

PERSPECTIVES on Science and Christian Faith

JOURNAL OF THE AMERICAN SCIENTIFIC AFFILIATION

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*"The fear of the Lord
is the beginning of wisdom."*

Psalm 111:10

Editor

ROMAN J. MILLER (Eastern Mennonite University)
4956 Singers Glen Rd., Harrisonburg, VA 22802
millerjr@rica.net

Incoming Editor

ARIE LEEGWATER (Calvin College)
Grand Rapids, MI 49546
leeg@calvin.edu

Managing Editor

LYN BERG (American Scientific Affiliation)
PO Box 668, Ipswich, MA 01938-0668
lyn@asa3.org

Book Review Editor

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212 Western Hills Dr., Siloam Springs, AR 72761
richardanne@cox.net

Incoming Book Review Editors

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3900 Lomaland Dr.
San Diego, CA 92106
rflietst@pointloma.edu

JAMES C. PETERSON (McMaster University Divinity College and Faculty of Health Sciences)
1280 Main Street West
Hamilton, ON L8S 4K1 Canada
peterso@mcmaster.ca

ARIE LEEGWATER (Calvin College)
1726 Knollcrest Circle SE
Grand Rapids, MI 49546-4403
leeg@calvin.edu

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2. Authors must submit **an electronic copy of the manuscript formatted in Word** as an email attachment. Typically 2–3 anonymous reviewers critique each manuscript submitted for publication.
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.

ARTICLES are major treatments of a particular subject relating science to a Christian position. Such papers should be at least 2,000 words but **not more than 6,000 words in length**, excluding endnotes. An abstract of 50–150 words is required. Publication for such papers normally takes 9–12 months from the time of acceptance.

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- **James C. Peterson** (peterso@mcmaster.ca): theology, ethics, biblical studies, philosophy, apologetics, bioethics, genetics, and medical education.
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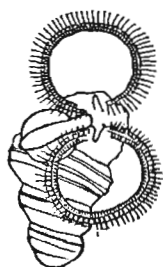
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Transitions: A Way of Life

One indication of vitality is growth and repeated transformations. We see it when our children move through predictable somatic and psychological changes as they progress through childhood into adulthood. Nature is replete with metamorphic renovations as juvenile forms give way to more mature forms. The trochophore (free-swimming larva with cilia) and the veliger (second larval stage seen in the diagram above with beginnings of foot, shell, and mantle) bear faint resemblances to their end product, the mature bivalve mollusk that forms the basis of a tasty meal.

Institutional vitality is frequently enhanced with transitions. New people bring new ideas and approaches. However with time those new ideas become traditional, staid, and standardized. Frequently, the infusion of new persons is again needed to bring a new freshness, a welcome change.

From its humble beginnings in 1949, *Perspectives on Science and Christian Faith* (formerly *Journal of the American Scientific Affiliation*) has been altered and improved many times over with the arrival and departure of multiple editors and their staffs. With this journal issue we now mark another such editorial transition.

I have appreciated the opportunity to serve as *PSCF* editor from December 1999 through the current issue. I have learned and grown by reading manuscripts (that I normally would not have read), communicating with authors and reviewers, and being forced to write the letter that declines to publish a specific manuscript. The success of the journal during the past years has been due to a very capable team that provided consistent service and expertise. Managing editor Lyn Berg has been a delightful co-laborer. She has consistently managed to make the issue "come out right" even when some details seemed to be lacking. Book review editor Richard Ruble successfully managed the myriad details in selecting books for review, editing reviewer critiques, and providing that information for the book review section of the journal. The copy readers, Kelly Story and Robert Greenhow, capably flagged most of the errors of commission and some of the errors of omission that were seemingly embedded in the text. Finally, the participation of editorial board members in giving advice and encouragement as well as umpiring some of the difficult decisions about manuscript acceptances has helped to improve our journal. To all of you, I simply say, "Thank you for your service and participation. It has been a pleasure to work with you."

I have confidence that Arie Leegwater, the incoming editor, will bring welcome changes in style, content, and approaches in 2008 and the years following. I look forward to seeing the transforming metamorphosis of the journal from its trochophoric to veligeric form. ★

Shalom.

Roman J. Miller, Editor

In This Issue

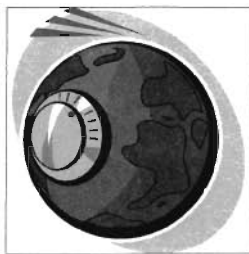
The contentious problem of global warming fills the first pages of this journal issue. Thomas Ackerman provides a scientific summary of global warming which is followed by Loren Swartzendruber's sermonizing perspective. Most of the remaining articles and communications of the issue deal with various aspects of science education. Your responses and reflections, if voiced as letters to the editor, may provide continuing dialogue on these important matters. Finally, we conclude the issue with book reviews, letters to the editor, and a three-year index.

Looking Back: The Journal 50 Years Ago!

Fifty years ago in the December 1957 issue, the *Journal of the American Scientific Affiliation* published three major articles:

- "Crossing In Relation to the Origin of New Groups" by William J. Tinkle, Anderson College
- "How the Study of Science. Has Increased My Faith" by H. Harold Hartzler, Goshen College
- "The Scientific Method and Faith" by John C. Sinclair, UCLA

To hear these voices from the past, you can access these articles as well as several communications from that issue at the ASA website by using the following link:
www.asa3.org/ASA/PSCF/1957/PSCF12-57dyn.html



Article

Global Warming: Scientific Basis and Christian Responses

Thomas Ackerman



Thomas Ackerman

Global warming has become a divisive force in American politics and in American life, a division which has extended to the evangelical Christian community.

From the Book of Job, Chapter 38:1, 33–37:

¹ Then the LORD answered Job out of the storm. He said:

³³ Do you know the laws of the heavens? Can you set up God's dominion over the earth?

³⁴ Can you raise your voice to the clouds and cover yourself with a flood of water?

³⁵ Do you send the lightning bolts on their way? Do they report to you, "Here we are?"

³⁶ Who endowed the heart with wisdom or gave understanding to the mind?

³⁷ Who has the wisdom to count the clouds? Who can tip over the water jars of the heavens when the dust becomes hard and the clods of earth stick together?

The era of procrastination, of half measures, of soothing and baffling expedients, of delays, is coming to its close. In its place we are entering a period of consequences – Winston Churchill, 1936.

In the last twenty years, the science of greenhouse gases and global warming has moved from the often stuffy pages of academic journals to the front pages of newspapers and even to the movie theater. It has become the subject of international reports,¹ international conferences and protocols,² and Congressional hearings. It has become a divisive force in American politics and in American life, a division which has extended to the evangelical Christian community. The Evangelical Climate Initiative, representing one segment of the evangelical community has produced a statement that proclaims the reality of global warming and its serious consequences and the urgent need for evangelicals to respond.³ In rebuttal, the Interfaith Stewardship Alliance

claims that global warming, if happening at all, is natural and benign, and evangelicals should actively oppose any measures to mitigate it.⁴ The result is that many citizens of the United States, including Christians, find themselves conflicted about the facts of global warming and the role of humankind in climate change.

In this article, it is my goal to address two broad themes. The first is the scientific basis of climate change, which I address by answering a set of science questions:

1. Is climate changing and, if so, on what time scale?
2. Do we understand the role of greenhouse gases in climate and climate change?
3. What is the impact of human activities on greenhouse gas concentrations compared to those of natural processes? Can these activities impact global climate?
4. Can we predict climate change during this century? What confidence should we have in such predictions?

The second theme is how evangelical Christians are responding to this issue. I attempt to categorize these responses under several headings. I end with my own personal response.

Thomas Ackerman attended Christian day schools from first grade through high school. He received a B.A. in physics in 1970 from Calvin College (Grand Rapids, MI), a M.Sc. in physics in 1971 from the University of Washington (UW, Seattle, WA) and a Ph.D. in atmospheric sciences in 1976, also from the UW. He is currently a professor in the Atmospheric Sciences Department at the UW and director of the Joint Institute for the Study of the Atmosphere and Ocean. He was previously the chief scientist for the Department of Energy's Atmospheric Radiation Measurement Program and a professor in the Department of Meteorology at the Pennsylvania State University. He has received the Leo Szilard Award for Science in the Public Interest from the American Physical Society and the NASA Distinguished Public Service Medal. He and his wife Linda have three children and one granddaughter.

Is climate changing and, if so, on what time scale?

Earth scientists (a term which refers collectively to scientists interested in atmospheric sciences, oceanography, polar processes, geosciences, and Earth climate history) deal with a very broad range of time scales. This range separates into three categories: weather (one to fourteen days), climate (year to centuries), and geological time (thousands of years to millennia and beyond).⁵ From a mathematical perspective, weather prediction is an initial condition problem. We specify a mathematical model of atmospheric fluid dynamics and associated physics, initialize that model with the current state of the atmosphere, and then integrate forward in time to predict the future state. Such predictive efforts, while very accurate in the time frame of a few days, decline in accuracy with time, generally failing to demonstrate any skill after about ten days. While we have extended the limit of useful prediction in the last few decades, there are real temporal limits to predictability due to our incomplete understanding of the weather system and our inability to specify completely and accurately the initial state of the atmosphere.

Climate, on the other hand, is a boundary condition problem. We take the same mathematical model (actually, one that is more complex because it must include a coupled ocean model and sea ice model) and now integrate it forward in time constrained by energy fluxes at the boundaries, primarily the top of the atmosphere. These include the changes in the energy output of the sun, orbital parameters for the earth which affect the amount of solar energy intercepted by the earth, and atmospheric composition. It may seem odd to include atmospheric composition as a "boundary" condition, but we do so because, except for water vapor, the important constituents of the atmosphere are largely unaffected by climate processes on the decadal to century time scale. Hence, they are specified externally rather than calculated within the model. Determining the accuracy of climate prediction is difficult and will be discussed later.

The important distinction between weather and climate prediction is that, on the climate scale, we make no claim to predict actual events. We are instead predicting the statistical envelope of weather events, which we aggregate to call climate. This point may be somewhat clearer if we consider the annual Fourth of July picnic. If we are asked in January to predict the weather on July 4, any reputable meteorologist will answer that it is impossible to do so. If we are asked to predict the climate on July 4, we can do so easily by accessing the record of observed weather and providing a statistical description of the mean temperature, likely range of temperatures and probability of rainfall. The fact that we cannot predict the exact weather on next July 4 has no bearing on our ability to predict the climate on July 4.

Changes on geological time scales are generally connected to changes in the boundary conditions of climate. These include changes in the solar energy output, long period cycles in the earth's orbital parameters, continental drift, and atmospheric composition. Our knowledge of changes on geological time scales is a mixture of what we infer from geological records and fairly simple models of large scale physics and chemistry. While we have considerable understanding of geological history, our predictive capability is very limited.

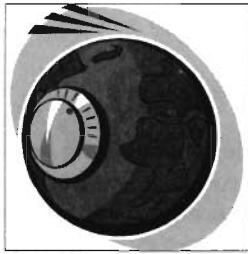
We are concerned here with change on climate time scales. The simplest variable that we can examine is the surface air temperature, since it has been measured in many places for decades to centuries. Reliable measurements on a global scale are available from about the mid-1800s and have been used to reconstruct temperature (Figure 1, p. 252). Surface air temperatures were generally unchanged from 1850 to 1900, increased somewhat from 1900 to 1940, decreased and flattened from 1940 to 1975, and then experienced a rapid rise from 1975 to 2005. Although the total change is small (less than 1 °C), this must be compared with the change in global temperature between the last glacial 20,000 years ago and the current interglacial, which is between 5 and 8 °C, or about 1 °C per 2,500 to 4,000 years. Thus a 1 °C change in one hundred years represents a significant fraction of that change and a very rapid acceleration of the rate of change.

There are many other indicators of a warming climate; we list some here without further discussion. References and further detail are available in the International Panel on Climate Change (IPCC) reports.⁶ These indicators include:

- Warming of the atmosphere over the last fifty years consistent with the changes in surface temperature
- Warming of the ocean
- Decrease in late summer arctic sea ice extent by 25% since 1900, mostly since 1950, and a corresponding decrease in sea ice thickness
- Retreat of almost every glacier in the world
- Lengthening of the growing season in the United States by three to five days in the last century
- Shifts in the poleward migration of birds and insects in the northern hemisphere toward earlier dates in the spring

The evidence of the last century, particularly the last quarter century, clearly shows a warming climate. In addition, the warming rate has accelerated over the last few decades (Figure 1).

A related question is whether this change is part of some longer term natural cycle. Although we do not have enough globally-distributed thermometer records that extend back in time, climate proxies—tree rings, coral growth, or lake sediment cores, for example—can tell



Based on thermometer records and other indicators, our climate is warming. The last decade or two are warmer than any comparable period in the last millennium. Further, the rate of warming is unprecedented in that same time period.

Article

Global Warming: Scientific Basis and Christian Responses

us about relatively warm and relatively cool periods. Figure 2 (p. 253) depicts a 1200-year record of temperature anomalies (differences from the mean temperature) based on these climate proxies. The diagram tells us one fact immediately. There is no simple cycle of warming and cooling recorded over the last 1200 years. The scientists who constructed this diagram carried out a statistical analysis of the records to determine whether the peaks and valleys could have occurred by random chance. The highest solid line represents a 99% confidence level that any events above this line did not occur by random chance. As we can see, the warming of the last fifty years is the greatest in the entire record, and there is a vanishing probability that this occurred by chance.

Based on thermometer records and other indicators, our climate is warming. The last decade or two are warmer than any comparable period in the last millennium. Further, the rate of warming is unprecedented in that same time period.

Do we understand the role of greenhouse gases in climate and climate change?

The so-called greenhouse effect is an indispensable component of the earth's climate.

