecular similarities exist between the genomes of chloroplasts and those of cyanobacteria, since the gene clusters from chloroplast genomes resemble those from cyanobacteria in both organization and structure. In chloroplast genomes, many genes contain promoters that greatly resemble bacterial promoters. When RNA polymerase begins making an RNA copy of the DNA, it always begins at a specific DNA site called the promoter. Promoters are specific DNA sequences that tell the RNA polymerase when and where to begin making RNA. These promoter-like sequences have also been demonstrated to play an essential role in the expression of chloroplast genes.[29] Some chloroplast genes also contain Shine-Dalgarno sequences, which are peculiar to bacteria and found at the front ends of messenger RNAs. Shine-Dalgarno sequences bind to the termini of 16S rRNAs and help ribosomes fasten to the mRNA so that it can use the RNA molecule to direct its protein synthesis.[30]

Not only do mitochondria and chloroplasts possess their own genomes, but the inheritance patterns of these genomes are distinct from that of the nuclear genome. In most species, the inheritance of mitochondrial and chloroplast genomes is marked by uniparental inheritance, which is to say that the offspring of a mated individual possesses the mitochondrial or chloroplast genome of one parent, typically the mother.[31] To illustrate this, classic experiments with frogs from the genus *Xenopus* showed that interspecific matings produced progeny with the mitochondrial DNA of the mother (Figure 3).[32] Similar results are commonly observed in other vertebrates.[33] Similarly for chloroplast genomes, matings between various strains of the single-celled green alga *Chlamydomonas reinhardii* have demonstrated uniparental inheritance of many chloroplast-encoded traits.[34] These modes of inheritance for organelle-based stand in stark contrast to the Mendelian inheritance patterns observed with genes from nuclear genomes.

All the RNAs found in mitochondria and chloroplasts, be they mRNAs,[35] rRNA,[36] or tRNAs are much more similar to those found in specific groups of bacteria than any

| Organism | Size (base pairs) | Number of genes encoded | Mitochondrial or chloroplast genome |
|---|---|---|---|
| *Homo sapiens* (Human beings)[38] | 16,569 | 37 | Mitochondrial |
| *Saccharomyces cerevisiae* (Baker's yeast)[39] | 85,779 | 35 | Mitochondrial |
| *Marchantia polymorpha* (The common liverwort—a moss-like plant)[40] | 186,608 | 75 | Mitochondrial |
| *Marchantia polymorpha*[41] | 121,025 | 128 | Chloroplast |
| *Arabidopsis thaliana* (A flowering plant)[42] | 366,924 | 57 | Mitochondrial |
| *Arabidopsis thaliana*[43] | 154,478 | 136 | Chloroplast |
| *Porphyra purpurea* (Red alga)[44] | ~191,000 | 255 | Chloroplast |
| *Zea mays* (Domestic corn)[45] | 140,387 | 104 | Chloroplast |

**Table 1. The Size and Number of Genes Encoded by Mitochondrial and Chloroplast Genomes From Distinct Organisms.**





*Another prediction of the endosymbiont theory is that we should be able to find organisms in the process of forming an interdependent relationship with an indwelling microorganism in which the microbe has yet to completely lose its cellular identity. Such an association would constitute an intermediate to the formation of a cellular organelle.*

eukaryote.[37] In fact the arrangement of the rRNA genes in chloroplast genomes bear exquisite similarities to those of cyanobacteria.[46] Mitochondria and chloroplasts also contain their own ribosomes and their ribosomes are much more similar to those from bacteria than the cytoplasmic ribosomes in eukaryotic cells.[47] For example, ribosomal subunits, the ribosomal accessory factors that assist ribosomal function and aminoacyl-tRNA synthetases from bacteria and chloroplasts are completely interchangeable. Such interchangeability also applies to mitochondrial ribosomes, but to a lesser extent.[48] Ribosomes from mitochondria and chloroplasts are also susceptible to the same antibiotics that typically inhibit bacterial ribosomes but never affect eukaryotic ribosomes.[49]

With respect to a living representative, the protein and RNA sequences of mitochondria show the greatest similarities to those found in the microbiological agent of epidemic typhus, *Rickettsia prowazekii*.[50] Furthermore, genomes from mitochondria of the jakobid protist *Reclinomonas americana* resemble a miniaturized version of a bacterial genome and show striking genetic affinities to the genome of *Rickettsia prowazekii*.[51] Thus in the case of mitochondria, we not only have a microorganism that most closely resembles modern mitochondria, but a eukaryote whose mitochondrial genome looks like a miniature version of the genome of *Rickettsia prowazekii*. For chloroplasts, repeated comparisons of chloroplast proteins and genomes from green plants with those of extant bacteria have demonstrated that the cyanobacteria are the most similar to chloroplasts, even though it is difficult to determine the exact organism that is the most similar to modern chloroplasts.[52]

Finally, there are copious examples of organisms that contain no mitochondria but have retained copies of mitochondrial genes in their nuclei,[53] and some that possess mitochondrial remnants.[54] For chloroplasts, there are non-photosynthetic, parasitic flowering plants, like *Epifagus virginiana*, whose chloroplast genomes have lost the photosynthetic genes,[55] and heterotrophic euglenoids like *Astasia longa* and parasitic protozoa that contain plastids with genomes that are clearly derived from chloroplasts.[56] Thus there are plenty of examples of secondary loss of these organelles. Hence mitochondria and chloroplasts contain proteins, genomes, RNAs, and ribosomes whose most similar counterparts are from bacteria. There are also extant organisms that resemble these organelles more than any other living thing and many examples of secondary loss of these organelles. These data corroborate the endosymbiont theory.

## Intermediates between Cytoplasmic Microorganisms and Organelles

Another prediction of the endosymbiont theory is that we should be able to find organisms in the process of forming an interdependent relationship with an indwelling microorganism in which the microbe has yet to completely lose its cellular identity. Such an association would constitute an intermediate to the formation of a cellular organelle. Insects form extensive associations with bacteria and fungi,[57] and by carefully exam-

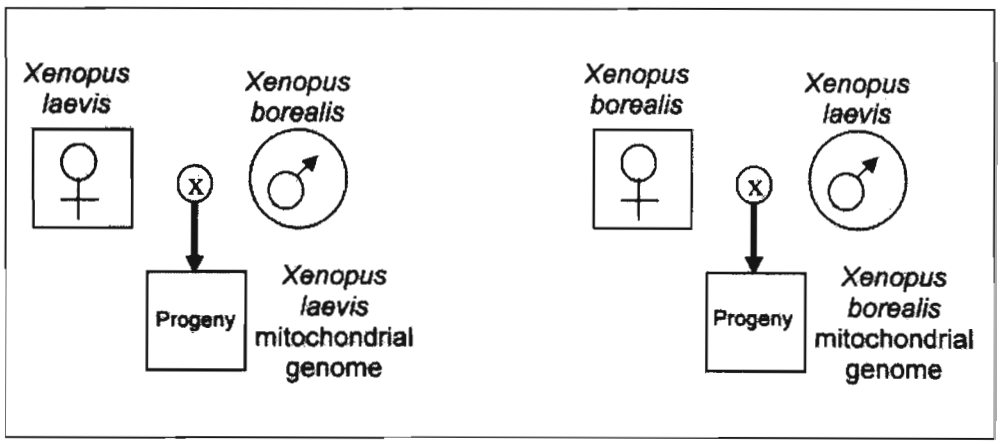



**Figure 3. Maternal inheritance of *Xenopus* mitochondrial DNA.** Reciprocal crosses between two species produce $F_1$ hybrids and each hybrid retains only the mitochondrial DNA from its mother.

ining several insect species and their indentured microbial servants, scientists have found what many think are such intermediates.

Small insects called aphids pierce plant tissues with syringe-like mouthparts and withdraw sap from the vascular elements of the plant. Consequently aphids can cause extensive damage to plants and pass plant viruses between plants, and are justly designated as plant pests. As a diet, plant sap is very rich in sugars but rather poor in amino acids, the building blocks of proteins. Therefore the aphid has a diet that is good for energy but poor for making proteins, since the insect cannot synthesize all of the amino acids it needs to stay alive. Instead the insect has a bacterium called *Buchnera* that lives inside the cells of its body that makes the amino acids it needs to live and reproduce.[58]

*Buchnera* are small, round bacterial cells, which live inside specialized cells that compose a bilobed structure within the body cavity of the aphid called the bacteriome (Figure 4A). The bacteriome is composed of 60 to 90 large cells called bacteriocytes or mycetocytes (Figure 4B), and within each bacteriocyte live thousands of *Buchnera* (Figures 4B, 4C). These bacteria are vital to the growth and propagation of the aphids. In fact the hitchhiking *Buchnera* cells are passed from the aphid mother to her progeny.[59] If aphids are treated with antibiotics that kill off the bacterial cells, the insects show a rapid reduction in growth and eventually become sterile. Antibiotic-treated aphids without their bacterial symbionts can only grow if they are supplemented with amino acids.[60]

*Buchnera* species that reside in different types of aphids are much more similar to each other than they are to any other organism. This strongly suggests that the ancestor of all modern aphids formed a symbiotic relationship with the ancestor of all modern *Buchnera* species that was then passed on to all the descendents of this aphid progenitor. Secondly, the microorganisms most closely related to *Buchnera* are members of the γ-proteobacteria group, which includes such familiar organisms as *Escherichia coli* (*E. coli*).[61]

A particular *Buchnera* strain called APS (formally referred to as *Buchnera* sp. APS) inhabits the body of the pea aphid, *Acyrthosiphon pisum*. The sequenced genome of *Buchnera* sp. strain APS is approximately four times smaller than that of *E. coli* K-12, and lacks genes for the biosynthesis of particular bacterial cell-surface components, regulatory systems that control gene expression during changes in environmental conditions and host defense systems that protect bacterial cells from viral infections. The gene order of *Buchnera* sp. APS is so similar to that of *E. coli* that the *Buchnera* genome looks like a diminutive version of the *E. coli* genome. The genome of *Buchnera* sp. APS also includes the genes necessary for the biosynthesis of all ten amino acids that are essential to the aphid host, but lacks the genes for the biosynthesis of all amino acids that are nonessential to the aphid.[62] These data show the complementarity of the symbiosis between *Buchnera* and the aphids—the endosymbiont provides the aphid with the materials that it cannot make or acquire from its diet and the host provides the endosymbiont with those materials that it cannot synthesize. Thus, aphids and their *Buchnera* symbionts fit each other like a hand and a glove. Nevertheless, *Buchnera* show definite affinities with the γ-proteobacteria and probably descended from them. Thus, *Buchnera* represents, in the minds of many biologists, an organism that is on its way to becoming an organelle, just like mitochondria or chloroplasts, and is intermediate between those organisms that have become internal compartments in cells, like mitochondria, and those that have yet to completely lose their cellular identity.

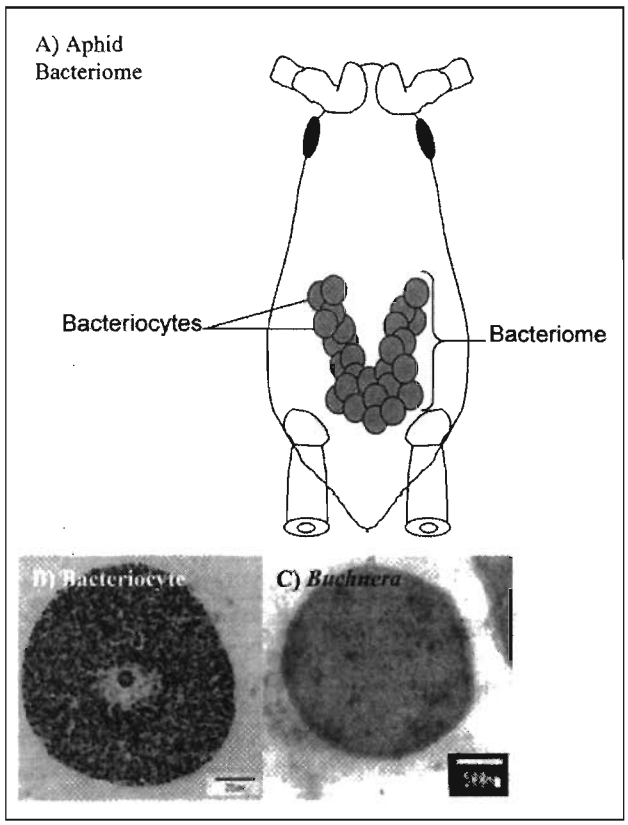
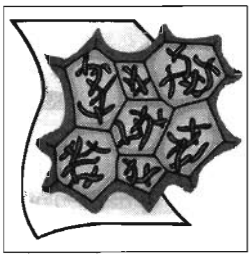



**Figure 4. Aphid bacteriome and individual bacteriocytes and *Buchnera* cells. (A) *Drawing of Aphid body with bacteriome positioned in the abdomen of the insect.*** The bacteriome is ventrally located, underneath the insect ovaries. It is also in contact with the insect hemolymph, the fluid that serves as the insect blood. The amino acids synthesized by the *Buchnera* are released into the hemolymph and carried to various parts of the body and the sugars acquired by feeding arrive to the bacteria via the same means. **(B) *Electron micrograph of an individual bacteriocyte.*** Each tiny dot in the cytoplasm of this cell is a *Buchnera* cell. The large dot in the center is the bacteriocyte nucleus. **(C) *Electron micrograph of an individual Buchnera cell from the cytoplasm of a bacteriocyte.*** Figure (A) was redrawn from M. B. Ponsen, "Alimentary Tract," Figure 2A in *Aphids: Their Biology, Natural Enemies, and Control*, ed. A. K. Minks and P. Harrewijn (Amsterdam: Elsevier, 1987), 79-97. Figures (B) and (C) were acquired from http://buchnera.gsc.riken.go.jp/intro.html and used with permission.





*While the prevailing model of neo-Darwinian evolution has tremendous explanatory power, it is difficult to determine how a force like natural selection might drive the transfer of genes from the mitochondrion to the nucleus in a hierarchical manner and at disparate rates.*

It also should be emphasized that relationships between aphids and *Buchnera* are not unusual among the insects. Aphids are related to whiteflies and mealybugs, organisms that also feed on plant sap and harbor bacterial endosymbionts.[63] Cockroaches, tsetse flies, and carpenter ants also contain endosymbionts that are different from *Buchnera* and were probably acquired during independent events.[64] In fact, symbiotic associations are found in many organisms in a variety of ecosystems.[65] Therefore, endosymbiosis appears to be a robust association between eukaryotes and bacteria that occurred in the past and continues today. Endosymbiosis allows organisms to exploit new food sources and lifestyles, and it creates situations that are mutually beneficial to both organisms.

## Organelle Origins and Intelligent Design

Based on the present available data, an endosymbiotic origin for mitochondria and chloroplasts seems to be a reasonable conclusion despite the unanswered questions that remain.[66] Chloroplasts from a variety of photosynthetic organisms show very similar features and have kept many of their bacterial features. It is difficult to convincingly explain these bacterial features in a nonhistorical manner. Despite this, it seems somewhat uncertain why some mitochondrial genomes are so different from their bacterial ancestors while chloroplast genomes have retained so many bacterial features. It could be that mitochondria were established much earlier in the eukaryotic lineage while chloroplasts are relative newcomers to eukaryotic cells. Even if this possibility is granted, it still does not explain the extensive remodeling of mitochondrial genomes versus chloroplast genomes, even though the larger size of chloroplast genomes might have more to do with their function.

Nevertheless, the remodeling of mitochondrial genomes seems to follow certain principles. First of all, molecular biologists have predicted that over time all the genes in organelles should experience transfer to the nucleus and deletion from the mitochondrial genome. The reason for this is a principle called Muller's ratchet, whereby deleterious mutations accumulate much more rapidly in asexually propagated genomes than in sexually propagated ones, where recombination is possible. Therefore, the asexually propagated mitochondrial genome is much more subject to gene decay than the nuclear genome, and natural selection should favor the transfer of essential mitochondrial genes to the nuclear genome, where recombination can protect it from gene decay.[67]

Perhaps a more pressing problem is the difficulty that one might have conceiving how genes from an enclosed compartment like the mitochondrion can migrate to another closed compartment of the cell, like the nucleus. Nevertheless several lines of evidence strongly argue that such transfers do occur. First, genomic sequencing projects have definitively demonstrated several cases where unequivocal copies of portions of the mitochondrial genome are inserted into the nuclear genomes of *Arabidopsis*, felines and humans.[68] Secondly, the transfer of marked chloroplast genes to the nucleus has actually been observed in transgenic tobacco plants, and at a rate that is comparable to the spontaneous mutation rate of nuclear DNA.[69] Given the frequency of gene transfer from chloroplasts to nuclei, it seems likely that the rates of gene transfer between mitochondria and nuclei are similar, especially since studies in yeast have observed a similar rate.[70] Balancing this tendency for nuclear transfer is the need for the maintenance of genomes in organelles so that they can detoxify dangerous reactive oxygen species that are side effects of their energy production mechanisms.[71]

Investigations into the transfer of genes from mitochondrial genomes to the nuclear genome have revealed surprisingly that this relocation seems to occur in some kind of hierarchical fashion.[72] If we examine the mitochondrial ribosomal protein genes and determine if they are encoded by the mitochondrial or nuclear genome, we observe a loose hierarchy of transfer of genes to the nucleus. For example, the genes that encode the mitochondrial ribosomal proteins are designated *rps* for ribosomal protein small subunit, and numbered. The *rps1* gene typically undergoes nuclear transfer before all the other *rps* genes. The transfer of the *rps10* gene from the mitochondrial genome to the nuclear genome usually follows after *rps1*

was transferred, and *rps11* goes to the nucleus after *rps10*, and so on. There are exceptions to this order, but the overall trend seems to argue for a hierarchy of gene transfer from the mitochondrion to the nucleus (Table 2[73]). Likewise the components of respiratory chain complex I also show an order to their nuclear transfer.[74] In both cases, the order of transfer does not correlate with the size of the gene or its genomic location (Table 2).

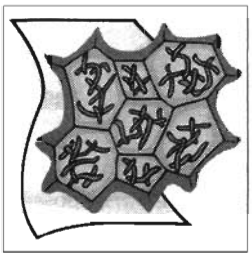
The observed order of transfer is also not an artifact of biological history, since mitochondrial genomes that encode a limited number of genes retain similar sets of genes, regardless of their phylogenetic placement. The transfer of genes to the nucleus differs within distinct evolutionary lineages and can also vary tremendously within particular lineages. For example, two prasinophyte green algae, *Nephroselmis olivacea* and *Pedinomonas minor* possess mitochondrial genomes that radically differ in size, gene content, and order.[75] In the green plants, gene content comparisons of the mitochondrial genomes of four different organisms provide ample examples of differences in gene transfer within this evolutionary lineage (Table 3). Similar discrepancies are seen in these and other evolutionary lineages. However many genes are transferred to the nucleus; they are typically transferred in the order suggested in Table 2.

While the prevailing model of neo-Darwinian evolution has tremendous explanatory power, it is difficult to determine how a force like natural selection might drive

**Table 2. Small Subunit Ribosomal Protein Genes Encoded by Mitochondrial Genomes.**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *rps1* | + | + | – | – | – | – | – | – | – | – | – | – | – | – |
| *rps10* | + | + | + | + | – | – | – | – | – | – | – | – | – | – |
| *rps11* | + | + | + | + | + | – | – | – | – | + | – | – | – | – |
| *rps2* | + | + | + | + | + | + | – | – | – | – | – | – | – | – |
| *rps7* | + | + | + | + | + | + | – | – | + | – | – | – | – | – |
| *rps8* | + | + | + | + | + | + | + | – | - | – | – | – | – | – |
| *rps4* | + | + | + | + | + | + | + | – | + | – | – | – | – | – |
| *rps19* | + | + | + | + | + | + | + | + | – | – | – | – | – | – |
| *rps13* | + | + | + | + | + | + | + | + | – | – | – | – | – | – |
| *rps14* | + | + | + | + | + | + | + | + | – | – | – | – | – | – |
| *rps12* | + | + | + | + | + | + | + | + | + | + | – | – | – | – |
| *rps3* | + | + | + | + | + | + | + | + | + | + | + | + | – | – |

The "+" signifies that the mitochondrial genome of the designated organism encodes the indicated ribosomal protein and "–" signifies that the mitochondrial genome of the organism does not encode the indicated ribosomal protein.
Legend:
(1) *Reclinomonas americana*, a jakobid protozoan.
(2) *Marchantia polymorpha*, a moss-like plant called a liverwort.
(3) *Nephroselmis olivacea*, a motile, single-celled green alga.
(4) *Phytophthora infestans*, a stramenopile, a group that includes the oocytes or water molds and algae with two different flagella.
(5) *Acanthamoeba castellanii*, a single-celled amoeba.
(6) *Thraustochytrium aureum*, a stramenopile.
(7) *Monosiga brevicollis*, a choanoflagellate (a protozoan that looks like a small piece of sponge tissue).
(8) *Tetrahymena pyriformis*, a ciliated, single-celled organism.
(9) *Arabidopsis thaliana*, a flowering plant.
(10) *Porphyra purpurea*, a rhodophyte (red alga).
(11) *Allomyces macrogynus*, a chytrid, an aquatic fungus with motile gametes.
(12) *Schizosaccharomyces pombe*, a single-celled fungus (yeast).
(13) *Plasmodium falciparum*, an apicomplexan (parasitic single celled organism that causes malaria).
(14) *Homo sapiens*, human beings.



*The field of mitochondrial evolution might be a place where ID advocates can make some predictions and test them. If the evolution of mitochondria is driven largely by natural selection acting on mutations, then the random changes in mitochondrial genomes should be either inconsequential and carried on, selected for and inherited in the majority of cases, or selected against and not inherited in a certain percentage of the cases.*

the transfer of genes from the mitochondrion to the nucleus in a hierarchical manner and at disparate rates. This suggests that another mechanism drives the hierarchical transfer of these genes to the nucleus.

Perhaps the new model of Intelligent Design (ID) could test its tenets in this case. ID is a somewhat recent proposal which posits that particular aspects of living organisms and the universe as well, are best explained by intelligent causes.[76] Despite the strongly theistic overtones of such a proposal, ID advocates tend to disavow any attempt to identify the designer. Instead, ID proponents wish to consider certain aspects of living organisms as having been purposefully made rather than fashioned by wholly impersonal forces. Many scientists have strongly objected to this proposal because of its perceived introduction of supernatural explanations into science.[77] However, a

**Table 3. The Partial List of Protein-Coding and tRNA Gene Content of Mitochondrial Genomes of Various Plants**

| Mitochondrial genes | *Marchantia polymorpha* (Liverwort)[78] | *Arabidopsis thaliana*[79] | *Oryza sativa* (Rice)[80] | *Beta vulgaris* (Sugar Beet)[81] |
|---|---|---|---|---|
| *rps1* | + | – | + | – |
| *rps10* | + | – | – | – |
| *rps11* | + | – | – | – |
| *rps2* | + | – | + | – |
| *rps7* | + | + | + | + |
| *rps8* | + | – | – | – |
| *rps4* | + | + | + | + |
| *rps19* | + | – | + | – |
| *rps13* | + | – | + | + |
| *rps14* | + | – | – | – |
| *rps12* | + | + | + | + |
| *rps3* | + | + | + | + |
| *rpl2* | + | + | + | – |
| *rpl5* | + | + | + | + |
| *rpl6* | + | – | – | – |
| *rpl16* | + | + | + | – |
| *ccmB*[82] | + | + | + | + |
| *ccmC* | + | + | + | – |
| $ccmF_N$ | + | – | + | + |
| $ccmF_{N1}$ | – | + | – | – |
| $ccmF_{N2}$ | – | + | – | – |
| *nad7* | – | + | + | + |
| Glycine tRNA | + | + | – | + |
| Phenylalanine tRNA | + | – | + | + |

commitment to ID does not necessarily commit one to miraculous creation, and purposeful forces that are wholly natural in their scope and activity could account for the origin of various intelligently designed structures or phenomena.[83] ID has not won many converts in the journals to date, but this is not all that surprising, since ID advocates have mainly reinterpreted already existing data and have yet to formulate a list of predictions that can evince future experimental success at this time.[84]

## *Can ID help explain the hierarchical transfer of rps or nad genes from mitochondrial to the nuclear genome? Perhaps it can ...*

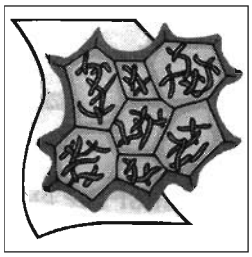
The field of mitochondrial evolution might be a place where ID advocates can make some predictions and test them. If the evolution of mitochondria is driven largely by natural selection acting on mutations, then the random changes in mitochondrial genomes should be either inconsequential and carried on, selected for and inherited in the majority of cases, or selected against and not inherited in a certain percentage of the cases. Changes in mitochondrial genomes should be steady with rare "quantum" events (large deletion, insertion, or inversion) that greatly change the structure of the mitochondrial genome. If, however, some kind of purposeful principle guides the sculpting of mitochondrial genomes, then we might expect a step-like series of changes in the structure of the mitochondrial genome until the genome becomes a kind of "optimal size" or "optimal structure." We should keep in mind that natural selection and ID need not be mutually exclusive, since the two could just as easily work side-by-side.[85] The difficulty is determining the contribution of natural selection as opposed to a contribution from some sort of as yet unidentified underlying principle that might guide mitochondrial genomic evolution.

Can ID help explain the hierarchical transfer of *rps* or *nad* genes from mitochondrial to the nuclear genome? Perhaps it can if we consider that ribosomes work as integrated wholes with "several well-matched, interacting parts that contribute to the basic function."[86] Given Muller's ratchet, we might predict that the genes most crucial to basic ribosomal function should experience the earliest transfer to the nucleus in order to protect them from gene decay, and those genes less constrained by amino acid specificity should experience later transfer to the nucleus.

The *rps1* gene typically is the first to experience transfer to the nucleus and ribosomal protein S1 has RNA unwinding activity,[87] is important for the binding of mRNA to the ribosome, influences the affinity of ribosomes for different mRNA initiation sequences, and is required for the translation of most or all natural mRNAs in bacteria.[88] Thus S1 ranks quite high in importance to the ribosome. The second gene to go to the nucleus is usually *rps10*, and this protein is not only an important ribosomal protein, but is also an inhibitor of transcription termination.[89] The third and fifth proteins to go to the nucleus are *rps11* and *rps7* and these proteins work together in the ribosome to control translational fidelity.[90] The fourth *rps* gene to go to the nucleus is *rps2*, and S2 assists in the incorporation of S1 into the 30S ribosomal subunit.[91] S8 is encoded by the sixth gene to experience transfer to the nucleus, *rps8*, and S8 plays a key role in assembling the small ribosomal subunit. S8 binds independently of other ribosomal proteins to the central domain of 16S rRNA during 30S subunit assembly and with proteins S6, S11, S15 and S18 forms the side projection of the 30S subunit.[92]

The seventh ribosomal protein gene, *rps4*, encodes S4, a protein that plays key roles in 30S subunit assembly and translational fidelity.[93] The next two *rps* genes transferred to the nucleus, *rps19* and *rps13* encode proteins that interact.[94] S19 constitutes part of the so-called "A" site of the ribosome,[95] and both proteins bind the 16S rRNA. The tenth and twelfth *rps* genes to go to the nucleus are *rps14* and *rps3*. *In vitro* studies have shown that these two proteins are required for ribosomal assembly, but not absolutely required for translation.[96] Therefore, these two ribosomal proteins are not as important as the others and there is less need to move them to the nucleus. The eleventh *rps* gene to experience transfer to the nucleus, *rps12*, encodes the famous S12 protein, which is the protein that undergoes alteration when bacterial cells become resistant to the antibiotic streptomycin.[97] However, mutations in *rps12* can actually increase translational accuracy.[98] Therefore, despite its importance in translation, the need for the cell to preserve *rps12* from gene decay is lower than other *rps* genes. Thus it appears that ribosomal protein genes are transferred to the nucleus in a hierarchy conditioned by the importance each gene to the function of the ribosome. This hierarchy is not irrevocable, but merely exists as a trend; since all ribosomal proteins are functionally important to the ribosome at some point in its activity. Thus the loose order of transfer is predicted.

ID theory also could potentially answer why chloroplast genomes are so homogenous relative to mitochondrial genomes and so bacterial in structure. Why should chloroplast genomes, which are so far removed from their cyanobacterial ancestors, keep their bacterial features? Could it be that the bacterial nature of chloroplast genomes is required for their function? This is a hypothesis that is testable and several experiments designed to





*ID theory also could potentially answer why chloroplast genomes are so homogenous relative to mitochondrial genomes and so bacterial in structure.*

evaluate it might provide ready answers. For example, we might expect that mutations that affect chloroplast function are lesions in some sort of bacterial-like regulation system. Furthermore, we might expect that complementation of chloroplast-specific mutations should work better with a bacterial gene rather than with a eukaryotic gene. Such experiments are readily workable in the single- celled alga *Chlamydomonas*, where a chloroplast-specific genetic system and a chloroplast transformation system are available.[99] Clearly these are questions for further research and it is possible that less orthodox ways of thinking about the origins of these organelles might be useful for further investigation and consideration.

## Conclusion

Two organelles from contemporary eukaryotic cells, mitochondria and chloroplasts, probably descend from ancient bacterial cells that were engulfed by other, larger ancient nonbacterial cells and formed symbiotic relationships with their captors. The contemporary biological world contains many examples in which endosymbiotic relationships are in the process of forming and the creation of interdependent relationships could be one of the primary forces driving species diversification. Furthermore, the tendency of organisms to form mutually-dependent relationships is at odds with a pure, neo-Darwinian view of nature, and is probably part of the original goodness God builds into creation as he makes it. Because the formation of mitochondria and chloroplasts was probably due to purposeful rather than wholly purposeless processes, investigations into the evolutionary and genetic behavior of these organelles is potentially better aided by ID theory rather than bald neo-Darwinism.

## Notes

[1]Walter L. Bradley and Charles B. Thaxton, "Information and the Origin of Life," in *The Creation Hypothesis*, ed. J. P. Moreland (Downer's Grove, IL: Intervarsity Press, 1994), 173–210. See also Stephen C. Meyer, "DNA and the Origin of Information," in *Mere Creation*, ed. W. A. Dembski (Downers Grove, IL: Intervarsity Press, 1998), 113–47; David Rosevear, "The Myth of Chemical Evolution," *Impact* 313 (1999); and Stephen C. Meyer, "Word Games: DNA, Design and Intelligence," in *Signs of Intelligence*, ed. W. A. Dembski and J. M. Kushiner (Grand Rapids, MI: Brazos Press, 2001), 102–17.

[2]F. J. R. Taylor, "An Overview of the Status of Evolutionary Cell Symbiosis Theories," *Annals of the New York Academy of Sciences* 503 (1987): 1–16.

[3]Lynn Margulis, *Origin of Eukaryotic Cells* (New Haven, CT: Yale University Press, 1970). The serial endosymbiosis theory of Margulis additionally proposes a bacterial origin for cilia and flagella, the propulsion structures of many eukaryotic cells. This part of SET is only supported by very slim evidence and has received little support from other researchers.

[4]Lynn Margulis, *Symbiotic Earth: A New View of Evolution* (New York: Basic Books, 1998), 5–12.

[5]Lynn Margulis and Dorion Sagan, *Acquiring Genomes: A Theory of the Origin of Species* (New York: Basic Books, 2002).

[6]Ps. 104:10–26.

[7]Rom. 12:4–13; 1 Cor. 12:4–31; Gal. 6:1–2; Eph. 4:11–13; Phil. 2:1–4.

[8]Charles Darwin, *The Origin Of Species* (London: Penguin Books, 1859), 228–9.

[9]Douglas. J. Futuyma, *Evolutionary Biology* (Sunderland, MA: Sinauer Publishing, 1998), 551–4.

[10]Ps. 19:1–4.

[11]John C. Rankin, *First the Gospel, Then Politics ...* (Hartford, CT: TEI Press, 1999), 20–9.

[12]John F. Haught, *God After Darwin* (Boulder, CO: Westview Press, 2000).

[13]Gen. 3:21.

[14]1 John 5:11.

[15]Jeffery P. Schloss, "Evolutionary Accounts of Altruism and the Problem of Goodness by Design," in *Mere Creation*, ed. W. A. Dembski (Downers Grove: Intervarsity Press, 1998), 236–61.

[16]Michael T. Ghiselin, "Darwin and Evolutionary Psychology," *Science* 179 (1973): 964–8.

[17]Lynn Margulis, *Symbiotic Planet: A New View of Evolution*.

[18]An organelle, like the nucleus, houses the chromosomes and is responsible for gene expression and replication of the chromosomes prior to cell division. Another organelle called the mitochondrion generates the chemical energy for the cell, and in plant cells, an organelle called the chloroplast houses the photosynthetic machinery and uses energy captured from the sun to assimilate carbon dioxide into the plant.

[19]For a running total of sequenced genomes, see the Genomes Online Database at http://wit.integratedgenomics.com/GOLD.

[20]For an accurate yet humorous and entertaining introduction to molecular biology and genetics, see Larry Gonick and Mark Wheelis, *The Cartoon Guide to Genetics* (New York: Harper Perennial, 1991).

[21]Betsy Dexter Dyer and Robert Alan Obar, *Tracing the History of Eukaryotic Cells: The Enigmatic Smile* (New York: Columbia University Press, 1994) 131–2. Dyer and Obar's points are reiterated here with some modifications. They state that we should not see living intermediates in the process of endosymbiogenesis, and this is incorrect, since we do see such intermediates. They do make the point that secondary loss is expected, which is reproduced here.

[22]W. H. Li, *Molecular Evolution* (Sunderland, MA: Sinauer Associates, 1997).

[23]D. Yang, et al., "Mitochondrial Origins," *Proceedings of the National Academy of Sciences USA* 82, no. 13 (1985): 4443–7; C. R. Woese, "Bacterial Evolution," *Microbiological Review* 51 (1987): 222–70;

M. W. Gray, "Rickettsia, Typhus and the Mitochondrial Connection," *Nature* 396, no. 6707 (1998): 109–10; M. W. Gray, G. Burger, and B. F. Lang, "Mitochondrial Evolution," *Science* 283, no. 5407 (1999): 1476–81; B. F. Lang, M. W. Gray, and G. Burger, "Mitochondrial Genome Evolution and the Origin of Eukaryotes," *Annual Review of Genetics* 33 (1999): 351–97. See also S. G. Andersson, et al., "The Genome Sequence of *Rickettsia prowazekii* and the Origin of Mitochondria," *Nature* 396, no. 6707 (1998): 133–40.

[24]Michael W. Gray and William F. Doolittle, "Has the Endosymbiont Hypothesis Been Proven?" *Microbiological Reviews* 46, no. 1 (1982): 1–42. See also M. W. Gray, D. Sankoff, and R. J. Cedergren, "On the Evolutionary Descent of Organisms and Organelles: A Global Phylogeny Based on a Highly Conserved Structural Core in Small Subunit Ribosomal RNA," *Nucleic Acids Research* 12, no. 14 (1984): 5837–52; R. Cedergren, et al., "The Evolutionary Relationships Among Known Life Forms," *Journal of Molecular Evolution* 28, no. 1–2 (1988): 98–112; S. J. Giovannoni, et al., "Evolutionary Relationships Among Cyanobacteria and Green Chloroplasts," *Journal of Bacteriology* 170, no. 8 (1988): 3584–92; S. Turner, et al., "The Relationship of a Prochlorophyte *Prochlorothrix hollandica* to Green Chloroplasts," *Nature* 337, no. 6205 (1989): 380–2; C. F. Delwiche and J. D. Palmer, "The Origin of Plastids and Their Spread Via Secondary Endosymbiosis," in *Origins and Algae and Their Plastids*, ed. D. Bhattacharya (Vienna: Springer-Verlag, 1997), 53–86; and S. E. Douglas, "Plastid Evolution: Origins, Diversity, Trends," *Current opinion in Genetics and Development* 8 (1998): 655–61.

[25]L. Margulis, *Symbiotic Earth: A New View of Evolution*, 22–8.

[26]B. F. Lang, et al., "Mitochondrial Genome Evolution and the Origin of Eukaryotes."