Solar radiation passes through our atmosphere, largely unattenuated by absorption, although about 30% of the incident radiation is reflected back to space by the atmosphere and the earth's surface. Outside of the air molecules themselves, the largest contributors to reflection are clouds and snow and ice surfaces. The earth's system balances this absorbed solar radiation by radiating heat to space at thermal infrared wavelengths over a range from about six to one hundred micrometers. The Stefan-Boltzmann equation relates infrared radiation to the temperature of a thermal black-body as

$$F = \sigma T^4$$

where F is the radiated energy flux, T is the black body temperature and σ is a constant. The equivalent black-body temperature of the earth as observed from space is 254 K or -19°C . Obviously, the earth's surface temperature is not this cold. In fact the average surface air temperature is about 286 K or 13°C . The reason for this warm surface temperature is well understood. The earth's surface, both land and water, emit thermal radiation. This thermal radiation is absorbed by the atmosphere, which in turn radiates energy back toward the surface, as well as to space. This downward radiation from the atmosphere, which we call the greenhouse effect, is responsible for the additional heating of the earth's surface that makes life as

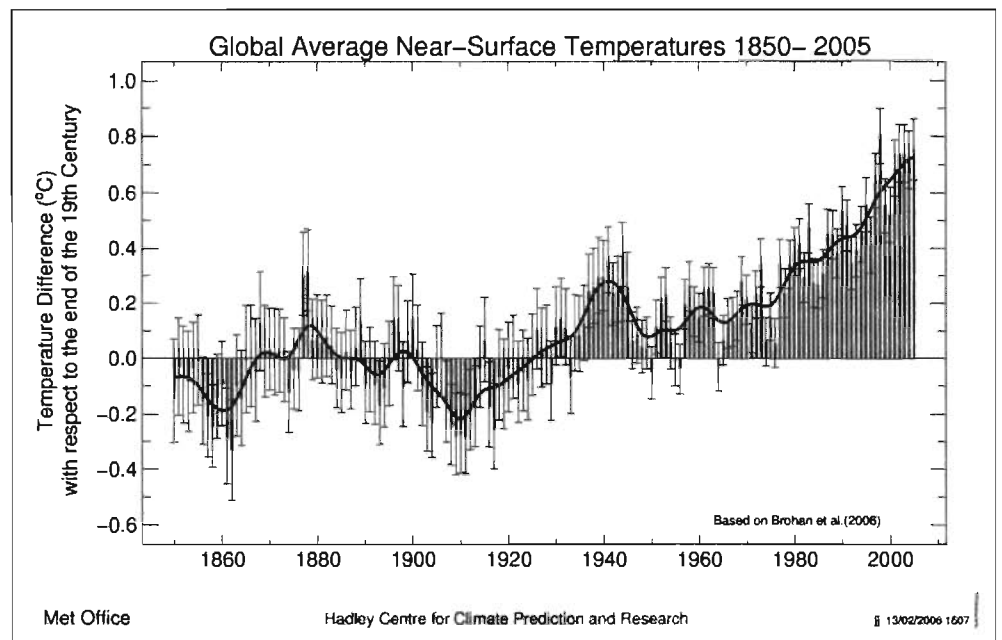


Figure 1. Surface air temperature plotted as a difference (in C) from the temperature from the value in 1900. The dark bars are the annual mean with the standard deviation indicated by the gray lines. The black curve is smoothed using a running average. (Courtesy of the Hadley Center, British Met Office, United Kingdom)

we know it possible. It is this radiation that prevents precipitous temperature drops at night or on very cloudy days.

The three principal greenhouse gases in the atmosphere are water vapor, carbon dioxide, and ozone. Water vapor is by far the most important, but the amount of water vapor in the atmosphere is closely regulated by temperature as described by the Clausius-Clapyron equation for saturation vapor pressure.⁷ When the vapor pressure of water in any air parcel reaches the saturation vapor pressure, condensation occurs and the excess water is removed from the atmosphere as precipitation.

Unlike water vapor, the global, annual-average atmospheric carbon dioxide (CO₂) concentration is unaffected by the state of the atmosphere itself. In the absence of human activity, annual average CO₂ concentrations are stable on time scales of millennia, as we can determine from ice cores (more on this later). When CO₂ concentrations do increase, then the atmospheric greenhouse effect increases, the thermal infrared radiation from the atmosphere increases, and surface temperatures increase. Ozone concentrations peak at altitudes of 25 to 35 km (the stratosphere) above the earth's surface due to chemical processes. Consequently, ozone is relatively unimportant in regulating near-surface temperatures but is very important in regulating stratospheric temperatures.

Radiative transfer, the physics of radiant energy movement in the climate system, is very well understood. Given an adequate description of the properties of a column of atmosphere, we can compute the solar radiation reaching the surface to an accuracy better than a few percent. Similarly, we can compute the downwelling thermal infrared radiation from the atmosphere, the greenhouse effect, to a few percent. We can match calculated and measured infrared spectra (radiation measured as a function of frequency or wavelength) to the same level of accuracy,

which demonstrates that we understand the detailed physics and chemistry of these gases. In fact, if we did not understand these processes as well as we do, we would not be able to make useful weather forecasts for more than a few hours.

We understand the role of greenhouse gases in regulating our current climate. It is important to ask whether we understand the role of greenhouse gases in past climate. This is an extremely interesting question, especially when considered over the total span of Earth climate history. Here we focus only on the last 500,000 years. Information on Earth history over this period comes primarily from ice cores. When snow compacts and turns to ice, small air bubbles are trapped in the ice. These bubbles retain the atmospheric composition of the time in which they were trapped in the column. So, if we drill an ice core in an undisturbed ice sheet, we can measure atmospheric concentration as a function of time. The longest ice core that we have is the Vostok core from Antarctica (Figure 3, p. 254). The 100,000 year cycles evident in this record are the Pleistocene ice ages. The most recent glaciation ended about 20,000 years ago and we are currently in a warm interglacial. The CO₂ curve exhibits a very similar behavior, indicating that Earth's temperature and CO₂ concentrations are intimately connected. Our current understanding of this trace of Earth climate history is that transitions between glacial and interglacial are triggered by changes in Earth's orbital parameters—the tilt of the earth's axis, the eccentricity (departure from sphericity) of the earth's orbit around the sun, and the precession of the earth's axis. CO₂ concentrations are part of a feedback loop where warmer temperatures release more CO₂, which then creates more warming through the greenhouse effect, which then releases more CO₂, etc. Thus, CO₂ concentrations are driving and are driven by temperature change on a geological time frame (millennia and longer).

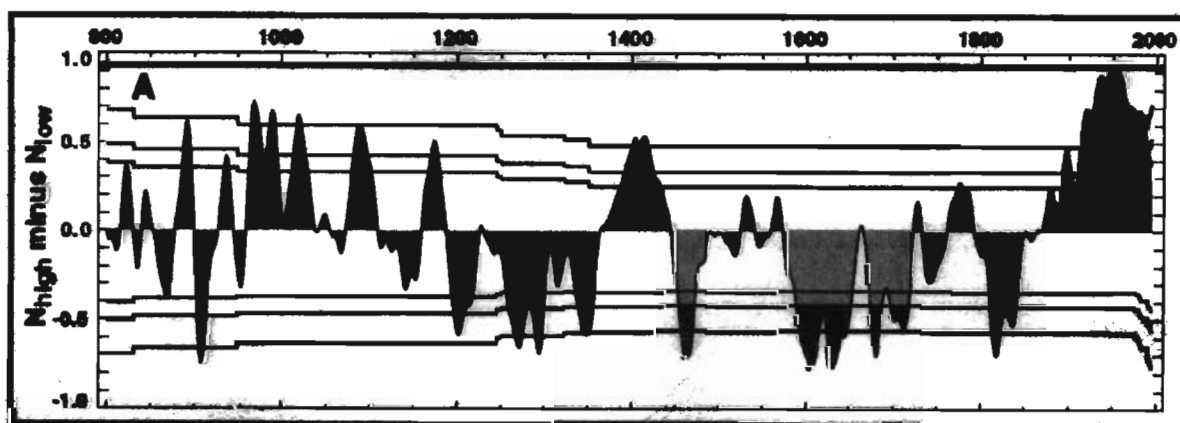
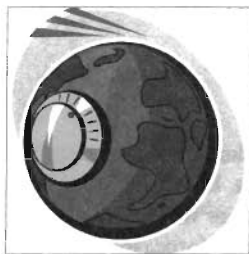


Figure 2. A statistical evaluation of temperature anomalies (difference from the mean) from climate proxies over the last 1200 years. Warm anomalies are shown as positive deflections and cold anomalies as negative ones. The solid lines represent confidence limits of 1, 2 and 3 standard deviations that the anomalies are not due to simple random events. The positive peaks around AD 1000 are the so-called Medieval Warm Period and the negative peaks from 1600 to 1850 are the Little Ice Age (from Osbourn and Briffa, *Science*, 2006).



Each American is currently responsible for adding five to six metric tonnes of carbon to the atmosphere each year through fossil fuel use. The aggregate of all this emission adds to the atmospheric burden of CO₂, which warms the planetary surface and atmosphere via the greenhouse effect.

Article

Global Warming: Scientific Basis and Christian Responses

What is the impact of human activities on greenhouse gas concentrations compared to those of natural processes?

Can these activities impact global climate?

The current CO₂ concentration is 385 ppmv.⁸ Human activity is currently increasing that concentration by a few ppmv every year (Fig. 4, p. 255). The CO₂ concentration began to increase from its pre-industrial value of 285 ppmv about 1850 and the rate of increase has accelerated with time. As we can see from the Vostok ice core record (Figure 3), CO₂ concentrations have varied between 180 and 280 ppmv over the last half million years. Thus, current values are the highest that have occurred in more than 500,000 years.

Natural variations in CO₂ concentrations can be seen in the annual cycle evident in Figure 4. The natural variability in the northern hemisphere summer is due to the annual growth of vegetation, which consumes CO₂, and in the winter, to respiration and decay, which releases CO₂. The average slope is the increase of CO₂ in the atmosphere due to the burning of fossil fuels. All combustion processes essentially turn carbon-based fuel and oxygen into H₂O (vapor) and CO₂.

The vast majority of natural atmospheric carbon has an atomic weight of 12, which scientists typically denote as ¹²C. A very small percentage of atmospheric carbon is Carbon 14 (¹⁴C), a naturally occurring radioactive carbon isotope with an atomic weight of 14. ¹⁴C is produced in the atmosphere at a roughly constant rate by the influx of high-energy cosmic rays from the sun. A cosmic ray can combine with a ¹²C atom to form a ¹⁴C atom. Because the latter is naturally radioactive, it decays spontaneously to ¹²C at a well-known rate.⁹ All living organisms, including humans, contain small amounts of this naturally occurring radioactive ¹⁴C. But, fossil fuel has no ¹⁴C because any ¹⁴C present at burial has decayed long ago and no additional ¹⁴C is produced deep in the earth.

From measurements of isotopic ratios, we know that the ratio of ¹⁴C to ¹²C (the abundant stable isotope of carbon) in the atmosphere is currently decreasing. From this, we conclude that the additional CO₂ being injected into the atmosphere is primarily from fossil fuel rather than any changes in the natural carbon cycle. We also know the rate at which fossil fuel is produced and consumed. The increase in atmospheric CO₂ represents about 50–60% of the emitted CO₂ from fossil fuel. The remainder is dissolved into the mixed layer¹⁰ of the ocean or stored in the biota on land.¹¹ Dissolving CO₂ into sea water produces carbonic acid. As a result,

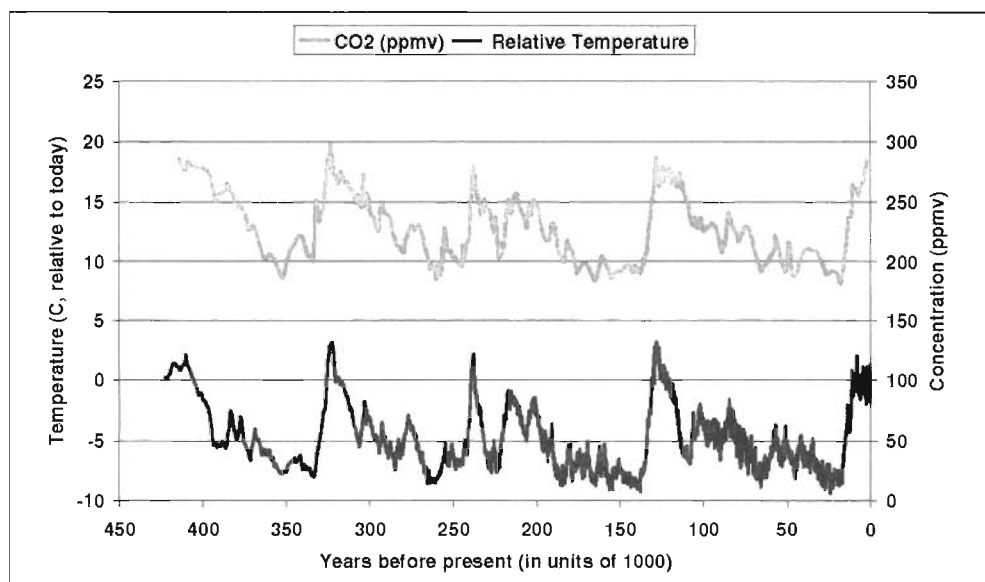


Figure 3. Data from the Vostok core drilled Antarctica. Times runs from left to right from 450,000 years before present to now. The temperature curve (lower) is calibrated in °C relative to current temperatures.

the mixed layer is slowly becoming more acidic with potentially serious consequences for ocean ecosystems such as coral reefs.

The amount of carbon cycled into and out of the atmosphere each year exceeds the amount added in one year by human activity (Figure 4). These two processes, however, are very different in their long term impact. The annual cycle represents a nearly conservative process—the same amount of CO_2 is added to and removed from the atmosphere each year. The only way to alter this natural cycle is an absolutely massive change in the earth's biological productivity. Humans have altered the biomass through deforestation in the tropics, but have actually re-forested major pieces of North America during the last century. Human activity, on the other hand, is a one-way process. Each year we add a few more ppmv to the atmosphere, increasing the overall burden of CO_2 in the atmosphere.

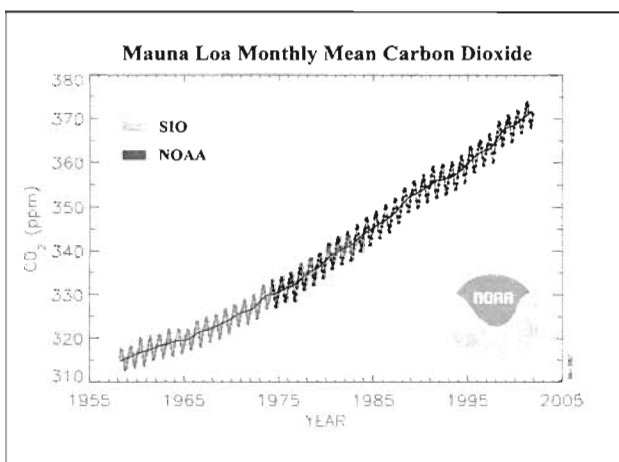


Figure 4. Monthly mean values of carbon dioxide measured at Mauna Loa Observatory, Hawaii. Data in the early years are from the Scripps Institution of Oceanography (SIO) and in the later years from NOAA. Similar curves with different annual cycles are available from Barrow, Alaska, American Samoa, and Antarctica.

One often hears the comment that human activity could not possibly affect climate because the earth is large and humans are small. We learned differently in the 1980s when we discovered decreasing ozone everywhere and the massive ozone hole over Antarctica. Ozone is indeed being destroyed by the chlorine and fluorine compounds that we were using for refrigeration and gaseous propellants. While each individual contribution was small, the number of humans is very large and the aggregate can affect our atmosphere. The same is true for CO_2 . Human activity has increased the CO_2 concentration by 35% in the last one hundred years or so. Each American is currently responsible for adding five to six metric tonnes¹² of carbon to the atmosphere each year through fossil fuel use. The aggregate of all this emission adds to the atmospheric burden of CO_2 , which warms the planetary surface and atmosphere via the greenhouse effect.