[27]Chloroplast genomes tend to be larger than mitochondrial genomes. Chloroplast genomes are also very bacterial-like and tend to be circular and lack extensive protein coatings like almost all bacterial genomes. See M. W. Gray and W. F. Doolittle, "Has the Endosymbiont Hypothesis Been Proven?"

[28]M. W. Gray, et al., "Mitochondrial Evolution."

[29]N. W. Gillham, "Chloroplasts and Mitochondria," in *Encyclopedia of Genetics*, ed. E. C. R. Reeve (Chicago: Fitzroy Dearborn Publishers, 2001) 721–35.

[30]E. H. Harris, J. E. Boynton, and N. W. Gillham, "Chloroplast Ribosomes and Protein Synthesis," *Microbiological Reviews* 58, no. 4 (1994): 700–54. In at least one case, the Shine-Dalgarno sequences play a negative regulatory role. See W. Plader and M. Sugiura, "The Shine Dalgarno-like Sequence is a Negative Regulatory Element for Translation of Tobacco Chloroplast *rps2* mRNA: An Additional Mechanism for Translational Control in Chloroplasts," *Plant Journal* 34, no. 3 (2003): 377–82. In some cases, obliteration of them does not affect translation. See N. W. Gillham, "Chloroplasts and Mitochondria."

[31]Leland H. Hartwell, Leroy Hood, Michael L. Goldberg, Ann E. Reynolds, Lee M. Silver, and Ruth C. Veres, *Genetics: From Genes to Genomes* 2d ed. (New York: McGraw Hill Publishers, 2004), 535–43.

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[33]R. P. Wagner, "The Role of Maternal Effects in Animal Breeding. II. Mitochondria and Animal Inheritance," *Journal of Animal Science* 35, no. 6 (1972): 1280–7.

[34]E. V. Armbrust, P. J. Ferris, and U. W. Goodenough, "A Mating Type-Linked Gene Cluster Expressed in *Chlamydomonas* Zygotes Participates in the Uniparental Inheritance of the Chloroplast Genome," *Cell* 74, no. 5 (1993): 801–11. Also see B. B. Sears and K. VanWinkle-Swift, "The Salvage/Turnover/Repair (STOR) Model for Uniparental Inheritance in *Chlamydomonas*: DNA as a Source of Sustenance," *Journal of Heredity* 85, no. 5 (1994): 366–76.

[35]Michael W. Gray and William F. Doolittle, "Has the Endosymbiont Hypothesis Been Proven?"

[36]For chloroplast rRNAs, see S. J. Giovannoni, et al., "Evolutionary Relationships among Cyanobacteria and Green Chloroplasts," *Journal of Bacteriology* 70, no. 8 (1988): 3584–92. For mitochondrial 5S rRNAs, see H. Kuntzel, M. Heidrich, and B. Piechulla, "Phylogenetic Tree Derived from Bacterial, Cytosol and Organelle 5S rRNA Sequences," *Nucleic Acids Research* 9, no. 6 (1981): 1451–61. For the 16S rRNAs of mitochondria, see M. W. Gray, D. Sankoff, and R. J. Cedergren, "On the Evolutionary Descent of Organisms and Organelles: A Global Phylogeny Based on a Highly Conserved Structural Core in Small Subunit Ribosomal RNA," *Nucleic Acids Research* 12, no. 14 (1984): 5837–52. Also see D. Yang, et al., "Mitochondrial Origins."

[37]For tRNAs of both organelles, see M. Sprinzl, et al., "Compilation of tRNA Sequences and Sequences of tRNA Genes," *Nucleic Acids Research* 26, no. 1 (1998): 148–53.

[38]S. Anderson, et al., "Sequence and Organization of the Human Mitochondrial Genome," *Nature* 290, no. 5806 (1981): 457–65; D. A. Clayton, "Replication and Transcription of Vertebrate Mitochondrial DNA," *Annual Review of Cell Biology* 7 (1991): 453–78.

[39]F. Foury, et al., "The Complete Sequence of the Mitochondrial Genome of *Saccharomyces cerevisiae*," *Federation of European Biochemical Societies Letters* 440, no. 3 (1998): 325–31.

[40]K. Oda, et al., "Gene Organization Deduced from the Complete Sequence of Liverwort *Marchantia polymorpha* Mitochondrial DNA: A Primitive Form of Plant Mitochondrial Genome," *Journal of Molecular Biology* 223, no. 1 (1992): 1–7.

[41]K. Ohyama, "Chloroplast and Mitochondrial Genomes from a Liverwort, *Marchantia polymorpha* – Gene Organization and Molecular Evolution," *Bioscience, Biotechnology and Biochemistry* 60, no. 1 (1996): 16–24. With exceptions, chloroplast genomes tend to be 120,000–160,000 base pairs in size. See M. Reith, "Molecular Biology of Rhodophyte and Chromophyte Plastids," *Annual Review of Plant Physiology and Plant Molecular Biology* 46 (1995): 549–75.

[42]M. Unseld, et al., "The Mitochondrial Genome of *Arabidopsis thaliana* Contains 57 Genes in 366,924 Nucleotides," *Nature Genetics* 15, no. 1 (1997): 57–61.

[43]S. Sato, et al., "Complete Structure of the Chloroplast Genome of *Arabidopsis thaliana*," *DNA Research* 6, no. 5 (1999): 283–90.

[44]M. Reith and J. Munholland, "Complete Nucleotide Sequence of the *Porphyra purpurea* Chloroplast Genome," *Plant Molecular Biology Reporter* 13 (1995): 333–5. The chloroplast genome of *Porphyra purpurea* (a red alga) shows the highest reported gene content of all chloroplast genomes.

[45]R. M. Maier, K. Neckermann, G. L. Igloi, and H. Kossel, "Complete Sequence of the Maize Chloroplast Genome: Gene Content, Hotspots of Divergence and Fine Tuning of Genetic Information by Transcript Editing," *Journal of Molecular Biology* 251, no. 5 (1995): 614–28.

[46]E. H. Harris, J. E. Boynton, and N. W. Gillham, "Chloroplast Ribosomes and Protein Synthesis." Also see M. Sugiura, T. Hirose, and M. Sugita, "Evolution and Mechanism of Translation in Chloroplasts," *Annual Review of Genetics* 32 (1998): 437–59.

[47]N. W. Gillham, *Organelle Heredity* (New York: Raven Press, 1978). Also see E. H. Harris, "Chloroplast Ribosomes and Protein Synthesis."

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[49]For mitochondrial ribosomes, see H. de Vries, A. J. Arendzen, and A. M. Kroon, "The Interference of the Macrolide Antibiotics with Mitochondrial Protein Synthesis," *Biochimica et Biophysica Acta* 331, no. 2 (1973): 264–75. Also see N. D. Denslow and T. W. O'Brien, "Antibiotic Susceptibility of the Peptidyl Transferase Locus of Bovine Mitochondrial Ribosomes," *European Journal of Biochemistry* 91, no. 2 (1978): 441–8; R. J. LaPolla and A. M. Lambowitz, "Mitochondrial Ribosome Assembly in *Neurospora crassa*. Chloram-

phenicol Inhibits the Maturation of Small Ribosomal Subunits," *Journal of Molecular Biology* 116, no. 2 (1977): 189–205; A. Dalhoff, "Pleiotropic Actions of Aminoglycosides," *Antibiotics and Chemotherapy* 39 (1987): 182–204. For chloroplast ribosomes, see N. W. Gillham, *Organelle Heredity*. Also see E. H. Harris, "Chloroplast Ribosomes and Protein Synthesis."

[50]S. G. Andersson, et al., "The Genome Sequence of *Rickettsia prowazekii* and the Origin of Mitochondria."

[51]B. F. Lang, et al., "An Ancestral Mitochondrial DNA Resembling a Eubacterial Genome in Miniature," *Nature* 387, no. 6632 (1997): 493–7.

[52]For a review, see Susan E. Douglas, "Plastid Evolution: Origins, Diversity, Trends." For genomic and protein phylogenies, see T. Rujan and W. Martin, "How Many Genes in *Arabidopsis* Come from Cyanobacteria? An Estimation from 386 protein phylogenies," *Trends in Genetics* 17, no. 3 (2001): 113–20. See also William Martin, et al., "Evolutionary Analysis of *Arabidopsis*, Cyanobacterial, and Chloroplast Genomes Reveals Plastid Phylogeny and Thousands of Cyanobacterial Genes in the Nucleus," *Proceedings of the National Academy of Sciences USA* 99, no. 19 (2002): 12246–51. Also see K. H. Chu, J. Oi, Z. G. Yu, and V. Anh, "Origin and Phylogeny of Chloroplasts revealed by a Simple Correlation Analysis of Complete Genomes," *Molecular Biology and Evolution* 21, no. 1 (2004): 200–6.

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[55]K. H. Wolfe, C. W. Morden, and J. D. Palmer, "Function and Evolution of a Minimal Plastid Genome from a Nonphotosynthetic Parasitic Plant," *Proceedings of the National Academy of Sciences USA* 89, no. 22 (1992): 10648–52.

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[59]Ibid.

[60]P. Baumann, N. A. Moran, and L. Baumann, "The Evolution and Genetics of Aphid Endosymbionts," *BioScience* 47, no. 1 (1997): 12–20.

[61]P. Baumann, et al., "Genetics, Physiology, and Evolutionary Relationships of the Genus *Buchnera*: Intracellular Symbionts of Aphids," *Annual Review of Microbiology* 49 (1995): 55–94.

[62]S. Shigenobu, et al., "Genome Sequence of the Endocellular Bacterial Symbiont of Aphids *Buchnera* sp. APS," *Nature* 407, no. 6800 (2000): 81–6.

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[64]D. Schroder, et al., "Intracellular Endosymbiotic Bacteria of *Camponotus* Species (Carpenter Ants): Systematics, Evolution and Ultrastructural Characterization," *Molecular Microbiology* 21 (1996): 479–90; N. A. Moran and P. Baumann, "Phylogenetics of Cytoplasmically Inherited Microorganisms of Arthropods," *Trends in Ecology and Evolution* 9 (1993): 15–20; C. Bandi, et al., "The Establishment of Intracellular Symbiosis in an Ancestor of Cockroaches and Termites," *Proceedings of the Royal Society of London Series B* 259 (1995): 293–9; and S. Askoy, A. A. Pourhosseini, and A. Chow, "Mycetome Endosymbionts of Tsetse Fly Constitute a Distinct Lineage Related to *Enterobacteriaceae*," *Insect Molecular Biology* 4 (1995): 15–22.

[65]Lynn Margulis, *Symbiotic Planet: A New View of Evolution*, 6–12.

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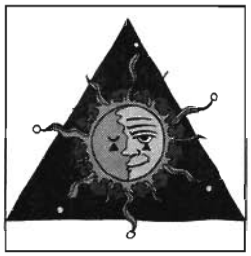
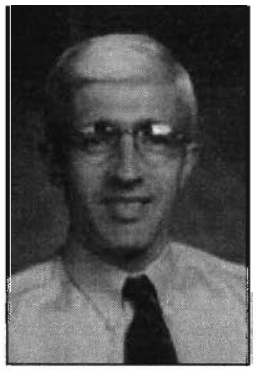




# The Untidiness of Integration: John Stapylton Habgood

*Kevin S. Seybold*



Kevin S. Seybold

*Born in 1927, John Habgood was educated at King's College, Cambridge, where he read natural sciences specializing in physiology.*

During the Middle Ages, it was not unusual for theologians to study the physical world. In fact, there was an amazing lack of strife between theology and science at this time. One reason for this cooperation was the large number of individuals trained in both theology and medieval science. It was the medieval theologian who tried to relate theology to science and science to theology.[1] Today, it is uncommon to have a theologian also easily conversant in the scientific literature. John Polkinghorne, Arthur Peacocke, and Alister McGrath are well-known contemporary examples of scientists who later have been trained in theology and turned their attention to the integration of the two. A less familiar example is John Stapylton Habgood, who studied natural science at Cambridge and later lectured in physiology and pharmacology there for several years. In 1954, Habgood took orders in the Anglican Church and rose through the ecclesiastical hierarchy to eventually become Archbishop of York in 1983 until his retirement in 1995.

This paper will review some of John Habgood's (now Lord Habgood) writings, particularly those that refer to his vision of how Christianity and science are related. In doing so, I hope to bring Habgood's works to a wider audience (particularly in North America) and to argue that his approach constitutes a viable model for the integration of science and religion.

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Born in 1927, John Habgood was educated at King's College, Cambridge, where he read natural sciences specializing in physiology. After earning a Ph.D., he became a demonstrator in pharmacology and a fellow of his college at Cambridge. In response to a mission effort in Cambridge, Habgood converted to Christianity in 1946 and began the life-long process of wrestling with his new faith, a process that is central to his understanding of what it means to be a Christian.[2] Habgood eventually served in a number of church roles, but maintained a dedication to his family and the people of his parish (regardless of how large that parish became). He also wrote several books during his years in the church, many of which deal with the relationship of Christian belief to science.

## Faith and Uncertainty

The foundation for any kind of dialogue between theology and science, according to Habgood in *Faith and Uncertainty*, is trust in each other's basic integrity and a willingness to work together.[3] There is, of course, a long history of just that kind of trust. It is in this tradition that his approach to science and religion is to be found. The "conflict" and "warfare" language used by John William Draper and Andrew Dickson White in the nineteenth century and too often heard in evangelical circles during the twentieth century is anathema to Habgood. Both science and religion are searching for truth, and both use similar forms of language in their attempts to describe that truth. For example, metaphor and analogy are used extensively in theology (e.g., lamb of God) and in scientific theorizing (e.g., billiard ball model of interacting particles). This metaphorical language is inadequate in both disciplines; yet the use of these figures of speech serve the

vital purpose of making something that is difficult to describe and understand more intelligible.

Language also has its limitations. The natural sciences as well as the behavioral sciences and theology suffer from the limitation that all knowledge is interpretation, and the language in which the interpretation is given helps to determine the results.[4] So, scientific data, no less than theological statements, are not removed from theory and the assumptions upon which those theories are based. Postpositivism refers to this as the theory-laden nature of data. I think Habgood would concur with the belief of many Christians that the Bible must be interpreted in light of societal and cultural factors present during Old Testament or New Testament times. He also, I believe, would agree with the less commonly held position that empirical data are also subject to interpretation based on some level of social construction. Indeed, Habgood sees the very concept of nature itself as a social construction.[5] In this, he is in agreement with Alister McGrath in his recent book on nature.[6]

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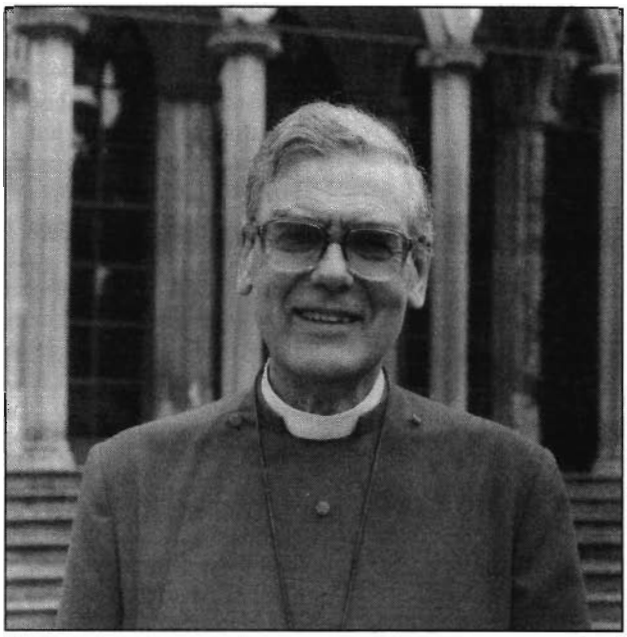
The findings and theories of science can assist theology as it develops its doctrines. For example, Habgood sees in Darwin's theory of evolution an opportunity to clarify certain themes expressed in Christian theology. In addressing the question why there are intelligent beings on Earth, for instance, Habgood sees evolution as support for a Christian position that God desired intelligent beings with which he could have relationships. He writes:

> Multiple connectedness, and the complexity which goes with it, are evolutionary winners. So it is not religious prejudice which makes one say that complex systems tend to ramify in the direction of ever greater complexity, and that self-conscious intelligence is not an accident.[7]

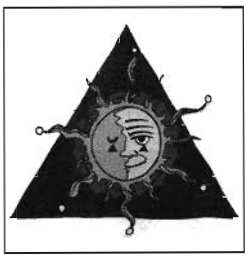
Concerning the issue of apparent waste within creation, Habgood again sees evolutionary theory as offering an understanding of the necessity of "dead ends" and suffering. These problems for theology are due to the freedom inherent within the world to be itself. He explains:



John Stapylton Habgood

> Natural selection provided a rationale for waste. Intolerable problems confront a theology which ascribes all that happens in the world to the direct, unmediated intention of God. But a world which is allowed to make itself, in order to develop the freedom to be itself, at least contains some explanation of why fragility and vulnerability are an essential component of it. A complex mixture of competition and co-operation are the conditions for free creativity – and free creativity is the basis of life ... There can be no freedom without clash of interests. There can be no creation without destruction. There can be no life without death.[8]

Integrating faith and practice, whether as a scientist, teacher, clergyman, or member of some other profession, is a struggle. Referring to the use of the Bible in discussions of contemporary issues, Habgood agrees that the Bible is relevant and "at the center of the tradition in which all Christians live." Nevertheless, he tries to make what he says on these contemporary issues accessible to everyone, even those (or perhaps, particularly those) who do not start from a Christian world view. Habgood says that he seldom quotes the Bible in such discussions or arguments because, while Christians will hopefully see the biblical basis for his arguments, non-Christians will find the quoting "off-putting." Using biblical texts for "proving arguments about contemporary problems" can give "the quite misleading impression that there is some quick way of short-circuiting the struggle to bring faith to bear on them. Christians are not in the privileged position of being able to look up the answer in the back of the book."[9]



# Communication

*The Untidiness of Integration: John Stapylton Habgood*

*Dialogue and cross-fertilization between science and religion work both ways; integration occurs along a two-way street. As an example of this two-way communication, Habgood considers the role theology should play in helping shape social, personal, and ethical issues.*

## A Working Faith

"To make statements about God is potentially to say something about everything."[10] This statement, found in the introduction of *A Working Faith*, suggests the unity that Habgood sees in creation and the importance he places on keeping the worlds of science and theology together. Dialogue and cross-fertilization between science and religion work both ways; integration occurs along a two-way street. As an example of this two-way communication, Habgood considers the role theology should play in helping shape social, personal, and ethical issues. While scientists are appropriately careful about opening their domain to theology, they live in the real world, and when scientists are asked to make comments about or are asked to help shape the important issues of the day (e.g., human cloning), theological (as well as philosophical, ethical, and moral) issues also need to be considered.

Another example of the two-way street of integration considers Einstein's query of whether God throws dice. Habgood answers the question with a strong "yes," God does throw dice. To accept this, however, does not mean that there is no rationality to creation. It does not take God out of the creative process. Habgood sees the combination of chance and selection as mechanisms whereby biological creativity is possible. Chance does not imply an unstructured, unplanned, blind universe with no God in control. It is not merely chance or just selection or only lawful relationships that drive creation. It is all of these processes operating under the will of God producing the kind of world we have today. Habgood states:

> It is not, therefore, empty talk, to say that this is God's world in which God's purposes are fulfilled ... Chance [provides] the possibility of freedom and creativity; chance [is] a component in God's design.[11]

It is clear that Habgood places a high value on the natural sciences as an *ancilla* to theology. Nevertheless, God cannot solely be revealed by or understood through nature. No amount of argument from science can substitute for revelation of God through our direct experience of him. This direct awareness of God is, in part, culturally conditioned so there are times when our accessibility to God is blunted by the context in which we live. However, Habgood believes that humans cannot fail to search for the transcendent. There is, Habgood might say, a kind of lure of the divine, a concept consistent with Alister Hardy's notion of the divine flame.[12] According to Hardy, the awareness of this divine flame is an element of the fundamental nature of human beings and derives, in part, from the evolutionary process.

The more recent work of David Hay[13] in the United Kingdom, supports the idea that children's spirituality is not merely a cultural construction, but emerges from biological predispositions. Also consistent with this view is the empirical evidence for a biological basis for God beliefs suggested by the research of Andrew Newberg.[14] Newberg's findings coincide with the recent report from the Commission on Children at Risk which suggests that the human brain is organized to ask questions and seek ultimate answers.[15] This characteristic of the brain reinforces the idea that one aspect of human uniqueness is this drive to draw meaning and purpose from experience and to make a connection with the transcendent. Human beings, Habgood argues, cannot permanently forsake this search for the transcendent or the search for meaning in life without giving up a part of us that is distinctively human.

This search for the transcendent and meaning in life implies to Habgood that we can never become comfortable in our established theological positions. While there are important differences between scientific and religious truth claims, they are similar in that they both rely, in part, on the consensus of those "who have taken the trouble to master their subject matter."[16] As a result, Habgood is concerned about Christianity that purports to know too much; of Christians who seem to know with too much certainty. While knowledge of one's direct experience with God is valuable, Christians, Habgood argues, must avoid having an arrogant knowledge that sees "no actual need to listen to what is going on in the rest of the world of thought and experience."[17] At the same time, however, there are problems and dangers in knowing too little. The difficult quest for the Christian is in finding the proper balance, a balance that is reflected in any attempt to integrate science and religion.

Whether bringing one's Christian faith to bear on contemporary social issues (e.g., cloning and global warming), integrating evolutionary theory into a theology of creation, or using scientific findings to support the human tendency to seek a reality beyond ourselves, the correct decision or position is often not obvious, and the consequences and implications of a particular decision are frequently unknown. Despite this uncertainty and untidiness, we must, Habgood argues, proceed the best we, especially as scientists, can in connecting our faith with our everyday lives.

## Being a Person

In his book *Being a Person*,[18] Habgood discusses, among other things, what it means to be a person. Personhood clearly has implications for a number of current controversies including abortion and euthanasia. As a clergyman, Habgood has had abundant experience dealing with the realities of illness and death, and the questions that surround those realities. Indeed, there is for Habgood a close connection between our knowledge of God (our theology) and our knowledge of ourselves as persons. Theology is irreducible and personal; it is, like personal knowledge, ultimately unfathomable.[19] So, to Habgood, knowledge of God and knowledge of ourselves as persons develop together. The two forms of knowledge are intimately intertwined.

*To Habgood, knowledge of God and knowledge of ourselves as persons develop together. The two forms of knowledge are intimately intertwined.*

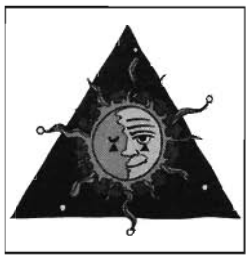
Being a person is defined by our relationships with others and, most importantly, by our relationship with God. These relationships are made possible through the workings of the brain. Language, theory of mind, episodic memory, and a future orientation are just some of the mental abilities that emerge out of a person's brain that make relationships possible.[20] The close relationship between the brain and mind requires, according to Habgood, two kinds of language to describe them: a scientific and analytical third-person account and a more personal first-person account. This difference brings to mind the distinction C. S. Lewis made between looking at a beam of light (third-person, analytical account) and looking along the beam (first-person, experiential account).[21]

Because personhood is so closely connected with our physiological being, it develops gradually as does our mental abilities which are based upon the physical brain. The gradual emergence of personhood has, according to Habgood, implications regarding how we understand and treat individuals whose identity or personhood might be gradually diminishing. Changes in personality and memory, growing or diminishing capacities, or changing relationships with others over the course of a lifetime do not ultimately affect our identity because we are fundamentally who we are because we are held in the mind of God. Despite the apparent diminishment of identity that often comes with decreases in the mental capacities that facilitate our relationship with others, our relationship with God is unchangeable and secure, and it is that relationship, according to Habgood, which is the Christian answer to the problem of identity.[22]

As indicated in the subtitle of *Being a Person*, our approach to and understanding of personhood is a good example of where faith and science meet and how our integration of the two can become untidy and messy. If there is such a close connection between personhood and our physical being, what implications does that have for our understanding of soul and spirit? If personhood is defined by our relationships with others and with God, how is a person changed as a result of neurological diseases such as Alzheimer's and Huntington's which affect so dramatically the ability to relate to others (and to God)? Finally, what are the implications for a Christian understanding of life after death (survival of the soul) if who we are as persons is so closely linked with our physical body? These questions, and many more, emerge from a critical yet honest reading of much of the scientific literature, particularly in the neurosciences and psychology. It is this kind of honest attempt at integration that Habgood has pursued during the course of his career.

## The Concept of Nature

In his most recent book, Habgood provides an extended discussion of nature, that thing which scientists (natural, social, behavioral) study. What do we mean by nature? Is it a purely objective entity or is it a socially constructed concept? Habgood begins by providing three classical definitions of nature.[23] First is nature as the character or quality of something. Second is a more abstract and generalized view that sees nature as a directive or unifying force. Third is the meaning of nature which includes the entire physical world, the whole of physical reality. Given the variety of meanings of the concept of nature, it is perhaps unsurprising that different disciplines have developed each claiming, to various extents, to be scientific. The familiar hierarchy of sciences—with physics, chemistry, and biology making up the lower levels and psychology, sociology, and anthropology comprising the higher levels—reflects this multiple conceptualization of





*Nature has, according to Habgood, both givenness and potential. There is a sense in which nature is what it is, it cannot be changed. ... Nature, however, also has potential for change, a potential whose modern form is represented by Darwin and the theory of evolution. There is, to Habgood, an unfolding of creation that is reflected in the biblical understanding of history.*

nature. It also invites interrelationships and crossovers between the different disciplines. Theology's role here is to remind the sciences of the broader context in which science is conducted and to provide, according to Habgood, "a rationale for the unity and intelligibility of the natural world."[24]

The different levels of scientific disciplines also suggest different levels of complexity. Habgood argues that at the higher levels of complexity, different kinds of explanations might be required because of the emergence of new properties at these higher levels. Levels of explanation appropriate for the sciences at the lower part of the hierarchy may or may not be appropriate for the disciplines at the higher portions of the hierarchy. Reductionistic explanations that are useful and accurate for physics might not work for psychology. We need to be respectful of the uncertainty embedded in the various levels and recognize that there are limitations to what we can know.

Habgood clearly brings a postpositivist view of science to his integration of science and religion. Science, like theology, is a social enterprise; it works, in part, because there is agreement among scientists that the procedures and results of experiments are correct. Another of theology's contributions to the science-religion dialogue, therefore, is to remind scientists that we are not gods and so we will not have a God-like understanding of nature, however one conceptualizes it.

Nature has, according to Habgood, both givenness and potential. There is a sense in which nature is what it is, it cannot be changed. This givenness of nature is reflected in the laws of nature (e.g., the fact that if you jump off the roof of your house, you will drop to the ground). Nature, however, also has potential for change, a potential whose modern form is represented by Darwin and the theory of evolution. There is, to Habgood, an unfolding of creation that is reflected in the biblical understanding of history. There is both hope and promise in biblical history as there is in creation.[25]

The potential found in nature is a reflection of the freedom God gives creation. God lets the world be itself, according to Habgood. He allows it to be free to change, just as he allows humans freedom. Without contingency, there would be no moral significance because creation would be just the working out of some preordained plan. With contingency, with "God's letting it be," there is the interaction of givenness and potentiality "which makes the world the fascinating, glorious, and tragic place it is."[26]

In a similar manner, our identity as individuals has an element of "God's letting it be," and contingency. Our identity is not given to us in advance, it develops as our relationships to others and to God mature. As part of creation, we share freedom and potentiality with the rest of nature. Nature is a process, not a finished product; it is dynamic and full of potential. Part of that process is freedom to make itself, and the outcome of that freedom can be disorder and suffering. That, however, is the price of the potentiality and freedom God has put into creation.

Seeing the world as God's creation suggests that the Creator can be known by studying his work. Indeed, as Habgood states in *The Concept of Nature*:

> There is one reality, but it is a created reality and is therefore capable of disclosing its creator ... all existence is grounded in the reality of God ... All existing things can witness to this ground by the givenness of their existence, in that they are what they are by virtue of their relationship with God."[27]

God, however, cannot ultimately be known through the study of nature. Natural theology, suggests Habgood, will not lead us, on its own, to God. God must be known via some other pathway (e.g., personal experience) before the evidence of nature can point to God. God does, however, express his love through creation. In that respect, the Incarnation, God's entry into time, shows us how God relates to his creation, from the beginning and even now.

## Conclusion

Life is often untidy. Despite all of the work done in recent years to bring science and religion together as dialogue partners, they are sometimes in conflict. But religion is still useful; it is not obsolete. As Christians in science, we must live with this untidiness, because we do not have complete truth or understanding. There appears to be both

order and freedom in creation. Humans are physical beings, yet something special seems to emerge from the material body that cannot quite be explained using scientific methods alone. Science is a powerful way of understanding the physical world, but religion and belief in God have not gone away, despite repeated predictions to the contrary. Untidiness or even tension between science and religion does not mean that one perspective is right and the other wrong. A person can be both an honest scientist and an honest Christian; science and religion can correct and illuminate each other.[28]

The approach to knowledge (scientific or theological) and the integration of faith and learning practiced by John Habgood can be summarized in the following quote in which he talks about integrity.

> The word integrity itself has two meanings. The first is "honesty" ... We have to be honest in facing our limitations, in facing the sheer complexity of the world, honest in facing criticism even of things which are deeply precious to us. But integrity also means wholeness, oneness, the desire for single vision, the refusal to split up our minds into separate compartments where incompatible ideas are not allowed to come into contact ... An undivided mind looks in the end for an undivided truth, a oneness at the heart of things. And this isn't just fantasy. The whole intellectual quest, despite its fragmentation, despite its limitations and uncertainties, seems to presuppose that in the end we are all encountering a single reality, and a single truth.[29]

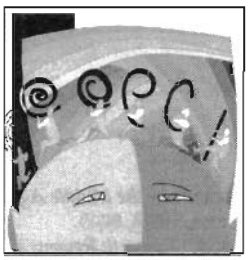
Science is very important in our society. Religion, on the other hand, is seen by many as being irrelevant. If we as believers want to have an impact on secular society, one of the ways we can do this is to try to engage society on issues and in areas that are important to it. Science is one of those areas. Religion does have something to say to science. That does not mean that a Christian will conduct experiments differently than a non-Christian. It does mean, however, that certain Christian doctrines can provide a framework to understand what a scientist—Christian or non-Christian—is studying (that is, nature). Science also has something to say to religion and faith. Believing scientists cannot ignore the evidence of science; it can help shape theological doctrine and belief. John Habgood understands this and has provided many valuable insights into the integration of science and religion in his books, articles, and sermons. His is an approach from which we all can learn.

## Acknowledgment

The author acknowledges the support of the John Templeton Foundation through its sponsorship of the Templeton Oxford Seminars on Science and Christianity. The author is grateful for the Foundation's support and that of the Council for Christian Colleges & Universities.

## Notes

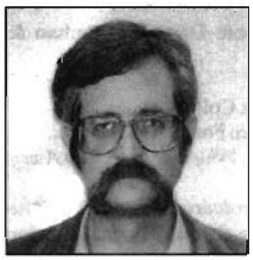
[1]Edward Grant, *The Foundations of Modern Science in the Middle Ages* (Cambridge, UK: Cambridge University Press, 1996), 84–5.
[2]John Munsey Turner, "Profile: John Habgood," *Epworth Review* 23, no. 1 (1996): 18–27.
[3]John Habgood, *Faith and Uncertainty* (London: Darton, Longman and Todd, 1997), 27.
[4]Ibid., 80.
[5]John Habgood, *The Concept of Nature* (London: Darton, Longman and Todd, 2002), 18.
[6]Alister McGrath, *A Scientific Theology: Nature* (Grand Rapids, MI: Eerdmans, 2001), 113.
[7]John Habgood, *Faith and Uncertainty*, 37.
[8]Ibid., 39.
[9]Ibid., 7.
[10]John Habgood, *A Working Faith* (London: Darton, Longman & Todd, 1980), ix.
[11]Ibid., 20.
[12]Alister Hardy, *The Divine Flame* (London: Collins, 1966), 27.
[13]David Hay, *The Spirit of the Child* (London: Fount, 1998).
[14]Andrew Newberg and Eugene D'Aquili, *Why God Won't Go Away* (New York: Ballantine Books, 2001).
[15]The Commission on Children at Risk, *Hardwired to Connect: A New Scientific Case for Authoritative Communities* (New York: Institute for American Values, 2003), 31–2.
[16]John Habgood, *A Working Faith*, 190.
[17]John Habgood, *Confessions of a Conservative Liberal* (London: SPCK, 1988), 93.
[18]John Habgood, *Being a Person: Where Faith and Science Meet* (London: Hodder & Stoughton, 1998).
[19]Ibid., 218.
[20]Warren S. Brown, "Cognitive Contributions to Soul," in *Whatever Happened to the Soul?* (Minneapolis, MN: Fortress Press, 1998), 99–125.
[21]C. S. Lewis, "Meditation in a Toolshed," in *God in the Dock* (Grand Rapids, MI: Eerdmans, 1970), 212–5.
[22]John Habgood, *Being a Person: Where Faith and Science Meet*, 227.
[23]John Habgood, *The Concept of Nature*, 3.
[24]Ibid., 30.
[25]Ibid., 144.
[26]Ibid., 151.
[27]Ibid., 163.
[28]John Habgood, *Religion and Science* (London: Mills & Boon, 1964), 151.
[29]John Habgood, *Confessions of a Conservative Liberal*, 95.





# Richard Dawkins and the Infected Mind

*Ben M. Carter*



Ben M. Carter

*Dawkins says that Darwinism has yet to achieve the same status of certainty that the heliocentric model of the solar system has achieved, and that its current dominance of biology may only be momentary.*

All living creatures share a common ancestor. This statement is true in the same sense that it is true that the sun is hotter than the earth or that you have a head.[1] Thus Richard Dawkins, ever the feisty polemicist, begins his latest book, a collection of essays entitled *A Devil's Chaplain*. However, he readily concedes that common ancestry does not verify Darwinism. What he calls "core Darwinism ... the minimal theory that evolution is guided in adaptively nonrandom directions by the nonrandom survival of small random hereditary changes,"[2] has yet to prove universally true. But, Dawkins says, it is currently "the only viable explanation we have" to account for the truth of evolution.[3] Then in a reversal that strikes this reader as remarkable, Dawkins says that Darwinism has yet to achieve the same status of certainty that the heliocentric model of the solar system has achieved, and that its current dominance of biology may only be momentary. Dawkins is quite willing to admit that future scientists may uncover facts that force them either "to abandon Darwinism or modify it beyond recognition."[4]

Nor does Dawkins believe that Darwinism, even perhaps core Darwinism, is universal in the sense that it can be applied in all walks of life. In politics he proclaims himself "a passionate anti-Darwinian,"[5] and he explicitly sees "no inconsistency in favoring Darwinism as an academic scientist while opposing it as a human being."[6] This is not a new position for Dawkins as readers of his *The Selfish Gene* will recall,[7] but it is perhaps insufficiently appreciated (certainly it is insufficiently appreciated by Dawkins himself) just how genuinely inconsistent Dawkins' formulation of such a dichotomy is.

The issue here turns on the way in which *is* and *is not* are transformed into *ought* and *ought not* when morality is introduced into an argument, as David Hume observed in the third book of his *A Treatise of Human Nature* (1740—the first two books were published in 1739). The point Hume was making is that what ought to be cannot be deduced from what is and vice versa. The problem for the Darwinist is that Darwinism, as a description of what is, could become the foundation of a political or moral theory about what ought to be, and as such might be construed to provide warrant for all manner of social injustices, as Dawkins well knows. After all, Herbert Spencer, an early proponent of social Darwinism, interpreted the development of human societies in survivalist terms, and Francis Galton, Darwin's cousin, coined the word eugenics in 1883.