Can we predict climate change during this century?

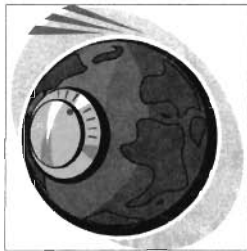
What confidence should we have in such predictions?

This is the critical question. We know that CO_2 is a greenhouse gas and warms the current climate system. Adding additional CO_2 (or any other greenhouse gas) to the atmosphere must warm the climate system, particularly the surface. The process is a bit like adding insulation to the attic of your house. If you put the same amount of heat into the house (the solar radiation into the planet), then the temperature in the house must increase because the insulation makes it more difficult to conduct that heat to the outside atmosphere. Adding more CO_2 to the atmosphere makes it more difficult for the earth's surface to radiate heat energy to space. So the real question becomes how much will the earth's climate system warm during this century as CO_2 concentrations increase?

Predicting the change in temperature for the earth's system due to increasing CO_2 is complicated because the earth's system is complex and climate is controlled by complex feedback loops. A feedback loop is a linkage of two (or more) components of a system that exhibit a round-trip information flow, i.e., changes in one produces changes in the other and vice versa. A detailed exposition of climate feedbacks is not possible here but a brief discussion is necessary.

The most important feedback loop in the climate system is between atmospheric temperature and water vapor. The amount of water in a parcel of air is limited by the saturation vapor pressure which is a function of temperature only. Thus, if we warm a parcel of air, we can evaporate more water vapor into that parcel. Saturation vapor pressure increases exponentially with temperature, and water vapor is the most potent greenhouse gas in the atmosphere. So, if the atmosphere warms, more water evaporates into the atmosphere, further warming the atmosphere and further increasing the amount of water. This loop is a positive loop because it enhances the original change. Water vapor feedback is so powerful that it amplifies the heating due to increasing CO_2 concentrations by a factor of two to four. Most positive feedback loops have some process that eventually stops the amplification. If not, the process becomes "runaway" and the system exhibits some form of catastrophic collapse. In the case of the atmosphere, a warmer atmosphere radiates heat energy more effectively to space. So, at some point, the increasing loss of radiation energy to space balances the increased radiational heating due to absorption by water vapor and prevents a drastic runaway.

A second, well-understood feedback loop is between temperature, ice cover, and solar radiation. Ice is highly



In order to ask what the future holds, we need to create scenarios of changes in climate forcing over the next century ... [M]odels are typically run for a series of scenarios based on a range of assumptions ... All climate models and all scenarios produce significant climate warming of 2–4 °C in surface air temperature by 2100 or sooner.

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reflective; it increases the solar reflectivity of the earth, also known as the earth albedo. If the earth warms, the amount of ice cover decreases, the reflectivity decreases thereby increasing the absorption of solar radiation and the earth warms further. This again is a positive feedback.

The most complex feedback loops involve clouds. Clouds regulate solar absorption by their reflectivity but also regulate infrared energy loss by enhancing the atmospheric greenhouse effect. In the current earth's climate system, clouds act to reduce the planetary surface temperature—their ability to reflect solar energy exceeds their ability to increase the greenhouse effect. The question for climate prediction is how will these two cloud effects balance in a warmer world. The short answer is that our current models indicate that clouds are overall a positive feedback, tending to amplify CO₂ warming. However, there is substantial uncertainty in that answer because cloud processes are very difficult to model, especially on a global basis.

Simulations of climate are made with a global climate model (GCM). A GCM is the best possible mathematical representation of all the processes that affect climate in the atmosphere, ocean, and cryosphere (ice on land and ocean), as well as some of the biological connections. Because these equations cannot be solved analytically, they are solved computationally on a global mesh. The typical horizontal dimension of that mesh is 100–300 kilometers, which translates into some 8,000 to 10,000 grid squares on the earth's surface. The atmospheric column above each square is typically divided into twenty-five to thirty layers. We solve equations in each layer in each box for temperature, humidity, three components of the wind, and pressure (or height since pressure is usually the vertical coordinate of choice). The global domain and the intricate physics and chemistry of climate make GCMs among the most computationally intensive and complex computer codes ever written.

But climate models are at the same time too coarse in resolution to describe what we actually know about cloud processes, chemistry, and surface interactions over land and ocean. The limits of resolution are primarily dictated by computer time. Increasing the

resolution of a model by a factor of two (say, going from 200 to 100 km in horizontal resolution) essentially increases the computational time to run a model by a factor of ten. Since we are already stressing the largest computers in the world, increasing computational burdens by a factor of ten to one hundred or more is simply not possible at this point. This lack of resolution results in two major problems. The first is a lack of regional specificity in our simulations. Our current models cannot adequately simulate the actual complexity of land features such as mountains and coastlines, which limits the ability of the models to capture regional patterns of temperature and precipitation. The second is an increase in overall model uncertainty because sub-gridscale processes must be represented through parameterization rather than through explicit physical and chemical equations.

Clouds are a good example of this problem. The physics of cloud formation occurs on spatial scales from micrometers to hundreds of meters. These processes cannot be resolved by the coarse spatial grids of a GCM, so our models use statistical representations of clouds based on the model-predicted average values of wind, temperature, and moisture at a scale of one hundred kilometers or more. Because the statistical representations or parameterizations are not based exclusively on fundamental physics equations, they are not unique descriptors and vary from model to model depending on the best understanding of the model designers. This in turn introduces uncertainty into the models. Most importantly, it affects the strength of the cloud feedback loops and thereby introduces uncertainty into our simulations of future climate.

Given these factors, what can we say about climate change over the next century? Actually, we can say quite a bit! We have run our current GCMs for the current climate, particularly focusing on the last 150 years. When supplied with the combination of natural climate forcing (small variations in the incoming solar flux and volcanic aerosol) and human forcing (increasing greenhouse gas concentrations, changes in air quality, and changes in land surface cover), the models do a very credible job of predicting global surface temperature change over the past 150 years (Figure 5). Logically, this model

prediction of past climate is a necessary rather than sufficient condition. It is possible for a climate model to get the "right" answer for the "wrong" reason. Given the complexity of the models and the climate system itself, however, this degree of agreement gives us high confidence that the models are simulating climate correctly.

In order to ask what the future holds, we need to create scenarios of changes in climate forcing over the next century. These scenarios are essentially projections of population growth, economic development, and energy usage. Any individual scenario has large uncertainties so models are typically run for a series of scenarios based on a range of assumptions from "business as usual," which results in very large carbon emissions, to environmentally friendly, which reduces human carbon emissions to near-zero by later in the century. All climate models and all scenarios produce significant climate warming of 2–4 °C in surface air temperature by 2100 or sooner (Figure 6). The differences between scenarios (heavy lines) are considerably greater than the differences among models for a given scenario (shaded regions). This suggests that the models, although they have some differences, are largely consistent in their prediction of future climate warming.

The lowest curve in Figure 6 is also noteworthy. This curve represents the evolution of Earth's climate if the CO₂ concentration were fixed at the year 2000 level. The climate continues to warm because there is a large thermal lag in the warming of the ocean. Climate scientists call this the "commitment" that we have made to climate warming through the addition of CO₂ and other greenhouse gases to the atmosphere. Even if we are able to stop the addition of greenhouse gases to the atmosphere at some time in

the future, the climate system will continue to warm for an extended period of time.

Global surface air temperature is a simple but convenient way to represent climate change. In discussing climate change, the IPCC report¹³ identifies a large number of changes that models predict over this century. A short list includes:

- Sea level rise of two to three feet by the end of the century due to thermal expansion of the ocean (water expands in volume when heated), and possibly much larger increases if significant melting of the Greenland and/or the West Antarctic ice sheets occurs
- Further drying of the sub-tropical dry zones such as the Sahel and the Mediterranean Basin, leading to increased stress on arid land ecosystems
- Increased rain and increased rain intensity in mid-latitude rainbelts, leading to higher probability of extreme flood events
- Increases in Arctic region temperatures that are two to three times the global average, producing longer growing seasons, significantly more melting of the permafrost, loss of Arctic sea ice, and significant stresses on natural Arctic ecosystems
- Ocean acidification inhibiting the formation of carbonate shells by small sea creatures and causing perhaps irreversible damage to coral reef ecosystems when coupled with warming ocean temperatures

In any such list one can identify changes that may be regionally positive, but the bulk of the changes that

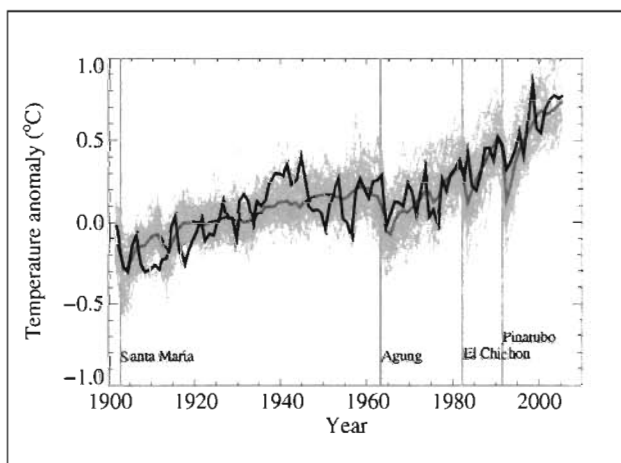


Figure 5. Global mean near-surface temperatures over the twentieth century from observations (heavy peaked line) and from fifty-eight simulations produced by fourteen different climate models driven by natural and human-caused factors that influence climate (grey background area). The lighter smoothed line depicts the mean of all fifty-eight runs. Temperature is plotted as the difference from the average from 1901 to 1950. Vertical grey lines indicate the timing of major volcanic eruptions. (Figure 8.1, IPCC Working Group 1, "Fourth Assessment Report.")

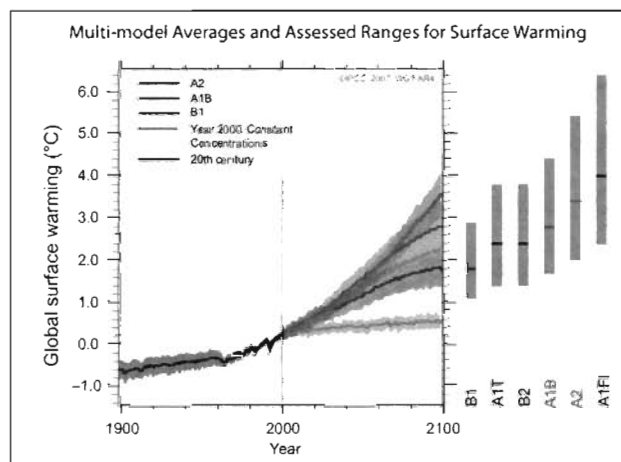


Figure 6. Global climate model simulations of projected climate change. A2, A1B, and B1 are differing scenarios of greenhouse gas emissions. Solid lines are the average of simulations by different models and the shaded areas represent one standard deviation in the model results. The bars at the right (dark line) provide best estimate and likely ranges at 2100 for all climate models as well as other techniques for estimating climate change due to greenhouse warming. The bottom curve shows warming over this century with greenhouse gas concentrations held constant at their year 2000 values. (Based on Figure SPM.5, IPCC Working Group 1, "Summary for Policy Makers.")



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(1) Cock-eyed
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(2) End-time
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(3) Denialists;
(4) Creation
care
proponents;
and (5) Social
justice
advocates.*

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we have identified are clearly negative. Recently, NASA Administrator Michael Griffin opined:

I guess I would ask which human beings—where and when—are to be accorded the privilege of deciding that this particular climate that we have right here today, right now is the best climate for all other human beings. I think that's a rather arrogant position for people to take.¹⁴

This view of climate change ignores the fact that natural ecosystems and human civilization have spent hundreds to thousands of years adapting to the current climate and will not easily adapt to rapid climate shifts over the short span of a century.

There is much more that can and has been said about climate change that awaits us over this century. The clear message from the climate science community is that, if we continue to add greenhouse gases to the atmosphere, warming will occur at a rate unprecedented in the last 10,000 years leading to global average temperatures warmer than at any time in the last 500,000 years. This warming will have large, but still somewhat uncertain, consequences for regional climate, particularly water resources. Most of these consequences will have negative impacts on the evolved natural ecosystems and human civilization. Ocean sea level rise and acidification will be harmful to coastal zones and small island countries, particularly in the tropical oceans. The Arctic region will see the most profound changes in climate and associated impacts on ecosystems and sustainability.¹⁵

Christian Responses to Climate Change

Our knowledge of climate science and understanding of CO₂-driven climate change has increased enormously over the past three decades. The preceding section is a very brief summary of the huge body of material summarized and cited in the IPCC reports. Textbooks containing more extensive summaries are appearing rapidly.¹⁶ For the most part, the world community has accepted the conclusions of the world scientific community as embodied in the IPCC reports. The Kyoto protocol, which seeks to begin the process of reducing CO₂ emission, was

signed in 1997 and has been ratified by 175 parties, including all of the developed countries of the world with two exceptions, Australia and the United States of America.

In the United States, opponents of the science of global warming go well beyond opposition to the Kyoto protocol alone to oppose the science itself and the attribution of current climate trends to increased greenhouse gases. The opponents come largely, but not exclusively, from the political right. Although there is no doubt that a large share of the opposition is driven by certain sectors of the business community (see, e.g., the editorial pages of the *Wall Street Journal* or the website of the Competitive Enterprise Institute), some members of the business community, including Ford Motor Company and General Motors Corporation, are beginning to address the greenhouse gas issue.¹⁷ Another significant share of the opposition, however, is drawn from the evangelical Christian community, the same community that supports such organizations such as the Christian Coalition of America and the Family Research Council. Recently, some fractures have occurred in this community as well, which raises the question of why this opposition has occurred and why some fractures are appearing now.

There is not a clear consensus on the definition of "evangelical." I use it here to refer to those Christians that believe in the sole authority and infallibility of the Bible, salvation only through the work of Jesus Christ, and a spiritually transformed personal life. The evangelical community includes most of the Baptist churches, Pentecostals, many independent community churches, and several small Presbyterian and Reformed denominations that have split off from the older mainline Protestant denominations. As a general rule, the evangelical Christian community is strongly aligned politically with the Republican party and very vocal on perceived issues of family and values. Among this community, one can identify five general categories of respondents to the issue of global warming:

1. Cock-eyed optimists
2. End-time militants
3. Denialists
4. Creation care proponents
5. Social justice advocates

I apologize in advance for the broad brush strokes used to describe briefly these positions, but some generalization is inevitable.

Cock-eyed Optimists. Evangelicals proclaim the goodness of God. Consequently, there is an implicit understanding in their worldview that God will provide for his people and that events in this world happen under God's control. Interpreting this statement in the presence of obvious evil and injustice in the world is one of the great intellectual challenges of Christianity. Some evangelicals tend to resolve this problem by simply declaring that God will provide all a believer's needs if he or she follows God's commandments. They also often argue that the United States has achieved its prosperity and strength because it is (or has been) a "Christian" nation blessed by God.

They take a similar position in discussions of the earth's resources and population. For example, *America's Providential History* states:

A secular society lacks faith in God's Providence, and consequently men find fewer natural resources. The secular or socialist has a limited-resource mentality and views the world as a pie (there is only so much) that needs to be cut up so that everyone can have a piece. In contrast, the Christian knows that the potential in God is unlimited and that there is no shortage of resources in God's earth.¹⁸

It is a simple step from this statement to conclude that the climate change issue is simply not a problem—God will provide. This particular view is popular with Christians who find climate change science difficult to understand and are conflicted by the multitude of opinions being heard within the Christian community. One trusts in God and therefore can dispense with the details.

Contemporary commentators from outside the evangelical community frequently refer to this position with bewilderment. In a recent column in the *Seattle Post-Intelligencer*, Mark Trabant wrote:

If you believe in literal truth—and the absolute, personal power of a Creator—then it doesn't really matter if we humans have fouled our own nest. We'll be taken care of later. That is a harsh way of dismissing the teaching of science, experimenting with stem cells or global warming.¹⁹

Few evangelicals would agree with this brutal characterization of their position, but it is worth pondering how this characterization came to exist.

End-time Militants. Believers in the Second Coming of Jesus Christ have long debated the chronology of events associated with the end times as deduced from biblical apocalyptic literature, particularly the Books of Daniel and Revelation. At one time, American Protestantism featured a range of positions on this chronology, differentiated to some degree by differences in opinion about the timing

of the Millennium, the 1,000 year reign of Christ at the end of time. During the last century, particularly the latter part, evangelicals in America became heavily invested in dispensational pre-millennialism with its strong emphasis on a literal interpretation of apocalyptic biblical literature, identification of current events as signs of the end times, and predictions of an imminent rapture. Even a cursory perusal of the dispensationalist (which has become the catch-word for pre-millennial adherents) media outlets whether in print, over the airwaves, or on the internet demonstrates that dispensational believers have also become extremely militant about their position on the end times, essentially declaring that no other position is biblically defensible.

The end-time militants are largely anti-environmentalists on two grounds. The first is fairly obvious. If the end is near, then why would one worry about preserving the climate of a planet that is soon to be destroyed by the wrath of God in the giant battle of Armageddon? In an article on his "Rapture Ready" website, Todd Strandberg writes:

In 2 Peter, we are told that someday the earth will undergo a fiery renovation. All of nature and everything man has created will be completely destroyed ... I know that environmentalists would bristle at the idea of a refurbished earth being the ultimate solution to all ecological problems. If the world is going to be "dissolved," there is no need for us to become too attached to it.²⁰

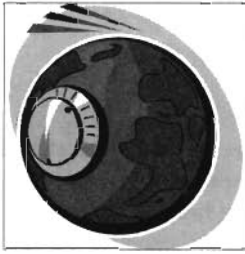
This statement is not unique; similar comments are quite easy to find. Strandberg is willing to carry this argument even further. In the same article, he writes:

The main job of a Christian leader is to guide lost souls to redemption ... In my view, any preacher who decides to get involved in environmental issues is like a heart surgeon who suddenly leaves an operation to fix a clogged toilet.²¹

In a thought-provoking article published in 2004 on the website *grist*, Glenn Scherer points out:

Forty-five senators and 186 representatives in 2003 earned 80- to 100-percent approval ratings from the nation's three most influential Christian right advocacy groups—the Christian Coalition, Eagle Forum, and Family Resource [sic] Council. Many of those same lawmakers also got flunking grades—less than 10 percent, on average—from the League of Conservation Voters last year.²²

His interpretation of these statistics is that the legislators' anti-environmentalism is derived from their end-time theology based on a literal reading of apocalyptic literature. This is a logical deduction but one that is difficult to substantiate because most politicians do not provide explanations for their legislative votes based on religious grounds.



[Cock-eyed optimists and end-time militants] choose not to deal with the issue of global warming although their reasons for not doing so are different. The creation care and social justice groups ... recognize the scientific basis of global warming and are convicted of the need to act now. The denialists are united by their rejection of global warming.

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One might argue that this split is party driven or largely tied to the perception that legislation favored by the Conservation Voters is anti-business, while the Christian right tends to be very pro-business. I think, however, that it is worth considering the role end-time theology plays in producing an anti-environment bias among legislators who are also evangelical Christians.

The second ground is perhaps even more difficult for those not familiar with dispensational theology to understand. Most end-time militants are convinced that the anti-Christ, the leader of the forces that will be arrayed against God at the end times, will be the representative of some world government. Quoting from again Strandberg:

The true goal of the environmental movement is to draw the world into a central body that would set the rules. This plan is part of the devil's master scheme to recreate the type of control he had during the time of the Babylonian Empire. The only way to get back to Babylon is to push for world unity. The environmental movement is a perfect disguise because it asks nations to surrender their sovereignty for a cause seemingly beneficial to all nations.²³

While Strandberg states this more bluntly than many, there is no doubt that a large majority of end-time militants sees the environmental movement as a monolithic force diametrically opposed to their religious beliefs.

End-time militants represent the most fervent evangelical opposition to the environmental movement in general and climate change in particular. Concerns about climate change are often literally seen as the work of the devil because the subject detracts from efforts to spread the Gospel, which is the only task of Christians given the imminence of the Second Coming, and because it supports the growth of the anti-Christ coalition. Those not familiar with dispensational theology may find this all to be seriously strange thought, but it is crystal clear to dispensational evangelicals.

Denialists. On July 28, 2003, Senator James Inhofe of Oklahoma concluded a speech on the floor of the Senate by stating:

With all of the hysteria, all of the fear, all of the phony science, could it be

that manmade global warming is the greatest hoax ever perpetrated on the American people? It sure sounds like it.²⁴

While Inhofe resides in Tulsa, OK, and has a long record of support for the oil and gas industry coupled with extreme anti-environment positions, he is also a fundamentalist Christian.²⁵ His comments represent another common evangelical position on climate change, one often coupled closely with the end-times response.

The Interfaith Stewardship Alliance (ISA), principally organized by Calvin Beisner of Knox Theological Seminary, is probably the leading expositor of this position.²⁶ Beisner and his colleagues argue that (1) recent and foreseeable climate change are largely natural in cause rather than the result of human activity, (2) climate change over this century will be moderate rather than catastrophic, (3) increased CO₂ will be good for plants and thereby help feed the world, (4) current plans such as Kyoto protocol would not produce significant mitigation, and (5) such efforts would seriously hurt the world's poor. These particular arguments are not novel nor confined to the ISA and its proponents. After all, there are denialists in the United States that are not connected in any way with the evangelical Christian community. The difference is that the ISA seeks to wrap its denialist position in a mix of biblical citations, free enterprise litany, and nationalistic flag-waving (see, for example, its Cornwall Declaration²⁷ which it asks evangelicals to sign and support).

It is difficult to characterize clearly evangelical denialists and their motives. In some cases, it seems that the primary motivation is a deep distrust of science in general and Earth and biological sciences in particular. This strain runs deeply through the fundamentalist wing of the evangelical community. Their distrust of science arises from issues such as evolutionary biology and the age of the universe. They have concluded that for the most part scientists are godless liberals intent on destroying the faith community and therefore cannot be trusted on environmental issues. Ergo, climate change is indeed a hoax, as Inhofe proclaimed.

Other groups, such as the ISA, attempt to present the denialist point of view as legiti-

mate scientific inquiry. Much like the creation science community, climate change deniers like to portray themselves as the true scientists who are being persecuted intellectually by the mainstream scientific community as a result of a grand conspiracy. Conspiracy theories are one of the mainstays of the far right, so this particular idea often resonates well with the fundamentalist wing that distrusts science in any case. It is difficult to tell whether groups such as the ISA truly believe the denialist science they cite or whether they find it convenient because it supports their already determined theological perspective. In either case, they provide a pseudoscience patina that allows a sizeable segment of the evangelical Christian community to oppose any action on climate change as premature due to "scientific uncertainty."

Perhaps the most interesting developments in the denialist perspective are the twin arguments that CO₂ is good for the earth and that environmental concerns and actions will hurt the poor. As we will see shortly, these two arguments arise as direct contradictions to positions argued by evangelicals that take climate change as a serious problem.

Creation Care Proponents. In all the discussions of the Christian relationship to the environment, there is no Bible verse cited more often than Genesis 1:28: "*God blessed them and said to them, 'Be fruitful and increase in number; fill the earth and subdue it. Rule over the fish of the sea and the birds of the air and over every living creature that moves on the ground'*" (New International Version).

There are a broad range of interpretations that surround this verse. Much of this discussion has centered on the idea and meaning of stewardship in the context of creation. The Calvinist tradition has a long history of grappling with this issue. While there are examples where the Calvinist interpretation has led to exploitation, there are also many examples, such as the Au Sable Institute,²⁸ where stewardship has produced active support for environmental preservation. The climate change issue is bringing new voices and new perspectives into alignment with these existing structures under the rubric of creation care.

We could select any number of organizations and statements to illustrate the creation care position. We have selected two that represent somewhat different perspectives on the creation care position. The first organization is the Evangelical Climate Initiative (ECI). In its statement on climate change, ECI claims:

Christians must care about climate change because we love God the Creator and Jesus our Lord, through whom and for whom the creation was made. This is God's world, and any damage that we do to God's world is an offense against God Himself (Gen. 1; Ps. 24; Col. 1:16).²⁹

The ECI and the closely allied Evangelical Environmental Network (EEN)³⁰ are driven in large part by creation care (as attested by the website name of the EEN). Their response to this mandate is to motivate the evangelical community to deal with the climate change issue by organizing within the evangelical community and interacting with the political sphere.

The second organization is Restoring Eden. Its mission statement states:

Restoring Eden makes hearts bigger, hands dirtier, and voices stronger learning to love, serve, and protect God's creation. Restoring Eden lives out the biblical mandate to "speak out for those who cannot speak for themselves" (Proverbs 31:8) as grassroots activists advocating for natural habitats, wild species and indigenous cultures.³¹

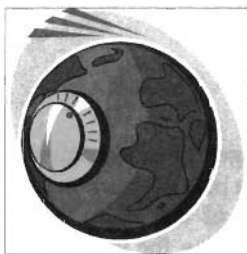
While the focus of Restoring Eden is on creation care, this focus is more personal and less organizational than ECI. This position resonates with many evangelicals, especially the young, who are in general wary of organizational structures.

For many evangelicals, creation care provides a very strong motivation to be engaged in discussions about and finding solutions to the climate change problem. This motivation is driven by the conviction that the climate change problem is real and the consequences are potentially severe. The contrast with the denialist camp as typified by the ISA is not so much in the area of the creation care mandate itself, which both subscribe to, but in the understanding of climate change as a critically important issue of our time.

Social Justice Advocates. In the context of Christian ethics, there is no more compelling text in the Bible than Micah 6:8: "*He has shown all you people what is good. And what does the LORD require of you? To act justly and to love mercy and to walk humbly with your God*" (Today's New International Version).

Evangelicals have wrestled for many years with how to live this commandment. What does it mean to act justly and to love mercy, especially to those who come from different cultures, races, and social and economic systems? While some parts of the evangelical community, particularly educational institutions like Calvin College and Wheaton College, have openly examined and debated these questions for years, many evangelicals have avoided them. Part of their discomfort was the often expressed opinion that the social gospel of the early twentieth century was the death knell for religious orthodoxy among the mainline Protestant denominations. Hence, any movement toward social justice would ultimately produce the same slide among current evangelicals.

Ironically, the rise of the religious right and the moral majority may be in part responsible for a renewed



From my perspective, Christians have a clear and compelling call to action ... We must take leadership in articulating the ethical standards on which actions are based, determining the technical solutions that are most consistent with our standards and most effective in meeting the needs of the less fortunate, and demanding political action on local, state, and national levels.

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emphasis on social justice among evangelicals. If some parts of the evangelical community could align itself with political parties and issues, then why not speak on issues of social justice? Evangelicals like Jim Wallis of *Sojourners* magazine speak cogently on social justice issues and challenge other evangelicals to do so. Some mega-church pastors such as Rick Warren of Saddleback Church have moved from a dominant focus on church growth and personal piety to address issues of social justice. The Evangelical Climate Initiative reflects this progression of thought. In its statement on climate change, the ECI makes the claim:

Christians must care about climate change because we are called to love our neighbors, to do unto others as we would have them do unto us, and to protect and care for the least of these as though each was Jesus Christ himself (Matt. 22:34–40; Matt. 7:12; Matt. 25:31–46).³²

Social justice in the context of climate change resonates far beyond the evangelical community. It is a keystone concept in the theology of many of the liberal Protestant churches, as well as some segments of the Roman Catholic Church. In the secular community, there is a growing body of literature on the ethics of climate change that addresses inter- and intra-generational equity. The former essentially focuses on the issue that it is the poor and those with the fewest natural resources that suffer the most from climate change and will continue to do so. The latter speaks to the legacy this current generation is leaving for succeeding generations. Evangelicals have a great deal to offer to these discussions of equity and are beginning to take a more active role in them.

As with the creation care issue, denialists tend to agree with the broad concepts of equity but take exception to the idea that it is the poor who will suffer most. This position is clearly at odds with the vast majority of literature on the subject³³ and difficult to defend sensibly. Countries like the United States and those of Western Europe have the wealth, technological expertise, and infrastructure to mitigate climate change impacts. All three of these are lacking in poor countries in the African Sahel and Southeast Asia or countries with very limited resources and options such as the Pacific Island nations.

The ISA group is correct in identifying the need to increase investment and provide cost-effective energy to these countries. It is incorrect in assuming that this cannot be done while addressing the profligate carbon emissions of the wealthy.

In this section, I have tried to delineate five responses, but these five could, in some sense, be grouped into three. The first two groups basically choose not to deal with the issue of global warming although their reasons for not doing so are different. Some members of these groups make common ground with the denialists in arguing that the science of global warming is questionable, but this is not their principal motivation. To a large degree, their theological position is that global warming is not important, regardless of the science. The creation care and social justice groups show considerable overlap. They recognize the scientific basis of global warming and are convicted of the need to act now. Their theological motivations are somewhat different but both groups tend to acknowledge the perspective of the other as ethically and morally sound.