However, if one can passionately oppose Darwinism when making political choices, why not when making artistic, ethical, philosophical, or religious choices? Dawkins may assert that it is dishonest to assign distinct magisteria to religion and science,[8] but, given his willingness to assign distinct magisteria to science and politics, or even to science and more general human concerns, it is not immediately clear why that should be. And this conundrum in Dawkins' thinking is especially striking since he is so willing to distinguish the truth of evolution (one kind of scientific claim) from the Darwinian interpretation of that truth (another kind of scientific claim). After all, Darwinism might be abandoned by future scientists, as Dawkins has admitted, yet science itself be

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unaffected, or, as theists from many traditions have observed, evolution might simply be the way God did it.

This possibility means, among other things, that when Dawkins describes mainstream Darwinian selection as "the differential survival of genes within gene pools,"[9] he is by his own standards quite wrong. Gene pools are identified by the genes within them. To say they survive means only that they endure. As genes in gene pools, they may have been created, intentionally selected for, or evolved in conformity to some program. The differential survival of genes within gene pools says not one thing about Darwinian evolution, and they still will be with us whether or not a Darwinian interpretation survives.

How are we to account for this glaring and long term inconsistency in Dawkins' thought?[10] Using Dawkins' own criteria, one might suspect his brain has been infected with a religious meme. He is an atheist who feels a profound sense of awe when contemplating the world, and Darwinism, as he has famously admitted, makes it possible to be both an atheist and intellectually fulfilled.[11] Indeed, he maintains that had he lived prior to 1859, the year Darwin's *On the Origin of Species* first appeared, he could not imagine being an atheist.[12] It is Darwinism then that makes Dawkins' atheism intellectually satisfying. In part this is because, as Dawkins says, "Darwin ... was a scientific materialist,"[13] and "Darwinism really matters in the universe."[14] If Darwin is right, then Darwinism, which Daniel Dennett called "reductionism incarnate,"[15] means that much of the universe, perhaps all of its replication processes and their consequences, is reducible to, and fully explicable in, material terms. This, of course, is a theological/philosophical conclusion, which means that, for Dawkins, it may well be a memetic one.

As Dawkins makes clear in his preface to Susan Blackmore's *The Meme Machine*, a preface that appears in shortened form as an essay "Chinese Junk and Chinese Whispers" in *A Devil's Chaplain*,[16] he coined the word meme in 1976 to underline for his readers that genes are only specific expressions of replication, and that the principles described in *The Selfish Gene* could apply to any replicator.[17] A meme, as defined by the Oxford Dictionary, is "a self-replicating element of culture, passed on by imitation."[18] A synonym proposed by C. J. Lumsden and E. O. Wilson in their 1981 book *Genes, Mind, and Culture* is culturgen.[19] A meme, like any other replicator, is entirely "selfish." It has only one purpose: replication, and it replicates best in minds that are host to complementary memes. These memes control our behavior in much the same way that genes control our phenotype, not directly but in interaction with their environment.[20] We are, as Dawkins explains to his daughter in a letter that appears at the end of *A Devil's Chaplain*, people, and we must be good at living in a world full of people. Memes help us do that.

Of course this means that some memes are beneficial. Dawkins would class scientific ideas among this category.[21] Others, like the advertisement jingle that rattles around in your memory, are simply irritating. Still others like some juvenile crazes can be benign. And others can be pathological. For Dawkins and Dennett, less so perhaps for Blackmore, religious beliefs are examples of pathological memes. Religious people are victims of these pathological memes in the same way that people with influenza are victims of a pathological virus. Minds, because they provide such favorable environments for ideas, are, to use Dawkins' phrase "typically massively infected" with them.[22] And, of course, memes are both the source of ideas and the ideas themselves.

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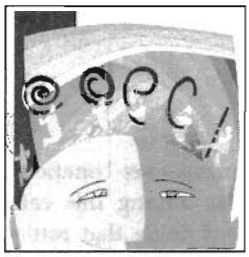
The mind, to function at its peak, must be able to counter pathological or viral memes and encourage those that are beneficial. One of the best pieces of anti-viral software the mind has devised is scientific reason.[23] Because scientific reason performs such a vital role for Dawkins, it is important to understand precisely what he means when he talks about it. For Dawkins science is preeminently about evidence.[24] However the truth claims of science are based not on evidence alone but on the kind of power science provides: the ability to manipulate matter and predict how it will behave.[25] Hence science, to use Peter Medawar's phrase, is the art of the soluble.[26] But how does one solve problems, and how does one know which problems can be solved? After all, Dawkins reminds us that appearances can conceal a truth rather different than the one they reveal because the human mind, "a material product of natural selection,"[27] is limited by its evolutionary history.[28] Our senses did not evolve to give us a true picture of the world, rather they evolved to give us a useful picture of it. They create a virtual reality with which we interact.[29] And, precisely because the reality it generates is a virtual one, the human mind is prone to illusion, prone to imposing patterns where none exist.[30] For Dawkins, the appearance of design in nature is one example of such an illusion.[31]



# Communication

## *Richard Dawkins and the Infected Mind*

*The world as conceived by Dawkins has no truly metaphysical dimension. He is a thoroughgoing materialist, and he understands materialism in terms of physicality. Plainly materialism so construed makes some profound metaphysical assumptions.*

Dawkins tells us that science functions as a way to test hunches.[32] The scientist is intrigued by a particular phenomenon, and wishes to construct an explanation for that phenomenon that can be tested repeatedly, and is consistent, precise, supported by the evidence, quantifiable, universal, and independent of cultural milieu.[33]

No one doubts that science, as a powerful problem-solving tool, can be advantageously applied to resolve certain kinds of questions. For example, a scientist might have a hunch that a particular agent in solution produces a physical effect that can continue to manifest even when diluted to such a degree that the admixture no longer contains a single molecule of that agent, and employ scientific methodology to explore that hunch. Dawkins admits that such a hypothesis is scientific though he finds it implausible.[34] But for Dawkins, the hunch that natural processes might reveal purpose, is unscientific. The interesting question is: why does Dawkins make such a distinction? The short answer is that for Dawkins *physical* is the key word. In the case of the first hunch, one is searching for a physical effect, but in the case of the second, one is not. However there is a longer answer that is worth examining.

The world as conceived by Dawkins has no truly metaphysical dimension. He is a thoroughgoing materialist, and he understands materialism in terms of physicality. Plainly materialism so construed makes some profound metaphysical assumptions. One such assumption is that metaphysical entities like spirits and disembodied souls do not exist because they are not physical. However, the overwhelming majority of people who live, and who have ever lived, believe they have souls distinct from their bodies and that they experience the presence of spirits. Therefore the materialist must believe that the overwhelming majority of people, many of whom are very bright, are fundamentally deluded about something extremely important, and that mere empiricism is insufficient for establishing the truth of a thing.

To state this problem in a different way: it is not enough that many people report seeing an elephant. Before their reports are credible, a theory of the world must exist that allows for the presence of the elephant. Or conversely, a theory that denies the existence of elephants might be a scientific theory in the sense that it is falsifiable, but most of us, because we have experienced elephants, would give it no credence. So what gives the claim that spirits and disembodied souls do not exist special scientific status? The answer is that such a claim has no scientific status at all. Rather it is a philosophical claim based on materialism, but materialism, as an exclusive interpretation of reality, has no scientific status. Dawkins merely thinks it does. He believes the methodological naturalism of science confirms his own metaphysical naturalism.

Pascal Boyer points out that religious ideas are invariably counterintuitive,[35] but he goes on to observe that a caterpillar's metamorphosis into a butterfly is also profoundly counterintuitive and that we accept it only because the empirical evidence for it is overwhelming. And, to the surprise of no one who knows anything about science, Boyer observes that the same can be said of many scientific conclusions.[36] Boyer also says that, despite their counterintuitive aspect, religious ideas, like scientific ones, often seem quite sensible when viewed from the perspective of those who hold those ideas.[37] Indeed, he points out that religious beliefs may well seem self-evident to believers.[38] And he argues that religious claims are selective, that the religious realm is not a domain where anything goes.[39]

That scientific analysis produces counterintuitive conclusions is no surprise to Dawkins. He often writes about it. In *A Devil's Chaplain*, he even describes how a quantum can simultaneously behave like a particle or, when interfered with by a nonexistent copy of itself, can behave like a wave.[40] What is it that convinces Dawkins of that truth? Empiricism. The phenomenon can be observed, tested repeatedly in a controlled environment, and quantified. But something more than empiricism is involved. Dawkins also has a theory of the world into which the phenomenon can be slotted.

Let us try a thought experiment. Let us suppose that something other than a nonexistent copy of a quantum is interfering with that quantum. Let us suppose that metaphysical entities are the cause, that the mind of God transforms the quantum into a wave, or perhaps little demons interfere

with it. The results of the scientific experiments would be identical, but to account for them one would appeal to the divine or the demon rather than a nonexistent quantum. Which supposition is more credible? One's world view decides. But notice that if we assume that the mind of God or a little demon affects a quantum, then we must also assume that the perception that it is being transformed by a nonexistent copy of itself is an illusion. Hence, one's world view will, in such cases, determine what one understands as an illusion.

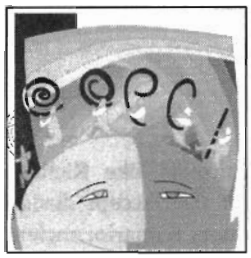
The Intelligent Design theory (ID) has illumined this issue in a new way. Though critical of ID, Michael Murray lays out the various options clearly and concludes that one might embrace a thoroughgoing methodological naturalism and still make room for design if, as Van Till has done, one adopted a Leibnizian rather than a Newtonian position.[41] The issue, according to Murray, is decided by how one imagines a world creator's involvement in creation. If the world creator does not exist, then the creator has no involvement at all, and methodological naturalism is the obvious option. But a world creator might exist and have arranged everything that happens from the beginning, stacked the deck, as Murray describes it. Such a situation would lend itself to methodological naturalism and still leave an important role for natural theology. On the other hand, a world creator might have created a world which required occasional intervention on the part of its creator. Such a world would prove problematic for methodological naturalism since it would mean that a naturalistic approach could not provide a true explanation of affairs. The important point here is that each of these three options entails an assumption about the kind of being the creator is, existing or nonexisting, deck-stacking or intervening. In other words, there is an implicit religious world view involved.

If one's world view dictates something like whether a quantum is transformed by a nonexistent copy of itself or by a mischievous little demon, that is whether some ontological possibility can be dismissed as an illusion, what is to prevent that world view from dictating whether the absence of design in nature is an illusion? If the design advocates have done nothing else, they have served to highlight how nonempirical, interpretive, and faith-based the materialist's argument is. Such a problem comes out clearly in Leif Edward Ottersen Kennair's critique of ID in an article that appeared in the September 2003 issue of *Zygon*. Discussing design theorists' claims to be engaged in genuine science, Kennair observes: "[E]ven if design theory proved to be true, its scientific value would be minimal unless it could predict and explain the world as it really is."[42] Since Kennair says that both Christianity and evolutionary psychology have a commitment to explaining the world as it really is,[43] one wishes he had explained how ID could be true yet also be of minimal value in explaining the world as it really is.

Anyway, why should an evolutionist like Richard Dawkins care so passionately about ID? Accept design and one can have the entire evolutionary scenario: ancient earth, fossils, genetic kinship, even a modified form of natural selection. One can have it all except hard-core Darwinism as an exclusive explanation. This is where the issue comes to a head for Dawkins. Darwinism makes his atheism intellectually fulfilling for him. He believes the universe to be a certain way, a realm ultimately describable in terms of matter in motion, and given that belief, Darwinism allows him to account for the universe as he finds it: swarming with creatures that evidence apparent design. Of course, Darwinism is—from Dawkins own perspective—a meme, and as such could be quite neutral, but in his mind it seems to have metastasized into the kind of "pathology" he would otherwise associate with religion. Dawkins is drunk on Darwinism.

*Why should an evolutionist like Richard Dawkins care so passionately about ID? Accept design and one can have the entire evolutionary scenario ... except hard-core Darwinism as an exclusive explanation. This is where the issue comes to a head for Dawkins. Darwinism makes his atheism intellectually fulfilling for him.*

To illustrate exactly how this works, I will cite an example Dawkins himself provides: the phenomenon of ring species, but I will preface this by noting a phenomenon that may be related: the evolution of language. In Gen. 11:1-9, we read the story of how God confused the languages of people and scattered them over the Earth. Those who left the plain of Shinar were not speaking any modern tongue. The languages of today obviously evolved from earlier versions. But they evolved not because there was competition that eliminated less fit languages and encouraged more fit languages. Instead they seem to have evolved through the process of replication itself. Information, as it replicates, can become unstable and hence tends to be modified. In the case of language, this does not suggest



# Communication

*Richard Dawkins and the Infected Mind*

*Darwinism is – from Dawkins own perspective – a meme, and as such could be quite neutral, but in his mind it seems to have metastasized into the kind of "pathology" he would otherwise associate with religion. Dawkins is drunk on Darwinism.*

the absence of intelligence but rather the presence of it.

This capacity for information to be modified into new but related expressions may also account for the well-known phenomenon called "ring species." Such a species is comprised of varieties that live in a habitat that can be diagramed as a ring. Along the trajectory of the ring, variations or subspecies appear. Although these varieties can interbreed, they gradually differentiate along the ring, until at its overlapping terminal points, they are intersterile. There are several well-documented examples of ring species including the greenish warblers (*Phylloscopus trochiloids*) of eastern Europe and central and northern Asia and the California salamander (*Ensatina eschscholtzii*), but perhaps the best known is the Herring Gull (*Larus argentatus*)/Lesser Black-backed Gull (*Larus fuscus*) ring.

The taxonomy of the Herring Gull and Lesser Black-backed Gull is so complex that authorities may distinguish between two and eight species in their ring which loops across the northern hemisphere. The Herring Gull hybridizes with subspecies in the west, the Lesser Black-backed Gull with subspecies in the east, but in Britain and western Europe, the gulls indisputably comprise two species. As Dawkins puts it, if you follow Herring Gulls westward, you will find that the Herring Gulls look less and less like Herring Gulls and more like Lesser Black-backed Gulls until when you arrive back in Britain you discover they have in fact become Lesser Black-backed Gulls.[44] Since the various species or subspecies exist together quite well along the trajectory of the ring, no obvious selective pressures underlie this change. Rather the change looks more like the change one associates with language modification. That is, it does not seem to be occasioned by natural selection. It is not Darwinian in the sense Dawkins usually uses the term though it may be evidence for the action of mind in the way we described it above (see endnote 2).

If species might evolve in the same way that language does, and if the evolution of language is evidence of intelligence, then the evolution of species might also evidence intelligence. For example, in the evolution of species, one has a shift in the genetic frequencies of gene pools. That means the information code in those pools changes. The same is true in the evolution of language: the information codes change. Not only do new words appear and old words take on new functions, but pronunciation and grammar shift over time, creating dialects and eventually new languages. Hence, we might think of the emergence of a new species in the way we think of an emergent language, as an expression of mind. Such a model fits comfortably into our information-rich world and allows us to capitalize on its information as an explanatory principle rather than as a phenomenon to be explained. It also allows us to acknowledge evolution as an increase in variety and complexity without having to account for that increase as a mindless process. However, I doubt materialists like Dawkins will find this proposal attractive, perhaps because their minds have been too heavily infected with a family of memes that blinds them to alternative interpretations.

## Notes

[1]Richard Dawkins, *A Devil's Chaplain* (Boston: Houghton Mifflin Company, 2003), 17–8, or true in the same sense that it is true that the earth revolves around the sun, 219.

[2]Ibid., 81. I find this an odd definition since nonrandom might well be evidence for mind. It is almost as though Dawkins were claiming that even if the design argument prevailed, Darwinism would be vindicated since mind would secure Darwinism's requirement that the direction of the change and the survival of the changes be nonrandom. Mind, after all, might simply be exploiting random changes in an opportunistic way, rather like domestic breeders have (see the first two chapters of Darwin's *On the Origin of Species*).

[3]Ibid., 84.

[4]Ibid., 81.

[5]Ibid., 10–1. Science, he acknowledges, "is not politically neutral" (p. 193).

[6]Ibid., 11. Interesting distinction between scientists and humans.

[7]Dawkins, *The Selfish Gene* (New York: Oxford University Press, 1989), 139.

[8]Dawkins, *A Devil's Chaplain*, 150.

[9]Ibid., 227.

[10]To be fair, this level of confusion is not unique to Dawkins. For example, Dr. Francisco Ayala in an article available on the Internet at www.counterblance.org (www.meta-library.net/evolution/evolution-print.html) writes: "Natural selection is a statistical bias in the relative rate of reproduction of alternative genetic units." But that is wrong. Selection itself whether natural or otherwise is a statistical bias. It may be, as he says later in his paper, "a consequence of the differential multiplication of living beings," but that does not tell us how "natural" such differential multiplication is or how much variety can be generated in such a manner. Yet this claim is fundamental to Ayala's

argument that Darwin completed the Copernican revolution by making the origin of design in living things comprehensible to human reason and thereby resolving the "conceptual schizophrenia" between the physical and the biological sciences.

[11]Dawkins, *The Blind Watchmaker* (W. W. Norton & Company, 1996), 6.

[12]Ibid., 5.

[13]Dawkins, *A Devil's Chaplain*, 191.

[14]Ibid., 79.

[15]Daniel Dennett, *Darwin's Dangerous Idea* (New York: Simon & Schuster, 1995), 82.

[16]The essay was modified in a way I found quite interesting. Most of the shortening involves the kind of editorial alteration that one would expect when a preface to one book is reprinted as an essay in another, and there is the bow to shifts in style, as, for example, when the "is not" in the preface becomes "isn't" in the essay. But one striking change of real content is the elimination of the reference to Plato found in the preface (xii). While preparing a paper on communication for the 51st annual Evangelical Theological Society conference in 1999, I wrote to Susan Blackmore and argued, based on Dawkins' reference to Plato in his preface to her book, that memes might stand-in for Platonic forms. She objected, but her reasons were quite unpersuasive. Perhaps my comments caused her to bring the subject to Dawkins' attention or perhaps others noticed the same thing I had. For whatever reason, the reference to Plato disappears in the essay.

[17]Dawkins, *A Devil's Chaplain*, 126–7.

[18]Ibid., 120.

[19]Ibid., 125.

[20]The environment of a gene is made up not only of the larger world in which the organism lives but also of other genes. The same is true of the meme, its environment is comprised in part by other memes.

[21]Dawkins, *A Devil's Chaplain*, 145.

[22]Ibid., 137.

[23]Ibid., 141.

[24]Ibid., 246. It is important to distinguish here between evidence and proof. Science, as an empirical enterprise, is inductive, so evidence is central to its truth claims. But not all truth claims rely on evidence. The truth claims of mathematics or deductive logic, for example, are based on algorithmic proofs that are compelling irrespective of any evidence.

[25]Ibid., 15, 19.

[26]Ibid., 198, 200.

[27]Ibid., 191.

[28]Ibid., 19.

[29]Ibid., 46. This idea that the mind creates a virtual reality is one Dawkins has explored before, particularly in *Unweaving the Rainbow* (Houghton Mifflin Company, 1998), see Chap. 11 "Reweaving the World."

[30]Ibid., 185.

[31]Ibid., 225.

[32]Ibid., 246.

[33]Ibid., 145. Such requirements suggest that science is ill equipped to construct a theory of unique things like the universe, the life and behavior of particular individuals, or the specific course that history took, especially if we assume, as Gould did, that a replay of events would lead to very different results.

[34]Ibid., 184.

[35]Pascal Boyer, *Religion Explained* (New York: Basic Books, 2001), 65. I refer to Boyer's book because in a footnote on page 118 of *A Devil's Chaplain* Dawkins refers to it as a thoughtful book on such subjects.

[36]Ibid., 68.

[37]Ibid., 12.

[38]Ibid., 17.

[39]Ibid., 29.

[40]Dawkins, *A Devil's Chaplain*, 18.

[41]Michael J. Murray, "Natural Providence (Or Design Trouble)," *Faith and Philosophy* 20, no. 3 (2003): 307–27.

[42]Leif Edward Ottesen Kennair, "Challenging Design: How Best to Account for the World as It Really Is," *Zygon* 38, no. 3 (2003): 546.

[43]Ibid., 544, 555.

[44]Dawkins, *A Devil's Chaplain*, 22.

# Books Received and Available for Review

Contact the book review editor if you would like to review one of these books. Choose alternate selections. Richard Ruble, Book Review Editor, *Perspectives on Science and Christian Faith*, 212 Western Hills Drive, Siloam Springs, AR 72761. richardanne@cox-internet.com

David Adams & Ken Schurb, eds., *The Anonymous God: The Church Confronts Civil Religion and American Society*, Concordia Publishing House, 290 pages, 2004

Mary Jo Bane, et al., eds., *Taking Faith Seriously*, Harvard Univ. Press, 382 pages, 2005

Chris Bosso, *Environment, Inc.: From Grassroots to Beltway*, Univ. of Kansas Press, 224 pages, 2005

David Chidester, *Authentic Fakes: Religion and American Popular Culture*, Univ. Cal. Press, 300 pages, 2005

William Cleary, *Prayers to an Evolutionary God*, Skylight Paths, 182 pages, 2004

Richard Deyo & Donald Patrick, *Hope or Hype: The Obsession with Medical Advances and the High Cost of False Promises*, American Management Association, 335 pages, 2005

Phil Dowe, *Galileo, Darwin, and Hawking: The Interplay of Science, Reason, and Religion*, Eerdmans, 205 pages, 2005

Hope Egan, *Holy Cow: Does God Care What We Eat?* First Fruits of Zion, Inc., 160 pages, 2005

David Hart, *The Beauty of the Infinite: The Aesthetics of Christian Truth*, Eerdmans, 450 pages, 2004

William Hutton & Jonathan Eagle, *Earth's Catastrophic Past and Future: A Scientific Analysis of Information Channeled by Edgar Cayce*, Universal Publishers, 572 pages, 2004

John McGraw, *Brain and Belief: An Exploration of the Human Soul*, Aegis Press, 400 pages, 2004

Brenda McNeil & Rick Richardson, *The Heart of Racial Justice: How Soul Change Leads to Social Change*, IVP, 188 pages, 2004

Michael Mallary, *Our Improbably Universe: A Physicist Considers How We Got Here*, Thunder's Mouth Press, 227 pages, 2004

Gilbert Meilaender, Bioethics: *A Primer for Christians*, Eerdmans, 126 pages, 2005

Keith Miller, ed., *Perspectives on an Evolving Creation*, Eerdmans, 526 pages, 2005

Lawrence Olsen, *Two Revelations: A High View of Science and Scripture*, Xulon Press, 174 pages, 2005

Brad Stetson & J. G. Conti, *The Truth about Tolerance: Pluralism, Diversity and the Culture Wars*, IVP, 206 pages, 2005

Richard Thompson, *God and Science: Divine Causation and the Laws of Nature*, Govardhan Hill Publishing, 216 pages, 2004

Mark I. Wallace, *Finding God in the Singing River: Christianity, Spirit, Nature*, Fortress Press, 184 pages, 2005

# Life, the Ultimate Challenge

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As one approaches final retirement from the affairs of this world, regret for failing to have kept alive potentially fruitful ideas can gnaw at the sense of a life well lived. There is a challenge today with consequences that may well reach back to the very beginning of humanity's struggle toward civilization. There would be soul-searching regrets if this challenge is allowed to die. At issue are competing views of what it is that tells us a newborn will breathe, a grain of wheat will germinate, a towering redwood will stay green, an anthrax spore is infectious, a stem cell will show differentiation. Reaching back to Genesis, a fundamental entity becomes evident in the birth and death of all forms of life with human life being endowed with unique properties.

The challenge at hand is wide sweeping. At the highest level of intellectual pursuit, scholars can struggle with the principle that tells us that any phenomenon will remain indeterminate if its primordial nature is affected by the procedures that are required for its investigation. Erudite scholars debate how the prevailing view of the nature of the life entity influences the beliefs, values, and actions of a society. The lessons taught at all levels of the life sciences, knowingly or unknowingly, are likely to favor one rather than another view of what life really is. All in all, to comprehend the supreme of all of the mysteries of nature brings into play the ultimate of contemplative powers.

Meeting this challenge begins with realizing that both the well being and the miseries of humanity stem from the properties that must be inherent in the life entity. The living world presents a magnificent array of behaviors. How humans differ from other species in responding to the motivations that underlie these behaviors is of particular significance. No species can survive apart from taking advantage of the resources in the physical environment, but humans excel in developing these resources. At the same time, no other species demonstrates equally the unbridled urge of individuals to hoard such treasures. Other species produce and care for their young but only among humans do the side effects of sexuality become paramount. While other species provide spectacular examples where the survival of the group takes precedence over the well being of the individual, only among humans do ill-starred leaders require untold numbers of members of their own species to kill each other. Although they may be endowed with the wherewithal to gain dominion over all other species, not yet have humans lived up to the sense of responsibility that is inherent in such a challenge.

Until the true nature of life is revealed to everyone's satisfaction, the challenge at hand poses a soul-searching problem for those whose success of their calling hinges on influencing the beliefs of others. The safe approach is to examine the strengths and weaknesses that may result in accepting any view of what it means to be alive. But this is not easy to do. Competition between opposing views tends to divide humanity into factions with diverse values and ambitions. Rarely is the actual infrastructure of these differences shared openly with the lay public. More often, proponents have relied on playing up the positive and playing down the negative outcomes from accepting the particular view they embrace. Through the centuries, the results from this competition have been catastrophic. Millions of lives have been diminished even to the point of being sacrificed while the world's people have been kept unaware of the actual causes of their miseries. To the extent that this is a valid observation, further advance of humanity toward civilization depends upon bringing into the open the pros and cons of the prevailing views of what life really is.

The view of the nature of life with by far the longest history is referred to here as the *discrete entity view*. Although expressed in many different ways, fundamentally this view sees life as being comparable to energy: equally impossible to experience absent interaction with matter; equally inconceivable to destroy and improbable to create anew; and equally likely to be infinite in time and space. Henri Bergson (1859–1941), provides a relatively modern statement of this view.

> Life moves of itself, in obedience to its own inherent *elan vital* ... [This] vital force has no aim, no goal, no guiding light outside it or guiding principles within it, it is sheer force, whose only inherent property is to flow, to push indefinitely onwards in any and every direction ... something real in its own right.[1]

By way of personal correspondence and his book, *Energy in the Evolution of Life*, Reginald F. Fox assists in wording a second view that is identified here as the *physical-chemical view*. This view sees life as something that can be modeled and studied in terms of interlocking chemical reactions and allows the inference that life can be recreated if the essential reagents are brought together under the requisite conditions.

How people react to either of these views seems to hinge less on the integrity of the view and more on what

they are led to believe would be the consequences. The discrete entity view, particularly as it is delineated by Bergson, suffers from portraying life, particularly human life, as being apart from destiny. The physical-chemical view gains acceptance by those who stand to benefit from including life among the things that humans can oversee or manipulate. These two states of affairs have served to divert scholars away from rather than toward attempting to reveal the true nature of life. The citizenry has thereby been denied the opportunity to weigh the integrity and to contemplate the probable consequences of both the discrete entity and the physical-chemical view of the nature of life.

That life and physical-chemical reactions are inseparable cannot be denied. At the same time, each chemical reaction involves the assembly of specific kinds of molecules with their atoms in a degree of stable arrangement. Each molecule has its unique arrangement. Each has its unique properties. A reaction is the reshuffling of the atoms in these molecules in response to a disturbance in a way that minimizes the effects of the disturbance, invariably by absorbing or releasing energy. Chemical reactions gain notice when the properties of the products differ from those of the reactants. Photosynthesis provides a representative example. The reaction begins basically with a supply of water and carbon dioxide molecules with their atoms in stable arrangement. The absorption of light acts as a disturbance that results in the reshuffling of the atoms in the reactant molecules in ways that restore stability. The properties of the products differ from those of the reactants and, in this case, energy is absorbed.

The positive features of the physical-chemical view include providing insight into and possible management of how the life entity functions. However, there seems to be an unlimited number of different life forms each with its unique morphological, physiological, and, possibly, psychological sets of characteristics. The DNA complex in each life form is sufficient to initiate the physical-chemical reactions that are required to yield the products that exhibit the properties that distinguish each species. The staggering physical-capacities of the animal brain and the wide range of tropistic responses of plant tissues to changes in the physical environment are also to be taken into account. The human brain contains billions of nerves and trillions of synapses which store and process the information that is required to maintain an equally wide array of physical-chemical reactions. These neurons and synapses are constantly renewing themselves seemingly in response to the required stimulation or even internal reflection. But all of these positive features leave open, in fact suggest, the presence of a second entity beyond the ordinary realm of chemical and physical kinetics.

When the full dimensions of the life entity are projected against the limitations of a chemical reaction, the physical-chemical view of life becomes hopelessly inadequate. Furthermore, many of the efforts to describe facets of the life entity based on this view end up asking inert bits of matter to behave advantageously. Most puzzling of all is how each of the countless gametes of all species can be provided with the wherewithal that is required to maintain indefinitely a single physical-chemical reaction. It is an enormous stretch of imagination, for example, to think of each unit in the clouds of pollen or streams of sperm to be supplied with specific sets of the essential reactant molecules. When the shortcomings of the physical-chemical view are taken into account, the actual nature and dimensions of the life entity parallel those of energy.

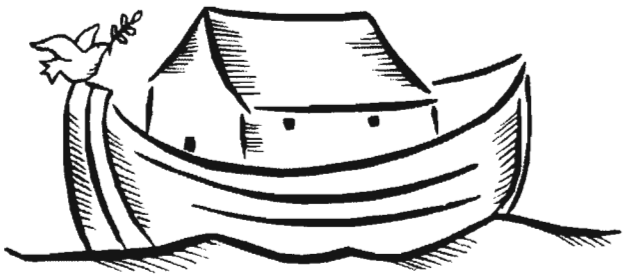
Life and energy may be comparable entities but they have not been treated as such through human history. The science and technology phases of humanity have been free to explore the properties of energy and to exploit the effects of its transformations on matter. In sharp contrast, humanity's notion of the properties of the life entity and their potential consequences are more likely to reflect tribal lore than the results of scientific inquiry. Although technological advances have been unlimited, it is little wonder that the daily news suggests that humanity's responses to personal and social problems remain pretty much equivalent to those of the earliest steps toward civilization. For example, citing Zbigniew Brzezinski during the previous century, 167,000,000 to 175,000,000 lives were deliberately extinguished by politically motivated carnage.[2]

The way things are going in the America of today lays a seriously threatening challenge at the door of those whose professional calling includes influencing the decisions of their fellow humans. This challenge must not be allowed to die. The public is giving way to changes in the prevailing view of what life is all about—changes that hinge on the prevailing view of what life is. Of equal concern is the apparent abandoning of faith in the efficiency of the logic and methods that characterize the pursuit of science. This state of affairs leaves the door open for interests who can afford the services of spin doctors whose training and sense of values enables them to control the decisions that people make. It is urgent that we bring into the open the strengths and weaknesses of the physical-chemical and the discrete entity views of nature's most awesome phenomenon and how the acceptance of either view influences how America's people live and what they live for.

## Notes

[1]R. G. Collingwood, *The Idea of Nature* (London: Oxford University Press, 1945),138.

[2]Zbigniew Brzezinski quoted in http://users.erols.comwhite28/warstat8.htm



# Results of a Survey of Archaeologists on the Biblical Flood

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For the last twenty-five years, I have been intrigued with archaeology and devoured any article on archaeology that appeared in the newspaper or magazines. In 1997, as I was reading the Jan/Feb issue of *Biblical Archaeological Review*, I decided I would like to celebrate my sixty-fifth birthday at a dig site in Israel. I wrote letters to a few archaeological excavations telling why I would be of value to their work team: twenty years of delicate camera repair work; fifty years in taking photographs, and previous work on a survey team at a construction site.

A few weeks later I received a letter from Dr. Yosef Garfinkel (Hebrew University) indicating they would be looking forward to having me come to Sha'ar ha-Golan,[1] in the upper Jordan Valley, and join them in their dig in the Yarmukian culture[2] that flourished between 6400–5800 BC. Having been raised in a conservative fundamental Christian church, I was surprised that we would be excavating in a time frame about 2,000 years before the generally accepted biblical creation date of 4004 BC! This concept was new to me but because this was the only acceptance letter, I joined them.

During my three-week stay in Israel, I kept wondering why the biblical flood of Genesis had not destroyed this very ancient town where I was digging. This made me curious, so whenever I met a new archaeologist, I would ask if they had found any evidence of the Genesis flood. Most replied "No," but a few did not want to talk about that subject. I felt I needed a broader survey than just a half dozen archaeologists. I figured I could do a good survey by e-mail. Thus from a directory of members of the prestigious American School of Oriental Research, I selected over one hundred names for the survey.

The e-mails that I received back contained twenty-six replies to the questions and six replies that only made comments about the questions. The survey asked four questions. The first question asked for their religious affiliation, and very few replied to it. The second question was "Have you found evidence that there was a worldwide flood at about 2350 BC as the Hebrew Bible suggests?" Twenty-six answered, "No"; none answered, "Yes." My third question was "Have you found any place in the archaeological time chart, back to about 10,000 BC where there could have been a worldwide flood as narrated in Genesis Chapters 6, 7 and 8?" Again, twenty-six answered "No"; none answered "Yes." My last question was "Could some of the stories in Genesis be flawed because of the 1,000 or more years that it took before they were written down?" To this question, sixteen answered, "Yes"; three said "No"; and one person replied, "Not sure."

Out of the twenty-six archaeologists that answered the survey, only about one-third answered the questions without any comments. Those who made comments expressed many thoughts on the biblical flood. I promised to keep all names anonymous, so their comments that follow are listed alphabetically as Dr. A, Dr. B, Dr. C, etc. Here is a sampling of those comments:

Dr. A: There is nothing in the archaeological record that supports a universal flood such as Genesis 6–8 depicts, not within the historical period or even in the prehistorical human period. By genre, the early chapters of Genesis are patently myth, not history, similar to the Mesopotamian myths of the Atrahasis and Gilgamesh.

Dr. B: There is some archaeological evidence for local floods in Mesopotamia, however, there does not seem to be any archaeological evidence for a *worldwide* flooding.

Dr. C: Most of the so-called histories in the Bible are stories. Stories have more value to mankind than histories, as they are an excellent vehicle to spread truth and other immeasurable values. That's why the Bible is an inspiring guide for so many people.

Dr. D: The biblical narrative about the flood shouldn't be read as historical accounts but as stories, similar to other Near Eastern stories, that attempt to explain and understand various aspects of existence—the damaging powers of water, the fragility of life, the widespread extent of evil and discord, the preferentiality of "the chosen few," etc. Furthermore, it is a good tale that would be entertaining to young and old alike.

Dr. E: The Bible is neither a scientific, historical, geological, etc. textbook—it used chance events, myths, legends, etc. to teach *religious* truths. It is currently being used for propaganda by unscrupulous, unlearned, often stupid people for their own agendas—missing the real value of the writing!

Following are some comments about the fourth question: "Could some of the stories in Genesis be flawed because of the 1,000 or more years that it took before they were written down?"

Dr. F: On your fourth question, all stories in all cultures and all times get somewhat "flawed" in telling/retelling particularly in an oral tradition phase. But that should not encourage you to think that they necessarily reflect the truth. Good luck with your progress.

Dr. G: The Mesopotamia parallels suggest that the biblical story did not evolve over 1,000 years but was borrowed a relatively late period [late pre-exile or early exile] from the Babylonians.

Dr. H: The stories are not flawed in their historical situations and intention.

Dr. I: I think transmission of the biblical text was accurate in essential points so that is not the solution to the problem ... a solution might lie along the lines of what "worldwide" meant to the then known world of the storyteller.

Dr. J: I don't accept the premises established by the question. I'm not convinced the Genesis material requires a 1,000 year oral tradition, but I also don't believe the Genesis account is "Flawed." The textual evidence of Genesis 6-9 can be legitimately read any of several ways. The original meaning could have been either (1) a universal flood, implied by "the face (or surface) of the earth" (Gen. 7:4), or (2) a local flood, implied by some of the Hebrew terms used, such as "earth" which can mean simply "Land, country" ... Likewise the scientific and geological evidence is not conclusive. I believe the flood was a real, historical account. We can only conclude that the flood waters covered the inhabited land (Gen. 6:7).