The denialists occupy a middle ground between the other two in some ways but are the most difficult by far to categorize. They are united by their rejection of global warming science. They often couch this rejection in pseudo-scientific language and arguments, most of which they borrow from other communities. It is difficult to know whether they reject the science on the basis of these pseudo-scientific arguments or whether they use them to bolster a pre-existing religious bias against science in general and global warming in particular. Regardless, their position is clearly at odds with scientific evidence and understanding of global warming. That does not seem to bother them, in part because they view scientists as largely irreligious and hopelessly biased in favor of global warming. On general theological grounds, they almost always support the creation care principle and sometimes support issues of social justice. They avoid applying these to the global warming problem by denying that it is important. One suspects that this position will become increasingly more untenable as the evidence for and scientific basis of global warming continues to increase.

A Personal Statement

Climate change due to increases in atmospheric greenhouse gas concentrations is real and is occurring now. The scientific understanding of the problem is robust and the projections of global change in this century are consistent and reproducible across differing models and methods. There is no longer any serious debate about these statements in the scientific community because there is no credible scientific evidence or model studies to support an alternate view.³⁴

The projected changes are potentially devastating to our world. Global temperature increases of 2–4 °C, as projected for this century, are well outside any changes seen in the last 1,000 years and most probably in the last 10,000 years of Earth's history. A global temperature increase of this magnitude and rapidity will translate into even larger regional changes in temperature and available water, stressing natural ecosystems and human environments. The suggestion that such changes would be benign is based on misguided hope rather than any realistic evaluation.

We, the developed countries of the world, bear major responsibility for this situation. We are emitting and have emitted the bulk of the excess greenhouse gases in the atmosphere. Our lifestyles are energy intensive and powered by prodigious fossil fuel consumption. Each American is responsible each year for the addition of more than five tonnes or 5000 kilograms of carbon to the atmosphere.

There are solutions to this problem, although I have not discussed them here. The solutions are not easy or cheap, but neither are they so difficult or expensive as to preclude application. Interested readers are invited to consider the wedge technology solutions of the Carbon Mitigation Initiative at Princeton University³⁵ as one viable approach.

We in the developed countries are the major source of the problem. Do we, therefore, bear a specific responsibility to solve the problem? This is the crux of the ethical question. If we deny that there is a problem, then of course there is no need for a solution. Americans as a nation are not attempting to solve the problem. In fact, we are obstructing the adoption of solutions through denial and procrastination, especially at the federal level.

If we agree that global warming presents a large risk to planet Earth and its inhabitants, then must we act? What is our motivation for doing so? From my perspective, Christians have a clear and compelling call to action. We are commanded to love our neighbors and to seek their welfare above our own. Putting our poorer neighbors at risk in this generation and our children (and others) at risk in the next generation is incompatible with the second of the great commandments. We are also commanded to care for God's creation, a command which Christians ought to take seriously. Putting the flora and fauna of the planet at risk by our actions is incompatible

with an ethos of climate care and stewardship. On the global warming issue, evangelical Christians have largely failed to take ownership or leadership. It is past time for this to change. We must take leadership in articulating the ethical standards on which actions are based, determining the technical solutions that are most consistent with our standards and most effective in meeting the needs of the less fortunate, and demanding political action on local, state, and national levels. We can do no less. ★

Acknowledgments

While the ideas expressed in this article are my own, I have profited from many discussions with friends and colleagues over the past few years. I thank Dennis Roosen daal and the members of the adult education class at First Seattle Christian Reformed Church for their interest and lively discussion when I presented this material to them. Amos Nascimento and Matt Ackerman provided insightful comments on an early draft that greatly improved this paper. I am most indebted to my wife Linda who has been incredibly supportive by patiently attending so many of my talks and providing gentle criticism of my ideas and presentation style.

Notes

¹The International Panel on Climate Change (IPCC) has recently issued its 4th Assessment Report on climate change. Summaries and complete reports are available at www.ipcc.ch Last accessed 12 September 2007.

²For example, the United Nations Framework Convention on Climate Change (1992), http://unfccc.int/essential_background/convention/items/2627.php Last accessed 12 September 2007; and the Kyoto Protocol to the United Nations Framework Convention on Climate, Kyoto (1998), http://unfccc.int/kyoto_protocol/items/2830.php Last accessed 12 September 2007.

³Evangelical Climate Initiative, *Climate Change: An Evangelical Call to Action*, www.christiansandclimate.org/statement Last accessed 12 September 2007.

⁴Interfaith Stewardship Alliance, *An Open Letter to the Signers of "Climate Change: An Evangelical Call to Action,"* www.interfaithstewardship.org/pages/article.php?&id=160 Last accessed 12 September 2007.

⁵I am an old-earth creationist. All credible evidence from astronomy, solar physics, planetary science, and Earth science supports this position. The only scientifically tenable position for a young-earth creationist is to argue that God created the earth with an appearance of great age, which is inconsistent with my understanding of the attributes of God.

⁶IPCC, 4th Assessment Report, see especially the Summary for Policy Makers and chapters 3–5 of *Working Group 1: The Physical Basis of Climate Change*.

⁷Atmospheric pressure is a measure of the total force exerted by a column of atmospheric gases. The vapor pressure of water is the force exerted by the water molecules only. Thus, in any atmospheric parcel, the vapor pressure of water is some fraction, usually small, of the total pressure. The amount of water in an atmospheric parcel is limited by the saturation vapor pressure, which is a function only of the temperature of that air parcel. If the vapor pressure of a parcel reaches the saturation vapor pressure, condensation must occur and vapor is converted to liquid water (or ice). Meteorologists often report vapor pressure in terms of relative humidity, which is the ratio (in %) of the observed vapor pressure to the saturation vapor pressure. At 100% relative humidity, condensation must occur.

⁸Part per million by volume (ppmv) is a measure of the number of CO₂ molecules in one million molecules of air.

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⁹The decay rate is typically reported as a “half-life,” the time it takes for an initial number of radioactive molecules to decay to ½ their initial number. The half-life of ¹⁴C is about 5,700 years.

¹⁰The mixed layer of the ocean is the top 60–100 m of water that is closely coupled to the atmosphere by fluxes of energy and water at the ocean surface. Deep ocean water is much colder and saltier and largely disconnected from the atmosphere.

¹¹Perennial plants such as trees sequester carbon in their biomass, thus removing it from the atmosphere. As part of this same growth process, carbon ends up in soils as organic matter.

¹²A metric tonne is 1000 kilograms, or approximately 2,200 lbs.

¹³IPCC, 4th Assessment Report, see especially the Summary for Policy Makers and chapters 10 and 11 of *Working Group 1: The Physical Basis of Climate Change*.

¹⁴Interview with Steve Inskeep on Morning Edition, National Public Radio, June 7, 2007.

¹⁵Arctic Climate Impact Assessment Project, *Impacts of a Warming Arctic* (2004): www.acia.uaf.edu Last accessed 12 September 2007.

¹⁶See, for example David Archer, *Global Warming, Understanding the Forecast* (Malden, MA: Blackwell Publishing, 2007) or Andrew Dessler, *The Science And Politics Of Global Climate Change* (Cambridge: Cambridge University Press, 2006)

¹⁷United States Climate Action Partnership, www.us-cap.org/index.asp Last accessed 12 September 2007.

¹⁸S. K. McDowell and M. A. Beliles, *America's Providential History* (Charlottesville, VA: The Providence Foundation, 1989).

¹⁹Mark Trabant, *Seattle Post-Intelligencer*, May 6, 2007.

²⁰Todd Strandberg, “Bible Prophecy and Environmentalism,” www.raptureready.com/rr-environmental.html Last accessed 12 September 2007.

²¹Ibid.

²²Glenn Sherer, “The Godly Must be Crazy” (October 27, 2004), www.grist.org/cgi-bin/printthis.pl?url=/news/maindish/2004/10/27/scherer-christian/index.html Last accessed 12 September 2007.

²³Todd Strandberg, “Bible Prophecy and Environmentalism.”

²⁴James Inhofe, Senate Floor Statement, July 28, 2003, <http://inhofe.senate.gov/pressreleases/climate.htm> Last accessed 12 September 2007.

²⁵I use fundamentalist here to distinguish those evangelicals who believe in an infallible Scripture and read Scripture literally. This position leads to positing a young earth and extreme opposition to almost all facets of biological evolutionary theory.

²⁶Interfaith Stewardship Alliance, see statements at www.interfaithstewardship.org/pages/home.php Last accessed 12 September 2007.

²⁷Cornwall Declaration (2005), www.interfaithstewardship.org/pages/cornwall.php Last accessed 12 September 2007.

²⁸Au Sable Institute of Environmental Studies, www.ausable.org/au.main.cfm Last accessed 12 September 2007.

²⁹Evangelical Climate Initiative, *Climate Change: An Evangelical Call to Action*.

³⁰Evangelical Environmental Network, www.creationcare.org Last accessed 12 September 2007.

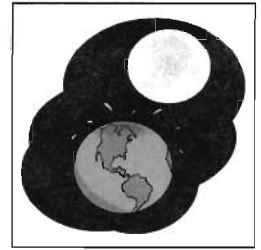
³¹Restoring Eden, www.restoringeden.org Last accessed 12 September 2007.

³²Evangelical Climate Initiative, *Climate Change: An Evangelical Call to Action*.

³³See, for example, *Climate Change 2007: Impacts, Adaptation and Vulnerability*, IPCC Working Group II Report and references therein, www.ipcc.ch Last accessed 12 September 2007.

³⁴This statement is likely to be challenged by the denialist camp. My point is that science proceeds by analysis of data and mathematical modeling. The scientific community has analyzed and modeled alternate theories such as solar variability, long-term natural cycles, cloud nuclei produced by cosmic rays, etc. None of these has stood up under peer-reviewed scrutiny and therefore these theories are not considered credible by the scientific community.

³⁵www.princeton.edu/~cmi Last accessed 12 September 2007.



Global Warming— An Anabaptist Responds in Sermon

Loren Swartzendruber



Loren Swartzendruber

Hear these words from the twenty-fourth Psalm, “*The earth is the Lord’s, and everything in it, the world, and all who live in it; for he founded it upon the seas and established it upon the waters.*”¹ And this familiar text from the New Testament book of Colossians, “*For by him (Jesus) all things were created: things in heaven and on earth, visible and invisible, whether thrones or powers or rulers or authorities; all things were created by him and for him.*”²

Earlier this week I received an email from an Eastern Mennonite University (EMU) faculty member, to let me know she would be praying for me as I prepared for this morning. She added, “And, I’m sure you’ll find a way to add a little humor to the subject.” Unfortunately, there is not a lot of humor to be found in the subject of global warming. But, I did see a few things in the daily papers just this week that made me smile. An editorial in the *Daily News Record* (Harrisonburg, VA) of April 11, 2007, referred to several baseball games being postponed the previous weekend due to snow. Several cities in the U.S. set near records for low temperatures, and crops were likely damaged due to the cold weather. And then the closing line, “Yes, global warming seems to be on a roll.” Now, that may be somewhat amusing, but it is also sad. It is sad for two reasons.

It surely does not characterize critical thinking, a proficiency that we in academia believe is imperative to model as faculty and to cultivate in our students. No critical thinker would suggest that taking a snapshot of several days within the context of thousands of years is a good measure of weather patterns and temperatures. It neither proves nor disproves global warming.

The second reason for sadness is perhaps more subtle. The problem is called “global

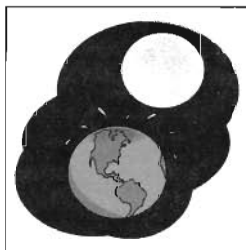
warming,” but we in North America tend to look at just one small part of God’s earth to gather data for our preconceived notions. Our tendencies toward provincialism are all too prevalent. As an institution that seeks to prepare students to live in a global context, such a narrow point of view is inadequate.

Christians around the world celebrate the resurrection of Jesus. Easter is a festival unlike any other in the church calendar. Jesus came into this messy, conflicted world, daring to take on our humanity, boldly entering into a world that God declared to be “good,” offering hope for the world’s redemption. Remember these words from the Apostle Paul:

*I consider that the sufferings of this present time are not worth comparing with the glory about to be revealed to us. For the creation waits with eager longing for the revealing of the children of God; for the creation was subjected to futility, not of its own will but by the will of the one who subjected it, in hope that the creation itself will be set free from its bondage to decay and will obtain the freedom of the glory of the children of God. We know that the whole creation has been groaning in labor pains until now; and not only the creation, but we ourselves, who have the first fruits of the Spirit, groan inwardly while we wait for adoption, the redemption of our bodies.*³

There is
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After studying pharmacy as an undergraduate at the University of Iowa, **Loren Swartzendruber** completed his B.S. at Eastern Mennonite University, M.Div. at Eastern Mennonite Seminary, and D.Min. at Northern Baptist Theological Seminary. Following a church pastorate, he was President of Hesston College (KS) from 1993–2003. In 2004, he became the president of Eastern Mennonite University, Harrisonburg, Virginia, and continues in that role. This article is based on a “global warming sermon” delivered at an Eastern Mennonite University chapel service in the spring of 2007. Loren grew up in Iowa where he worked with his father in a family farm implement dealership. He and his wife Pat are the parents of four grown children.



If global warming is a reality ..., the projected impact will be devastating unless we can mobilize our best minds and behaviors to reverse the trends. As a Christian church, we are called to love the world that God created. ... We do have the human capacity ... to address the realities, test ideas for change, and project possible outcomes.

Article

Global Warming – An Anabaptist Responds in Sermon

Peter Dula, EMU Professor of Bible and Religion, said:

We are beginning ... to articulate that the current ecological crisis is indicative not just of a Christian betrayal of creation, but of creation's God. It is not just a Christian abandonment of the environment but Christian abandonment of the scriptures. The old dualisms that enabled environmental neglect—soul/body, spirit/matter, rational/natural, redemption/creation—are breaking down. As they break down, some old theological truths are re-emerging. The redemption Christ brings is not redemption *from* creation, but redemption *of* and *for* creation.

Here we stand, in the early years of the twenty-first century. These are just a few minutes within one short day on a very tiny spot within all of God's creation. A mere blip on the screen of God's incredible movie, a movie without beginning or end, a movie of good/evil, pathos/joy, sin/redemption, Garden of Eden/destruction/new Jerusalem. This movie does have a plot, and it is going somewhere. This is a movie for which there is no Oscar.

We may be a small part of this grand cosmic story, but we cannot forsake hope and personal responsibility. Our children and grandchildren and great grandchildren will rightly expect an accounting of our actions or, God forbid, our apathy. Our faith and theology do not allow us to absent ourselves from responsibility. Nor can we yield to the tempting comfort of fatalism. We are created in God's image; therefore we have enormous responsibilities and opportunities.

So, what about global warming? What are the facts and are they indisputable? Is it for real, and if so, what will be the consequences? And if it is real, and there are consequences, is there anything we can do? Is it too late? The topic is clearly too large to address in just a few minutes, but let me offer some thoughts for our continuing dialogue.