## Conclusion

Twenty-six responses are perhaps not enough to draw a completely valid conclusion, but I think it is significant that 100% of those answering the questions have never found any evidence of a literal worldwide Genesis flood in any historical time period up to 10,000 years ago. Also, 100% of those who only commented on the questions never indicated that they had found any evidence of a literal worldwide Genesis flood either.

So whatever we may decide about the nature of the biblical flood account, the *Harper's Bible Dictionary* is apparently correct when it says, "Despite numerous attempts to find archaeological evidence for a universal deluge, one has not been found ..."

### Notes

[1]www.hum.huji.ac.il/archaeology.golan
[2]Josef Garfinkel, *The Yarmukians* (Bible Land Museum, 1999).

# The World's Oil Supply Revisited

*Glenn Morton, ASA Member, Apartment A505, 50 Liangmaqiao Road, Chaoyang District, Beijing 100016 PRC. glennmorton@entouch.net*

In the years since I first published on this,[1] there have been an increasing number of people becoming aware of the potential difficulties the world will soon face with oil supply. In my previous article, it was noted that many experts were saying the world would soon face perpetually declining oil production rates. By the end of this century, there will be no commercial quantities of oil as we have today. The big argument has been over when the production rate will peak and begin to decline.

At the time I wrote the last piece on this topic (July 2000), oil production in many countries was thought to be stable. But December 1999 was the peak of Great Britain's oil production. Since then production in many of the world's major oil supplying countries has plummeted. Britain has become a net oil importer this year, and the government expects to see a 20% decline in the pound due to this event.[2] Oman was producing 960,000 barrels per day (bbl/d) in 2000 but they are hoping not to go below 650,000 bbl/d in 2004.[3] Indonesia's production has dropped 17% since then.[4] Since the world's production is the sum of the individual country's production, the decline in major suppliers is worrisome.

In 2000, we produced 71% of the world's oil from countries whose production is post-peak. By 2002, just two years later, that had increased to 75.3%. Exploration success continues to decline with the oil industry finding one barrel of oil for every nine it produces.[5] In 2012, the world will produce 50% of its oil from old worn out fields producing small quantities per field.

The immanent decline in oil production was highlighted during 2004 by special sections devoted to the issue at conventions of the Society of Petroleum Engineers, the Offshore Technology Conference, the Society of Exploration Geophysicists, and by a conference on reservoir management I attended. The industry knows that we no longer will be able to fuel the world.

The concerns are summed up in a simple mathematical relationship. Today, the world produces 80 million barrels per day (mmbbl/d). By 2020, the present fields will only

produce 40 mmbbl/d due to the normal decline in production rate. But demand will be 120 mmbbl/d.[6] In the next sixteen years, the oil industry must place on stream as much oil as we are producing today, 80 mmbbl/d of new production (Figure 1). No one I know in the industry believes this is possible. Total hydrocarbon supply shows the same issue.[7]

The deepwater has been the great hope for the oil industry. But the deepwater discovery rate peaked in 1996 and it is falling.[8] Reports say only 150 billion barrels of recoverable oil are in the deepwater.[9] Eighty billion has already been discovered with 20 billion put on production. The world burns 27 billion barrels of oil per year, the deepwater only represent 5.5 years of world oil supply.

During the twentieth century, oil fields lasted 10-60 years, while production gradually declined. The physics of fluid flow and the small holes through which oil entered a well bore on its way to market limited how fast oil could be extracted. But new techniques of completing oil wells has vastly increased the flow rate. A century ago, 400 bbl/day was considered a good oil well. Today we have wells initially producing 45,000 bbl/day. At those rates the field is drained quickly. This technology has put the energy suppliers on a tread-mill which gets faster with each passing year. Our ability to keep up is on the verge of collapsing.

In 2004, Saudi Aramco published for the first time a reservoir model of Ghawar.[10] Ghawar is the largest field in the world and produces 6% of the world's oil. Today, the oil column at Ghawar is less than 150 feet thick, compared to the original 1,300 foot thickness. Engineers who have worked Ghawar, say that reservoir models indicate an imminent collapse in production by 2008 to 2009.[11] The reservoir model shows that the engineers are correct. The oil in the model divided by the production rate indicates that there are only a few years left in the largest field in the world. Reports suggest Ghawar production is now declining at 8% per year.[12]

What is more disturbing is that Saudi Arabia is the leading purchaser of electric submersible pumps.[13] These pumps move fluid up the well faster. It is a sign that the natural flow of the rock is dropping and the amount of water production is increasing. When these conditions occur, to keep the amount of oil extracted constant, one simply moves more fluid up the borehole. Where this technology has been applied, it inevitably leads to future precipitous drops in oil production.[14]

Matthew Simmons, an energy investment banker and recognized authority on world production, has warned the world of the upcoming Saudi problem.[15] The Saudi's have responded by saying that they could increase their production by 50% and keep it there for fifty years. But to do that will require them to produce more oil than they have in reserves.[16] With the problems at Ghawar, this will be impossible.

What will happen? Energy demand will continue to increase.[17] In the short term, natural gas will be liquified and moved from country to country. There are huge

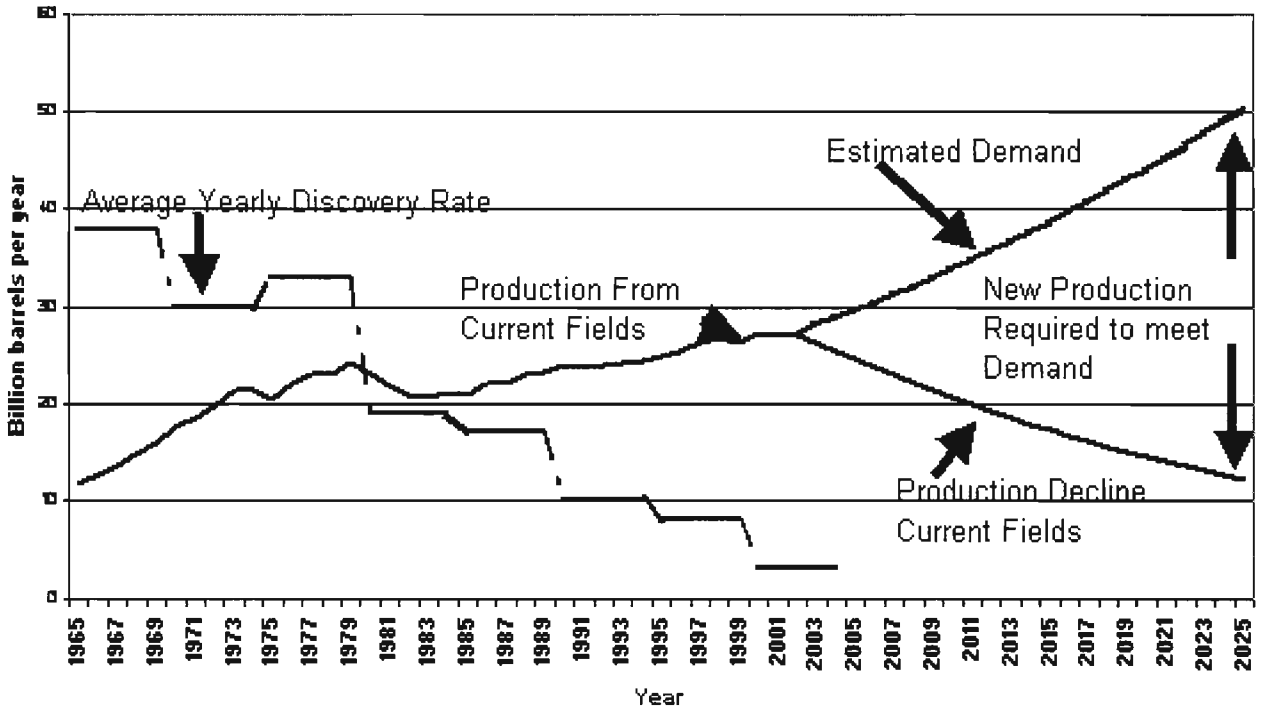



**Figure 1.** Discovery Rate, Production Rate, Future Demand. Data from various sources referenced in this paper.

stranded natural gas reserves in Siberia and the Middle East.[18] But moving them to market requires huge investments. Coal use will also increase.[19] The world is said to have a two hundred year supply of coal. That will not be the case. As oil declines, coal usage must increase five-fold. A two hundred year supply is suddenly a forty year supply.

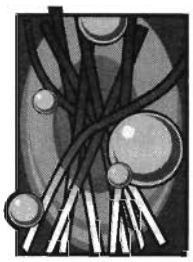
In the next few years, the world will face a severe oil shortage and substitutes are not identified. This is why the oil price has risen from $20/bbl to $45+/bbl in two years. We depend upon energy to provide us with potable water. We depend on it to make fertilizer, without which crop yields will fall. We depend upon it for transportation to move that food to us. A world with a perpetually falling oil production, which some say will begin in 2005,[20] will be a very different place technologically, calorically and politically. Countries like Russia, which have energy, will hold sway over those that soon will not—like Britain.

Literally this is a problem of feeding the hungry and bringing peace. What can we do? We need to commercialize hydrogen fusion. In 1% of the world's deuterium is 500 thousand times more energy than will be burned in all the fossil fuels combined.[21] But there is no sense of urgency among the governments of the world to solve this problem. There should be.

## Notes

[1]G. R. Morton, "The Coming Energy Crisis," *Perspectives on Science and Christian Faith* 52, no. 4 (2000): 228.
[2]"Energy Drag 'Could wipe 20% off Pound,'" *Evening Standard*, Feb. 23, 2004, 34.
[3]Nassir Shirkhani, *Upstream* (Dec. 19, 2003): 8 and *BP Statistical Review of World Energy* (June 2003).
[4]*BP Statistical Review of World Energy*.
[5]Chip Cummins, "Data Cast Doubt on Oil Discoveries," *Wall Street Journal*, January 23, 2004, p. A2.
[6]It is not just charts and rumors at an oil industry conference which support such a pessimistic view of oil's future. See Jacqueline Dougherty, "Half Empty?" *Barron's* (March 15, 2004): 19, which says that we will need to place on stream 39 million barrels per day of *new* capacity by 2010.
[7]Rex Tillerson, President ExxonMobil (Dec. 8, 2004). www.tipro.org/TIPRO-Web/ppt/TillersonPresentation.ppt Meeting the Challenge accessed 1-9-05; James R. Katzer, Strategic Planner at ExxonMobil Research gives similar numbers, 110 million barrels per day demand in 2020. www.cosmos-club.org/journals/2002/ katzer.html
[8]Ivan Sandrea, "Deepwater Oil Discovery Rate May Have Peaked; Production Peak May Follow in 10 Years," *Oil and Gas Journal* (July 26, 2004): 20.
[9]Darius Snieckus, "Deepwater Technology Struggles to Catch Up," *Offshore Engineer* (Dec. 2003): www.oilonline.com/news/features/oe/20031203.Deepwate.12992.asp
[10]Shiv N. Dasgupta, "Reservoir Monitoring with Permanent Borehole Seismic Sensors: Ghawar Field Arab-D Reservoir," *74th Annual SEG International Exposition Expanded Abstracts* II (2004): 2247–50.
[11]Personal Communication, March 2004. For fear of hurting these men's careers, names will be withheld.
[12]Matt Simmons,"Saudi Arabia in Crisis," Hudson Institute (July 9, 2004): www.globalpublicmedia.com/transcripts/222.
[13]Sandrea, "Deepwater Oil Discovery Rate May Have Peaked."
[14]Jeff Gerth, "Forecast of Rising Oil Demand Challenges Tired Saudi Fields," *New York Times*, February 24, 2004, final edition, sec. A, p. 1.
[15]www.simmonsco-intl.com/files/Kuwait%20Talk.pdf
[16]Shirkhani, *Upstream*.
[17]David J. O'Reilly, Chairman of ChevronTexaco, "The New Energy Equation," *World Energy* 7, no. 3 (2004): 28.
[18]www.lngexpress.com/lngrev/intro_sglocs.asp. 450 trillion cubic feet is equivalent to 81 billion barrels of oil on an energy equivalent basis. That is a three-year replacement of the energy from oil.
[19]Rebecca Smith, "After Long Taking its Lumps, Coal Is Suddenly Hot Again," *Wall Street Journal*, April 1, 2004, p. 1.
[20]Kenneth Deffeyes, personal communication, Oct. 29, 2004.
[21]David Price, "Energy and Human Evolution," *Population and Environment: A Journal of Interdisciplinary Studies* 6, no. 4 (March 1995): 301–19. www.oilcrash.com/articles/energy.htm

# Challenge of the Tangles: Re-evaluating Concepts of Life's Origins



*Wayne Frair, ASA Member, 1131 Fellowship Road, Basking Ridge, NJ 07920-3900. frair@sprynet.com*

The current Chairman of the ASA's Commission on Creation, Robert C. Newman, has unfolded some persistent problems for holding a macroevolutionary view for origins of life.[1] In opposition to this, ASA Advisory Council Member Francis S. Collins has expressed his support for evolution,[2] a concept commonly conceived as a "tree of life." Now the explosion of new knowledge about the complexity of life has led to new challenges:

> Yet ill winds are blowing. To everyone's surprise, discoveries made in the past few years have begun to cast serious doubt on some aspects of the tree, especially on the depiction of the relationships near the root.[3]

Lateral gene transfer has uprooted a single-trunked tree of life. The roots are tangled and so are the branches.[4]

Jennifer A. Marshall Graves has extended the analogy two steps further to include a tangle of the "twigs" of the tree of life and the obscuring nature of the leaves. The increasing understanding of so-called "junk" nucleic acids is adding to the complexity of present problems (see Figure 1). Graves bequeaths to future generations the problems of untangling evolutionary complexity. She further prophesies that evolution not only will be used to answer the "how does it work?" questions but also "those of ultimate concern to humans," namely the "why?" questions.[5]

Evolutionary difficulties are recognized in many fields. "The fossil record of avian evolution [is] ... a tangled wing."[6] See R. H. Thomas for arthropod controversies.[7] Genomic comparisons of apes and humans may not be

in the widely accepted similarity range of 95–99% but 10% lower.[8] How humans could have evolved upright walking "is still a great mystery ... there are still many more questions than answers"[9] "The new discoveries—'Toumai,' the 'Millennium Ancestor,' the 'Rootstock ground ape,' and the 'Kenya Flat-face'—render our own evolutionary progress through an ever-bushier thicket substantially more complex."[10]

While I was a graduate student in the Department of Zoology at the University of Massachusetts in the early 1950s, George Gaylord Simpson gave a fascinating presentation on the evolution of horses, showing a beautiful and convincing diagram of a linear series from *Eohippus* to the modern *Equus*. But today this captivating concept lies in the graveyard of "beautiful theories" destroyed by "ugly" facts!

In his last great book, Harvard's Stephen Jay Gould emphasized that horse evolution, at best, is not linear but "bush"-like. It represents another tangle of the branches. Gould pointed out:

> [Biologists are looking for] exemplars of triumphant evolution. We take this only extant and labyrinthine path through the phyletic bush, use the steamroller of our preconceptions to linearize such a tortuous route as the main pathway, and then depict this straggling last gasp as the progressive thrust of a pervasive trend.[11]

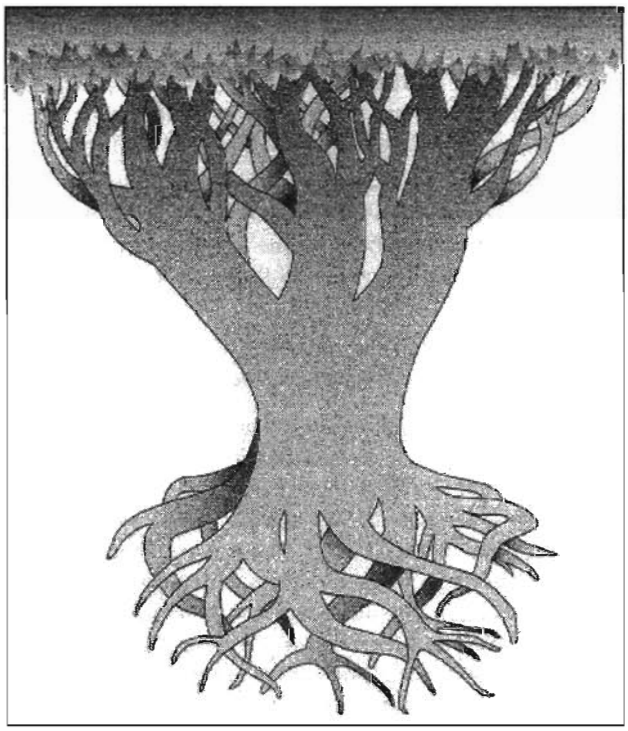


**Figure 1.** Diagrammatic representation of the tangled "tree of life" showing a tangle of the roots and branches and with leaves adding more obscurity to the tangle of the twigs. Reproduced from Maher[4] with permission from *The Scientist* and from the illustrator, Ned Shaw.

Today it appears that the fog associated with Darwinism is becoming increasingly denser than ever before, thus challenging biologists to reconsider what frequently has been called "the *fact* of evolution." *Theory* is a preferable term.[12] As early as 1960, G. A. Kerkut reported that "relationships and affinities are difficult to determine" for a large number of distinct animal groups. He recognized this condition to be consistent with a concept of separate origins (discontinuity).[13]

Regarding the confusion resulting from increasing uncertainties imposed by the evolutionary tangles, I am reminded of an incident related by the late anthropologist Loren Eiseley, with his characteristic wit and insight. He and his doctorate advisor, Frank Speck, were strolling in the Philadelphia Zoo. They discovered a beautifully patterned wood duck paddling in a pond.

"Do you believe unaided natural selection produced that pattern?" asked Speck.

Eiseley affirmed his belief in evolution bolstered by modern genetics but added regarding evolution that in situations like this "something seems to go out of focus, as though we are trying too hard, trying, it would seem, to believe the unbelievable."[14]

The popular "tree of life" has become an almost unanticipated and ambiguous tangle of roots, branches, and twigs. Are many scientists "trying too hard" to find large scale evolutionary "relationships and affinities?" Is it necessary, as Graves has suggested, to bequeath the problems of the tangles to future generations? Minimally it appears that all evolutionary biologists will need to become much more cautious and flexible about their current interpretations. Maybe the time is ripe for mainline scientists (including Christians) more seriously to appraise other models of origins involving discontinuity of groups, rather than evolutionary continuity.[15]

## Acknowledgments

For suggestions regarding this paper, I am grateful to Jerry Bergman, Linda Doll, Betty Frair, Jim Jekel, and William T. Snyder.

## Notes

[1]Robert C. Newman, "Some Problems for Theistic Evolution," *Perspectives on Science and Christian Faith* 55, no. 2 (2003): 117–28.
[2]Francis S. Collins, "Faith and the Human Genome," *Perspectives on Science and Christian Faith* 55, no. 3 (2003): 142–53.
[3]W. Ford Doolittle, "Uprooting the Tree of Life," *Scientific American* 282, no.2 (2000): 90.
[4]Brendan A. Maher, "Uprooting the Tree of Life," *The Scientist* 16, no.18 (2002): 26-27; and John Whitfield, "Born in a Watery Commune," *Nature* 427, no. 6976 (2004): 674–6 (reference to "scrambled phylogenies," p. 675).
[5]Jennifer A. Marshall Graves, "The Tree of Life: View from a Twig," *Science* (editorial) 300, no. 5626 (2003): 1621.
[6]Pat Shipman, *Taking Wing*: Archaeopteryx *and the Evolution of Bird Flight* (New York: Simon & Schuster, 1998), 273.

[7]Richard H. Thomas, "Wingless Insects and Plucked Chickens," *Science* 299, no. 5614 (2003): 1854–5.

[8]Tatsuya Anzai, et al., "Comparative Sequencing of Human and Chimpanzee MHC Class I Regions Unveils Insertions/Deletions as the Major Path to Genomic Divergence," *Proceedings of the National Academy of Sciences* 100, no. 13 (2003 June 24): 7708–13. In July 2003 (personal communication), researchers at the Institute of Physical and Chemical Research (Riken) in Tokyo, Japan, reported finding a 15% difference between human and chimpanzee genes.

[9]Jonathan Kingdon, *Lowly Origin: Where, When, and Why Our Ancestors First Stood Up* (Princeton, NJ: Princeton University Press, 2003), 2.

[10]Ibid., 346.

[11]Stephen Jay Gould, *The Structure of Evolutionary Theory* (Cambridge, MA: Harvard University Press, 2002), 908. Other papers presenting geological challenges regarding a "tree" of life are Michael J. Benton, "Finding the Tree of Life: Matching Phylogenetic Trees to the Fossil Record through the 20th Century," *Proceedings of the Royal Society of London*, B 268, no. 1481 (2001): 2123–30; and D.-G. Shu, et al., "Head and Backbone of the Early Cambrian Vertebrate *Haikouichthys*," *Nature* 421, no. 6922 (2003): 526–9. A book expressing a host of evolutionary enigmas is Roderic D. M. Page, ed., *Tangled Trees: Phylogeny, Cospeciation, and Coevolution* (Chicago, IL: University of Chicago Press, 2003). Dealing mainly with the "evolution" of hosts and their parasites, most of the authors intrepidly endeavor to deal with their "jungles," "interpretations," "mysteries," "difficulties," and "complexities."

[12]Peter J. Bowler, *Evolution: The History of an Idea*, 3rd ed. (Berkeley, CA: University of California Press, 2003), 380–1.

[13]G. A. Kerkut, *Implications of Evolution* (New York: Pergamon Press (now with Elsevier Science Publishing, 1960), 17.

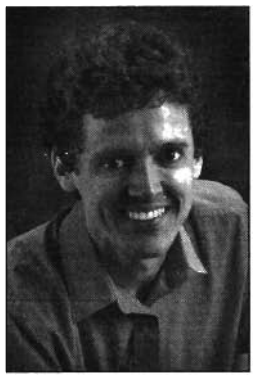
[14]Loren Eiseley, *All the Strange Hours: The Excavation of a Life* (New York: Charles Scribner's Sons, 1975), 93–4.

[15]Richard V. Sternberg, "On the Roles of Repetitive DNA Elements in the Context of a Unified Genomic Epigenetic System," *Annals of the New York Academy of Sciences* 981 (2002): 154–88. Sternberg believes that the rampant hypothesized evolutionary "parallelisms and reversals" can result from forcing "non-hierarchical data into a tree-like structure"; Frank L. Marsh, *Evolution Creation and Science* (Washington, DC: Review and Herald, 1944); ——, "The Genesis Kinds in Our Modern World," *Journal of the American Scientific Affiliation* 12, no. 2 (1960: 4–8, 11, 13); Wayne Frair, *Biology and Creation* (St. Joseph, MO: Creation Research Society Books, 2002); James P. Gills and Tom Woodward, *Darwinism under the Microscope* (Lake Mary, FL: Charisma House, 2002); David P. Cavanaugh and Richard V. Sternberg, "Analysis of Morphological Groupings Using ANOPA, A Pattern Recognition and Multivariate Statistical Method: A Case Study Involving Centrarchid Fishes," *Journal of Biological Systems* 12, no. 2 (2004): 1–31. This involves a procedure which can distinguish phylogenetic continuity or discontinuity as well as morphospace diversification trajectories.



# The Relevance of Augustine's View of Creation Re-evaluated

*Andrew J. Brown*



**Andrew J. Brown**

*Davis Young's 1988 article, "The Contemporary Relevance of Augustine's View of Creation," contributed to the debate over the interpretation of the days of creation in Genesis 1 by drawing on Augustine's most significant work on this biblical text,* The Literal Meaning of Genesis. *The task left undone at that time was to more fully explore the basic interpretive approach of Augustine as a way of providing a context for his specific outcomes. This article confirms that Augustine is a figure worth studying among church thinkers, surveys his position on the days of creation, then attempts to more carefully analyze the interpretive factors that drove Augustine to his conclusions. Six categories of factors are identified: exegetical constraints, theological factors, pastoral concern, apologetic motives, philosophical influences and operating presuppositions. Without grasping these various influences on his interpretation, Augustine's conclusions may be cited for and against modern interpretive positions with little real understanding of his reasoning or its validity. Augustine's thinking, once understood, is indeed relevant for contemporary study of creation in Genesis. It prompts us to consider the influence of world view presuppositions on our own interpretation, encourages us to notice and be deliberate about the role of our theological framework in our interpretation, heightens our awareness of the apologetic ramifications of our positions, assists our reconciliation of knowledge from biblical and natural sources, and reminds us of the ultimately pastoral purpose of biblical interpretation.*

*Augustine is perhaps the most important thinker amongst church fathers on creation in Genesis.*

The quest to understand the Bible, including Genesis, and reconcile that understanding with information from outside the Bible can be greatly assisted by reference to our Christian exegetical heritage. This article takes up the unfinished task of painting a fuller picture of Augustine's hermeneutic in order to thoroughly understand how he arrived at his unique and influential interpretation of the seven days of creation in Gen. 1:1–2:3.

Davis Young's 1988 article, "The Contemporary Relevance of Augustine's View of Creation," sought to contribute to the debate over the interpretation of the days of creation in Genesis 1 by drawing on Augustine's important work, *The Literal Meaning of Genesis (De Genesi ad litteram).*[1] Young endeavored to debunk the claim that the days of creation had only been interpreted literally throughout church history until the pressures of modern science had their interpretive impact. In the course of his analysis, Young made one telling comment: "There is no doubt that Augustine's view is strange and difficult to absorb."[2]

This difficulty, however, has not prevented other writers from making such sweeping claims as, "Irenaeus, Origen, Basil, Augustine and Thomas Aquinas, to name a few, argued that the days of creation were long periods of time."[3] Admittedly, more thorough attempts to understand the thinking of Augustine and other church fathers have appeared since Young's article.[4] The increased reference to our exegetical heri-

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tage is positive, yet the problem of misleading use of the church fathers for polemical purposes still exists.[5] If the authority of the Church fathers is to be enlisted,[6] their thinking needs to be more clearly and fully understood. Three specific things are needed.

1. We need a deeper appreciation of our spiritual and exegetical heritage in the church fathers as well as medieval and subsequent commentators. The modern sense (myth?) of absolute progress sometimes causes us to undervalue this heritage.

2. We must more closely scrutinize sources to properly understand them on their own terms. We are at risk of mining these thinkers' writings for short statements that support our opinion without being genuinely interested in their governing thought systems that give sense to those statements.

3. The insights achieved through such scrutiny demand wider exposure. Few people combine thorough knowledge of science and religion issues with broad exposure to the history of biblical exegesis.[7] Those engaged in science/religion discussions might gain fuller access to the riches of ancient biblical exegesis through interdisciplinary dialogue.

In pursuing a more sophisticated understanding of Augustine's interpretation of the days of creation, let us first establish why Augustine's work in particular warrants such attention.

St. Augustine (354–430 AD)

## The Peculiar Relevance of Augustine's Views

Augustine is perhaps the most important thinker amongst church fathers on creation in Genesis. No other patristic figure left such a store of writings on Genesis. His first work of biblical commentary, which followed shortly after his return to North Africa after his conversion, was *De Genesi contra Manichaeos (DGnM)*[8] in about 389.[9] He worked on the abortive *De Genesi Ad Litteram liber imperfectibus*[10] around 393–394, by which time he was a priest at Hippo. Chapters 11–13 of his *Confessions* (written 397–400) and chapter 11 of *De Civitate Dei*[11] (dating from about 417–418) also concern Genesis.[12] But between 401 and 415, Augustine completed one of his major exegetical works, *De Genesi ad litteram*,[13] our best source for his mature thinking about the early chapters of Genesis.[14]

Augustine commands widespread respect as one of the pre-eminent minds of the patristic church.[15] Jerome surpassed him for philological expertise, and perhaps Origen for intellectual ability, but Augustine was an able philosophical thinker and theological synthesist.[16]

Augustine's thought was highly influential on Christian theology throughout the medieval period and continued to prompt debate in the time of the Reformation.[17] Calvin's rebuttal of instantaneous creation in his discussion of Gen. 1:5 is witness to the durability of Augustine's ideas.[18]

Augustine's "literal" commentaries on Genesis feature what might appear to us to be a nonliteral interpretation of the days. This sets his approach in contrast to both the overtly allegorical version of the days in Origen and Clement of the Alexandrian school[19] and his own work in *DGnM* and *Confessions*, and to a more obviously literal line such as Basil's or, later, Calvin's.

Augustine's hermeneutic is self-conscious and candid. "Augustine is often remarkably explicit about the principles determining his exegesis."[20] This assists the modern reader to understand, critique and, where appropriate, utilize his approach. *De Doctrina Christiana*[21] is Augustine's most direct treatment on biblical hermeneutics, but he also comments on hermeneutical issues throughout his Genesis commentaries.

Augustine is indeed a pivotal thinker where the history of interpretation of the days of creation is concerned. Before analyzing the factors that influence his interpretation, we must revisit his approach to the days.



*The Relevance of Augustine's View of Creation Re-evaluated*

## Augustine's Understanding of the Days of Creation

Augustine's exegesis developed throughout his life, trending from a primarily allegorical approach toward one that he regarded as literal. Allegorical interpretation dominates the early presentation of the days of creation in *DGnM*. Augustine seeks to bypass Manichean objections to the literal sense of Genesis 1[22] by presenting the seven days with their creative details as an allegory of human history laid out in seven stages.[23] To expound the prophetic significance of the Genesis text in this way is only appropriate, since "words can in no sense express how God made and created heaven and earth and every creature ..."[24] *DGnM* I.25 goes on to utilize the seven days as an allegory of the Christian's spiritual journey, given as a call to moral excellence and progress in spiritual understanding.[25] The *Confessions*, Book XIII, written about ten years later than *DGnM*, contain a similar treatment of Gen. 1:1–2:3, yet with a new defensiveness; Augustine protests that it would be "unthinkable" for a particular statement of Genesis to "have no special meaning."[26] Allegory for Augustine unlocks a richness of meaning that God wants to communicate through the text, transcending literal reference.

*Augustine's exegesis developed throughout his life, trending from a primarily allegorical approach toward one that he regarded as literal.*

However, Augustine's earlier *De Genesi ad litteram liber imperfectibus* already reveals a growing desire to uncover the literal sense, although he later reflected, "my inexperience collapsed under the weight of so heavy a load,"[27] explaining why he abandoned the work at Gen. 1:26. One of the aspects of the literal sense of Genesis that created this heavy interpretive load was the difficulty of reading the days straightforwardly, for reasons explored below. Passing years brought greater confidence in interpreting Scripture, so that Augustine later returned to the task of a literal exposition of the early chapters of Genesis in *De Genesi ad litteram* and completed it to his satisfaction.

In the latter two works, Augustine flirts with a literal understanding of the days as we might consider it—creation in six of the days we are used to.[28] He considers the possibility of the production of the first three days of creation in the sun's absence by means of an intermittent or orbiting light source.[29] The difficulties that remove this straightforwardly literal option are the same in both works.

First, he finds it *rationally implausible*: "As for material light, it is not clear by what circular motion or going forth and returning it could have produced the succession of day and night before the making of the heaven called firmament, in which the heavenly bodies were made."[30] "I find no way that [days and nights] could be before the lights of the heaven were made."[31]

Second, he meets *exegetical* difficulties. In Augustine's Old Latin version, Sirach 18:1 reads: "He who remains for eternity created all things at once."[32] And Ps. 32:9[33] and Gen. 2:4ff together raise the problem that God's creative command could not be said to be fulfilled suddenly if the vegetation had arisen according to normal processes, for which even the third day would not have been sufficient.[34] As Lavallee points out, Augustine's exegetical challenges here are amplified by the Old Latin translation of Gen. 2:4, which states: "When day was made, God made heaven and earth and every green thing of the field before it appeared above the earth ..."[35]

Third, he has *theological* difficulty with the suggestion that God in his perfection and power might require time to create anything.[36] Regarding the creation of light, he protests: "It would be strange if this could have taken as much time to be done by God as it takes us to say it."[37] Most importantly, God's rest on Day Seven must not be taken too literally. Augustine writes:

> Whatever evening and morning were in those days of creation, it is quite impossible to suppose that on the morning following the evening of the sixth day God's rest began. We cannot be so foolish or rash as to imagine that any such temporal good would accrue to the Eternal and Unchangeable.[38]

The seventh day has no evening, because God's rest (or the rest he gives to creatures) is unending.[39]

Seeking an alternative but still literal understanding of the days of creation, Augustine in *DGnM* and initially in *De Genesi ad litteram* interprets the evening-morning pattern to represent first matter awaiting form and then having received

form.[40] This might be termed a metaphysical explanation, and although Augustine abandons it,[41] it could be the ancestor to his final metaphysical solution, which runs as follows.

To arrive at an instantaneous creation,[42] which he sees as necessary for the three reasons listed above, he argues that in reality the days were divided differently than solar days and really constitute the one day recurring seven times.[43] The chronological aspect of the sequence fades away to leave a rational or ideal or what Augustine calls a "causal connection."[44]

> These seven days of our time, although like the seven days of creation in name and in numbering, follow one another in succession and mark off the division of time, but those first six days occurred in a form unfamiliar to us as intrinsic principles within things created. Hence evening and morning ... did not produce the changes that they do for us with the motion of the sun. This we are certainly forced to admit with regard to the first three days, which are recorded and numbered before the creation of the heavenly bodies.[45]

To be consistent we must apply this implication to all seven days.[46]

As a rational sequence, Augustine locates the seven days within angelic intellect(s). This seems inscrutable to the modern reader when angels are not even mentioned in Genesis 1–2. But in Augustine's Neo-Platonically influenced thinking, angels occupy the highest levels in the intellectual and metaphysical hierarchy and could not possibly be omitted from the Genesis account, "as if they were not among the works of God." By a process of elimination Augustine concludes that the angels "are that light which was called, 'Day.'"[47] The six days of creation embrace the angels' own formation, under the name "Light" or "Day," along with their comprehension of all of God's (instantaneous) works of creation. He explains:

> The minds of angels, united to the Word of God in pure charity, created before the other works of creation, first saw in the Word of God those works to be made before they were actually made; and thus those works were first made in the angels' knowledge when God decreed that they should come into being, before they were made in their own proper natures. The angels also knew those works in their own natures as things already made, with a knowledge admittedly of a lower order called evening.[48]

The angels' knowledge of created things "in the Word of God"[49] (= "morning") and "in themselves"[50] (= "evening") might roughly equate to our "rational" and "empirical" epistemological categories respectively. This fits the Platonic cast of Augustine's mind, for whom innate knowledge, especially as including divine revelation, is superior to but does not exclude knowledge gained through the senses.[51] God's intended creation was innately comprehended by the angels, provoking their praise to him, (logically) before it was produced as material reality.[52]

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*The seven-day scheme provided in the Bible pertains not to creation's* performance *so much as to its* revelation *to humans.*

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So creation actually occurred instantaneously, more as a series of events in the rational world rather than the material world, although it produced material creation. The seven-day scheme provided in the Bible pertains not to creation's *performance* so much as to its *revelation* to humans. The scheme is heuristic, an example of accommodation in divine communication. "Why, then, was there any need for six distinct days to be set forth in the narrative ...? The reason is that those who cannot understand the meaning of the text, *He created all things together,*[53] cannot arrive at the meaning of Scripture unless the narrative proceeds slowly step by step."[54] The "framework of the six days of creation," seeming "to imply intervals of time," is an instance of the customary way in which Scripture speaks "with the limitations of human language in addressing men of limited understanding, while at the same time teaching a lesson to be understood by the reader who is able."[55] Our solar days "indeed recall the days of creation, but without in any way being really similar to them."[56] The sophistication and unfamiliarity of this treatment of the days of creation should prompt us to more thoroughly examine Augustine's interpretive principles.

## Interpretive Principles at Work in Augustine's Understanding

It is little use knowing what Augustine made of the days of creation if we do not grasp why he interpreted Genesis in this way.[57] Recent hermeneutical theory has made us more aware that there are other factors in a person's interpretation of a text besides grammatical content. I list the contributing factors in Augustine's exegesis of the creation days in order of their relationship to the biblical text, moving from immediate internal (exegetical) constraints to theological constraints, then constraints rising from Christian spirituality (pastoral and apologetic factors), and finally completely external (philosophical) constraints, along with methodological factors.

*The Relevance of Augustine's View of Creation Re-evaluated*

*The "Rule of Faith" operates in a kind of tension with the verbal meaning, not indicating the right interpretation of a text, but prohibiting wrong ones, thus defining "an array of allowable interpretations." ... A "Rule of Charity" ... asked of each proposed interpretation what its spiritual benefit would be for those who would be taught ...*

## Exegetical Constraints

The literal meaning of the Genesis text remains a significant factor in Augustine's interpretation. Kathryn Greene-McCreight is aware of the recent hermeneutical perspective that locates meaning largely in the reader/reading community,[58] but her in-depth study of Augustine's hermeneutic found that in his Genesis work "the verbal sense ... wields its own impact on interpretation and ... places limits on the text's polysemy."[59] The text's meaning is not limitless or purely subjective; Augustine clearly deals with the lexical, grammatical, and syntactical features of the text. For instance, he finds confirmation of his instantaneous creation position in Gen. 2:4, whose syntax and punctuation he analyses closely, arriving at the arrangement, "When day was made, God made heaven and earth and every green thing of the field." He states: "Hence, I do not now appeal to another book of Holy Scripture to prove that God *created all things together*."[60]

Furthermore, the theological principle of inspiration causes Augustine to accept the whole of Scripture as the Word of God, meaning that it should speak with one voice.[61] Therefore texts from elsewhere in Scripture (i.e. New Testament and Apocrypha) help to establish the meaning of a given text. Greene-McCreight cites Augustine's interpretation of the days of creation as a specific instance of this practice, the influence of Sir. 18:1 being evident despite his claim that he does not need to appeal to it.[62] Augustine must attempt to reconcile all biblical statements regarding creation, including Sir. 18:1, Ps. 32:9 and even John 5:17.[63]

## Theological Factors

The prime controlling interpretive factor here is the "Rule of Faith." Karla Pollmann explains that clear biblical statements provide the "extrapolated core of the biblical message," which "forms the normative horizon to which all attempts to interpret the Bible must refer."[64] The Church's teaching is assumed to coincide with that of Scripture as a whole, and in turn a traditional systematic theology sets the parameters for the message a given text may be understood to contain.[65]

Augustine explicitly employs this principle by laying out the Apostles' Creed as his interpretive boundary as he begins his exegesis in *De Genesi Ad Litteram liber imperfectibus*.[66] Notice also the theological pressure in Augustine's difficulty with the concept that God could require rest on the seventh day.[67] The "Rule of Faith" operates in a kind of tension with the verbal meaning, not indicating the right interpretation of a text, but prohibiting wrong ones, thus defining "an array of allowable interpretations."[68] Belief in inspiration is an aspect of this "Ruled reading" and meant that in every biblical text Augustine sought the true voice of God.[69]

## Pastoral Concern

Augustine may have been a reluctant recruit to the priesthood in 391 AD,[70] but "care for souls" came to be a prime motivation for his exegetical work.[71] Alongside the "Rule of Faith" operated a "Rule of Charity" that asked of each proposed interpretation what its spiritual benefit would be for those who would be taught; would it lead to love for God and neighbor?[72] The goal of edification could be met even where different readers deduced a different meaning from the same text; any interpretation that yielded truth and profit and did not depart from the "Rule of Faith" was permissible.[73] Augustine writes:

> From the words of Moses ... there gush clear streams of truth from which each of us ... may derive a true explanation of the creation as best he is able, some choosing one and some another interpretation.[74]

In fact, God had designed Scripture to address its readers according to their differing abilities, according to the much discussed principle of "accommodation."[75] A person who cannot understand that the six days were repeated "without lapse of time," should leave that higher understanding to those equipped to grasp it, knowing that "Scripture does not abandon you in your infirmity, but with a mother's love accompanies you in your slower steps."[76] Such statements sound condescending, but they also preserve every believer's right and ability to derive some degree of truth from Scripture, no matter what the person's intellectual level. Scripture is meant for the believer's "progress."[77]

When facing the findings of natural philosophy, Augustine thinks first of the welfare of those within the Church who in

their weakness are easily swayed by outside criticism of Scripture. He attacks the critics for the damage they do to these souls, and then reproves the weak believers for paying too much attention to such opponents and so allow the benefits of Scripture to be denied to them as they cease to respect it.[78]

## Apologetic Motives

Augustine considers the reputation of Christianity in the eyes of its doubters and detractors. When he refers to aspects of astronomy or cosmology, he does not seem primarily interested in them for their own sake.[79] He states:

> What concern is it of mine whether heaven is like a sphere and the earth is enclosed by it and suspended in the middle of the universe, or whether heaven like a disk above the earth covers it over on one side? But the credibility of Scripture is at stake ...[80]

Both Young and Lavallee place too much weight on Augustine's regard for "science,"[81] Young because he seeks support for taking notice of science, Lavallee because he is nervous about this very thing.[82] Augustine's concern here is again for the spiritual welfare of hearers, in this case those outside the faith.[83] He writes:

> It is disgraceful and dangerous for an infidel to hear a Christian, presumably giving the meaning of Holy Scripture, talking nonsense on these topics, ... [exposing the writers of Scripture to derision] ... to the great loss of those for whose salvation we toil.[84]

It was important to him to demonstrate in every instance the consistency of Scripture with external facts established by "proofs that cannot be denied."[85] If the heavens were spherical, he would have to show that Ps. 104:2[86] did not contradict this.[87] If anything thought to be a teaching of Scripture is plainly disproved, "this teaching was never in Holy Scripture!"[88]

However, Augustine does interpret according to what is rationally plausible to him. As we saw above, he cannot conceive of literal days preceding the sun. This is more an issue of personal reasoning than of empirical data, and may recall an objection he had to the Christian Bible while a Manichean adherent. Even while he recognizes that legitimate and true conclusions can arise from observing the natural world, his own view of the world seems much more theologically and intuitively than empirically or experientially produced.[89]

## Philosophical Influences

The influence of Augustine's metaphysical inheritance is clear. In the time leading up to his conversion in Italy, Augustine came under the influence of Christian Neo-Platonists, and Chadwick sees Augustine's conversion as a marrying of Neo-Platonism and Christianity, the latter transforming elements of the former, such as its a-temporality, replacing the quest for God with his self-revelation, re-personalizing God, and incorporating salvation.[90] Augustine will speak of the world's order and beauty witnessing to its Creator, but quickly moves on to heavenly things.[91] The physical world is good, but in a rather derivative way.

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*Augustine's account of creation elevates the angelic/transcendent realm, impacting his exegesis of the six days of creation.*

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Augustine's account of creation elevates the angelic/transcendent realm, impacting his exegesis of the six days of creation.[92] Timeless ideals are prized, being for the Christian Platonist connected to the eternal "Word of God," and the universe consists of an ontological hierarchy. Thus an instantaneous creation pivoting on angelic reason and conceptualized in terms of the weekly cycle, along with Augustine's profound interest in the number six, begins to make sense.[93] Exegetical and theological factors may have forced Augustine to look for a more sophisticated interpretation of the days of creation, but his Neo-Platonist metaphysic provides the basis for his particular solution.

## Methodological Presuppositions

*Plurality of Meaning:* We saw previously that Augustine allows for plurality of meaning in the biblical text, even though Scripture as God's Word communicates coherently.[94] This plurality operates firstly on the level of the reader. In the *Confessions,* Augustine seems frustrated by the diversity of interpretations of Genesis 1, but responds: "How can it harm me that it should be possible to interpret these words in several ways, all of which may yet be true?" Moses' intended meaning is the quest of every reader of Genesis, Augustine says, but with so many interpretations and no way to verify "what Moses had in mind," the reader should accept whatever he believes to be the true meaning, whether or not it is the intended one.[95] In *De Genesi ad litteram,* Augustine outlines a three-stage hermeneutical process when reading "the inspired books":[96]

1. In the light of "Catholic belief," choose the meaning "which appears as certainly the meaning intended by the author." This remains the ideal for Augustine.[97]

2. "If this is not clear, then at least we should choose an interpretation in keeping with the context of Scripture and in harmony with our faith."

3. If the context is no help, "at least we should choose only that which our faith demands."



*The Relevance of Augustine's View of Creation Re-evaluated*

*In Augustine's metaphysic, the immaterial was not less real than the material but more real. But though he takes "day" as (in effect, but not by admission) a metaphor, this for Augustine remains literal exegesis. ... The narrated creation events really occurred, though figurative expressions occur in the telling, and some events took place on a transcendent plane.*

So a reading which abandons certainty about author intention or even textual meaning is permissible if it satisfies the "Rule of Faith."[98] Augustine even countenances plurality in author intention, stating that Moses was aware of the various meanings that could be drawn from the words he communicated, and immediately speculating[99] that if he was not, the Holy Spirit certainly was aware of all the true meanings that were embodied in the given words. Ultimately it is this inspired status that makes possible an abundance of meanings in the text, extending beyond the human author's conscious intention. Greene-McCreight explains: "Multiple interpretations are allowable if they are all supported in the context of the passage's plain sense as a whole, for the ultimate authorship of the text is Divine."[100]

*Literal v. Allegorical Meaning:* While Augustine defends the place of allegorical meaning,[101] he decides at the beginning of *De Genesi ad litteram* that he will attempt to explain Genesis 1–3 as "a faithful record of what happened," since this is the more challenging task for this text.[102] When he catches himself offering "an allegorical and prophetical interpretation," he returns to his purpose of discussing "Sacred Scripture according to the plain meaning of the historical facts, not according to future events which they foreshadow."[103] Later he opposes the belief that actual history begins with Gen. 4:1, confirming the historicity of events narrated in Genesis 1–3, which he labels historical narrative.[104]

How can we reconcile his location of the creation days within angelic intelligence with this claim? Augustine himself answers this potential objection by distinguishing literal light from material light, and defending the angelic comprehension of created things and their resulting praise of the Creator as "a truer evening and a truer morning."[105] In Augustine's metaphysic, the immaterial was not less real than the material but more real. But though he takes "day" as (in effect, but not by admission) a metaphor, this for Augustine remains literal exegesis. "He is reading the creation story as a creation story," rather than as the story of the Church or the individual believer's experience, explains Williams.[106] Lewis's claim that Augustine allegorizes the days of Genesis misses this point.[107] The narrated creation events really occurred, though figurative expressions occur in the telling, and some events took place on a transcendent plane.

However, literal meaning does overflow the bounds of verbal meaning in Augustine's usage.[108] Augustine betrays some doubts about the literality of his own treatment in moments of defensiveness.[109] While the product of the six creative days is the visible universe we know,[110] yet as a sequence in angelic awareness they move away from historical reality. For Augustine, the days exist as a moment on the boundary of the Ideal (God's intention to create and perfect knowledge of how he will) and the Corporeal, the material world we see.

*Tentativeness in Exegesis:* Augustine advocates humility and tentativeness about one's interpretations.[111] Following his defense of his treatment of the days as being genuinely literal, he continues:

> Whoever, then, does not accept the meaning that my limited powers have been able to discover or conjecture but seeks in the enumeration of the days of creation a different meaning, which might be understood not in a prophetical or figurative sense, but literally and more aptly ... let him search and find a solution with God's help.[112]

Augustine's cautious and questioning style of writing in his commentaries maintains the impression. In the *Confessions,* he castigates those who are dogmatic about understanding Moses' intended meaning:

> They have no knowledge of the thoughts in his mind, but they are in love with their own opinions ... Even if their explanation is the right one, the arbitrary assurance with which they insist upon it springs from presumption, not from knowledge.[113]

Any alternatives that do not violate the "Rule of Faith" are permissible: "If our conclusions seem impossible to anyone, let him seek another by which he can show the truth of Scripture."[114]

His tentative attitude allows him room for progress in interpretation. His commentaries reveal interpretive mobility as he considers an interpretive option for a time before eventually abandoning it, for exam-

ple, the possibility that "day" might refer "to the form of a thing created" while "night" would refer "to the privation ... of this form."[115] Thus Augustine remains conscious of the limited capacity of humans to receive God's truth and the resulting diversity of interpretive opinion, while retaining his faith in the interpretive quest for that truth.

Perhaps we can now better understand why Augustine interpreted Genesis 1 as he did, but how much weight should we give his interpretation, eccentric as it still seems compared to the approaches of some of his contemporaries[116] and from our modern standpoint?

## The Authority and Value of Augustine's Legacy

### His Authority

Young underlines the importance of "the views of Augustine, the church's greatest theologian between Paul and Aquinas," feeling his own position vindicated by Augustine's, while Lavallee warns that this "illustrious" figure presents a flawed example of exegesis.[117] The Protestant community has probably under-recognized the importance of pre-Reformation tradition and failed to access its riches, fearful of human authorities displacing "Christ alone." Yet figures such as Augustine are validated by the acknowledgment of the whole church spectrum and have stood the test of centuries of Christian scrutiny, a test that modern Christian teachers and commentators have yet to face. That all sides of the debate over the days of creation in Genesis appeal to Augustine and other church fathers constitutes a common acknowledgment of their authority. As a leader in historical Christian theology and exegesis, then, Augustine's ideas warrant the effort required to properly understand them.

### His Interpretation of the Days of Creation

Augustine's instantaneous creation may appeal to some as the right way to understand creation, although it is a minority position.[118] Even medieval interpreters who were influenced by Augustine's work showed a tendency to revert to a more concrete and literal understanding of the Genesis days.[119] Recourse to the Hebrew bypasses many of the textual issues Augustine struggled with (notably the Old Latin of Sir. 18:1 and Gen. 2:4–5) and in any case sidelines the Sirach reference,[120] reducing the exegetical pressure to interpret the days instantaneously, although reconciling Gen. 1:3–2:3 and 2:4–25 continues to offer challenges.[121] Pressure against a "plain sense" or "literal" understanding of the days of creation now comes primarily from a different, scientific quarter – geology, paleontology and astronomy – offering evidence of the earth's great age.[122] Augustine's interpretation is significant in that it sets an example of interpretive innovation that is both reverent toward Scripture and satisfies the requirements of Christian theology.

The centrality of angels or angelic knowledge and the metaphysic underlying it is quite foreign to the modern Western mind, so that close adherence to Augustine's proposal about the days of creation must now be very rare. Yet Augustine's mitigated Platonism finds some commonality with the metaphysical dualism in Christian thinking, which commonly distinguishes heavenly and earthly spheres. The "two-register cosmogony" explanation of Genesis 1–2 by Meredith Kline is a striking partial resurrection of an Augustinian viewpoint, particularly as it pertains to Gen. 1:1–2.[123] In any case, Augustine's Neo-Platonic solution helps us to be aware of our own inevitable but usually unconscious integration of biblical and prevailing cultural world-pictures.

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Augustine's definition of the genre of Genesis 1–3 as history did not deny that figurative or metaphorical elements, e.g., the expression "their eyes were opened," could be embedded within a historical text.[124] He certainly understands anthropomorphic statements as embedded metaphor in this sense[125] providing a precedent for a position like Collins's, who treats the seven days of creation themselves as one of the text's anthropomorphisms.[126] Augustine's statement, "God made everything together, although the subsequent framework of the six days of creation might seem to imply intervals of time," also seems to justify the claim by modern day Framework Hypothesis advocates of a "historic precedent" for their position in Augustine.[127] Perhaps it was Calvin, though, who applied more consistently than Augustine himself the implications of the assertion that Genesis 1–3 is history. Free of many of Augustine's exegetical constraints, Calvin arrived at an outcome much more amenable to literal interpreters of the Genesis days.[128]

### His Interpretive Approach

I agree with Young in advocating Augustine's caution and humility in exegesis. It is always possible that "a rival interpretation which might possibly be better" than our own exists out there.[129] Claiming or behaving otherwise



risks presumption and may betray a love for one's own opinion rather than for the truth, which one might not yet have fully discovered.[130] Yet Augustine's "generosity towards other interpretations" only applies to views that satisfy the "Rule of Faith."[131]

Defenders of some modern positions argue passionately about the creation days because they see opposing views as falling outside of Christian orthodoxy. Perhaps the fact that Augustine is particularly careful not to transgress the boundaries of Christian orthodoxy should alert us to the relative breadth of those boundaries where the days of creation are concerned.

We do well to admit that the "Rule of Faith" is a real and, within limits, legitimate constraint on our interpretation. Greene-McCreight effectively shows how verbal meaning and the framework of Christian doctrine interact to produce Augustine's interpretation of Genesis,[132] and adopts this duality herself. She writes: "Within our trajectory, it is the very substance of the gospel and the identity of the God who created and redeemed the world which directs and guides reading the Scriptures according to the plain sense."[133] Augustine displays no fear that "Ruled Reading" will distort the verbal sense of the text at hand, since for him the text expresses a part of the message of which established Christian teaching defines the whole.[134] Scripture is the vehicle for God's truth, "an instrument of God's self-revelation."[135] Greene-McCreight sees this as the primary consideration in Augustine's exegesis of Genesis.[136] Augustine's confidence in the "Rule of Faith" is cast in doubt by the subsequent course of church history, but that element of it that seeks God's message in every biblical text is vital to the coherence and viability of contemporary Christianity.

Is there then any other legitimate source of truth besides Scripture? We saw that for Augustine, data about the natural world may be well enough established that it may modify biblical interpretation. He states: "When they [opponents of the faith] are able, from reliable evidence, to prove some fact of physical science, we shall show that it is not contrary to our Scripture." However, any external claim that cannot be reconciled with Scriptural teaching or Catholic faith must be either proven false or at least assumed to be so.[137] The "Book of Scripture" and the "Book of Nature" have one author, and so cannot contradict one another.[138]

Augustine's example would leave room for the scientific enterprise and even permit scientific knowledge to alter interpretation of Scripture in certain circumstances. Young celebrates this while Lavallee finds it a dangerous loophole for illegitimate harmonization.[139] I think that, like Augustine, most of us—for reasons either of apologetic accountability or personal worldview integrity—must take some notice of the information derived from human experience and attempt to reconcile it with the biblical story.[140]

Augustine reminds us of the pastoral factor in interpretation. Scripture was given for human benefit, and so the interpreter of Scripture has to consider the impact of his or her efforts on their potential recipients. Whether carried out for one's own benefit or for the benefit of others, interpretation is as much a moral and spiritual enterprise as an intellectual one. The desired outcome of biblical interpretation is the same as the desired outcome of the angels' contemplation of the works of God in creation in Augustine's scheme of the creation days: that interpreters might "direct to the praise of their Creator the gift of their creation."[141]

## Conclusion

If we take the time to thoroughly investigate the hermeneutical perspective of rightly recognized ancient Christian thinkers like Augustine, or at least consult those who have, we may avoid superficial mining of their statements for polemical ammunition or other purposes, and begin to access the insights of time-tested approaches to Genesis and other texts. Their findings and their interpretive reasoning will not always win or even deserve our emulation, but they certainly warrant our consideration and can only deepen our own exegesis of biblical texts. Augustine's view of creation is relevant today, but it takes effort to access, otherwise we simply make him say what we wish to hear.

*Augustine reminds us of the pastoral factor in interpretation. ... [It] is as much a moral and spiritual enterprise as an intellectual one. The desired outcome of biblical interpretation is ... that interpreters might "direct to the praise of their Creator the gift of their creation."*

## Notes

[1]Davis A. Young, "The Contemporary Relevance of Augustine's View of Creation," *Perspectives on Science and Christian Faith* 40, no. 1 (1988): 42–5.

[2]Ibid.

[3]Dick Fischer, "The Days of Creation: Hours or Eons?" *Perspectives on Science and Christian Faith* 42 (1990): 15–6. He cites only an unpublished paper of Hugh Ross for support. Ross himself has done more research, e.g. Hugh Ross, *Creation and Time* (Colorado Springs: Navpress, 1994), 16–24. Yet he still claims that the Ante-Nicene fathers generally "accepted that yôm could mean "a long time period," in David Hagopian, ed., *The Genesis Debate: Three Views on the Days of Creation* (Mission Viejo, CA: Crux, 2001), 125.

[4]Louis Lavallee, "Augustine on the Creation Days," *Journal of the Evangelical Theological Society* 32 (1989): 457–64; Robert Letham, "'In the Space of Six Days': The Days of Creation from Origen to the Westminster Assembly," *Westminster Theological Journal* 61, no. 2 (1999): 149–74; Jack P. Lewis, "The Days of Creation: An Historical Survey of Interpretation," *Journal of the Evangelical Theological Society* 32 (1989): 433–55. Compare C. J. Collins, "How Old Is the Earth? Anthropomorphic Days in Genesis 1:1–2:3," *Presbyterion* 20 (1994): 124–5; and Douglas F. Kelly, *Creation and Change: Genesis 1.1–2.4 in the Light of Changing Scientific Paradigms* (Fearn, Ross-shire: Mentor, 1997), 126–9.

[5]Duncan and Hall quote Augustine's *De Genesi ad litteram* 4.33.52 (despite citing a different reference in their endnotes) as denying that creation took place slowly or that the ages were established "at the plodding pace at which they now pass." This intended refutation of the day-age view fails to acknowledge that in that context Augustine is denying that any time was involved, and that Augustine explicitly discounts a literal interpretation of the days nearby, stating that "those creatures that shoot forth roots and clothe the earth would need not one day but many to germinate ... and ... to come forth," in Hagopian, ed., *The Genesis Debate*, 175–6. Karla Pollmann regards it as characteristic of reception of Augustine historically that "rather than the whole theory of Augustine's hermeneutics, parts of it are quoted out of context" to justify readers' own positions. Karla Pollmann, "Hermeneutical Presuppositions," in *Augustine through the Ages: An Encyclopedia*, ed. Allan D. Fitzgerald, O.S.A. (Grand Rapids/Cambridge: Eerdmans, 1999), 429.

[6]Augustine's name alone appears on forty-two out of the 307 pages of *The Genesis Debate*, counting endnotes, and the exponents of each of the three positions represented ("the 24-hour view," "the day-age view," and "the framework view") are keen either to claim his authority or to deny it to their opponents. The major statements concerning Augustine occur on pp. 47–8, 69, 90, 110–1, 171, 175–6, 205, 219–20, 224, 266, and 291.

[7]Two individuals who have combined theological and science/religion specializations are Alister McGrath and Thomas Torrance, but well-qualified biblical exegetes or analysts of historical exegesis who are competent in science/religion are rarer.

[8]I am using the abbreviation used in Teske's introduction, Saint Augustine, *On Genesis: Two Books on Genesis against the Manichees and on the Literal Interpretation of Genesis: An Unfinished Book*, trans. S. J. Roland J. Teske, *The Fathers of the Church: A New Translation* 84 (Washington, DC: The Catholic University of America Press, 1991).

[9]Henry Chadwick, *Augustine*, ed. Keith Thomas, *Past Masters* (New York: Oxford University Press, 1986), 27; and C. Kannengiesser, "Augustine of Hippo," in *Historical Handbook of Major Biblical Interpreters*, ed. Donald K. McKim (Downers Grove, IN: InterVarsity, 1998), 22.

[10]Augustine, *On the Literal Meaning of Genesis: An Incomplete Book*.

[11]Augustine, *The City of God*.

[12]Roland J. Teske, "The Genesis Accounts of Creation," in *Augustine through the Ages*, 381.

[13]Augustine, *On the Literal Meaning of Genesis*.

[14]For summaries of these works, *Augustine through the Ages*.

[15]Henry Chadwick, "Augustine," in *A Dictionary of Biblical Interpretation*, ed. R. J. Coggins and J. L. Houlden (Philadelphia: Trinity International Press, 1990), 65.

[16]G. Bonner, "Augustine as Biblical Scholar," in *From the Beginnings to Jerome*, ed. P. R. Ackroyd and C. F. Evans, *Cambridge History of the Bible* (Cambridge: Cambridge University Press, 1970), 561.

[17]F. Robbins, *The Hexaemeral Literature: A Study of the Greek and Latin Commentaries in Genesis* (Chicago: University of Chicago Press, 1912; reprint, 1988), 64, 66, 78, and 81.

[18]J. Calvin, *Genesis, The Geneva Series of Commentaries* (London: Banner of Truth, 1965), 78.

[19]Letham, "In the Space of Six Days,"150–1; Lewis, "The Days of Creation," 437–40.

[20]David F. Wright, "Augustine: His Exegesis and Hermeneutics," in *Hebrew Bible/Old Testament: The History of Its Interpretation*, ed. Magna Saebo (Gottingen: Vandenhoeck & Ruprecht, 1996), 716.

[21]*On Christian Teaching*. See the summary of Pollmann, "Hermeneutical Presuppositions," 426–9.

[22]Augustine, *On Genesis ... An Unfinished Book*, I.14.20 (p. 68). Page numbers are added to citations from this combined edition to assist location.

[23]Ibid., I.23 (pp. 82–8).

[24]Ibid., I.23.41 (p. 88).

[25]The Hexaemera of Ambrose and Basil, while literal in approach rather than allegorical, also display this hortatory motivation. Saint Ambrose, Bishop of Milan, *Hexameron, Paradise, and Cain and Abel*, trans. John J. Savage, *Fathers of the Church* 42 (New York: Catholic University of America Press, 1961; reprint, Ann Arbor, MI: UMI, 1997); Basil, "Hexaemeron," in *Basil, A Select Library of the Nicene and Post-Nicene Fathers of the Christian Church* (Edinburgh: T. & T. Clark, 1989).

[26]Augustine, *Confessions*, trans. R. S. Pine-Coffin, *Penguin Classics* (Harmondsworth: Penguin, 1961), 13.24 (p. 335).

[27]Augustine, *On Genesis ... An Unfinished Book*, 42.

[28]His later treatment of the days of creation in *The City of God* (XI.7) is virtually a synopsis of the much longer *De Genesi ad litteram*: Augustine, *The City of God*, ed. Philip Schaff, vol. 2, *A Select Library of the Christian Church: Nicene and Post-Nicene Fathers, First Series* (Peabody, MA: Hendrickson, 1887).

[29]Augustine, *The Literal Meaning of Genesis*, trans. John Hammond Taylor, 2 vols. (New York: Newman Press, 1982), 1.16.31, 4.21.38.

[30]Ibid., 4.21.29. See also 1.12.24–5, 1.16.31, 2.14.28, the latter reading: "No one could conceive how the three days passed by before the beginning of the time that is reported as commencing on the fourth day."

[31]Augustine, *On Genesis ... An Unfinished Book*, 6.27 (p. 162).

[32]Augustine, *Literal Meaning*, 4.33.52; Augustine, *On Genesis ... An Unfinished Book*, 7.28 (p. 164). Augustine accepted the Septuagint behind the Old Latin as inspired, and therefore accepted the apocryphal books as Scripture. See Bonner, "Augustine as Biblical Scholar," 544–6; Wright, "Augustine: His Exegesis and Hermeneutics," 719.

[33]Ps. 33:9 (Latin; English). In the NRSV, this verse reads: "For he spoke, and it came to be; he commanded, and it stood firm." Version chosen not critical.

[34]Augustine, *Literal Meaning*, 4.33.52. The particular problem in Gen. 2:4–5 is that Augustine's Latin version suggests that vegetation was made by God before it appeared above the earth. When this is put alongside Gen 1:11–13, it seems impossible to Augustine to fit the creation of vegetation in seed form and its growth to maturity into the space of one creation day.

[35]Ibid., 5.4.8; and Lavallee, "Augustine on the Creation Days," 459.

[36]Augustine, *On Genesis ... An Unfinished Book*, 11.34 (p. 170). Cf. 7.28 (p. 164).

[37]Augustine, *Literal Meaning*, 1.10.19.

[38]Ibid., 4.18.34.

[39]Ibid., 4.18.31.

[40]Augustine, *On Genesis ... An Unfinished Book*, 12.37, 15.51ff (pp. 173, 81). Also 10.32 (p. 169): "We should understand that the corporeal work followed after the rational and incorporeal work." Cf. Augustine, *Literal Meaning*, 2.14.28, 4.1.1.

[41]Augustine, *Literal Meaning*, 4.26.43. See Taylor's comment in endnote #2, p. 247.

[42]Ibid., 4.33.52, 4.35.56. This is a slight shift from the apparent admission of a chronological element to the days in the *Confessions*, where Augustine sees the material forming of creation occurring in the six days, since only material creation can change and thus show the effects of time. Without change, time does not pass (Augustine, *Confessions*, 12.12, p. 289). Even in *De Genesi ad litteram* 4.31.48, Augustine appears momentarily to concede that the days represent a chronological sequence: "Day, therefore, and evening and morning did not all occur simultaneously at the time of creation, but separately and in the order set forth in Sacred Scripture." However, he shortly follows this by reiterating: "There are no periods of time between the steps in this process" (Augustine, *Literal Meaning*, 4.32.50). This is an example of his vacillating way of reaching conclusions – he briefly adopts certain positions only to abandon them later in the commentary.

[43]Augustine, *Literal Meaning*, 4.26.43, 4.33.52, 5.3.6, etc.

[44]Ibid., 4.33.51.

[45]Ibid., 4.18.33.

[46]Compare Augustine, *On Genesis ... An Unfinished Book*, I.12.43 (p. 175), where Augustine allows that days four to six might be our familiar solar days.

[47]Augustine, *The City of God*, XI.9.

[48]Augustine, *Literal Meaning*, 4.32.49.

[49]Ibid.

[50]Ibid., 4.23.40.

[51]Augustine treats this knowledge of things in themselves as legitimate, although as inferior as evening is to morning, so long as those who contemplate created things "rise up from a knowledge of a creature to the praise of the Creator" (Ibid., 4.28.45). This seems a worthy principle for Christian scientific study.

[52]Ibid., 4.26–34. Augustine also shared the contemporary belief that mathematics revealed the inherent order of creation in a very direct way, such that creation had to "occur in six days" because of the perfection of the number six. This claim does not seem to form an integral part of Augustine's scheme of the days as just described, although it is certainly consistent with his Neo-Platonic sympathies (Augustine, *The City of God*, XI.30; Augustine, *Literal Meaning*, 4.2–7).

[53]Here Augustine quotes Ecclesiasticus (Sirach) 18:1. Taylor points out that in the Old Latin, *qui vivit in aeternum creavit omnia simul*, "*simul* ... seems to be a mistranslation of the Greek κοινη|/," meaning "commonly" or "without exception" (Augustine, *Literal Meaning*, 254).

[54]Ibid., 4.33.52.

[55]Ibid., 5.6.19, Augustine, *On Genesis ... An Unfinished Book*, 1.14.20 (p. 69), 3.8 (p. 149), 7.28 (p. 64).

[56]Augustine, *Literal Meaning*, 4.27.44.

[57]Davis Young acknowledges this point by reserving a separate section for Augustine's interpretive principles (Young, "The Contemporary Relevance of Augustine's View of Creation," 42–3).

[58]For instance, see Stanley Fish, *Is There a Text in This Class? The Authority of Interpretive Communities* (Cambridge: Harvard University Press, 1980).

[59]K. E. Greene-McCreight, *Ad Litteram: How Augustine, Calvin, and Barth Read the "Plain Sense" of Genesis 1–3*, vol. 5, *Issues in Systematic Theology* (Frankfurt am Main: Lang, 1999), 80. She uses the term "verbal meaning" or "verbal sense" for what we might call the literal meaning, made up of lexical meaning, grammar and syntax, p. 107.

[60]Augustine, *Literal Meaning*, 5.3.6, Lavallee, "Augustine on the Creation Days," 460. Lavallee here inadvertently misquotes Augustine as saying: "I *do* now appeal to another book of Holy Scripture to prove that God 'created all things together.'" So although Augustine depends on the Sirach quote earlier, he claims here that he does not need to, which partly negates Lavallee's criticism of Augustine for his dependence upon an Apocryphal book as Scripture.

[61]Chadwick, "Augustine," 68; Pollmann, "Hermeneutical Presuppositions," 426; and Wright, "Augustine: His Exegesis and Hermeneutics," 726.

[62]Greene-McCreight, 59. Lavallee shares the Protestant disdain for the Apocrypha and so criticizes Augustine for depending on it. I share this view of canon but recognize that Augustine's practice was in keeping with the Western Church generally on this point.

[63]Augustine, *Literal Meaning*, 4.33.51, 4.11.21. Lavallee shares the Protestant disdain for the Apocrypha and so criticizes Augustine for depending on it. I sympathize with this view of canon but recognize that Augustine's practice was in keeping with the Western Church generally on this point.

[64]Pollmann is discussing Augustine's hermeneutical treatise, *De Doctrina Christiana* (*On Christian Instruction*) (Pollmann, "Hermeneutical Presuppositions," 427).

[65]Greene-McCreight, *Ad Litteram: How Augustine, Calvin, and Barth Read the "Plain Sense" of Genesis 1–3*, 35–36, 50.

[66]Augustine, *On Genesis ... An Unfinished Book*, 1.2 (pp. 145–6).

[67]Augustine, *Literal Meaning*, 4.8.15, etc.

[68]Greene-McCreight, *Ad Litteram: How Augustine, Calvin, and Barth Read the "Plain Sense" of Genesis 1–3*, 36.

[69]Fitzgerald, 426. Belief in inspiration has ramifications for Augustine's hermeneutic, such as his willingness to countenance polyvalence in meaning. See below.

[70]Frederick Copleston, S.J., *Augustine to Scotus*, vol. II, *A History of Philosophy* (New Jersey: Paulist Press, 1950), 44.

[71]The last of four chapters in his hermeneutical work, *De Doctrina Christiana*, covered how the Bible was to be preached to believers.

[72]Bonner, "Augustine as Biblical Scholar," 557; Greene-McCreight, *Ad Litteram: How Augustine, Calvin, and Barth Read the "Plain Sense" of Genesis 1–3*, 36; Thomas Williams, "Biblical Interpretation," in *The Cambridge Companion to Augustine* (Cambridge: Cambridge University Press, 2001), 67–8.

[73]Augustine, *The City of God*, XI.32; Augustine, *Confessions*, XII.30 (p. 308).

[74]Augustine, *Confessions*, XII.27 (p. 304).

[75]The term itself is used by Augustine in Taylor's translation in *De Genesi ad litteram*, 1.14.28. See also Greene-McCreight, *Ad Litteram: How Augustine, Calvin, and Barth Read the "Plain Sense" of Genesis 1–3*, 60–1.

[76]Augustine, *Literal Meaning*, 5.3.6. The following context is also relevant. See also last paragraph under "Augustine's Understanding of the Days of Creation."

[77]Ibid.

[78]Ibid., 1.20.40.

[79]Robbins says: "Throughout his Hexaemeral works, Augustine expresses great impatience with physical science and a feeling that it is useless to discuss such questions" (Robbins, *The Hexaemeral Literature*," 69). See also Greene-McCreight, *Ad Litteram: How Augustine, Calvin, and Barth Read the "Plain Sense" of Genesis 1–3*, 76.

[80]Augustine, *Literal Meaning*, 2.9.20.

[81]Peter Harrison warns that this term is really anachronistic when applied to a time before the nineteenth century (Peter Harrison, "'Science and Religion': Constructing the Boundaries," *Journal of Religion*, forthcoming).

[82]Lavallee, "Augustine on the Creation Days," 461–4; Young, "The Contemporary Relevance of Augustine's View of Creation," 42–5.

[83]Wright, "Augustine: His Exegesis and Hermeneutics," 708.

[84]Augustine, *Literal Meaning*, 1.19.39.

[85]Williams, "Biblical Interpretation," 60.

[86]Ps. 103:2 (English; Latin).

[87]Augustine, *Literal Meaning*, 2.9.21.

[88]Ibid., 1.19.38.

[89]He does, however, accept the popular conception of the four elements seen to constitute the world in his day: earth, water, air and

fire (Ibid., 2.1–5). He avoids taking Ps. 135:6 (Latin; Ps. 136:6 English) literally when it speaks of the earth being founded on the waters, but affirms with Genesis against the common understanding that there could be waters above the air.

[90]Chadwick, *Augustine*, 25, 28–9.

[91]A. H. Armstrong, "Augustine and Christian Platonism," in *Augustine: A Collection of Critical Essays*, ed. R. A. Markus (Garden City, NY: Doubleday, 1972), 14.

[92]*City of God* witnesses the importance of "principalities and powers," including angels, in Augustine's thinking (Augustine, *The City of God*, XI.9,19).