There is a massive and mounting body of scientific evidence that global warming is a reality. Scientists from all around the world have gathered data and there is strong consensus among the world's leading experts

that global warming is well documented. The Intergovernmental Panel on Climate Change (IPCC) has released numerous reports concerning the scientific evidence for global warming and future implications.

Not everyone is convinced. The opinions against the reality of global warming generally fall into one of several categories: (1) it is a hoax being perpetrated on the American people; (2) it is primarily articulated by the liberal media; and/or (3) what we are experiencing now is simply a repetition of numerous cycles throughout past millennia.

I have real problems with some of these arguments. Scientists, as professionals, are inclined to go where the data lead them. Of course, every individual researcher has to make choices about what to study and the methodologies to be employed, but the peer review standards are far more objective and rigorous than the general public fully understands.

When Senator Inhofe of Oklahoma suggests the "American people" are being duped, he is not only ignoring the opinions of scientists in many nations of the world, he is suggesting that we are a very gullible people.

The argument that this is a "liberal" agenda is rapidly cracking. I seriously doubt that all of the scientists involved are either liberal or conservative politically. Recently, the political world was shocked to witness a dialogue between Newt Gingrich and John Kerry in which Kerry was rendered almost speechless by Gingrich's assertion that global warming is a reality. Arnold Schwarzenegger is hardly an icon of liberalism, but he has become energized about what he believes is a serious challenge to the future of the planet.

What I find most distressing about this debate, as is the case for so many debates in our society, is how quickly it becomes politicized. In my opinion, this is a scientific and a theological/moral issue, not one to be politicized. To ignore a potentially devastating world problem because a particular politician has become a major spokesperson for it, is frankly disturbing.

We know there have been climate cycles in the past. Ice ages have come and gone;

we know that from geological research. There is just one small (or large!) problem with the idea that this is just another “routine” cycle—we are now on this side of the industrial revolution, and there are far more people on planet Earth than at any other time in history. Assuming a normal life span, I will have lived during a time when the world’s population will have grown from two billion to nine billion.

Let us be honest – there are all too many people, including those in the Christian church, who behave as though some lives are more dispensable than others. The expectation of Jesus, “To love our neighbors as ourselves,” is an inconvenient truth. Sometimes it is assumed that “neighbors” are only those who reside within the borders of our own nation. And then only if they have been here for at least a few years.

If global warming is a reality, and there are those who genuinely believe it is not so, the projected impact will be devastating unless we can mobilize our best minds and behaviors to reverse the trends. There are plenty of places where any of us can research what experts are saying about the potential impact of unmitigated global warming. The IPCC report notes: “Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases.”⁴

We are, however, the ones who are producing the most greenhouse gas emissions and can best afford counter-measures to limit its consequences. This is a looming humanitarian catastrophe. Recently the U.S. military was ordered to begin preparing contingency plans because it is recognized that this is a threat to global security.

What if the scientists are wrong? What if global warming proves to be the biggest hoax in recorded human history? Does that let us off the hook for making changes? I think not. For myself, I would rather be guilty of being duped while having made an effort to support “care for the creation” initiatives, even if my grandchildren and great grandchildren eventually call me ignorant, than to disregard current realities and hope the problem goes away. I do not want my descendants to question my commitment to be a good steward of what God entrusted to our generation.

As a Christian church, we are called to love the world that God created. Where do we go from here? We do not have all the answers for how changes can be made and their potential impact. We know some things, but there is much more to be done in the next decade to ascertain the impact of specific changes. A column by George Will (*Richmond Times-Dispatch*, April 12, 2007) suggested that since some proposed changes would appear to have negligible impact, we should question the reality itself. Again, in my mind, this is an example of fuzzy thinking.

Of course, we are learning as we go. Of course, we will make mistakes. What else is new? We do have the human capacity, I believe, by the gift of God, to address the realities, test ideas for change, and project possible outcomes. Just because some proposed “solutions” are extreme or over the top, does not mean that we should ignore reasonable considerations.

We should celebrate those achievements already realized. I am grateful that EMU has long led the way among higher education institutions to gain efficiencies in energy usage. Because of research done by science faculty and careful work by leaders of our Physical Plant staff, we have been saving large amounts of energy for several decades. In an AAPA (formerly Association of Physical Plant Administrators) 2004–2005 Facilities Core Data Survey of energy usage by ninety universities across the entire U.S., EMU ranked third from the best in the least energy used per gross square foot of building space. That is a remarkable achievement. EMU’s usage cost is \$0.90 per gross square foot. The comparable numbers at three other Virginia institutions are \$1.53, \$1.78, and \$1.98.

As we go forward with building and renovation plans, we will utilize proven “green” technologies. With many inputs, we intend to make EMU a model institution in which our use of resources is consistent with our theology and faith.

As a university we can make decisions that are environmentally friendly; I invite us as individuals and families to examine our practices to better reflect our biblical understandings. To students at EMU and all across the world, I extend this challenge: hone your God-given talents, grow your entrepreneurial skills, and stretch your scientific minds to co-create, with God, a better world. As disciples of Jesus, we can do no less.

I close with the prayerful words of Patricia Winters:
Giver of life and all good gifts:
Grant us also wisdom to use
only what we need;
Courage to trust your bounty;
Imagination to preserve our resources;
Determination to deny frivolous excess;
And inspiration to sustain through
temptation.⁵
Amen.

★

Notes

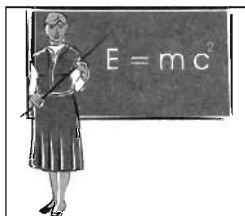
¹Psalms 24:1–2 (New International Version).

²Colossians 1:16 (New International Version).

³Romans 18:18–23 (New International Version).

⁴Working Group II Contribution to the Intergovernmental Panel on Climate Change Fourth Assessment Report; Climate Change 2007: Climate Change Impacts, Adaptation and Vulnerability, April 6, 2007, 2.

⁵Elias Amidon and Elizabeth Roberts, eds., *Life Prayers: From around the World: 365 Prayers, Blessings, and Affirmations to Celebrate the Human Journey* (New York: HarperCollins, 1996), 115.



Article



Sean M. Cordry

Six Easy Pieces: One Pedagogical Approach to Integrating Science/Faith/Origins into College-Level Introductory Physics Courses

Sean M. Cordry

*As educators,
we want to
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origins issues
that we do.*

In this article, I compare my experience having taught two different "stand-alone" science/faith/origins classes with my experience of integrating science/faith/origins issues into introductory physics courses. (Both sets of experiences have been in the context of Christian liberal arts colleges.) The latter setting proved to be quite challenging, and I have tried three approaches to meet this challenge: (1) readings from auxiliary texts, (2) student "journaling," and (3) presenting limited topical lectures. This third approach has been the most "successful" by far due to its intriguing and nonthreatening nature. I will provide a synopsis of each lecture, when each occurs during the physics course, the pedagogical structure of the presentation order, and a few caveats of which to be aware.

Many of us in education have multiple professional roles: scholar, teacher, Christian. As we grow in our professions and confessions, we strive to weave these roles together into a unified tapestry. Naturally, we want to equip our students to begin working through the same types of issues and questions that we do: What does it mean to be a Christian and a scientist? Is the Bible in conflict with modern science? Can a Christian believe in the Theory of Evolution or the Big Bang?

Having been a physics professor at two different Christian colleges for more than eleven years, I have seen and/or tried a

variety of ways to help students work out their salvation at the stage of budding scientists or mathematicians; some of these ways are informal and some formal. Informally, students ask questions in various contexts, resulting in private or public conversations. For example, a student might ask about the age of the earth during a lecture on carbon-dioxide measurements from two hundred thousand-year-old Greenland ice cores. Alternatively, a teacher might create the opportunity to have a regular Bible-study/discussion group that focuses on science/faith/origins (SFO) issues; such groups might meet in a dorm, student union, or even someone's home.

A formal approach to addressing SFO issues with students involves a highly-structured, pedagogically sound environment for eliciting and addressing certain questions/concerns that the students have. A common, formal setting is a course solely (or mostly) devoted to SFO topics; I will refer to this context as a "stand-alone" setting. Another approach is to integrate SFO topics into an otherwise secular course; I will refer to this context as the "integration" setting.

Sean Cordry, currently associate professor of physics at Carson-Newman College. Sean did his doctoral work in the area of physical acoustics, studying at both the National Center for Physical Acoustics in Oxford, Mississippi, and the Applied Physics Laboratory in Seattle, Washington. After completing his B.S. from Harding University and a Ph.D. from the University of Mississippi, he has pursued a career teaching physics at small liberal arts colleges. His research focuses primarily on pedagogy issues and curricular design, with several articles in *The Physics Teacher*. He is also interested in Christian responses to environmental, energy and population issues. He is married to Melynda Cordry, and they have two children: Savannah (15) and Duncan (13). All four of them have second-degree black belts in Tae Kwon Do.

This article has three primary intentions: first, to compare my experiences in both the stand-alone and the integration settings; second, to describe one particular approach to addressing SFO issues in an integration setting; and finally, to humbly offer advice from my experience in talking with students about SFO issues.

Stand-alone Courses and the Integration Challenge

I have taught stand-alone SFO courses to both college freshmen and seniors. While these two groups have vastly different maturity levels, they share some important characteristics: they were smaller classes of around fifteen students; each group was relatively homogeneous in its own maturity level; and, the students were all highly motivated, interested (the courses were elective), and open-minded. These traits enabled me to create an intimate, seminar-style course where open dialogue and honest questioning could run to a productive end.

With the upper-division students I used a combination of texts: Alister McGrath's *Intellectuals Don't Need God and Other Modern Myths: Building Bridges to Faith through Apologetics* [Zondervon Publishing House, 1993], William Lane Craig's *Reasonable Faith: Christian Truth and Apologetics* [Crossway Books, 1994], and Theodore Schick's *Readings in the Philosophy of Science: From Positivism to Postmodernism* [Mayfield Publishing Company, 2000]. My focus in this course was to prepare these sheltered, fundamentalist-leaning students for entry into secular graduate schools. To that end, I had them write a number of position/response papers, and I made frequent use of oral exams in which students had to answer questions from me and their peers. These oral exams forced the students both to speak spontaneously about SFO issues and to formulate good questions.

The freshman-level course was somewhat different, naturally. I used Nancy Pearcey and Charles Thaxton's *The Soul of Science: Christian Faith and Natural Philosophy* [Crossway Books, 1994]. The main focus of this course was to demonstrate the historical development of science and its roots in Christianity. I made heavy use of short, paragraph-length reading responses and group discussions. The freshmen were clearly "in a different place" than the seniors: their critical thinking abilities were not well developed, and their own faith was still largely grounded in the spiritual capital that they had inherited from their parents.

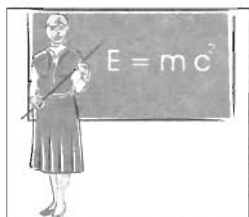
Student response to these stand-alone courses was very positive: they found the courses edifying, intellectually stimulating, and of a high personal value. The seniors found the course much more gratifying than the freshmen. However, I think this speaks to the intellectual development of the students and at what point in their own lives

they are ready to rigorously deal with SFO issues. The integration setting for SFO issues, on the other hand, has proven to be a much more difficult context in which to operate; getting satisfactory student participation and feedback has been a challenge.

In order to integrate SFO topics into my introductory-level physics courses, I decided to devote the day after each major exam to various SFO issues. Logistically, this schedule worked well: I did not lose much "physics time," and the students gained a little break in routine. Initially, my pedagogical approach was the same as that for the stand-alone SFO courses: assign significant reading and reflection, and then have great discussions during class. Supplemental texts seemed to be appropriate, so one year I used Ian Barbour's *When Science Meets Religion: Enemies, Strangers or Partners?* [HarperCollins, 2000], and the next year I used John Polkinghorne's *Quarks, Chaos and Christianity: Questions to Science and Religion* [Crossroad, 1994]. The time I used Barbour's text, students were required to keep a reflection journal (but no journal was required when I used Polkinghorne's text).

Unfortunately, trying to recreate the intimate, seminar-style environment of a stand-alone SFO course failed miserably. As I reflected on this sad state of affairs, I identified three important reasons for the failure. First, and perhaps most important, I had failed to account for the dramatically different student demographics between introductory physics courses and stand-alone SFO courses. In the physics courses, the courses are more populous; the students are highly heterogeneous in their maturity, interest, and motivation; and there is a significant portion of closed-mindedness among the population—they already know the answers, or so they think. A second reason for failure was that a significant proportion of the students resented the additional readings and reflections; the extra work was seen not so much as the straw that broke the camel's back, but more like the *straw-bale* that squashed the camel. Finally, I had naively assumed that a good, comfortable working relationship in the physics conversational arena would translate into a good, comfortable working relationship in the faith conversational arena. I was wrong. As a class, we could have terrific conversations about physics, but not about our faith—the personal level of trust needed was not there.

I was committed to the idea of integrating SFO issues into my introductory physics courses, but now knew that it would not be possible to recreate the seminar-style environment that had worked so well previously. My goals would need to be more modest, so I took a different tack: topical teasers—short introductory SFO lectures "sprinkled" throughout the course. I would still devote each day after an exam to some SFO issue, but I would do most of the talking; my goal would be to stimulate interest in—rather than facilitate a deep exploration of—SFO



I was committed to the idea of integrating SFO issues into my introductory physics courses, but now knew that it would not be possible to recreate the seminar-style environment that had worked so well [in my "stand-alone" classes]. ... I took a different tack: topical teasers – short introductory SFO lectures "sprinkled" throughout the course.

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topics. Student response to this integration approach has been very positive; comments on student course evaluations indicate that they enjoy and benefit from our "Science and Faith" days—even when I present them with challenging ideas.

The Six Easy Pieces

The six topical teasers comprise the six easy pieces¹ with the first three occurring during the first semester of the course, and the remainders in the second semester. A synopsis of each piece follows, but there is an overall structure that I would like to indicate first. The first two pieces form a couplet dealing with textual biblical issues: "Erroneous Explanations of Nature in the Bible," and "Tohu Wabohu." The next three pieces—"Chaos and Parameter Sensitivity," "Anthropic Coincidences," and "Infinite Unobservables"—form a triplet providing a chance to talk about some of the physical and metaphysical aspects of the apparent fine-tuning of our universe. Finally, I present to them some of the reasons for accepting an "Old Earth" position in the piece "Layer by Layer."

Easy Piece #1: Erroneous Explanations of Nature in the Bible

Goal: Biblical explanations of nature reflect the worldview of the time

Students are often interested in interpretations of the creation accounts in the opening chapters of Genesis, and in my experience the opening creation story (Genesis One) is often a major stumbling block for them when it comes to accepting biological evolution and Big Bang cosmology. However, since the creation texts are such "hot buttons," I prefer to start with more innocuous texts—ones not normally associated with SFO issues; my favorite one being Job 38.