[93]Augustine, *Literal Meaning*, pp. 248–9, notes 8 and 9.

[94]Gerald Bray, *Biblical Interpretation: Past and Present* (Downers Grove: InterVarsity, 1996), 126; Manlio Simonetti, *Biblical Interpretation in the Early Church: An Historical Introduction to Patristic Exegesis*, trans. J. A. Hughes (Edinburgh: T. & T. Clark, 1994), 108. Chadwick writes: "Like most ancient writers, Augustine assumes that even matter-of-fact narratives are polyvalent." That is, plurality of meaning is not just present in the literal/allegorical duality but even within the literal sense (Chadwick, "Augustine," 67).

[95]Augustine, *Confessions*, XII.18,24.

[96]Augustine, *Literal Meaning*, 1.21.41.

[97]Augustine, *Confessions*, XII.32.

[98]This is really a concession rather than a desirable outcome for Augustine, and probably has pastoral care motives in mind.

[99]In a rhetorical question expecting a positive answer.

[100]Greene-McCreight, *Ad Litteram: How Augustine, Calvin, and Barth Read the "Plain Sense" of Genesis 1–3*, 71.

[101]"No Christian will dare say that the narrative must not be taken in a figurative sense" (Augustine, *Literal Meaning*, 1.1.1).

[102]Ibid. Simonetti points out that for his less technical treatments, Augustine continued to permit himself a more allegorical approach. This might have facilitated more immediate pastoral application. *Confessions* XIII with its allegorical treatment of Genesis 1 might be such an example (Simonetti, *Biblical Interpretation in the Early Church*, 107).

[103]Augustine, *Literal Meaning*, 1.17.34.

[104]Ibid., 8.1.1–3.

[105]Ibid., 4.28.45.

[106]Williams, "Biblical Interpretation," 62.

[107]Lewis, "The Days of Creation," 443.

[108]Augustine, *Literal Meaning*, 4.28.45; and Greene-McCreight, *Ad Litteram: How Augustine, Calvin, and Barth Read the "Plain Sense" of Genesis 1–3*, 49. See also Collins, "How Old Is the Earth?" 125; Letham, "In the Space of Six Days," 156; and Young, "The Contemporary Relevance of Augustine's View of Creation," 42.

[109]Augustine, *Literal Meaning*, 4.28.45. Greene-McCreight, *Ad Litteram: How Augustine, Calvin, and Barth Read the "Plain Sense" of Genesis 1–3*, 45, refers to "slippage" of the term "literal" in Augustine's usage.

[110]So that they have not been removed to the realm of prophetic symbolism or moral instruction, as in *DGnM* I.23, 25.

[111]Young picks up on this, displaying a scientist's commitment to the principle of tentativeness in findings (Young, "The Contemporary Relevance of Augustine's View of Creation," 42, 45).

[112]Augustine, *Literal Meaning*, 4.28.45, also 1.20.40, etc.

[113]Augustine, *Confessions*, XII.25 (pp. 301–2).

[114]Augustine, *Literal Meaning*, 5.9.24.

[115]Ibid., 4.1.1. He takes up this possibility (also found in *DGnM*) as early as 1.17.35 and does not finally abandon it until 4.26.43. See Taylor's note #2 on p. 247.

[116]Such as the tradition of Basil.

[117]Lavallee, "Augustine on the Creation Days," 464; and Young, "The Contemporary Relevance of Augustine's View of Creation," 42.

[118]Patristic precedents do exist for a nonliteral treatment of the days in Origen, but Augustine again is seeking to be true to the literal sense and not fall back on allegory (Letham, "In the Space of Six Days," 150–1).

[119]Robbins, *The Hexaemeral Literature*," 77.

[120]Thus I agree with Lavallee that Augustine's exegesis was troubled by his dependence on Old Latin and his use of the Apocrypha (Lavallee, "Augustine on the Creation Days," 459–60).

[121]See Taylor's explanation, note #67 (Augustine, *Literal Meaning*, 252–4). Meredith G. Kline, "Because It Had Not Rained," *Westminster Theological Journal* 20 (1958): 146–57, is one attempt to offer a solution.

[122]I do not intend to discuss this evidence in the present article, nor to imply its unquestioned validity. But see below on consideration of outside data in the course of interpretation.

[123]Meredith Kline suggests that the "formless and void" earth of Gen. 1:2 is in 1:6–8 itself divided into heavens and earth, making the "heavens" of Gen. 1:1 a different metaphysical plane. This sounds very much like Augustine in *De Genesi ad litteram* 1.9.15 and esp. *Confessions* book XII (Meredith G. Kline, "Space and Time in the Genesis Cosmogony," *Perspectives on Science and Christian Faith* 48, no. 1 [1996]: 2–15).

[124]Augustine, *Literal Meaning*, 10; and Greene-McCreight, *Ad Litteram: How Augustine, Calvin, and Barth Read the "Plain Sense" of Genesis 1–3*, 47.

[125]E.g., God's forming Adam from the dust in Gen. 2:7 (Augustine, *Literal Meaning*, 6.12.20).

[126]Collins, "How Old Is the Earth?" 120.

[127]Hagopian, ed., 291. See also their argument on pp. 219–20.

[128]Calvin, *Genesis*, 78.

[129]Augustine, *Literal Meaning*, 1.20.40.

[130]Augustine, *Confessions*, XII.25 (pp. 301–2). Such principles sound like truisms but are not evident in all interpreters' attitudes to their work and to that of others.

[131]Ibid. The phrase, "generosity towards other interpretations," comes from Williams, "Biblical Interpretation," 63. Note the call for "equal respect for the opinions of others, provided that they were consistent with the truth," by which Augustine means the body of truth established in Christian tradition.

[132]Greene-McCreight, *Ad Litteram: How Augustine, Calvin, and Barth Read the "Plain Sense" of Genesis 1–3*, 54.

[133]Ibid., 250.

[134]Many modern commentators do not believe that it is possible to derive a unified message from the Christian Bible, which would make derivation of a "Rule of Faith" from the Bible difficult or impossible.

[135]Henry Chadwick, "Augustine," in *Dictionary of Biblical Interpretation*, ed. John H. Hayes (Nashville: Abingdon, 1999), 86.

[136]Greene-McCreight, *Ad Litteram: How Augustine, Calvin, and Barth Read the "Plain Sense" of Genesis 1–3*, 35.

[137]Augustine, *Literal Meaning*, 1.21.41.

[138]Though it is the former book that captures Augustine's interest.

[139]Lavallee, "Augustine on the Creation Days," 463–4; and Young, "The Contemporary Relevance of Augustine's View of Creation," 43. Young's case is somewhat hampered by the fact that the particular example he cites of Augustine's use of the knowledge of the natural world of his day, the four elements, is clearly obsolete to the modern reader, lending apparent credibility to Lavallee's assertion that we should "refrain from harmonizing Scripture with transitory scientific theories."

[140]Collins, "How Old Is the Earth?" p. 114, makes a good case that "Bible writers assume we bring our empirically-gained knowledge with us when we read their works."

[141]Augustine, *Literal Meaning*, 4.22.39.

# Book Reviews

## ANTHROPOLOGY & ARCHEOLOGY

**THE CAVE OF JOHN THE BAPTIST: The Stunning Archaeological Discovery That Has Redefined Christian History** by Shimon Gibson. New York: Doubleday, 2004. 304 pages, index. Hardcover; $24.95. ISBN: 0385503474.

Gibson is a field archaeologist who has worked extensively in Israel and the Middle East. He is currently in charge of the Mount Zion excavations in Jerusalem. His book is divided into two parts: the first describes the discovery of a cave Gibson links to John the Baptist; the second provides further research into who John was, his tomb, and various relics purported to be his. An appendix includes the relevant writing of Josephus about John. A selected bibliography and notes are also included. Numerous illustrations give the reader a feel for the reconstruction of the cave, while colorful photographic plates depict monasteries, churches, relics, and personnel involved in the dig.

This book presents in detail new data derived from the author's excavation of the site. He draws a reasonable conclusion that the site is associated with John's period "in the wilderness." Its greatest strength is its detailed explanation of the finds at the site and how they fit into the broader archaeological picture of that region in the Early Roman period. The details were, at times, so abundant that it rendered the work boring to read for a nonspecialist. The greatest weakness of this book is the author's penchant for making interpretive assertions not based upon the data, but upon his pre-conceived notions about source materials. The Gospels are frequently referred to as "gloss" and the author goes to great pains to discount the Christian interpretation of John the Baptist without using the data to show why he makes these assertions. Given the title's claim to "redefine Christian history," this tendency was perplexing. The author has not "redefined" history, but has presented interesting new contextual data on the practice of baptism by the Jews, John, and Jesus.

This book is recommended for people whose interest is especially in the field of archaeology and not recommended for those more interested in the implications of the find.

*Reviewed by David Condron, Marine Engineer, Friend Ships, Lake Charles, LA 70601.*

**THE IMAGE OF GOD AND THE BIOLOGY OF ADAM: A New Look at the Theology and Natural History of Our Beginnings** by Richard E. Ecker. 2004. 73 PDF pages. Ebook; $6.95. At www.booklocker.com/books/1777.html.

The author, a retired medical scientist, is a creationist and an evolutionist. In this short book, he defines his thoughts on human origins. The author says his aim is to expand the concepts of sin, salvation, and praise of God. He agrees with the position taken by many who hold that there can be no contradiction between Christian faith and the discoveries of science.

Ecker explores the concept that both science and the scriptures speak of a beginning. He says there was a creation *ex nihilo*, a postulate deeply embedded in the beliefs of the "creationists." He explores the possible significance of the "Big Bang," holding that it is only a theory. Ecker accepts the creation account as metaphor.

The author accepts hominid evolution although he considers that humans were "created to be different." Ecker equates the beginning of human life not with conception but with the implantation of the embryo. The author also postulates that the creation of humanity in the image of God may have begun with the implanting of a unique embryo into the womb of a single female. It is then, and not at conception, that the image of God was imparted. This may have happened about fifty thousand years ago.

A major premise of the author is that the emergence of humans is linked with the origin of the soul. Ecker says we inherit "a sinful nature" through the disobedience of the man and woman in the Garden of Eden.

I do not think the author wholly achieves his aim. I think other writers have better dealt with the topics Ecker discusses. Over the last two decades, molecular biology has contributed a vast amount of new information relevant to the study of DNA and the relatedness of all living things in nature. Ecker does not integrate these relevant findings of science with the emerging concepts of the scriptures. This may be partly due to the brevity of this book.

Science is moved along by scientists affirming or contradicting new ideas. Ecker has offered a few debatable points which may provide stimulation to scholars and help to move the discussion forward.

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## ENVIRONMENT

**THE COSMOS AS THE PRIMARY SACRAMENT: The Horizon for an Ecological Sacramental Theology** by Dorothy C. McDougall. New York: Peter Lang Publishing, 2003. 187 pages, index, bibliography. Hardcover; $61.95. ISBN: 0820467146.

McDougall (Ph.D. in systematic theology from St. Michael's College) is director of the Doctor of Ministry Program at Toronto School of Theology. She has taken up Thomas Berry's challenge from *The Dream of the Earth*, to integrate the "New Cosmology" into Christian theology. Berry asserted science gives a coherent world view to which we must fasten our hopes if we are to survive the current ecological crisis. This world view asserts "the universe is the only self-referent mode of being" and "the fundamental revelatory experience." Berry thought Christian theology must shift emphasis from redemption to creation in order

to address scientific reality. McDougall has done just this in the area of sacramental theology.

McDougall reviews two approaches to ecological theology: Stewardship and Ecological-Egalitarian. She finds the Stewardship model has the fatal flaw of anthropocentrism. This makes it unable to adequately address the "hierarchical, dualistic, patriarchal framework" which is central to the Stewardship model. "Contextualizing Genesis and recognizing its faulty anthropology ... opens the doors to its affirmation that the whole of creation is created by the word of God and is imbued with the divine character." She believes only an ecofeminist cosmology "confirms the dignity and equality of all life forms." The Cosmos has value "because it was intended by God to be what it is."

The author's idea of Cosmos as Primary Sacrament is original and she describes how it overcomes the "spatial distance of transcendence." She avoids pantheism because she maintains the personality of God while affirming a sacramental encounter with God in the Cosmos. She goes further and asserts that Jesus as a sacramental experience of God is "a product of the cosmic process," rather than independent of it. In her words, "The cosmos as primary sacrament addresses the limitations of a theological approach that universalizes the Christian story and absorbs all of history into itself." What does this mean for humans? "It calls for a redirection of human freedom toward justice and love."

McDougall proposes Berry's New Cosmology as the standard by which we must judge any theology, or any revelation for that matter. This is evident from her comments about the "faulty anthropology" of Genesis related above. For her, science has the last word on what is reality, and our view of Scripture, as well as our theology, must bend to this truth. Any theology which proceeds based on Scripture as the final authority is just plain faulty in her view. She makes the same mistake as Berry in devaluing Redemption as the primary story for humanity.

Both McDougall and Berry place humanity within a broader Creation which makes Redemption into a works-based theology of "justice and love." This fails to take the biblical account of sin seriously. Instead, it treats sin as a moral failure on the part of humans, overcome by believing in the New Cosmology. This New Cosmology has the scent of a useful myth for sociological manipulation, or "metanarrative." No convincing case is made as to why the new metanarrative is necessary other than to avoid impending ecological doom. In a way, it is reminiscent of Plato's view expressed in the *Republic* about the conditioning of the ruling Guardian class. People must be given a myth to believe about society that is useful for maintaining the stability of the society, regardless of whether the myth is true or not.

It was disappointing that McDougall did not engage Christian thinkers like Francis Schaeffer (*Pollution and the Death of Man*) or J. R. R. Tolkien (*The Lord of the Rings*) and the implications of their work for a Christian view of ecology. Schaeffer offered a reason for humans to value each created thing according to its proper order as God made them. Thus, he escaped McDougall's critique that the Stewardship model does not give value to creation beyond its usefulness to humankind. Tolkien's regard for creation as valuable in and of itself is apparent through the characters of Tom Bombadil and the Ents. The Stewardship model is not as flawed as McDougall claims.

In all, this book contains original ideas building upon the work of others in the field. It is too expensive to recommend that individuals purchase it, but it would be a worthwhile addition to a seminary's theological library.

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**GAIA'S GIFT: Earth, Ourselves, and God After Copernicus** by Anne Primavesi. New York: Routledge, 2003. 160 pages. Paperback; $27.95. ISBN: 0415288355.

Primavesi, a fellow of the Centre for the Interdisciplinary Study of Religion, Birkbeck College, University of London, has written her second book on the Gaia Hypothesis. She was formerly a research fellow in environmental theology at the University of Bristol. She is the author of three earlier books: *Our God Has No Favorites: Liberation Theology of the Eucharist* (1989); *From Apocalypse to Genesis: Ecology, Feminism and Christianity* (1991); and *Sacred Gaia* (2000).

Primavesi is a strong proponent of the Gaia Hypothesis. This hypothesis formulated in the mid-1960s by James Lovelock proposes that the planet Earth acts as a single organism which maintains conditions necessary for its survival. This hypothesis has not been substantiated but has provided interesting leads about the interaction of physical, chemical, geological, and biological processes on earth. Lovelock, collaborating with Lynn Margulis, suggested that the earth's biosphere, atmosphere, lithosphere, and hydrosphere are in some kind of balance, i.e., they maintain a homeostatic condition.

Primavesi in *Sacred Gaia* maintained that while science and theology are often seen as contraries, which negate and dilute one another, Gaia harmonizes both systems of thought. Also, in this book, she describes Gaia's analysis of humans' and earth's evolution, which helps us to recognize the sacredness of our origins and our responsibilities for the future.

In *Gaia's Gift*, Primavesi explores further human relationships with the earth and she asks the reader to complete the ideological revolution set in motion by Copernicus and Darwin concerning human importance. She brings together several aspects of modern knowledge and issues of concern, such as injustice between countries and persons and threats to the earth's environment. These are put in the context of the history of religion.

Primavesi is an excellent writer, her thoughts are well organized and presented clearly to the reader. *Gaia's Gift* contains an introduction and follows with nine chapters. Primavesi adds an extensive bibliography. There are thirteen footnotes in the book, and all thirteen are discussed thoroughly at the end of the book. I believe additional illustrations, beyond the three in the book, would have been useful in clarifying some of the points made in the book. I also think a final chapter summarizing her conclusions would have benefitted the reader.

It was a difficult book for me to review since I disagree with several of Primavesi's basic tenets concerning the

environment and theology. She is a follower of a determined movement to develop whole new theologies of nature and humanity to replace traditional religious beliefs, which she believes are responsible, in a significant way, for the environmental degradation of the earth.

One theme of this movement, which Primavesi espouses, is the claim that anthropo-centrism is the culprit in environmental degradation. They suggest that the "dominion" passages of Scripture (e.g., Gen. 1:26–28) have been used by traditional Christian movements to justify humans having unlimited power over nature and that nature is valuable only to satisfy material needs of humans. In contrast, the Judeo-Christian tradition, to which I subscribe, recognizes our responsibilities as stewards of God's creation, to use science and technology for the good of humanity and the whole world, as stated clearly in the Statement of Faith for our American Scientific Affiliation.

Another theme in *Gaia's Gift* deals with the separation of the created and the Creator. Primavesi sees the natural order on earth to be the actual embodiment of God and that nature represents all that is good on the earth. She maintains that everything that humans do tends to alter nature from the perfect to the less perfect. In contrast, I follow the Judeo-Christian tradition which views the creation as distinctly separate from the Creator, that the creation is worthy of our respect and as evidence of God's hand on the earth. The natural order on the earth reflects God's handiwork.

I would recommend this book for those wanting to know more about some of the new ideas and thought on theologies of nature and humanity, which contrast with the more traditional Judeo-Christian theology on the Creator and his creation.

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**FOR THE BEAUTY OF THE EARTH: A Christian Vision for Creation Care** by Steven Bouma-Prediger. Grand Rapids, MI: Baker Academic, 2003, 234 pages. Paperback; $21.99. ISBN: 080102298.

It would be hard for Bouma-Prediger to find a more engaging title than the first words of Folliot Pierpoint's well-known hymn "For the Beauty of the Earth" for his book on the critical importance of a Christian approach to the natural world. As a member of the religion department of Hope College, Bouma-Prediger reflects a concern that is rampant among both students and the larger public alike, namely, a disregard for the environment and a preoccupation with individual consumption. In a creative fashion, he calls attention to the world of nature that surrounds us as well as the dangers inherent in present practices that need the attention of all Christians. The book is a part of a growing body of literature dealing with what has come to be known as "ecological theology."

Taking a cue from Romans 8, Bouma-Prediger details the ecological dangers of the present under the rubric "the *groaning* of creation." In a survey that will be familiar to many in the biological sciences, he describes the problems of population growth, rampant hunger, biodiversity extinctions, deforestation, water shortage, topsoil loss, waste disposal, energy overuse, air pollution, and climate change. A more complete list of the current dangers to our planet would be hard to find.

He addresses the critical section of the book with a section on the question "Is Christianity to blame?" This is probably the core theological critique of the volume. The author notes how easy it has been for Christians to overemphasize the sixth day of creation and assume that all the rest of the earth (resources both natural and organic) were put here for the enjoyment and sake of humankind. The command to Adam to go out and have "dominion" has been taken by much of Christendom as a license to rape the earth with no thought of replenishment or preservation. Further, the theological separation of body from soul has given humans permission to ignore the natural environment and place undue emphasis on eternal reality. Again, Christian eschatology has denigrated the physical and implied that the future will not involve that which can be experienced through the five senses. Finally, through its part in the rise of modern science, Christendom has mistakenly seen nature as needing to be exploited and used rather than preserved and treasured.

In a very helpful section, Bouma-Prediger explores Scripture and finds a strong support for ecology in the Judeo-Christian tradition. He reconsiders the Genesis account of creation and finds strong support for the contention that God is Creator of "heaven and EARTH"—as the Apostles' Creed asserts. On the basis of several other passages, he builds a theology of creation asserting that: (1) humans exist in an environment (earth) that is created by God; (2) humans are the apex of creation and share in agency with God; (3) humans have been called into covenant by God to work for the good of all creation; and (4) God has a will for the present and future of the whole creation. He continues with a section on the Holy Spirit and the place of Christ in an ecological theology. He asserts that only through a crucified Christ do faithful persons find the power to confess their pride and sin and lay hold of the strength to become active in caring for the environment. Here morality is expanded to include ecology in addition to personal ethics.

In a practical section on ecological ethics, Bouma-Prediger offers suggestions on how action can be taken. He advocates involvement in the conservation movement, animal rights campaigns, biocentristic concern for all life, the wilderness movement, and the land-ethic association. A number of these are relatively new in comparison to the Sierra Club that has advocated concern for the environment for several decades. However, the challenge to get involved is at the center of the goal of this volume.

The book is not easy reading, even if one agrees with the major thesis. At times, the detail seems overdone. Yet, the content will be applauded by many *PSCF* readers who are involved full-time in the study and investigation of the natural world. One can easily imagine the content would be greatly enlivened by Bouma-Prediger himself in using this volume as a basis for classroom interaction and field trips. It is, without question, scientifically and theologically sound.

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# Book Reviews

## ETHICS

**HUMAN DIGNITY IN THE BIOTECH CENTURY** by Charles W. Colson and Nigel M. de S. Cameron, eds. Downers Grove, IL: InterVarsity Press, 2004. 252 pages. Paperback; $15.00. ISBN: 0830827838.

Charles Colson, of Watergate fame, subsequently has distinguished himself as the founder of the Prison Fellowship and, more lately, as the chairman of the Wilberforce Forum, a gathering of scholars and thinkers dedicated to reflection on the interface of culture and Christian faith. In this volume he has paired with Nigel Cameron, the founder of the journal *Ethics and Medicine* and president of the Institute on Biotechnology and the Human Future, among other appointments. The book is a compilation of essays by well-informed members of the Wilberforce Forum on the ethical and public policy issues surrounding developments in biotechnology.

The chief impression one gets after reading this volume is that the issues surrounding stem-cell research and cloning are not simple. The authors are in almost total agreement that life begins at conception and thus there is no "pre-embryonic" stage at which human life is not present. The authors further insist, therefore, that the embryo should be given the same rights of protection that are detailed for prisoners and other physically challenged or dependent individuals in the Nuremberg Code. They distinguish between "therapeutic" and "enhancement" goals in research and insist that public policy should always weigh the relative value of seeking cures as opposed to increasing assets among a favored few.

While the essays cover a wide range of issues in the development of biotechnology, two essays caught this reviewer's special interest: "The Biotech Revolution: Major Issues in the Biosciences" (David Prentice), and "Techno *Sapiens*" (Christopher Hook). Prentice's essay provided a description of "stem cells" that was very informative. Stem cells are *pluripotent* in that it is possible for them to form all the tissues of the adult human body. While they are among the first cells that form in the embryo, stem cells can also be obtained from fetuses, umbilical cord blood, placenta, and virtually all adult tissues as well as from certain adult tumors. At present, it is difficult to culture these cells in the laboratory apart from their source and only a small percentage of laboratory animals into which they have been inserted have survived. Matching the stem cells with the tissue of the recipient is also a problem and at present it is anticipated that many will have to take medication to resist rejection. Prentice suggests that, while continued research is valuable, sources other than embryos would be highly preferred since they do not involve the taking of life.

Hook's article is subtitled "Nanotechonology, Cybernetics, Transhumanism and the Remaking of Humankind." Cybernetics is the term given to efforts to add prostheses to the human body to replace lost functions or to augment biological activity. While the heart "pace maker" is a simple example, the research has advanced greatly to include computer chips to enhance interactions between neurons, electrode implants in retinas to enhance sight, memory chips to be implanted in the brain, augmented reality devices that allow for rear sight ability, and brain implants that reduce the incapacity to produce movement in patients in vegetative states.

"Nanotechnology" is the term applied to manipulating matter (and life) at nanometer scale (one-billionth of a meter). Present research has been applied to light-weight sensing devices for use by the military. Future possibilities include molecular engineering resulting in implanted devices which detect tumors, replace red blood cells, repair neurons in the brain, re-engineer tissue, replace DNA components, and produce *in-vivo* drugs.

"Transhumanism," the term applied to efforts to transcend present humanity and to create *post-humans* with greatly extended capacities, has, according to Hayles, four characteristics: information patterns are more essential than physical bodies to the nature of being; consciousness is epiphenomenon (there is no soul); the body is simply a prosthesis; enhancement of human function is a natural evolutionary extension.

Christian reflection on these biotech developments must take into account the degree to which such conclusions depends on natural law, legal positivism, utilitarianism, or hedonism. While these authors could be said to take a conservative position on the issues, they raise profound and literate concerns that should be considered. I predict that the book will become a seminal resource for scientists, individual Christians, church bodies, and politicians alike. Among graduate students in ethics, the sciences, philosophy, and theology, it would be a valuable resource for dialogue.

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## FAITH & SCIENCE

**SCIENCE AND RELIGION: Are They Compatible?** by Paul Kurtz, ed. Amherst, NY: Prometheus Books, 2003. 368 pages, no index. Hardcover; $20.00. ISBN: 1591020646.

This book is an encyclopedic survey of the science-religion field. Paul Kurtz is emeritus philosopher and author or editor of forty books. The articles are opinion pieces, some only four pages, many without references, originally published in *Skeptical Inquirer* and *Free Inquiry*. Essays range over a wide field subdivided into seven sections: Cosmology and God; Intelligent Design: Creationism vs. Science; Religion and Science in Conflict; Science and Ethics: Two Magisteria; The Scientific Investigation of Paranatural Claims; Scientific Explanations of Religious Belief; and Accommodating Science and Religion. Authors include such luminaries as Sir Arthur C. Clarke, Richard Feynman, Stephen Jay Gould, Steven Pinker, Richard Dawkins, Owen Gingerich, and Steven Weinberg.

Yet this is not a science textbook, but a history and philosophy of science interpreted via a narrow, reductionist, secular humanist conceptual framework inimical to religion, and ultimately undermining science itself. The book's major thesis contrasts science as open-ended rational inquiry based on empirically testable, repeatable, and veri-

fiable methods for discovering the true workings of the universe ("the scientific method") with religion characterized as subjective, unscientific, irrational, wishful thinking, unverifiable, dogmatic, harmful if not evil, and subversive of science. A few authors (Gingerich, Neil deGrasse Tyson, William Dembski, Taner Edis, Timothy Moy, Daniel Dennett, Gould, and Martin Gardner) resist the one-sided ideological bias of philosophical naturalism which pervades the book.

There are surprises along the way: Dennett presents science as an ideal shared by both believers and nonbelievers, noting that "we are the species that discovered doubt" (p. 155). Alas, most of the thirty-five authors, who stake their professional calling on skepticism and doubt, fail to apply these checks on human error to their own paradigm or world view. The major strength of the volume is the affirmation of science as rational inquiry. Its major blind spot is incomprehension of: (1) the extra- scientific and theistic, in particular Christian, presuppositions of a world intelligible for scientific inquiry; and (2) religion as a spiritual quest, which reflects the dual nature of *Homo sapiens* as a living soul.

Most authors conflate all the world's religions with such cults and sects as Jim Jones, New Age, etc. Paradoxically, some, like James Lovelock and Chet Raymo, argue for a new paganism of Earth worship (Gaia), and many seem to elevate naturalistic science to an idol. The more intellectually honest observers note in passing the affinity between ethics and religion. Moy sketches a complex setting for "The Galileo Affair," and concludes that the perceived conflict between science and religion is due to "a confusion of boundaries between these two ways of understanding the world" (p. 143). Gould proposes a nonoverlapping magisteria (NOMA) in which science investigates the material world of facts while religion addresses ethics and morals. This proposal remains unsatisfactory to both atheists and believers. For atheists like Kurtz, ethics should be de-coupled from religion altogether (p. 355). But the alternative merely begs the question, given the naturalistic fallacy: you cannot logically derive an "ought" from an "is." Science can be helpful in analyzing different sets of facts and outcomes, but it cannot determine which alternative outcome or set of facts is preferable, desirable, or why humans should choose one over the other.

Many authors, including Kurtz, dismiss religion as superstition and harmful to society. Yet science can also be misused, just like religion, for ulterior and immoral ends. Nazism and Communism were responsible for the murders of more millions in the twentieth century than all of the barbarisms and religious wars in the previous five millennia of recorded human history. Both Nazism and Communism were inimical to religion. Both extolled science, technology, and atheism as the official dogma rooted in social Darwinism and the Aryan "superman" in the former, and economic determinism and dialectical materialism in the latter.

In sum, the book, with exceptions noted above, falls short due to its reductionist conceptual framework which trivializes science and dismisses religious faith. Nonetheless, the book is recommended for scientists and educators who need to know what their students are up against, namely, scientism and secular philosophy misnamed "humanism," dressed up in democratic garb. C. S. Lewis' *Mere Christianity* offers a felicitous answer why humans need God: the human machine was designed to "run on God." This explains the persistence of religion across time and space, which baffles most contributors to this volume.

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**THE SACRED COSMOS: Christian Faith and the Challenge of Naturalism** by Terrence Nichols. Grand Rapids, MI: Brazos Press, Baker Book House Company, 2003. 240 pages. Paperback; $17.99. ISBN: 1587430460.

*The Sacred Cosmos* is an outstanding challenge to naturalistic thinking. Terrence Nichols, professor of theology at the University of St. Thomas, has established a high standard for future contributions to "The Christian Practice of Everyday Life" series. The series is intended for a broad audience of educated lay people with Nichols' work culminating in a very readable book for undergraduate classes in science and religion.

*The Sacred Cosmos* chronicles the relationship of science and Christianity from biblical times to the present, with most of the emphasis on current issues. Many nuggets pepper the book, such as a short section where Ockhamism is argued to lay the groundwork for naturalism, the emergence of modern science. "By driving a wedge between the being of God and the being of creatures, and exalting God's will over his being, Ockhamism led to the modern conception of God as external to creation and creatures" (p. 40). Consistent with a focus on current issues, chapters 6 and 7 examine human nature, and the location and function of mind, brain, and soul. Nichols weaves together Thomistic thought and theology of the spirit to offer an intriguing thesis of "the soul as a dynamic organizing principle" (p. 176).

*The Sacred Cosmos* succinctly describes key issues interfacing science and Christianity. As such the book is an excellent text for undergraduate courses, particularly since many of the rhetorical questions are ideal for classroom discussion. Nichols deftly portrays a world where the Creator acts in many and varied ways and with different levels of participation in the material and immaterial world. He shows how this variety is consistent with the nature of God known through special revelation.

ASA members will not be disappointed in purchasing a copy for themselves, or at a minimum, ordering and reading a library copy.

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

**GOD AND COSMOS: A Christian View of Time, Space and the Universe** by John Byl. Carlisle, PA: The Banner of Truth Trust, 2001. 243 pages, index, bibliography. Paperback; $12.99. ISBN: 0851518001.

Byl is professor of mathematics and head of the Department of Mathematical Sciences at Trinity Western University, Langley, British Columbia, Canada. He gained his Ph.D. in astronomy at the University of British Columbia

and is the author of numerous published papers. An important contribution relevant to the topic of this book was "Preliminary Considerations: On Scientific and Theological Method," *Promise* 5, no. 3 (1998): 1–11.

The book is divided into nine chapters of relatively short length. It is easily readable as mathematical and cosmological terminology are left out to facilitate assimilation by the reader. The author mixes in fifteen figures that are not overwhelming to the reader, and they enhance the understanding of the author's point of view. An extensive index and bibliography are included for easy reference.

The first chapter lays out very succinctly the author's purpose in writing the book along with the fundamental question to be asked. He wants to probe deeply beneath the origins of the universe and dig deeper into the various underlying philosophical and theological issues that affect a person's thinking on cosmological issues. His emphasis is on the theological presuppositions and implications while looking at the significance of the Bible for cosmology.

From the start, the author refutes the claim of science that theology is only concerned with the questions of *Who* and *Why* while science is supposedly concerned with the questions of *When* and *How*. He immediately refutes the claims of *concordism* and *complimentarianism*. Further, in discussing cosmology, he refutes any claim of objectivity (observation) within science and in particular cosmology. He categorically states that scientific theory is most always subjective. Further, his contention is that scientific theories are not so much a result of natural observation, but to the contrary, are most often the result of humans imposing scientific theories on nature as a result of their irrational intuition due to the fall of humankind into sin.

Byl is saying that science, and cosmology in particular, are incapable of having enough true observational objective data to actually come to any meaningful theories, and that it is virtually impossible to separate the true from the false. It is also Byl's conclusion that it is impossible for men and women of science to be disconnected from their philosophical and theologically biases in their selection and assessment of theories.

In scientific and cosmological theories, according to Byl, equal weight should be given to observation, logic, and Scripture, and not necessarily in that order. If any theory fails the test of these three, then it should be rejected out of hand. In fact, he indicates that any theory or claim that goes beyond observation and Scripture (possibly using logic to expand upon it) should be rejected as false.

After the first chapter, the balance of the book is devoted to answering a few key questions: (1) Is a belief in the all-authoritative and inerrant Scripture tenable in our scientific age? (2) Are the scientific theories of modern cosmology sufficiently established to warrant their elevation above Scripture?

The author does an excellent job of debunking the major cosmology theory of the day, i.e., the Big Bang Theory. He does this by pointing out its numerous theoretical and observational deficiencies. In the concluding chapter, he does an excellent job of enumerating his conclusions in the support of a Christian cosmology. He concludes that the limit of human knowledge, especially the ever changing scientific knowledge base, gives even more support to the supremacy of the Bible as a guide to cosmic epistemology and the only source of absolute truth.

*Reviewed by Stan Hatkoff, Adventist Medical Center, Portland, OR 97216.*

**DAWKINS' GOD: Genes, Memes, and the Meaning of Life** by Alister McGrath. Williston, VT: Blackwell Publishing, 2005. 202 pages. Paperback; $18.95. ISBN: 1405125381.

Richard Dawkins, the author of *The Selfish Gene* and *The Blind Watchmaker*, is one of the world's best known atheists. McGrath thinks Dawkins has a "wonderful way with words" (p. 1) and writes that *The Selfish Gene* is "a marvelous book ... stimulating, controversial, and informative" (pp. 1, 7).

Dawkins, considered the first and most systematic ethologist of the gene (p. 19), thinks Darwinian evolution encompasses a worldview by which the important questions of life are to be answered (pp. 42–3). God serves no "utility function" (p. 44). Religions are "mind parasites" (p. 120) and theism is a "virus of the mind" (p. 121).

McGrath argues that Dawkins goes beyond Darwin in espousing atheism. While it is clear Darwin abandoned orthodox Christianity, it is less clear that he became an atheist. He was most likely an agnostic (p. 80). Darwin's major problem with Christianity was related to pain and suffering, "one of the most significant obstacles to Christian belief," according to McGrath (p. 74). Darwin was deeply troubled by the death of his daughter at age ten and his own chronic pain, and he thought the idea of hell repugnant.

Alister McGrath, professor of historical theology at Oxford University, is a well-published author with a Ph.D. in molecular biophysics. In this book, McGrath argues that some of Dawkins' main assumptions are flawed. McGrath's assessment of Dawkins is straightforward: "To put it bluntly, Dawkins' engagement with theology is superficial and inaccurate, often amounting to little more than cheap point scoring" (p. 83). Dawkins' view that "the alleged convergence between religion and science is a shallow, empty, hollow, spin-doctored sham" is an archaic view (p. 138). To Dawkins, science and religion conflict. To McGrath, they are in harmony.

Dawkins, writes McGrath in a quite devastating analysis, is like a schoolboy in a debating society who relies "on rather heated, enthusiastic overstatements, spiced up with some striking oversimplifications and more than an occasional misrepresentation ... to make some superficially plausible points" (p. 9). McGrath thinks Dawkins knows nothing about Christian theology (p. 99). "Dawkins' views on the nature of faith are ... an embarrassment ... to scholarly accuracy" (p. 102).