In the thirty-eighth chapter of Job, there are many vivid descriptions of nature: the "foundation of the earth" [v. 4], God holding back the waves of the ocean [v. 11], "store-houses of snow ... hail" [v. 22], water jars in the heavens [v. 37], etc. We know positively that these descriptions are erroneous, yet they are consistent with the worldview of the time during which the text was written. As a class, we briefly discuss how we should deal with these texts; generally it is concluded that God would have spoken in ways that made sense to those people at that

time. I emphasize to them the fact that the character and nature of God is not maligned by questioning the physical descriptions of nature. For some students, this is the hardest of the six pieces because it challenges them to rethink the way that they look at the biblical text itself.

Easy Piece #2: Tohu Wabohu²

Goal: (The first) creation narrative in Genesis provides an ancient taxonomic description of nature

I begin this piece by asking the students to try to read the first Genesis creation narrative as if they have never seen it before. Then the students must answer a series of questions designed to highlight some troublesome issues within the text itself: (1) What happens on each "day?" (2) What was provided as food for people? for animals? (3) How could there be night and day without the sun, moon, and stars? (4) To whom was God speaking? (5) Who is the "us" in 1:26? (6) In 1:2, what does "formless" mean? How about "void"? How does this compare to 2:1? I have intentionally chosen these questions in order to get the students to see that there are confusing aspects of the text that are completely irrelevant to any scientific issues; I hope to have them understand that this narrative has a history of being a very difficult text to understand—even before Charles Darwin's day. I then underscore my point with some of St. Augustine of Hippo's comments on this text.

I present the students with the so-called forming-and-filling interpretation³ of the first creation narrative, which is new to most of them. This interpretation emphasizes some of the larger theological issues: creation is tidy—God is a god of order, not chaos; creation is intentional, not the result of war or destruction; there are domains of creation claimed by God himself and domains given to humanity.⁴ I point out that the forming-and-filling interpretation is consistent with descriptions of nature found in other biblical passages.⁵ Generally, this piece is not as challenging to the students because they are used to hearing alternate interpretations to the six-day literal interpretation. At the end of the conversation, I remind them of what we learned from the book of Job earlier: an erroneous description of nature does not malign the description of God's character.

Easy Piece #3: Chaos and Parameter Sensitivity

Goal: Small changes can lead to big differences.

This piece begins the next topical series and is merely a lead-in to the fourth piece—although a critically necessary lead-in. Students do iterative calculations on a simple equation:

$$y_{n+1} = ry_n(1 - y_n)$$

where the value r is a variable parameter, ranging from zero to four. Figure 1 provides a graphic representation of what the students experience as they do their calculations. For small values of r , the values of y_n converge to a single value, but as the value of r increases, the values for y_n will oscillate between two values; further increases in the value of r lead to multiple stable values for y_n , with the eventual onset of chaotic behavior.⁶ See Figure 1.

Easy Piece #4: "Anthropic Coincidences"

Goal: The universe appears to be fine-tuned for life.

I begin this piece by reminding the students of what we learned in the last piece: that sometimes small changes can have enormous consequences. Stephen Barr has a nice discussion in his book, *Modern Physics and Ancient Faith*,⁷ of several so-called anthropic coincidences—that is, facts about the universe that are critical for biological life. I use three of these coincidences that I think are accessible to my students: the number of dimensions of the reality, the strength of the nuclear force, and the three-alpha process.⁸ The students enjoy this discussion because it reminds them of teleological and intelligent design arguments/discussions that they have heard before.

This piece ends with a brief discussion about the distinction between the notions of faith *affirming* and faith

proving. As Christians, I tell them, we find these anthropic coincidences faith affirming, but not faith proving since there are alternate explanations for these coincidences that do not invoke God's power or sovereignty.

Easy Piece #5: Infinite Unobservables

Goal: We must choose between a single infinite unobservable or an infinite number of unobservables.

At this point in the second semester, students have studied electromagnetic theory, waves and optics, and our next unit includes topics in nonclassical physics. I remind the students of the behavior of light through two slits and introduce them to the idea that electrons are capable of producing the same constructive/destructive interference patterns. This leads into a discussion of nonlocality and randomness—some of quantum mechanics more "eye-popping" results. Eyes continue to pop as I explain the many-worlds interpretation of quantum mechanics, which suggests that every possibility is actualized—that "reality" is continually "splitting" into many different realities that are separated from each other. For example, if I were to roll a six-sided die, then six different realities are created: one in which the die is cast with the number one, another where the die is cast as the number two, and so on. In this hypothesis, the notion of improbable becomes problematic because all events—regardless of how "improbable"—occur in *some* reality; everyone who plays the lottery is a winner *somewhere*.

In the many worlds interpretation of quantum mechanics, each reality has the same set of physics "rules": the same gravitational constant, the same charge-to-mass ratio for electrons, etc. However, another hypothesis, the Multiverse—cousin to the many worlds hypothesis, allows the possibility that there are other realities where the "rules" may be different: a different gravitational constant, electrons with a different charge-to-mass ratio, etc. Adherents to the Multiverse idea may not be impressed by the anthropic coincidences, arguing that a universe with precisely those qualities must exist among the unlimited pantheon of universes; what is amazing, they would contend, is that we find ourselves in *that* particular universe—not that *the* universe has those particular properties which make life possible.

In this piece, I follow Stephen Barr's discussion about the conflict between a Christian worldview and that of philosophical naturalism: the former explains the anthropic coincidences via the action of a single infinite being—albeit the being is outside the realm of experimental verification; alternately, the latter suggests that the solution to the coincidences is an infinite number of universes—each of which is outside the realm of experimental verification. Barr sums it up eloquently: "It seems that to abolish one unobservable God, it takes an infinite number of unobservable substitutes."⁹

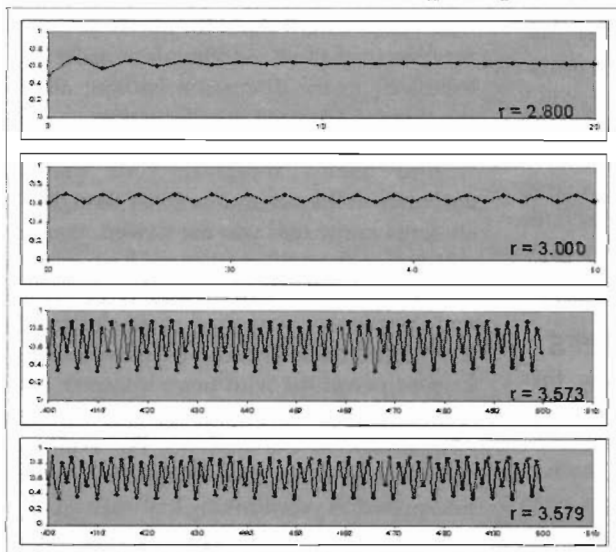
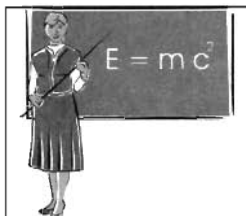


Figure 1. In the third piece, students perform iterative calculations with a quadratic equation. As one parameter in the equation, r , is varied, the calculated sequence of numbers can either converge (first graph), oscillate (second and third graphs) or behave chaotically (fourth graph). (The vertical axis represents the value of the calculation and the horizontal axis represents the iteration number.)



For those who may be considering this approach (or some other approach) to embedding SFO conversations into a “regular” course, I offer some advice ... I provide a list of five common postures that one could encounter ... resist the urge to chase [tangents] ... And finally, recognize your role as authority in the classroom.

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Easy Piece #6: *Layer by layer; decay by decay*

Goal: The physical evidence for an old earth is significant and robust

My goal with this piece is to give students a glimpse of the reliability and overwhelming evidence in favor of an ancient earth; students clinging to a young-earth position need to recognize the fact that they hold such position over and against scientific evidence. I begin by talking about dating objects by layers: tree rings, stalactite rings, and ice cores. Tree rings make a particularly nice place to start because students have all seen them—their existence is undeniable. Furthermore, tree-ring time-lines (dendrochronology) extend backwards more than 12,000 years in time¹⁰—a tangible fact that seriously challenges those students with a dedication to a young-earth posture. Similarly, stalagmites and glacial ice-cores can be dated to 40,000 and 100,000+ years, respectively. Following the more tangible, we talk about the less tangible: radiometric dating methods, touching on issues of applicability, calibration, and contamination. I attempt to counter some of the misinformation promulgated by certain young-earth creationists.¹¹

After a scientific discussion, I remind them that the controversial nature of the creation narratives in Genesis are quite ancient, pre-dating Darwin by centuries. At this point, sometimes a student suggests that God could have made the earth to merely *look* ancient—but that it is really quite young. (If a student does not bring it up, I will.) I suggest two deep-seated flaws in a young-earth-looking-old point of view: first, God—the Father of Truth—has told the biggest “whopper” of all time and space; and second, if natural history has been fabricated by God, then why not human history as well?¹²

Caveats and Characters

For those who may be considering this approach (or some other approach) to embedding SFO conversations into a “regular” course, I offer some advice as one who has hit a few potholes, tar pits, and snags over the years. First, there are some predictable responses and “characters” likely to appear in your course. In Table 1, I provide a list of five common postures that one could encounter, as well as some words of wisdom (I hope!) for dealing with them.

Students like to chase rabbits if you get them engaged in SFO conversations, so my second piece of advice concerns tangents: resist the urge to chase the rabbits. Remember: you have an agenda that is larger than the mere academic exercise of brain-storming and “what-if” scenarios; what you want to communicate to them is important, so keep your agenda on the front burner. It is worth emphasizing a couple of points here: first, students generally bring very little other than hearsay and rumor to the discussion table; and second, even though they have seen many talk shows on television¹³ and participated in many late-night dorm chat sessions, they have little experience in discussions with a destination (resolution). An inexperienced teacher, out of a sense of connecting with students, can easily fall into the trap of letting the classroom dissolve into the sharing of collective ignorance.

Tangents can also lead into traps, as mentioned above. Some students can “lie in wait” with some particularly difficult facet of the SFO issue in an attempt to push their own agenda or their favorite/interesting idea. It is both honest and expedient to tell a student that their question or comment is worth pursuing in greater detail, but that because of time considerations it cannot be explored presently. Then ask the student if he or she would like to make an appointment to talk with you at length about the question. In this way, you can allow individuals to make contributions to the discussion without allowing them to hijack the discussion.

And finally, recognize your role as authority in the classroom. Even though the students know that you are flawed, you are still larger than life and were born with a natural ability to solve Maxwell’s equations and the relativistic motion of an electron in a magnetic field. Expect that what you say may be perceived with more intensity than you intend; your emotions can easily be exaggerated by the students. For example, your minor annoyance at an idea can be interpreted as you thinking that such an idea is the dumbest thing you have ever heard. An actual serious criticism that you might level at an idea will be interpreted by some as a devastating logical slaughter. A gentle, humble, and patient posture can alleviate much of this type of over-reaction.

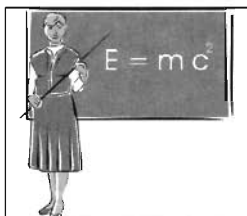
However, other students over-react to your authority role in the opposite direction: your expertise, faith, and agenda are immediately rendered suspect if you do not automatically embrace the student's personal SFO ideas. Why do some react this way? Obviously, students can have quite strong opinions on SFO issues, but what may not be so obvious is the emotional attachment that may exist between themselves and the ideas. Students are not simply an individual with their own ideas; they carry with them the knowledge and experiences of their friends and families. The ideas that they carry may be intimately connected to friends, pastors, parents, or a favorite teacher; if you successfully challenge a cherished idea, then you

have created a dissonance in that personal relationship. A student might resist an idea out of sheer loyalty; challenging the idea is tantamount to challenging certain individuals in their lives.

Some students have, in fact, been pre-programmed, so-to-speak, to react negatively toward whatever you say that causes them to rethink any of their previously held faith convictions. They have been warned by pastors or parents or others that "those liberal college professors" are going to try to "undermine your faith." As I talk with students, I have found four things that help minimize negative reactions: (1) Take a posture of sharing not

Table 1. Common Characters

Character	Sounds Like and Advice
The Expert	<p>"I know a guy who ...," "My pastor said ...," "I read on the internet ..."</p> <p><i>Never argue with a fool; people might not know the difference.</i> –An old proverb</p> <p>Not that the student is a fool, but that arguing is the exact wrong response—especially since the student may not be correctly remembering everything he or she heard or read. It is better to use this opportunity to talk about what constitutes reasonable and reliable authority. For example, in what areas might we expect a pastor to have "expert" knowledge? I like to use language similar to this: "We sometimes meet good, Christian people who have good intentions, but say things that are just not right."</p>
The (Unhealthy) Skeptic	<p>"Don't try to cram your liberal ideas down my throat."</p> <p>This is not something that I have heard directly about myself, but I know of other colleagues who have received this kind of comment on student course evaluations. See my comments on "authority" in the discussion below for ways to mitigate this problem.</p>
The Suck-up	<p>"I can't believe some people still think ..."</p> <p>These are students who see themselves as "enlightened" and tend to look down on students with more conservative positions. These students provide an opportunity to demonstrate love and model respectful conversations. This type of response can be helpful: "It can be hard to see how someone might not be convinced by the evidence that we find convincing, but we must still love them and gracefully grant them the space to disagree."</p>
The Zealot	<p>Asks "baiting" questions.</p> <p>Avoid getting drawn in to a pre-existing argument or discussion—something might be happening in the hallway or dormitory of which you are unaware. Also, there could be a trap waiting for you, so tread carefully; it might be advisable to offer to meet privately with the student since your conversation with him/her might lead to unnecessary confusion and consternation for other students.</p>
The Post-modernist	<p>"Everyone has to find the interpretation that works for them." "You can't really tell or know for certain."</p> <p>This comment really reflects immature critical thinking skills: a cognitive developmental level where the students can recognize different viewpoints, but do not yet know how to evaluate them properly. They can just as easily feel the same way about the speed of light as a universal speed limit.¹⁴ This position is the one general category of comment whereupon I will firmly and openly disagree with the student—in a loving, gentle manner, of course; I do not want them to think that the knowledge claims of science are merely matters of opinion where one is free to pick and choose according to one's taste. We do not yield the pursuit of truth to vagueness or indeterminacy simply because the going gets tough or we do not like where it leads us.</p>



I have four [suggestions] that help minimize negative reactions:

(1) Take a posture of sharing not preaching;

(2) Emphasize God's sovereignty, care of, and work in creation;

(3) Indicate that your ideas about SFO issues are not just biblically informed but biblically grounded; and

(4) Be honest about your own faith struggles ...

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preaching; (2) Emphasize God's sovereignty, care of, and work in creation; (3) Indicate that your ideas about SFO issues are not just biblically informed but biblically grounded; and (4) Be honest about your own faith struggles and your faith journey—you appear to them to have all the answers now, but such was not always the case, and you are still on the journey.