McGrath is an engaging writer. He is knowledgeable but not pedantic; scholarly but not ostentatious; pious but not mystical; relevant but not simplistic. While conceding a lot to atheism, McGrath nevertheless writes in such a way as to reassure believers that their faith is well-founded. His candor is refreshing in an atmosphere of dogmatism and unwarranted certainty on both sides of the argument. McGrath thinks that the debate between theism and atheism is at a stalemate: "Nobody can prove God's

existence and nobody can disprove it" (p. 92). McGrath is not so much concerned in this volume with defending Christianity as to showing that Dawkins misrepresents it and is unjustified in his atheism.

This is not a big book. It has just 159 pages of actual text, excluding acknowledgments, notes, bibliography, and index. Michael Ruse said of this book "I cannot wait to see Dawkins' review of Alister McGrath's critique." Based on Dawkins' writings, it seems clear that his attitude to theism, despite McGrath's critique, is: "Possible but not likely."

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

## HISTORY OF SCIENCE

**SIGNOR MARCONI'S MAGIC BOX** by Gavin Weightman. Cambridge, MA: Da Capo Press, 2003. 312 pages, index. Paperback; $15.00. ISBN: 0306813785.

Signor Guglielmo Marconi's life is the story of the birth of modern communications. This superb book is the social micro-history of an era, a technology that defined it, and the man, who, more than any other early wireless researcher, engineered it. The author, Gavin Weightman, is a journalist, film maker, and a most excellent and entertaining writer.

ASA members who are theorists may find the book somewhat disconcerting. Marconi accomplished his inventions with almost no knowledge of, or even interest in, their theoretical underpinnings. He began with an 1896 show in a London theater of two wooden boxes transmitting messages to each other "through the ether." Seven years later, Theodore Roosevelt would send a message to the King of England across the Atlantic.

Marconi's competitor, Reginald Fessenden, first sent a wireless voice message in 1900 ("One, two, three, four, is it snowing there, Mr. Thiessen?"). The birth of radio, from Chelmsford, England, 7:10 PM, June 15, 1920, is described. From Oliver Lodge's first experiments, which he too quickly dismissed as being of no practical application, being interested instead in the scientific possibilities of spiritualism, to the sudden explosion of amateur radio, fueled by teen-aged "gurus" of the 1900s, the story is told chronologically by a born storyteller.

This book is a keeper. It has application to science-religion issues, primarily because it portrays a real person, a pragmatic scientist, careful not to claim too much, relentless in the pursuit of how (not why) things worked. It is also a social history, detailing how fortunes were made and lost, and how some early scientists abandoned their professionalism in the pursuit of fame and fortune, while others fell prey to the ever elusive quest to finding a "scientific" approach to the divine. Marconi was not one of these.

It is the twenty-first century. We take wireless communications for granted, complaining bitterly when our cell phone encounters a "dead spot" – perhaps in the Colorado mountains. We forget that it was not always this way. I remember, as a boy in 1937, "helping" my father string a long aerial outside our Ohio home. How pleased he was to finally hear KDKA Pittsburgh from 75 miles away! Marconi set a sea change in motion, and the world today is far different because of it. Read this book. It will give you a perspective on the sweeping changes of technology. You will be entertained as well as educated.

*Reviewed by John W. Burgeson, IBM Corporation (retired), Mancos, CO 81328.*

## NATURAL SCIENCES

**REFLECTIONS ON THE NATURE OF GOD** by Michael Reagan, ed. Radnor, PA: Templeton Foundation Press, 2004. 160 pages. Paperback; $19.95. ISBN: 1932031693.

This is a beautifully produced book which teaches more about God than about science. It does this through a collection of beautiful photographs of the universe, nature, animals, plants, and humans. Interspersed with the pictures are quotations which point to the awe and mystery of creation, existence and consciousness. Those quoted include scientists, poets, theologians, philosophers, and visionaries.

Michael Reagan writes that the purpose of this book is to consider God's nature through pictures and words, to reflect on the implication of being part of creation, and to remind us that the greatest insight of all is the sense of wonder. The introduction by theologian Martin E. Marty observes that viewers and readers of this book are likely to be awestruck. He is right.

This book makes a wonderful gift, a coffee table fixture, or a bedside companion. Christians will come to a new appreciation of Paul's words: "All things have been created through Christ and for him ... and in Christ all things hold together" (Col. 1:17).

Templeton Foundation Press (TFP) is to be commended for producing such a splendid book. Books like this help TFP to achieve its goal of teaching about the reality of love, creativity, worship, and purpose in people and the creation. This volume helps people perceive that "weeds are flowers too, once you get to know them" (A. A. Milne).

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

## ORIGINS & COSMOLOGY

**DISMANTLING EVOLUTION: Building the Case for Intelligent Design** by Ralph O. Muncaster. Eugene, OR: Harvest Press, 2003. 254 pages. Paperback; $11.99. ISBN: 0736904646.

Muncaster received his college education at the University of Colorado. His bachelor's degree is in engineering design and his master's degree is in business administration. He has authored a book entitled *A Skeptic's Search*

*for God*, as well as a series of booklets under the general title, *Examining the Evidence*.

In reading the book, I am impressed by the extensive literature research Muncaster has done. He approaches the subject like an engineer or scientist would to be informed on the current status of published works on the subject of neo-Darwinism. Since engineers are usually trained to design specific objects (automobiles, highways, bridges, computers), Muncaster filters the data regarding evolution by asking if biological organisms reveal the evidence of being designed. He refers to Michael Behe's irreducible complexity concept in analyzing the evidence for biological evolution. He devotes considerable space to the probability of complex life forms originating by chance mutations, starting from a pre-biotic soup.

I recommend this book enthusiastically as a handbook of flaws and shortcomings of neo-Darwinism and as a handbook listing evidences for the rationality of intelligent design in complex life forms. Both Behe and William Dembski, pioneers of the Intelligent Design movement, have recommended the book on the front cover.

It is important to note that Muncaster fully believed in neo-Darwinism for most of his adult life. He also confessed that he was an agnostic toward God's existence. His changed attitude resulted from an intense study of the writings of evolutionists. He found the scientific evidence for evolution to be very weak.

*Reviewed by O. C. Karkalits, McNeese State University, Lake Charles, LA 70609.*

**IN WHOM WE LIVE AND HAVE OUR BEING: Panentheistic Reflections on God's Presence in a Scientific World** by Philip Clayton and Arthur Peacocke, eds. Grand Rapids, MI: Eerdmans Publishing Co., 2004. 322 pages. Paperback; $35.00. ISBN: 0802809782.

This is one of the most stimulating books I have read. It kept my attention from start to finish and I highly recommend it to those among us who continue to struggle with how God is related to the physical world. I remember the early concern of John Wesley that Newton's *Pincipia* would diminish the authority of the Bible. He later changed his mind and actually penned a volume on "natural philosophy" suggesting that there was no conflict between God's "Book of Nature" and the "Book of Salvation." Alas, the question of how or whether God acts in nature was not to be as easily answered by Wesley's formula.

This volume is a brilliant expose of "panentheism." It addresses skepticism and the persistent tension between transcendence and pantheism among believers. It is composed of papers delivered at a symposium in England sponsored by the Templeton Foundation. The editors, Philip Clayton and Arthur Peacocke, teach at Claremont School of Theology and direct the Ian Ramsey Centre at Oxford, respectively.

*The Oxford Dictionary of the Christian Church* defines "Panentheism" as the belief that the Being of God includes and penetrates the whole universe, so that every part of it exists in him, but (as against Pantheism) that his being is not exhausted by the universe. While such a definition might imply a consensus approach among scholars, this collection of essays provides a rich variety of emphases on a common theme. Among the central issues addressed are:

- What shall be considered evidence of God's action on or in the physical world?
- Was the world created by God *ex nihilio*, i.e., out of nothing?
- Is God still active in the world or is he not, as the Deists claim?
- In what ways is God in the world but not of it?
- Does God transcend nature and if so how?
- If God created, and is creating, how is evil explained?
- Is God affected in any way by what happens in the world?
- How is a panentheistic God related to the God of the Bible—classical theism?
- Does God ever violate natural law and perform miracles?
- Is God all-powerful? Is cosmic evolution going any place?
- Is God influencing nature and humans in any way leading toward an eschaton?

Clayton, in the concluding essay, identifies thirteen ways answers to these questions are addressed by scholars writing in this volume. I found the trifold model of panentheism suggested by Niels Henrik Gregersen (University of Aarhus, Denmark) very provocative. His model included *soteriological* panentheism, *expressive* panentheism, and *dipolar* panentheism. Soteriological panentheism perceives the world's "being in God" not as essential but as a gift. It is not as if everything in creation embodies God, but only those aspects that are "Godlike." Thus, creation *becomes* Godly while it still remains a created reality. In the future, at some eschatological time, will God be truly "all in all" as 1 Cor. 15:28 proclaims?

Revelational or *expressive* panentheism owes its seminal ideas to nineteenth century idealism. Here God is understood to be the divine Spirit that expresses itself in the world by moving out of God and returning to God. In this movement, God is enriched by world history. Most akin to the philosophy of Hegel, this type of panentheism de-emphasizes any personal qualities of God and comes close to pantheism except in its emphasis on history rather than nature.

Gregersen sees the third type of panentheism, *dipolar*, as typified in Whiteheadian process theology. Asserting God's transcendence (timeless, beyond space) while contending that God is also timely, spatial, and actively involved in the world, process thought gives prime importance to the ongoing process of change that can be seen and experienced in series of *events*. God is both purposefully involved in the evolving processes of the world yet is affected by the frailty, the sin, the grandeur, and the progress of the world.

This book is almost a "must" read for those of us trying to relate Christian faith to science. Although the answers are not final, the approach certainly stimulates thought and, in fact, renews a conviction that God is the One "in whom we live and have our being."

*Reviewed by H. Newton Malony, Senior Professor Graduate School of Psychology, Fuller Theological Seminary, 180 North Oakland Avenue, Pasadena, CA 91101.*

**HONEST TO GENESIS: A Biblical and Scientific Challenge to Creationism** by Margaret Gray Towne. Frederick, MD: Publish America, 2003. 381 pages. Paperback; $19.95. ISBN: 159286497X.

This is an informative book by *ASA and CSCA Newsletter* co-editor Margaret Towne who holds degrees in theology and biology. In it is a wide-ranging study of the origin and ordered development of the cosmos. The book has a sound binding and the typeface is reader orientated. There are no footnotes. There is a foreword, table of contents, preface, and a carefully selected list of references. The appendices also list articles for further reading. There is no index.

Towne affirms the biblical doctrine of creation and links this with the observations of science. She postulates that the inter-relatedness of the biota is explained by an evolving process. She shows how the discoveries of molecular biology, the ineradicable fossil record, paleontology, and even the geographical distribution of distinctive flora and fauna support this view.

The author outlines how the accumulating evidence of change in the biota appeared initially to be contrary to the scriptural teachings of that time. These scientists held to their convictions but others in the early decades of the twentieth century accepted the separation of science from their fundamentalist Christianity, represented by "creationism," allowing each to go their separate ways. Many in this latter group considered that the role of the Creator was threatened.

Towne's expertise in these fields allows her to succinctly explain the meaning of the story of the early parts of Genesis for the thoughtful, seeking Christian and yet to effectively answer the counterclaims made by the "creationists." This primeval story she says concerns theological issues and was not meant to accommodate our current scientific concepts. Failure to appreciate how these ancient writings should be interpreted allows personal assumptions to be inserted in their meaning.

Then, in Chapter 6, the author—in a sensitive approach to the issue—explains these misunderstandings and emphasizes the need for Christians to face up to the meaning of the postulates of the inerrancy and infallibility of the Scriptures. God's written message is shrouded in the language and literature of an ancient alien culture and, in the author's view, the cosmos is made meaningful for us in this modern era through this channel and the Creator's handiwork that is seen in nature. Both sources must be observed, researched, and inquired into by the seeker.

The information extracted by hard work from geology, paleontology, molecular biology, genetics, biogeography, and other disciplines is expanding rapidly but the interpretation of the findings has resulted in divisive issues arising in Christian communities. This focuses, in the understanding of many, on one man—a naturalist, Charles Darwin—and his book, *The Origin of Species*. Evolution, in Towne's view, is the unifying concept in science and it and religion are not in conflict. Evolution neither confirms nor denies a Creator as the former is science and the belief in a Creator is through faith. Science does not speak about purpose, values, or meaning in the cosmos whereas this is the home ground of religion.

In Chapter 7, Towne shows that there is no necessity to fear the truth. She says that some Christians are defending their beliefs and in doing so do a disservice to the churches which they are a part. Fundamentalism, once rhetorically moderate with intellectual depth is now seen as a militant, anti-intellectual, ecclesiastically separate branch of the churches. Subsequent chapters discuss origins and confront the dogmas based on a young earth "creationism" with carefully argued responses. This discussion is excellent because it answers each postulate of the "creationists." Towne accepts the recent studies of the human genome confirming that humans are an evolved species.

Minor errors are minimal. Towne states: "Darwin saw that tortoises and finches varied in the Galapagos from island to island" (p. 191). Darwin believed the tortoises were foreign imports and the finches were assumed by him to be similar on all of the islands and are not mentioned in the *Origin*. The human embryo has pharyngeal arches, not gill slits (p. 194), an important distinction.

The message of this book is that trained, disciplined critical thinkers are urgently needed in Christian communities. *Honest to Genesis* makes excellent reading, leaving the impression that intellectual bondage is not the hallmark of authentic Christianity. I highly recommend this book to all readers of this review, especially students and leaders in churches. Also for libraries. It is a suitable book for discussion in study groups.

*Reviewed by KNP Mickleson, 21 Windmill Road, Mt. Eden, Aukland, New Zealand.*

**HONEST TO GENESIS: A Biblical and Scientific Challenge to Creationism** by Margaret Gray Towne. Frederick, MD: Publish America, 2003. 381 pages. Paperback; $19.95. ISBN: 159286497X.

In pursuing the worthy goal of convincing fellow believers that creationism and evolution are compatible and complementary and should be embraced by the thoughtful evangelical, Towne has proceeded from some debatable premises. She begins by espousing a discredited view of Old Testament (OT) Genesis (the JEDP Hypothesis); then enjoining a liberal view of Genesis 1–11 (calling it myth/legend and asserting its substantial dependence upon Mesopotamian epics); controverting the evangelical doctrine of biblical inerrancy; and concluding by introducing a culturally circumscribed Paul and a culturally limited Bible.

JEDP was demolished twenty years ago by Kikawada and Quinn in *Before Abraham Was*, wherein they demonstrate the literary unity of Genesis 1–11 (as a microcosm of Genesis *and* of the Pentateuch) by showing that the author knew and used the Ancient Near Eastern creation epic format found in the Atra-hasis Epic and other Middle Eastern creation epics. This usage of that format (most likely, in my view, by Moses c. 1400–1200 BC) and comparison is hardly doubted by any evangelical scholar of standing. Further, there are not *two* creation or flood accounts as Kikawada and Quinn have shown. Genesis and the Pentateuch were not artlessly compiled, in the view of most evangelical OT scholars, by naive scribes/redactors in Babylon in post-exilic times but skillfully composed by a

brilliant, Egyptian-educated Hebrew of Pharaoh's court, Moses. *The Treaty of the Great King* by Meredith Kline placed the Pentateuch back in the Late Bronze Age where evangelicals have always thought it belongs. *The Literary Structure of the Old Testament* by David Dorsey and countless additional books by many evangelical scholars demonstrate the literary finesse and cultural awareness of OT writers. To hold that the writers of the OT were naive and artless is not acceptable or demonstrable in evangelical circles today.

Kenneth Kitchen in his latest volume, *On the Reliability of the Old Testament* (2003), calls on the documentarists to acknowledge the eroded foundation of the documentary hypothesis (p. 499) and the reasonableness of the traditional view of a Late Bronze Age genesis of the Pentateuch. No trace of any J, E, D, or P document exists, says Kitchen, except in the minds of the minimalists. A tsunami of two hundred years of archeological knowledge of the Ancient Near East has been lavished upon late twentieth and early twenty-first century Bible scholars and has obliterated the foundations of OT documentarism. Kitchen further shows how, as the OT writings proceed through the apparent history of the OT, each entry betrays evidence of the era in which it was written, not evidence of late compilation/redaction.

As to myth/legend in Genesis 1-11, while the author of Genesis *was* intimately aware of the Mesopotamian myths of creation and flood (he was Oriental and thus conveyed concrete ideas by way of stories), he reflected the Babylonian stories polemically, *not* didactically; he argued *against* their content. He did not embrace them or inscripturate a Hebrew version of them for his people. As a monotheistic Yahwist, Moses opposed the polytheistic Mesopotamian creation epics' ideas.

Scientific creationists and their literalist brethren are not likely to consider theistic evolution a viable alternative when it comes with a denial of biblical inerrancy. A carefully nuanced understanding of the Bible is eminently compatible with a doctrine of Christian evolutionary creationism. The Bible *is* inerrant. Few evangelical scholars do not embrace inerrancy.

The last thing Christian evolutionary creationism should ask scientific creationists to embrace is a Jesus who did not know what he was doing or did not do what he should have done. Jesus Christ did not become a man to teach us or to clarify for us cosmology, botany, paleobiology, etc. We can do that ourselves with the minds he gave us. He came to die for sin. He did that quite efficaciously if we are to believe the brilliantly-educated Apostle Paul.

Further, the whole Bible is sufficient and necessary to inform Christian living and thinking without having to be demythologized. Jesus and Paul well knew what they were talking about. They did not intend to speak to OT misunderstandings, if any, but to speak to sin and redemption from it—and this they did very well. (A high view of Scripture does not preclude belief in evolution.)

What is needed here is a sturdy philosophical foundation for Christian theistic evolution. This requires dealing with philosophy, Christian theology, modern science, the Bible as literature, and hermeneutics. We need an approach that discusses the difference between physics and metaphysics and shows how the Bible speaks to the latter and not the former, a distinction literalists fail to make. We need a book that explains the import of understanding the Bible first as God-breathed (with all that that implies) ancient Hebrew literature that spoke to its age salvifically and theologically and against its age's underlying (poly)theology but *did not* speak, *and did not intend* to speak, to science; the Bible gives redemptive information. As depraved humans, we cannot help ourselves salvifically. We *can* find out about nature on our own but *cannot* discover God and redemption. We need a volume that explicates the *exclusive but complementary* nature of Christian theology and modern science (they both come from the same God, after all); a tome that explains how a properly founded hermeneutic can be applied to the Bible to exegete it seriously, if not always literally. If this is done well, then theologians *and* scientists can meet and discuss the interaction and interrelationship of modern science with Christian theology. Scientist and theologian will be able to take each other *seriously* and speak *to* and not *past* each other. Then the Lewontins, the Berras, and the Dawkinses will be able to see that Christians can think after all.

This volume, *Honest to Genesis*, falls short of healing the breach between science and Christians; it creates a new breach among Christians.

*Reviewed by Terry Bartholomew, 334 S. Diamond St., Mansfield, OH 44902-7822.*

**THE COSMIC BLUEPRINT** by Paul Davies. Radnor, PA: Templeton Foundation Press, 2004. 222 pages, references, index. Paperback; $16.95. ISBN: 1932031669.

Bernard J. Piersma, chemistry professor, reviewed the first edition (1988 hardcover) of this book in *PCSF* 42 (March 1990): 53. That edition has been out of print for several years. Davies has added a six-page preface to this edition, but otherwise the book appears to have undergone little change.

Piersma's review may be revisited on the ASA web site; he recommended the book "enthusiastically" and I echo that recommendation and his review which excellently catches the flavor and importance of the book. Sixteen intervening years have not dimmed the book's luster. It should be a "keeper" for every ASA member.

Davies is the author of over twenty-five books. His 1983 book, *God and the New Physics*, was reviewed by Robert Shacklett in *JASA* (Dec. 1984). His 1995 book, *Are We Alone?* was reviewed by Lucas Morel in *PSCF* (June 1996). Davies is currently a professor of natural philosophy in the Australian Centre for Astrobiology at Macquarie University. In 1999, he was elected as a Fellow of the Royal Society of Literature.

Most ASA members are familiar with LaPlaces' 1819 claim that the universe is completely determined, the future fixed in every detail. Davies completely demolishes this claim. He also regards reductionism as a failed research program, writing:

> Complete reductionism is nothing more than a vague promise founded on the outdated and discredited concept of determinism ... (it) simply dodges many

> of the questions about the world that are most interesting to us ... it denies that the arrow of time has any reality. Defining a problem away does not explain it (p. 140).

Davies also rejects the concept of "uncaused creativity," one espoused by Bergson, Popper, and Denbigh, on the basis that it is simply "unscientific." That leaves, for him, only one position, "organizing principles," in the hunt. As part of his argument, he writes:

> I have been at pains to argue that the steady unfolding of organized complexity in the universe is a fundamental property of nature ... there must be new general principles ... which have yet to be discovered (p. 142).

A Christian apologist ignores books such as this at the considerable risk of being excluded from the conversation. If you have not read it, get it. Study it. Think how to present the "Christian" perspective in a book study group. Must we argue for the Bergson alternative? Or are there other possibilities to explain our existence in this complex and wonderful world?

*Reviewed by John W. Burgeson, IBM Corporation (retired), Mancos, CO 81328.*

**CREATIONISM'S TROJAN HORSE: The Wedge of Intelligent Design** by Barbara Forrest and Paul R. Gross. New York: Oxford University Press, 2004. 315 pages, notes, index. Hardcover; $40.00. ISBN: 0195157427.

Philosophy professor Barbara Forrest and distinguished biologist Paul Gross wrote this book to warn readers about the movement known as "the Wedge." The Wedge seeks to overthrow the theory of evolution (and what they perceive as an atheistic naturalism infecting education and culture more broadly), primarily through promotion of "Intelligent Design" (ID). Gross coauthored the provocative 1994 book *Higher Superstition: The Academic Left and its Quarrels with Science*. The common thread between the two books seems to be a deep concern that what is taught about science be determined by scientific evidence, not political or religious agendas.

Unlike books such as Robert Pennock's *Tower of Babel*, *Creationism's Trojan Horse* is not primarily a scientific critique of ID. Only one chapter is devoted to debunking its claimed scientific achievements. Most of the book describes the history and aims of the movement (with help from an internal roadmap that was leaked on the Internet) and its political and public-relations activity. This approach has merit; while the early vision for the Wedge envisioned parallel scientific research and public persuasion, almost all of the effort and success thus far has been on the propaganda side.

The efforts of the Wedge include conferences, books aimed at nonexpert audiences, campaigns to influence school curricula, and lobbying in Washington. These are documented with copious endnotes and commendable attention to accuracy and detail. There is also some "dirt" as one might expect in a book hostile to the Wedge, most of which was old news. Many readers of this journal already know that their main biologist follows Rev. Moon and that *Icons of Evolution* is rife with misrepresentation and rhetorical tricks. Also familiar is the Wedge's audience-dependent equivocation about its religious goals. For those who don't follow the issues closely, however, this material might provide a wake-up call.

The final chapter, an attempt to document the Wedge's religious agenda, betrays some ignorance of Christianity and of the variety of Christian positions on origins. For example, pages are wasted trying to tie the Wedge to "creationism," with no apparent appreciation for the numerous ways that term is used. Quotes saying that Christians should work to advance God's purposes in the world are portrayed as advocating "theocracy" rather than as principled people living with integrity. In a section on religious backers of the Wedge (in which the specter of theocracy is invoked repeatedly), little distinction is made between those who truly are scary (like Christian Reconstructionists) and mainstream organizations like InterVarsity. The authors would have benefitted by consulting an evangelical Christian on this chapter—but it should give us pause that the picture we present to the world allows two intelligent people to misunderstand us.

A related shortcoming is that there is little mention of the majority of Christians in science who accept the theory of evolution, and none at all of those of us who feel the Wedge's biggest problem is a faulty theology of God and nature. One gets the false impression (unfortunately, one also promoted by the Wedge) that all of Christianity, or at least evangelical Christianity, is depending on the Wedge to save its concept of God. It is too bad that neither the Wedge nor these authors seem to appreciate that the god threatened by evolution is the "god of the gaps," not the Christian God.

Despite these flaws, its thoroughness makes *Creationism's Trojan Horse* worth reading for those who are concerned about the movement's influence on public opinion and science education. If nothing else, it should dispel any illusion that the Wedge is a scientific enterprise rather than primarily a propaganda movement. For a healthy Christian perspective, readers can consult other works such as *Perspectives on an Evolving Creation*.

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## PHILOSOPHY & THEOLOGY

**DOES GOD EXIST? The Craig-Flew Debate** by Stan W. Wallace, ed. Burlington, VT: Ashgate, 2003. 231 pages. Paperback; $29.95. ISBN: 0754631907.

This fine book is based on an engaging—at times, witty—debate between William Lane Craig, Christian philosopher, and Antony Flew, atheist philosopher. Flew's goal in the debate was not to show that God does not exist: "I [am] going to try to show that there are no sufficient reasons for believing that there is [a God]" (p. 24). In his final response at the end of the book, Flew admits being *unable* to "offer any substantial evidencing reasons for believing that [Richard] Swinburne's God does not exist, and able only to argue that sufficient evidencing reasons for believing that he does exist have not, and cannot, be produced" (p. 200).

In chapter 1, Keith Yandell helpfully lays out the *perspectives* of the debates (the Humean theory of meaning and of verification, and varieties of theism and atheism) and the *issues* in the debate (cosmological, design, and moral arguments and Jesus' resurrection—although Yandell does not discuss Craig's religious-experience argument). The next chapter presents the Craig-Flew entire debate (including Q&A).

In the next portion, various philosophers respond to the debate, offering various complementary perspectives on it. Theist *R. Douglas Geivett* (chap. 3) maps out and astutely analyzes the methodologies and explanations used by both debaters, concluding with a challenge on engaging in a "religious experiment" in light of natural theological arguments. Atheist *William Rowe* (chap. 4) challenges Craig's arguments connecting God to objective moral values or to the universe's fine-tuning. Rowe blurs distinctions when he criticizes divine design because of horrendous evils in the world. However, one can *still* detect design even if one does not know the character of the designer (e.g., torture racks and thumb screws are clearly evidence of design!). Rowe believes Flew ceded too much ground to Craig and offers suggestions to remedy that.

Theist *William Wainwright* (chap. 5) discusses the nature of the burden of proof between atheist and theist. He notes the ambiguity of Flew's term "atheist" (which could include the agnostic), offers some helpful correctives, and then suggests that the presumption of belief is in favor of *religious conviction*, given the universality of the human religious impulse across the centuries and civilizations (pp. 80–1). Atheist *Michael Martin* (chap. 6) slantedly describes Flew as a "philosopher" but Craig—a notable philosopher—as a (mere) "apologist" (p. 85). He proceeds to defend the possibility of the universe's having *no* cause (being can come from nonbeing) and of objective ethics without God. He presents arguments against the (questionable) nature of religious experience.

Theist *Keith Yandell* (chap. 7) raises some objections to Flew and offers some criticisms of and modifications to some of Craig's arguments. Atheist *Keith Parsons* (chap. 8) tackles two of Craig's arguments, asserting that "the universe is improbable and ... the Resurrection of Jesus is not" (p. 124). Theist *David Yandell* (chap. 9) asks Craig for further clarification on his cosmological argument but sees his case as having "some weight" while "none of Flew's arguments bear much weight" (p. 139). Agnostic *Paul Draper* (chap. 10) criticizes the line-up of Craig's arguments and doubts whether they succeed. Acknowledging Craig's skill as "an excellent philosopher," however, Draper wishes Craig well in his pursuit of defending God's existence (p. 153).

In the final two chapters, both Craig and Flew respond to objections and criticisms from the other eight philosophers. I found Craig's responses to be well argued and persuasive, Flew's arguments much less so. Oddly, Flew devotes much space criticizing the Augustinian-Calvinist understanding of God. Many people, including myself, hold to a more Arminian/Molinist view and think Flew argues against a straw man. (Rowe himself earlier noted Craig's own Molinist view on this topic [p. 72]).

The book is an absorbing debate and highlights a number of key arguments—pro and con—for the existence of God. Despite its streamlined index, the book's theism-atheism bibliography is useful. This book would make an excellent philosophy of religion textbook. I enthusiastically recommend it.

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**CHRISTIAN FAITH AND THE PROBLEM OF EVIL** by Peter van Inwagen, ed. Grand Rapids, MI: Eerdmans Publishing Co., 2004. 316 pages. Paperback; $35.00. ISBN: 080282697.

The problem of evil is both intriguing and confounding: intriguing because it is so basic to the human condition; confounding because there seems to be no solution to it. As I opened this book's pages, I was somewhat skeptical of the publishers claim that it would provide new insights. Is it possible to say anything new about such a perennial and ancient problem? Perhaps not, but the chapters in this book contain some interesting summaries and insights on the current discussions. Barbara Omolade's article "Faith Confronts Evil" deals with the evil of slavery, especially American slavery. She quotes Orlando Patterson who observed that "slavery in the United States was harsher than other slave systems" (p. 284) because it provided fewer privileges and opportunities for manumission. Robert Stanley's "God, Evil, and the Thought of Simone Weil" is also noteworthy. Weil was a Jew devoted to aspects of Christianity (Catholicism) who refused baptism to remain identified with those outside the church. One of Weil's novel thoughts was that the Greeks were better forerunners of Christ's coming than were the Old Testament prophets.

Someone has commented that the problem of evil (or/and suffering) is the Achilles' heel of Christian faith. The kernel of the problem is why a good and omnipotent God allows such horrendous and widespread malevolence with its undesirable consequences, humanly speaking. The absence of a convincing answer to this chronic problem sometimes results in atheism, agnosticism, and feeble faith. Carol Winkelmann in her chapter entitled "In the Bible, It Can Be So Harsh!" gives a list of some theodicies for evil: dualistic (struggle between good and evil), Augustinian (free will), punishment/retribution, redemptive/atonement, Irenian/evolutionary (moral contrast), remedial/instructive (soul-making), faith solution (mysterious evil), process (a persuasive God), suffering God, and liberation (faith leads to action). The problem with all of these defenses is that they have a counter-argument. As the editor points out in his essay, "The Argument from Evil," disclaimers should "explain why he or she thinks" theistic contentions are flawed. "Then I, or some other defender of theism, can attempt to meet this objection, and the objector can reply to the rejoinder and ... but so philosophy goes: philosophy is argument without end" (p. 73).

In corresponding with the editor of this volume, I received the following response concerning his purpose:

> I'm not trying to solve the problem of evil—that is, I was not trying to answer any question about why God allows evil or allows the vast amount of evil that actually exists or allows this or that particular evil

> (like the Holocaust or the existence of people who would prefer not to have existed). That's beyond me. I don't think anyone could know the answer to any of those questions unless God had told him the answers, and I don't think God has told anyone the answers to those questions. He certainly hasn't told them to me.

Therefore, do not expect this book to contain the last word. Expect it to be stimulating and informative, and you will have gotten your money's worth.

Van Inwagen, editor of this volume and author of many books, is a philosophy professor at the University of Notre Dame. He is included among the book's fourteen authors (most are philosophers). The authors are associated with religious and secular (private and public) institutions. Their essays come from a conference held at Calvin College in 2000. The book's cover reproduces a morbid painting by Pieter Brueghel the Elder (circa 1525–1569) entitled "The Triumph of Death." The footnotes and bibliography point readers to additional resources.

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**THE UNIVERSE NEXT DOOR: A Basic Worldview Catalog** by James W. Sire. Downers Grove, IL: InterVarsity Press, fourth ed., 2004. 259 pages, Preface, index. Paperback; $16.00. ISBN: 0830827803.

In reviewing the first edition (1976), Richard H. Bube described the book as

> ... perform[ing] a valuable service by gathering together the major presuppositions of some eight different worldviews that have affected and do affect people's perception of themselves and the world. The worldviews treated include: Christian theism, deism, naturalism, nihilism, atheistic existentialism, Christian existentialism, pantheistic monism, and the new consciousness. The book traces the disintegration from Christian theism down to nihilism, and then the abortive attempts to recover what had been lost.

Succeeding years have seen three further editions of this enormously popular work (250,000 copies). In examining an edition appearing almost three decades later, one might ask if the author has stayed pretty much with the original, adding the odd reference here and there, or whether he has developed an extensive revision. Or more to the point—is this a 1976 or a 2004 catalog? Of course *Universe* is not *just* a catalog. It defines, analyzes, compares, and holds up Christian theism as the ideal.

Sire's preface indicates that the chapters on Christian theism, deism, naturalism, nihilism, existentialism and monism have received "only occasional changes" (p. 11). However, chapters on the "New Age" and "postmodernism" have received extensive revision in the light of recent developments. Most significant is his revision of what worldview is all about in the concluding chapter, "The Examined Life." Sire moves in his understanding of worldview from an emphasis on *presuppositions* to that of *fundamental orientation of the heart*. This he accomplishes by stressing the *pretheoretical roots of the intellect*, by adding the *notion of story* to the set of presuppositions, by emphasizing *knowing the really real*, and *relating worldview to behavior* (p. 11).

In bringing the literature up to date, it would have been helpful to reduce footnote clutter by removing more of the less relevant earlier references. This is perhaps most telling in the chapter on Naturalism where the author fleetingly deals with evolution by adding the equivalent of an entire page of footnotes in an attempt to include the major players of the last fifteen years. The cryptic description in 8 pt. type fails to sort out the major issues that consume the pages of *PSCF* and many web sites (pp. 69–70). Curiously, the index does not mention intelligent design—a major topic during this period.

One source of confusion may be found in Sire's second proposition on the nature of God: "God created the cosmos as *a uniformity of cause and effect in an open system*" (pp. 29 ff). While this statement and following discussion is unchanged from the first edition, it would have been helpful to clarify his understanding of *'open'* in the context of the current controversy over *open theology* in evangelical circles.

*The Universe Next Door* effectively serves the college student meeting the concept of world view for the first time. It should be supplemented with the author's *Naming The Elephant: Worldview as Concept* (IVP, 2004) and a course or two in philosophy taught by one who resists the urge to impose his or her own agenda.

This inexpensive work packs much into its well-written pages. It is time to replace the older edition on your shelf.

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## Religion and Christian Thought

**I DON'T HAVE ENOUGH FAITH TO BE AN ATHEIST** by Norman L. Geisler and Frank Turek. Wheaton, IL: Crossway Books, 2004. 447 pages. Paperback; $15.99. ISBN: 1581345615.

If you were asked to give a scientific defense of your faith—ignoring your relationship with God and focusing entirely on independently verifiable facts—could you do it? If not, perhaps you need to read *I Don't Have Enough Faith To Be An Atheist*. In it, Geisler and Turek lay out the case for Christianity with unemotional precision.

*Enough Faith* is based on the seminar that Geisler and Turek have been presenting since 1996 entitled "The Twelve Points That Show Christianity Is True." In the proud tradition of French philosopher René Descartes, who famously began by proving his own existence ("I think, therefore I am"), the twelve points begin with "Truth about reality is knowable." Then, in logical fashion, Geisler and Turek build on this foundation.

Having established that truth is knowable, Geisler and Turek construct a basic framework of faith: God exists; miracles are possible; the Bible is historically reliable; Jesus is God; and the Bible is the Word of God. Authors of

Christian apologetics often have a difficult decision to make: pick a specific topic and focus on it in great detail, or superficially cover a broad range of theological topics. In *Enough Faith,* Geisler and Turek take the middle road, and do so successfully. It is skillfully written to include enough evidence to convince the reader without becoming overwhelming. As a result, even at 447 pages, it is a surprisingly easy read.

Early in the book, Geisler and Turek make the argument that, contrary to popular belief, atheism requires a lot of blind faith. The truth of the gospel, on the other hand, is well supported by logic and reason. As each of the building blocks is put into place, this argument is repeated and strengthened.

The early chapters, under the heading, "It's true that the theistic God exists," are especially effective. Geisler and Turek expertly summarize many of the cosmological and teleological arguments that have been presented in greater detail by Hugh Ross and others. These arguments are often stunningly powerful, such as when the origin of the universe is used to make five independent compelling arguments for the existence of a Creator. For example, Geisler and Turek describe the findings of NASA's Cosmic Background Explorer (COBE), launched in 1989, which found temperature ripples in cosmic background radiation. These findings, which confirm the instantaneous creation of the universe, caused COBE project leader George Smoot to remark, "If you're religious, it's like looking at God." Indeed, modern humanists cannot—and do not—dispute the facts; they can only refuse to look where the evidence indisputably points.

One of *Enough Faith's* strengths is its versatility. Although it tells a cohesive story that can be read from cover to cover, it also functions well as an apologetics reference book. Each chapter, or group of chapters, makes a self-contained argument for one of the "twelve points," and can be read and re-read as needed.

*Enough Faith* will appeal to a broad range of readers, from the resolute skeptic to the mature Christian who is looking to reinforce the foundation of his faith. However, the book's greatest value is for those who are close to salvation—on one side or the other. A sincere seeker who sees too many intellectual hurdles to faith will see the gospel presented and defended in a rational and logical way; a new believer who has committed his life to Christ will be given confidence, and the resources to defend his faith to others. However, I would caution against giving this book indiscriminately to every non-Christian acquaintance; the efficacy of the intellectual approach is very often determined by the recipient's heart, and no amount of logic and reason can overcome it.

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**SCRIPTURE ALONE: Exploring the Bible's Accuracy, Authority, and Authenticity** by James R. White. Bloomington, MN: Bethany House Publishers, 2004. 224 pages. Paperback; $12.95. ISBN: 0764220489.

White is director of Alpha and Omega Ministries, a Christian apologetics organization; an adjunct professor with Golden Gate Baptist Theological Seminary; and a professor of apologetics at Colombia Evangelical Seminary. A man of many parts, he is author of two dozen books and numerous articles on religious themes, and he has engaged in many formal debates on current religious issues. He speaks and writes with passion and conviction from a Bible-believing, reformed Baptist perspective in defense of a doctrine that he thinks is being degraded in the evangelical church.

The ASA has long grappled with issues involving science and the Bible, generating much heat with diverse interpretations seeking to relate the source of their faith with day-to-day activity. This is *not* the book if you are looking for answers to stem cell questions, the interpretation of Genesis One or Joshua's long day. Rather it seeks to draw us to *sola scriptura,* a view that "all a person must believe to be a follower of Christ is found in Scripture and in no other source" (p. 19). White's position comes out of the Reformation confessions—specifically the London Baptist Confession of 1689 which is almost identical with the Westminster Confession of 1648. He affirms the 1996 Cambridge Declaration of the Alliance of Confessing Evangelicals and the earlier 1978 Chicago Statement on Inerrancy.

White considers the biblical texts that frame the nature of Scripture; questions of inerrancy, interpretation and exegesis; the cannon of Scripture; allegations of corruption and contradiction, other "voices" and the timeless sufficiency of Scripture. A major feature of the book is a series of dialogues between the author and fictional opponents who represent other positions. Dialogues spell out the arguments pro and con in an effective way, yet the author wins every point, something rare in real life. I suspect that readers will consider some dialogues less desirable because of the seeming use of *straw men.*

*Scripture Alone* considers science only in passing in warning against

> forcing the Bible into conformity with modern scientific categories that came into existence and usage long after God's word was recorded ... Christians are guilty of attempting to exegetically read into many passages scientific concepts that are just as anachronistic and misrepresentative of the text as the alleged errors of the atheists (p. 138).

One must look elsewhere for help in relating God and nature. White affirms the Chicago statement denying that

> biblical infallibility and inerrancy are limited to spiritual, religious, or redemptive themes, exclusive of assertions in the fields of history and science ... [or] scientific hypotheses about earth history may properly be used to overturn the teaching of Scripture on creation and the flood (p. 62).

White's work is of value for those new to Protestant Christianity such as graduates of *Alpha* and *Christianity Explored* courses and others who need to brush up on the topic.

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**THE RESURRECTION OF CHRIST: A Historical Inquiry** by Gerd Ludemann. Amherst, NY: Prometheus Books, 2004. 245 pages. Hardcover; $26.00. ISBN: 1591022452.

A review in *PSCF* of a book on Jesus' resurrection seems apt for two reasons: (1) if the resurrection of Jesus did not occur, Christianity is false and any attempt at scientific interface is groundless; and (2) readers have an opportunity to contrast its arguments with those of N. T. Wright's *The Resurrection of the Son of God*, considered by Ludemann to be "scholarship led astray by theology" (p. 200).

Ludemann thinks that "historical research shows with definite clarity that Jesus was not raised from the dead" (p. 190), "Jesus' resurrection by God must now be regarded as a falsification" (p. 190), and those who believe it are deceiving themselves (p. 205). He thinks that since Jesus was not resurrected, "Christian faith is as dead as Jesus and can be kept alive only by self-deception" (p. 19).

Of course, much of what Ludemann writes is his opinion, to which he is entitled. For example, he contends that the appearance of the resurrected Jesus to more than five hundred people was a mass ecstasy (p. 81); at least parts of Luke's gospel are inauthentic (p. 112); John's victory in the race to the tomb shows his priority over Peter (p. 117); parts of John's gospel have numerous inconsistencies (p. 125); Peter's vision of the resurrected Jesus was a delusion or wishful thinking (p. 165); and none of Jesus' disciples were present at the crucifixion (p. 173). It would be easy to conclude that Ludemann's presentation is based on his acceptance of naturalism with a concomitant rejection of supernaturalism.

Ludemann bases his argument on points which have been debated many times orally and in print (i.e., *Jesus' Resurrection: Fact or Fiction? A Debate Between William Lane Craig and Gerd Ludemann* [InterVarsity Press, 2000]). He contends that the accounts of Jesus in the New Testament were written by partisans many years after the time of Jesus and are therefore unbelievable. However, even partisans can speak the truth. Doctors, car salesmen, politicians, preachers, and many other professionals could, in a sense, be considered partisans. This does not mean that their conflict of interest renders them always untrustworthy.

Since history cannot be relived, a person's attitude about historical events is always based on faith in the data. Christians cannot prove Jesus was raised from the dead. But which comes first, proof or faith? As someone insightfully observed, Christians do not believe Jesus was raised from the dead because they have proved it; Christians keep trying to prove it because they believe it.

This is a scholarly book, requiring a good deal of concentration to read. Therefore, it may appeal only to scholars. Nevertheless, the question it addresses is central to the validity of the Christian faith. For that reason, those who would be fully persuaded in intellect as well as emotion may find some cognitive exercise and challenge in thinking about the arguments presented in this book. As the Apostle Paul long ago observed, Christians are to be pitied, are of all people most miserable, are still in their sins, and base their faith on a historical falsehood, if Christ was not resurrected.

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## SCIENCE EDUCATION

**EDUCATING FOR SHALOM: Essays on Christian Higher Education** by Nicholas Wolterstorff; ed. Clarence W. Joldersma and Gloria Goris Stronks. Grand Rapids, MI: Eerdmans Publishing, Co., 2004. 310 pages. Paperback; $24.00. ISBN: 0802827535.

Initially I must admit two things: first, I agreed to review this volume because its author was professor in my alma mater, Yale Divinity School (YDS); and second, I was prepared for a boring endeavor when I first turned its pages. I am glad I stuck with the review. Wolterstorff (formerly of Calvin College, more recently professor of philosophy at YDS) has thought long and hard about the topic of *Christian education* and I, for one, am richer for thinking with him on this important topic. I wish my near forty years in undergraduate and seminary teaching had been informed by his insightful reflections.

Wolterstorff's essential thesis is that Christian Education should be education for Shalom. "Shalom" means that ultimately education that is Christian should result in a change of the person's core outlook on life so that the dominant goal of existence becomes justice for all persons. As a prelude to extensive elaboration of this theme, Wolterstorff suggests that Christian higher education has gone through four major developments in conceptualizing its goals. The first goal has been the Christian service model wherein the purpose of the experience was to prepare persons for Christian occupations such as evangelism, ministry, missionary service, medicine, teaching, etc. However, most Christian colleges have found this goal to be too restrictive and have turned to a Christian humanist model. Herein education is for "freedom." Liberal education is intended to free students by initiating them into the cultural heritage of humanity. This meant detachment from the immediate, transactional, mundane environment of everyday life and enmeshment in the classics—the result of which resulted in persons who could gain perspective on the world in the genre of Plato's philosopher kings. In this endeavor, mastering the Christian heritage was to assume central focus.

A third goal of Christian higher education has been termed *Socialization* or *Maturation*. Herein the college functioned as the nurturing force whereby students came into their own and learned to express their God-given talents and to follow their God-directed vocational calling. In this venue, students found their place in society and left the institution to actualize their unique ideals.

Finally, Christian higher education has become the place for *pre-professional training*. Herein, the reputation of the college came to rely heavily on how many of its students specialized and went on to graduate training in their chosen fields. The goal here came to be that of preparing students to make major contributions as leaders in their chosen fields. Although Wolterstorff does not address this development, it is apparent that many "church related" (as compared to "Christian") colleges have adopted this approach.

Education for *Shalom* means opening up the student to the wounds of society. To quote Wolterstorff:

> To dwell in shalom, is to find delight in living rightly before God, to find delight in living rightly in one's physical surroundings, to find delight in living rightly with one's fellow human beings, to find delight even in living rightly with oneself (p. 23).

Toward this end, Wolterstorff recommends "practicing scholarship in Christian perspective." This means that the sciences as well as humanities are explicitly related to the foundational assumptions of the Christian faith through cultural analysis and reflection. In such curriculum, philosophical, religious, and ethical questions are incorporated and not relegated to the department of religion. Such education will intentionally result in graduates who, hopefully, live (or "dwell," Wolterstorff's term) as Christians when they graduate.

Much of the book includes in-depth analysis of these themes. Wolterstorff shows a keen appreciation for the philosophical underpinnings of his thesis, the changes that have occurred since the Enlightenment, and the radical presuppositions of postmodernism. Of particular interest is his incorporating into his argument the ideas of the theologian Abraham Kuyper, one of the foundational scholars of Wolterstorff's Dutch culture with whom many *Perspectives on Science and Christian Faith* readers may be unfamiliar. In regard to postmodern contention that all theories are biased, Wolterstorff discusses the value of incorporating special interest perspectives (such as feminism) into one's thinking.

Many of us are involved in higher education and, of course, almost all of us claim to be Christian. I can seriously contend that, since my graduate course on the History and Philosophy of Education, I have not read a volume that stimulated my reflection on these issues as much as this collection of Wolterstorff's essays. I recommend it.

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## SOCIAL SCIENCE

**THE CULTURES OF CREATIONISM: Anti-Evolutionism in English-Speaking Countries** by Simon Coleman and Leslie Carlin, eds. Burlington VT: Ashgate Publishing Co., 2004. xv + 208 pages, index. Hardcover; $79.95. ISBN: 075460912X.

Dissection of creationism has become a cottage industry. Beginning with Dorothy Nelkin's *Science Textbook Controversies and the Politics of Equal Time* (1977), an increasing number of historians, sociologists, anthropologists, philosophers and scientists have sought to analyze the creationist paradigm.

Christopher Toumey's preface to this multi-author work poses the question: "Must creationism always be an intrinsically American package of practices and beliefs?" (ix). By creationism Toumey and his fourteen co-contributors mean the package of ideas that Henry Morris and his colleagues at the Institute for Creation Research have disseminated throughout North America, to other English-speaking nations and beyond, to conservative Catholics and Protestants, other religions such as that of the Hare Krishna, conservative Judaism, Canada's First Nations, and the aboriginals of Australia and New Zealand. Rather than a *direct* transfer of the package to another culture, Toumey finds instead, a transfer of *particular* features to be cast with indigenous aspects of the receiving culture—cultural syncretism.

Methodologies range from interviews of participants and surveys of student attitudes to textual analysis. The authors from the US, Canada, and the UK are academically dispassionate for the most part with the exception of Michael Ruse who is *not* happy with creationism in general and Phillip Johnson, Michael Behe, and Alvin Plantinga in particular.

Readers who have lived within the Christian community during the creationist revival will react to this multifaceted analysis both as observers and participants. In any case, the authors seem to have accurately covered all the bases—facts and names, occasions, and chronologies. For this we are indebted to the earlier standard set by Ronald Numbers, *The Creationists: The Evolution of Scientific Creationism* (1992).

Editors Coleman and Carlin's introduction offers an insightful overview of each chapter which can stand alone if time does not permit a full reading of the text. David Knight then describes T. H. Huxley's high profile evolution takeover which won the day in a late nineteenth century England where the educated felt that Genesis was no longer to be taken literally in a time when "historical, moral and scientific doubt" removed God from science. "Most people adopted an evolutionary view less austere than Darwin's, where God within the shadows had begun, and was gently steering in the shadows" (p. 41).

Simon Locke closely investigates publications (discourse analysis) from the British Creation Science Movement (1989–1996) in a late twentieth century comparison of Britain and the US. He finds US creationists to be more prevalent, diverse, and politically active, providing a basis for the different models for creationism found in the two nations.

The chapter "Creationism, American-Style" is framed on the notion that this creationism "revolves around clashing world views." It was interesting to find that a *softer* creationism has emerged in the 90s. "Neo-creationism" accepts astronomical and geological evidence for an old earth and biological evidence for evolution but not for the origin of life or other *complex* stages in the development of biological diversity. Intelligent design and a nuanced anti-evolutionism are part of a package which has been avidly debated in *PSCF* over the last fifteen years. Sadly, neither the debate nor the resultant diversity of neo-creationist positions is mentioned. Other than Ronald Numbers, writers in this field continue to ignore the major American discussion of creation over the last six decades. Thus, the authors provide a simplistic view of a complex situation.

Robert Layton's fascinating chapter, "The Politics of Indigenous 'Creationism' in Australia," comes from the

perspective of one who accepts the aboriginal Alawa belief. Layton writes:

> My position stems partly from the experience that indigenous beliefs provide a rational ground for action in the world which is justifiable within the limits of empirical investigation available to believers ...
>
> The kind of ontological questions that can be framed within indigenous discourse tend to be ones which an evolutionary theory would not consider admissible, somewhat as "Western" creationists debate whether the days of creation described in Genesis were actually 24 hours long or figures of speech, but deny evidence for gradual change in fossil species (p. 158).

Other chapters examine creationism in Canada, Australia, New Zealand, and Kenya. Each chapter closes with a useful set of references. *The Cultures of Creationism* offers a useful *outsider* analysis of the creationism of the late twentieth century. Collectively, we have a reasonably consistent story. It would be interesting to see how this would contrast with an *insider's* perspective.

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**LOVE THAT WORKS: The Art and Science of Giving** by Bruce Bander. Radnor, PA: Templeton Foundation Press, 2004. 162 pages, index. Paperback; $14.95. ISBN: 1932031774.

Bander is an international journalist, photographer, teacher, and author. His main interests are travel and social psychology. He has been a staff writer on newspapers in New Zealand and the United States and a writer-editor for *National Geographic*. Through the years, Bander has continued his studies in the fields of social and cultural trends in the Western world with particular emphasis on sociology, psychology, history, anthropology, and current events.

Bander has studied love, one of his favorite topics, for over thirty years. This book is result of that study. As a testimony to his expertise, he has been married to his wife Mary for nearly twenty years.

Bander has taken an interesting approach to the topic of love and romance. He has divided his subject matter into two equal parts. Part I is *Love in the Dark*; Part II, *Love for Life*. Bander draws on theology, philosophy, history, literature, psychology, and sociology to demonstrate why romance alone is a very poor basis for a stable love and a lasting relationship.

In Part I, he points out that during the twentieth century, romance was basically very sweet and safe; people moderated its temptations with other types of love that are all but forgotten in our time. Today love for most lovers has degenerated into uncontrolled, sexual, hot wishful fantasies or as Bander puts it "scratching a sexual itch." He asks us to look at ourselves. We are looking for the perfect person, the image of the one we want to love. Yet Bander makes the point of implying that we ourselves are not healthy and therefore not ready for a new relationship. He says that we look for the ideal person but when we find that person we realize that he or she is looking for the perfect person also. He makes the point that we are more likely to be consumers rather than producers of love. He indicates that nothing in life fails as often and as miserably as love. So the question is where does the failure lie? The failure may lie, Bander indicates, in the vastly incomplete romantic love that we practice, with its wishes and fantasies.

In Part II, Bander says to make relationships work again, we need to understand the dynamics of love and rediscover types of love that are linked to higher levels of emotional maturity. The English word "love" is the most misused and ill-defined word in the English language. Bander goes on to define the biblical definitions of love used by the Greeks, i.e., *eros*, *philia*, and *agape*. He says that too many of us are stuck in a level of love that the Greeks called *eros* which is the urgent desire for self-fulfillment that is most often associated with sexual or sensual love. This type of love leads us to reach out for something or someone to make ourselves more complete. In personal relationships, *eros* love says, "I want, I need, therefore I love."

The next higher level of love is *philia*. In *philia* the object of love becomes important in its own right, Bander explains, not merely someone to be used, but someone valued for his or her own sake. This kind of love emphasizes giving more than getting.

The highest level of love, *agape*, is "true love," in which the lover has the welfare of the one being loved as the primary motive. *Agape* is a decision and a commitment to love; it is giving unconditional love. In *eros* we marry the person we love. In *agape* we love the person we marry.

*Reviewed by Stan Hatkoff, Adventist Medical Center, Portland, OR 97080.*

**PSYCHOLOGY AND THE BIBLE: A New Way to Read the Scriptures** by J. Harold Ellens and Wayne G. Rollins, eds. Westport, CT: Greenwood Publishing Company, 2004. Four volumes. Hardcover; $300.00. ISBN: 0275983471.

Ellens writes in his series foreword that these books may interest the informed professional, but are primarily intended for the lay reader, local library, and the undergraduate university student. They seek to explore the interface of psychology, religion, and spirituality in practical ways. The chapters are too numerous to mention by name, but listing a few of them may indicate the flavor: Sexuality in the Hebrew Bible, A Romantic Psychologist Reads the Bible, The Psychodynamics of the Fall Story, Psychoanalyzing Ezekiel, The Bible and the Psychology of Shame, and A Psychobiography of Jesus.

Each volume, with a different picture on its cover, illustrates a volume topic. Volume one, "From Freud to Kohut," has a picture of Freud; volume two, "From Genesis to Apocalyptic Vision," a picture of God driving Adam and Eve from Eden; volume three, "From Gospel to Gnostics," a picture of Ezekiel; and volume four, "From Christ to Jesus," a picture of Jesus. The 9.5 by 6.5 inch volumes contain 1,424 total pages and sixty-two articles by different authors. Each volume contains a foreword, bibliography, glossary, index, and author biography.

Perhaps the first reaction to this book is its cost. However, it is not one book but a set of four. Even so, that comes to $75 a book. Pretty expensive! On the other hand, compared with the cost of college textbooks, this set seems reasonably priced. My guess is that its primary purchasers will be libraries or professional, Christian psychologists. This relatively small market dictates price. And I got all four volumes sent to me free so you could read this recommendation; obviously the publishers need a lot of marketing to make this a profitable adventure. Would I buy this set? Yes, if I were a psychology teacher, a Christian counselor, a person interested in the Bible and psychology, or just a sponge for knowledge. Otherwise, I would recommend my city or college library put it on their shelves.

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

**RELIGIOUS THOUGHT AND THE MODERN PSYCHOLOGIES** (2d ed.) by Don S. Browning and Terry D. Cooper. Minneapolis, MN: Fortress Press, 2004. 304 pages, notes, index. Paperback; $25.00. ISBN: 0800636597.

This is a revision of a volume published in 1987 by the first author. Both editions probe major theories of psychology for their implicit or explicit assumptions they make along five dimensions: (1) the type of metaphor they utilize; (2) the basic need of life; (3) the essential obligation that motivates behavior; (4) the kinds of permissions/constraints imposed on humans by the environment; (5) and the rules and roles their theories recommend. The theories of Freud, Maslow, Perls, Skinner, Jung, Erikson, Kohut, Ellis, Beck and Bowen are analyzed and critiqued via the theological propositions of Reinhold Niebuhr. The authors label their approach "hermeneutic realism" and suggest that probing the underlying presumptions of social theory is grounded in the hermeneutic philosophy discussed in the writings of Gadamer of Ricoeur. This is the essential question asked in these theories: What is their underlying understanding of the nature and potential of human life?

The basic theoretical model of Freud is seen to be instinctual egoistic mechanism wherein the mind basically functions to satisfy individualistic needs. Little room is left for mutuality beyond some form of a social contract in which other persons function either to impede or enhance the meeting of individual goals. The basic theoretical model of the *humanistic psychologists* (Maslow, Rogers, Perls) is expressive individualism—sometimes called a culture of "joy." Here it is assumed that if each person actualizes him/herself there will be perfect harmony. No place is given to the problem of those times when persons' actualizing might come into conflict with one another. Skinner, in turn, takes a radically different view. Instead of individual actualization, Skinner's conditioning model sees the goal of life to be justice which will be assured by the planned schedule of reinforcements—those conditions which determine behavioral outcomes. His model is that of elite husbandry. Little room is left for individual agency or responsibility. Jung is seen as an instinctual self-realist whose thinking is kin to the humanistic psychologists in their confidence that individual actualization will result in social harmony. Jung is more aware than others of the issue of evil in life and the complex way in which instinctual forces (archetypes) have darker dimensions. These illustrate the type of analysis the book provides.

Browning and Cooper are convinced that these deep metaphors in psychology are quasi-theological in their implications. Niebuhr's proposals about humans as body/spirits who are both finite and infinite in their behavior provide the backdrop to the authors' critique.

Apart from the practical help these theories have given to counselors, there is a need to qualify their constructs with theological acumen in order to account for both personal development, mutuality, and sacrificial love.

This volume is seminal and foundational. It should be read by all psychologists who are concerned to relate their work as mental health professionals to their Christian faith. It would be helpful for those in the American Psychological Association who are pushing for all psychotherapeutic treatment to be grounded in empirical research to read it also. Unless the hermeneutic assumptions underlying any given empirical study are explicitly detailed, treatment based upon such conclusions will simply repeat the situation that this volume addresses, namely, naive positivistic assumptions that such outcomes are self authenticating. All research is theory laden—from the choice of topic to the methods of investigation.

Although the substantive "hermeneutic realism" of the volume is not compromised, the inclusion of two prefaces coupled with the syntactic style of referring to "I" in one part of the book and "We" in another part, is somewhat disconcerting. A semantic comment is also in order, Niebuhr is overtly the preferred theological foil against which each psychological theory is compared. Personally, I have no quarrel with this because I am a theological child of the mid-twentieth century during which Niebuhrian thinking was the vogue. Maybe my critique is not in order, but the question remains, "Should not the authors have been a bit more circumspect in admitting the 'effective history' (their term for the impact of a given theorist's culture and personal history) of Niebuhr?" Further, should it not be at least acknowledged that they chose one among a number of theological options available to them for their work? As we used to say, "Skinner himself had to be behaviorally conditioned." Nobody can avoid the impact of their own time and space, not even Niebuhr.

*Reviewed by H. Newton Malony, Ph.D., Senior Professor, Graduate School of Psychology, Fuller Theological Seminary, 180 North Oakland Avenue, Pasadena, CA 91101.*

**THE SONG SPARROW AND THE CHILD: Claims of Science and Humanity** by Joseph Vining. Notre Dame, IN: University of Notre Dame Press, 2004. 216 pages. Hardcover; $25.00. ISBN: 0268043620.

Vining is Hutchins Professor of Law at the University of Michigan. He practiced law in Washington, DC, and served in the Department of Justice. He writes and lectures on legal philosophy, administrative law, environmental law, corporate law, comparative law, and criminal law. He has written three previous books: *Legal Identity, The Authoritative and the Authoritarian*, and *From Newton's Sleep*.

This book is organized into chapters with notes, an index, and a further reading list. Vining begins by introducing the reader to totalitarian thought and the pinnacle of its achievement in twentieth century ideology, particularly Fascism and Communism. He shows how each system of totalitarian thought, while distinct, has at its root the desire to explain everything. The danger, he warns, is that such systems also extend to explanations of the humans who developed them. Thus, the Nazis and the Communists both immunized themselves against critique by encompassing the critique in prior explanation. Vining's concern is that he detects similar strains of thought in modern science, a desire to explain everything, even the scientist, as being subject to the explanatory power of the Total Theory. Sociobiology would be a good example of this "scientific" thought. "The new totalism in the second half of the twentieth century is in cosmological vision rather than in social or political theory."

But in the process of explaining the human, the Total Theorist has taken away any qualitative distinction between the human and such beings as song sparrows. And here's the rub: we conduct experiments on song sparrows to see how their ability to sing is impacted by deafening them at birth so they could never hear their mothers sing. "What is the answer to the proposal that a child be treated like a young song sparrow? One or more deafened, one or more kept in silence, one or more sacrificed from time to time and its brain sliced and stained? Humans are continuous with the rest of nature, and nature can be nothing more than a system."

Vining proposes a meeting place for scientific and other forms of thought in law, "for the distinctive feature of life and the human (in its recognition by us) is that it is not entirely subject to our purposes." The law gives us the space to evaluate the claims of science and total theory from other important areas of being: love, loyalty, truth.

In all, Vining has brought up an excellent point in tying cosmological Total Theory with previous social and political totalitarian systems. The inevitable logic of such thinking leads to lack of concern for individual worth and focuses on species and systems. The main problem with his book is that it is written in a musing style that often leaves one confused about what he is really trying to say. It is like reading his diary rather than a case about why we should be careful about Total Theory. In fairness to him, he knew that and explicitly wrote that the book is primarily a conversation or meditation rather than an argument. Still, from such a lawyer with such a good point to make, I would have preferred a solid argument I could follow and present.

*Reviewed by David M. Condron, Marine Engineer, Friend Ships, Lake Charles, LA 70601.*

# Letters

## Energy Conservation: Reflections on the Pitts/Gentry Dialogue

I found the duel between Brian Pitts and Robert Gentry (*PSCF* 56, no. 4 [Dec. 2004]: 260–84) interesting but tortuous. With energy conservation at issue, Pitts writes: "While it is true that the photons lose energy, the energy is transferred to the gravitational field" (p. 260). In response to which Gentry fires off salvos to prove that there is no exchange of photon energy with the gravitational field. Haven't these folks ever heard of Occam's Razor? "Terms, concepts and assumptions must not be multiplied beyond necessity." Or to quote another version: "All things being equal, the simplest explanation tends to be the right one." Pitts and Gentry are wrestling with the same question, "Where has all the energy gone?" Let's see if we can find a simple explanation that Sir William of Ockham would approve of.

Set up a simple experiment in a closed system containing a battery connected to a bulb with a switch. Measure the energy in the system—let's say *X joules*. Turn on the switch, come back in two months when the battery is dead, and ask yourself the question: "Where has all the energy gone?" The answer of course is that it hasn't gone anywhere. The closed system still contains *X joules* of energy, only it is no longer available to perform the work of lighting the bulb.

Starting with the classic definition, "Entropy is the energy within a closed system that is no longer available to perform work," we can infer a dichotomy between graded and degraded energy, where graded energy (sometimes referred to as Gibbs free energy) would be available to perform work, while degraded energy (entropy) would not. Granted, Gibbs free is measured in *joules*, whereas entropy is (ordinarily) measured in *joules/Kelvin*. However, entropy (degraded energy) may also be represented as a ratio of joules of degraded energy to the total joules of energy in a system.

Avoiding infinity issues, and assuming a sample size of one closed universe, we are asking the same basic question, "Where did all the red-shifted energy go?" And the answer is, of course, the same: "It hasn't gone anywhere!" The universe still contains the same quantity of energy that it started out with. It's just that the quantity of degraded energy (entropy) is always increasing, and the quantity of graded energy (Gibbs free) is always decreasing. From which we can infer an inverse relationship between graded and degraded energy which we can state in simple English:

> *The sum of graded and degraded energy in the universe is always constant.*

Graded energy is the backbone of structure in physical theory. A system with a highly specific arrangement (complex structure) is associated with a higher level of graded energy (Gibbs free) than one that can be arranged in a more random way. From this we may in turn infer a relationship between the increase of universal entropy and the

decrease (de-gradation) of universal structure, including the structure of light. This would suggest a more holistic explanation for the so-called "cosmological" red shift. Go back to our battery/bulb in a closed system analogy. In the beginning the bulb was emitting a bright bluish-white light, but as the battery ran down (as entropy increased) the light became more and more reddish. If we are dealing with a sample size of one closed universe, one in which entropy is increasing, the same principle applies.

No doubt some of the red shifts observed in the universe are caused by a divergence mechanism. But the magnitude of the red shifts associated with some far-away objects suggests a more holistic–systemic–mechanism. Are we missing something here? Is the "runaway universe" really expanding in the manner described by BBC, or is the tail of the "cosmological" red shift wagging the dog of BBC, as Gentry suggests? The fact is that anything that would cause the waveform of light to lose energy would produce a red shift, fooling us into believing that some objects are moving away at incredible speeds, giving us false readings about the rate of expansion, the age of the universe, etc.

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## Three Dialogues: A Gentle Connecting Rejoinder

In the spirit of Wittgenstein, if excessive verbiage masks incommensurability, appropriate clarity may be sought by delving right to the heart of the matter. In dialogue #2, Robert Gentry defends an alternative model of the universe alleged to possess "spherical symmetry" with a Cosmic Center which he deems appropriate for fixing "the throne of God ... in the heavenly Sanctuary."[1] Whatever scientific merits this thesis may have, virtually *banishing* God in this way to a remote location within the universe of his own creation hardly comports with the eternal and *omnipresent* God of Scripture who is in no wise confined by *any* space time constraints.

As Creator of all that is seen and unseen, God need not even *tip his hand* as to how he created or still creates, which is the central issue behind dialogue #3.[2] Human limitations simply preclude any *objective* decision as to the possibility of God's kenotic "hand" operating within *material nature*. But then, perhaps there is no such "hand" to be sought. Following Howard Van Till, the perceived absence of any such "hand" would be fully expected if his handiwork imbues the entire created universe. Denial of Christ is another "belief" position equally consistent with the perceived absence of any "hand" or even handiwork. Nevertheless, believers and "unbelievers" alike must always enter by the same "gate" where available evidence remains underdetermined. Divergent belief expectations notwithstanding, each will find their particular "belief" position to have been validated in accordance with their own expectations.

Therefore dwelling upon "defeating" naturalism or materialism seems an inadequate approach that is inherently limited in virtue of not calculating the function of deep "conversion" into the larger picture. An appreciation of the deep structure of naturalism[3] might help to clarify this multi-leveled issue. Beyond this, however, far more than a merely esoteric interaction between theology and science is at stake.

In dialogue #1, Ross McKenzie delves to the required depth by identifying the sort of eye-opening knowledge, even authentic enlightenment, which is available in principle to *anyone* who is sufficiently docile. Unfortunately this is "only accessible to those who already know God through revelation and redemption."[4] If docility and enlightenment through Christ truly function as enabling imperatives, as *sine qua non* preconditions for true understanding, presumably the pursuit of prayer for conversion would integrally bind these three dialogues together in a crucial way. Therefore a plea for persistent and genuine prayer on behalf of all unbelievers, wisely including ourselves, seems to be the very heart of this deeply compelling and convoluted matter.

### Notes

[1]Robert V. Gentry, "Collapse of Big Bang Cosmology and the Emergence of the New Cosmic Center Model of the Universe," *Perspectives on Science and Christian Faith (PSCF)* 56, no. 4 (2004): 275.

[2]James Madden and Mark Discher, "What Intelligent Design Does and Does Not Imply, *PSCF* 56, no. 4 (2004): 286–91; Howard J. Van Till, "Is the ID Movement Capable of Defeating Naturalism? A Response to Madden and Discher," *PSCF* 56, no. 4 (2004): 292–5; and Madden and Discher, "What Would Count as Defeating Naturalism? A Reply to Van Till," *PSCF* 56, no. 4 (2004): 296–8.

[3]T. J. Trenn "What is the Deep Structure of 'Naturalism'?" *PSCF* 54, no. 1 (2002): 39–40.

[4]Ross H. McKenzie, "Foundations of the Dialogue between the Physical Sciences and Theology, *PSCF* 56, no. 4 (2004): 252.

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## Natural History in Seventy Words: A Contribution to the Cosmology Dialogue

In the beginning, the Spirit of God stirred absolute nothingness. The stirring generated waves that turned into physical matter with relative space-time and the other laws of nature. Then God dispersed the matter that eventually formed into galaxies. Roughly ten billion years later, God intervened to bring forth the first cellular life, and God continued to orchestrate mutations and natural selection that culminated with the formation of anatomically modern humans.

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## Is Carter's Critique Relevant?

Carter's March rebuttal (*PSCF* 57 [2005]: 77) of my December letter (*PSCF* 56 [2004]: 309) illustrates the problem I attempted to address. I am not in the least surprised that the group he references found Mannoia's paper excellent: she punched the right evangelical buttons. It is universally acknowledged that matters where one is deeply involved are the most difficult to evaluate rationally. Pro-life is the current evangelical shibboleth, not to be challenged.

Carter taxes me with misinterpreting Mannoia's appeal to intuition. Perhaps, but she builds her case in part on our feeling that "embryos are indeed persons." This precisely parallels the feeling of slaveholders that Negroes were not persons, with all the consequent evils. While it is certain that attitudes motivate actions, they do not establish the morality of efforts. I take this to be a consequent of her statement. I stand by my criticism.

Carter then challenges my critique of equating having a history with being a person by bringing in values. One may claim that an entity with a history has a value, but it may also have a disvalue. If one is orthodox, he believes that Satan has a history. But the father of lies lacks positive value. Some things are intrinsically good; some, extrinsically good. Some share both types of value. There are similar evil characterizations. I fear Carter has not thought matters through.

In this connection, I am delighted that he could ascertain Mannoia's intent, writing: "... Mannoia means no more than this." He repeats this feat in his penultimate paragraph. I was restricted to the published text, for I lack the insight of the seer. I only tried to treat the statements honestly.

Carter arbitrarily dismisses my recognition that many, if not most, zygotes fail to implant. But if each zygote *is* a person, then God's purpose must be to multiply the number of souls in heaven (or limbo, depending on one's theology). Thus we may increase the number of such souls by expanding hES production, each new stem cell line producing a new eternal soul. The fact that unfertilized ova may be stimulated to mimic zygotes also bears on this, though Turner's syndrome (single X female), which Carter mentions, has a different etiology. May I suggest that the entire matter requires more careful thought?

Carter twists my quotation of Caiaphas in order to proclaim it nonsense. What he tries to make me argue is nonsensical. Why would I suggest, contrary to the passage, that Caiaphas was volunteering? The parallel is not the individual's choice of giving himself as Christ did—no embryo can do that—but of physicians and egg and sperm donors using embryos to produce benefits for others. Does not this match Caiaphas' claim that Jesus be sacrificed to benefit the nation?

I noted a factual error and Carter commented, "Apparently everyone but Siemens snoozed past that one! But did they?" immediately invoking the church fathers. I can make no sense out of this loaded language beyond the fact that I have not pronounced the evangelical shibboleth.

Carter's final charge is that I am too hard on a student, as if I gave Mannoia a grade. Are students not responsible for facts, for logic, for the consequences of their claims? This does not require that every lapse result in failure. Still, when I read students' papers, especially the better ones, I called attention to problems. But I wonder if this is the real objection. Is the underlying difficulty that I have, behind Mannoia's text, noted the lacks in the pro-life underpinnings? Any challenge to dogma, real or imagined, produces strong reactions, rather like Carter's. But these areas, more than others, require rational analysis. Like it or not, we have to act on incomplete information. Instead of closing our minds, we should recognize the fallibility of our moral claims, even as we note that scientific laws are corrigible.

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## Copernicus Clarified

It has been called to my attention that, in my recent review (*PSCF* 56, no. 4 [2004]: 299–300) of Owen Gingerich's volume *The Book Nobody Read: Chasing the Revolutions of Nicholaus Copeprnicus*, I confused Copernicus with Tycho Brahe in stating that Copernicus advocated a *dual revolutionary* hypothesis whereby the planets revolved around the earth and the earth, in turn, revolved around the sun. In fact, Copernicus contended that *all* the planets revolved around the sun.

Further, my review stated incorrectly that Copernicus was a priest. This was not true in spite of the fact that he served as a canon of the cathedral at Frauenberg, Poland. Although, as a church administrator, there was the possibility that he would become the successor to his uncle, the bishop of the northern-most diocese of Poland, Copernicus made the decision to forego the priesthood and to turn his primary attention to the study of astronomy.

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