Conclusions

This approach to integrating SFO issues into my introductory courses has been successful as far as I can tell: students are engaged and animated during the discussions, and they give me positive feedback, both formally and informally. Here are examples of the positive comments that are typical:

- Science and faith days were excellent. They challenged me to think about my faith and beliefs in positive ways.
- These [science and faith] days were always interesting.
- I like the sci-faith [sic] presentations as a way to challenge us to think outside our box.

Even though the overwhelming majority of comments related to our SFO discussions are positive, there are some detractors. For example, despite my efforts to communicate that I was not trying to force-feed them, here was one comment from someone who did not get the message: "I know it's not a philosophy class, but sometimes it seemed like you were trying to impose your beliefs on us." (I am not sure what this individual thinks about their philosophy classes.) A few students would like to broaden discussions: "The faith and science days are good but I wish that there was more open discussion on these days to hear other people's opinion." (Note what she reveals about her critical thinking skills: she appears to regard my lecture content as "opinion," equally weighted with that of her peers.)

It would be desirable in the future to try to assess the long-term impact of the Six Easy Pieces: Do students seek out more SFO information on their own? Did the Six Easy Pieces help mold and mature their faith? How many students would be willing to take a full course on SFO issues? Perhaps someday I can collect and process such data.

In the meantime, I keep trying to get a little spark started—to plant a seed, to hope for an irrigator, and to pray for growth.¹⁵ ★

Notes

¹With apologies to the late Richard Feynman.

²A Hebrew phrase meaning "formless and void."

³Ronald F. Youngblood, *The Book of Genesis: An Introductory Commentary*, 2d ed. (Grand Rapids: Baker Book House, 1991), 24.

⁴This is based partly on the notion of the significance of naming objects to the Hebrews. God gives names to "day" and "night" [Gen. 1:5], "heaven" [v. 8], "earth" and "seas" [v. 10]. Also, in verses twenty-eight through thirty, God explicitly delineates the domain of humanity.

⁵Other passages have the same taxonomic descriptions of what we call the universe: Haggai 2, Psalm 8, Ezekiel 38 and Zephaniah 1.

⁶James Gleick, *Chaos: Making a New Science* (New York: Penguin Books, 1988), 176–7.

⁷Stephen M. Barr, *Modern Physics and Ancient Faith* (Notre Dame: University of Notre Dame Press, 2003), 118–37.

⁸The is the process by which three alpha particles can combine to form a carbon nucleus through a resonance-enhanced interaction. See Barr, *Modern Physics and Ancient Faith*, 121ff.

⁹Barr, *Modern Physics and Ancient Faith*, 157.

¹⁰M. Friedrich, S. Remmele, B. Kromer, J. Hofmann, M. Spurk, K. F. Kaiser, C. Orzel, M. Kuppers, "The 12,460-year Hohenheim Oak and Pine Tree-Ring Chronology from Central Europe—A Unique Annual Record for Radiocarbon Calibration and Paleoenvironment Reconstructions," *Radiocarbon* 46, no. 3 (2004): 1111–22. Special thanks to Henri D. Grissino-Mayer of the University of Tennessee for this reference.

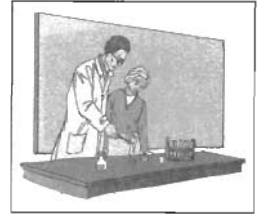
¹¹Some young-earth creationist literature gives readers the impression that calibration and contamination issues are facets of radiometric dating that scientists have never thought about. John D. Morris' book, *The Young Earth* [Colorado Springs: Creation Life Publishers, Inc., 1994], contains a chapter on radiometric dating, and represents a nice example of this type of "straw-man" argument against the reliability of radiometric dating.

¹²I like to point out that human memories are physical processes. Perhaps, I tease them, you have only just been created—but with all of the memories of a complete life: all the people you have known and loved never existed, all your favorite experiences never happened.

¹³Television talk shows are notorious, in my opinion, for providing examples of how to have bad conversations. Most of these shows are structured to create dissonance and excited emotional states, which are better for attracting viewers and garnering high ratings. Some, for example Bill Maher's "Politically Incorrect," spin idea after idea with no actual deep exploration or resolution of the ideas.

¹⁴In physics we know that nothing can exceed 2.998×10^8 meters-per-second, but the students have seen enough science fiction programs that they can be skeptical of this well-established universal limit. The line between the statements of science and those of science fiction can be blurry.

¹⁵With apologies to the Apostle Paul (See 1 Cor. 3:6).



Paradise Regained: Teaching Science from a Christian Standpoint in a Postmodern Age

Amalee Meehan

The scientific study of life and questions of faith have always been wedded, until the age of modernism provoked an uneasy but prolonged divorce. This article addresses the need to reclaim an ancient paradise where the Christian story/vision and the world of science are partners rather than enemies, and suggests Shared Praxis in the science classroom as a possible approach. It supports a perspective that honors science as a rigorous discipline whose fruits have advanced the human race in ways unimaginable to our ancestors yet at the same time seeks the wisdom of our Christian tradition.



Amalee Meehan

... Earth's crammed with heaven,
And every common bush afire with God;
But only he who sees, takes off his shoes,
The rest sit round it and pluck blackberries ...¹

Early May is the season of contented mating and proud parenthood along the banks of the River Charles. Only this morning, I spotted two terrapins floating on an old tree trunk, content in each other and with the morning's sun. Further along, two proud Canada geese displayed their brood of downy goslings for all the world to admire. These moments of perfection are moments in the human quest for truth when the forces of faith and reason click in a collective effort to explain and give glory for the created world and wonder of life. These creatures who have made their home along the Charles—feeding, breathing, procreating, and caring for their young—manifest the characteristics of living things clearer than any biology lesson could communicate. The natural world around us has so much to teach, not only knowledge of facts but wisdom for life, if only we are prepared to open our minds and our hearts.

Modern science was born out of an intellectual revolution sparked by Galileo (1564–1642) that became a bonfire with Newton (1642–1727). Galileo attempted to investigate the world from a strictly quantitative point of view. Experimentation that yields quantifiable results became the central methodology of the emerging scientific

enterprise.² The advances of Galileo and Newton led modern thinkers to reject the ancient understanding of the world as organic, and to replace it with a mechanistic model. Armed with this mechanistic outlook, which reduces reality to a set of basic particles and forces, the modern scientific enterprise set about unlocking the mysteries of the universe, presuming that even the greatest mysteries were now within reach of their scientific method. With each new discovery, modern science tightened its grip as the only system of explanations necessary for the heretofore incomprehensible; science became the new religion. Rather than seeking the answers to the great questions of life and death through faith, modern thinkers looked to hard-nosed, empirical data and to hypotheses advanced, confirmed, or rejected through the scientific method for certainty and reliability.

The advances of Galileo and Newton led modern thinkers to reject the ancient understanding of the world as organic, and to replace it with a mechanistic model.

Amalee Meehan is a teacher of biology and mathematics at Coláiste Iognáid, a bilingual (English and Gaelic) Jesuit high school in Galway, Ireland. She holds a B.Sc. from the National University of Ireland, Galway, and M.Ed. from Trinity College, Dublin. Amalee is on leave from her teaching position to complete a Ph.D. in Theology and Education at the Institute of Religious Education and Pastoral Ministry, Boston College. Although steeped in her native Celtic heritage and a fluent Gaelic speaker, Amalee is very interested in other cultures and has spent time visiting places as diverse as Sarajevo and the Usambara mountains of northern Tanzania.



This age of postmodernism has brought another new way of understanding the whole process of learning.

The atomic structure of the material world reveals that it is dynamic, relational, paradoxical, predictable in its effects, and yet uncertain and relative ...

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But the world keeps evolving, our understanding of life keeps changing, and this age of postmodernism has brought another new way of understanding the whole process of learning. The atomic structure of the material world reveals that it is dynamic, relational, paradoxical, predictable in its effects, and yet uncertain and relative, as Einstein insisted. Accordingly, no longer are we prepared to accept the objectivity of any learning process and outcome; what learners bring to the study and the socio-cultural context in which they work makes a difference to learning outcomes. Yet science continues to be taught and examined as if it had never left the age of modernism; to a large extent it still reflects the modern understanding of science as objective and certain. One has to look no further than standardized tests such as MCAS (Massachusetts Comprehensive Assessment System) examinations to see these assumptions at work.

Postmodern Understanding of Faith

Christian understanding of "faith" has also shifted in comparable ways from the modernist stance of absolute truths revealed and taught as infallible beliefs toward deep faith convictions that can embrace paradox and ambiguity; faith in the age of postmodernism is more of a leap than a certainty. The modernist legacy often poses faith and science as enemies, but tradition, time, and perhaps postmodernity, suggest they are more entitled to be friends and partners. From early Christianity, most biblical scholars have recognized the need to interpret the Bible in the light of wider knowledge. Augustine of Hippo had some strong advice on this matter:

Usually, even a non-Christian knows something about the earth, the heavens, and the other elements of this world ... about the kinds of animals, shrubs, stones, and so forth, and this knowledge he holds to as being certain from reason and experience. Now, it is a disgraceful and dangerous thing for an infidel to hear a Christian, presumably giving the meaning of Holy Scripture, talking nonsense on these topics; and we should take all means to prevent such an embarrassing situation ... the shame is not so much that an

ignorant individual is derided, but that people outside the household of faith think our sacred writers held such opinions, and, to the great loss of those for whose salvation we toil, the writers of our Scriptures are criticized and rejected as unlearned men.³

It is clear that Augustine had great respect for scholarly learning and believed that it should inform interpretation of the Bible. A primary theological warrant held by Christians for commitment to education was the conviction that faith and reason are essential partners in the life of Christianity — understanding and faith, reason and revelation need and enhance each other. This is well summarized in a classic statement of Thomas Aquinas: "Just as grace does not destroy nature but perfects it, so sacred doctrine presupposes, uses, and perfects natural knowledge."⁴

In light of postmodern systems of understanding, a key question arises for Christian schools: are we in danger of fossilizing science in our high schools or, by contrast, can we grasp the opportunity as Christian educators to teach science in faith-filled and life-giving ways? In other words, will we continue to glibly accept the assumptions of the modern scientific world view or will we take postmodernism as an opportunity to teach for spiritual wisdom and in ways deeply compatible with a faith perspective on life?

I am not proposing here that we blend high-school teaching of religion with that of science, or attempt to square scientific findings with dogmatic truths. Rather, I am lifting up the purpose of the science class as the rigorous teaching of content, scientific method, techniques of experimentation — the whole broad curriculum. But if we accept that all education is formative (or indeed malformative) we must remain conscious of the potential that science holds for young inquiring minds, and the endless possibilities of integrating life with learning. To lose sight of this aim would be a disservice to the subject, to our students, and to ourselves. My goal is not to subsume science into faith nor simply to "use" science to teach faith. Both religious education and science education must stand with integrity in their own right. Nonetheless, in keeping with ancient

Christian insight and now affirmed by postmodernism, science education and religious education can be partners for the spiritual benefit of students. Science can be taught in ways that nurture people in spiritual wisdom for life; religious education can be taught in ways that respect, and are enhanced by, the findings of science. My focus here is squarely on the spiritual potential of science education.

I propose ... a pedagogy [particularly in the science class] that honors both the rigorous discipline of science and a life-giving faith.

The science class offers limitless opportunities to acknowledge the human tendency to ask questions, to investigate life, to soul search. As spiritual beings we are constantly searching; there is a persistent desire in us to understand the source of that yearning within. Our Christian tradition sees the quest to know the world as the search for God. Church-sponsored schools present us with an abundance of opportunities to work with ourselves and our students as time and tide allow, so that we do not end up teaching in a vacuum, transmitting no coherent set of values but whatever might be the flavor of the day. Therefore, I propose a pedagogy that raises a consciousness of our Christian faith, particularly in the traditional hotbed of questions—the science class. It is a pedagogy that honors both the rigorous discipline of science and a life-giving faith. We are, in the end, two-winged creatures—we fly to deep truths on the wings of reason and faith.

Biology As a Representative Discipline

Although other fields can be included, science is generally taught as the disciplines of biology, chemistry, environmental science, and physics (standardized testing and curricular frameworks tend to reflect this division). This article concentrates on biology (the science of life and life processes) as a representative discipline. I locate the teaching-learning process in secondary schools that uphold Christian values in their mission and identity, and I suggest shared praxis as a teaching approach that lends itself to teaching biology grounded in Christian faith for a postmodern world. I focus on Darwin's theory of natural selection ("Survival of the Fittest") as a case study of one aspect of the biology curriculum; in the current climate, it appears most pressing. My premise is that both the spiritual perspective of Christian faith and the work of scientists have worthy voices to lend in the balanced learning of the origin, development, and continuation of life.

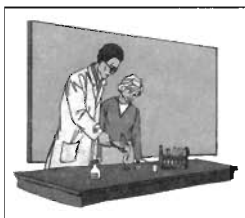
In schools across the western world, including Christian institutions, what students encounter in biology class regarding the theory of evolution can be very different from what they have learned in Sunday school and religious education classes, or stories they have heard in Christian community settings. The experience can be confusing and disconcerting. It can give the impression that science is attempting to de-throne God as the author of life and to install a random world "red in tooth and claw" instead. The biology teacher has a unique opportunity to offer uncompromised scientific integrity that is not only supported but enhanced by Christian faith. There can be no conflict between Scripture and nature when God is the Author of both. Confident that all truth is of God, there is no fear of what we might discover. Christian educators are uniquely poised to raise a sacramental consciousness—a disposition to see the ultimate in the ordinary—in their teaching of biology.

From the beginning, the emphasis of Christian faith, following the emphasis of the Bible, has been on the relationship between God and the world rather than on a scientific analysis of creation. Empirical questions about how or when the world was created have been secondary issues to theology.⁵ On the other hand, science has a long history of dealing with secondary causes of interactions within nature, but it cannot deal and does not attempt to deal with the primary questions of ultimate origin, meaning and purpose of nature. Although they may have quite different starting points, both science and theology grapple with the mysteries of life. The two interests dovetail around mystery, human desire for knowledge and meaning, and the will to investigate; it is this that lends science resonance with spiritual questions and concerns.

Darwin and Evolution

From the ballrooms of Paris to the bivouacs around Gettysburg, Darwin's theory of evolution was the talking point of the 1860s. There was nothing new in the notion of evolution; many early Greek philosophers had evolutionary views.⁶ By the time Darwin was born, the view among "naturalists" that the world is developing and changing continually had been in circulation for some time. Darwin's contribution was to explain how this happens. Hence, it was more for his theory of natural selection that Darwin was both lauded and vilified.

Darwin's theory of natural selection suggests that many more individuals are born than can possibly survive. Nature selects as survivors those organisms with some competitive edge that makes them best adapted to survive the harsh conditions of life. In the "struggle for existence," any member of a particular species who gains an advantage over fellow members is more likely to survive and procreate its kind, whereas those with weaker traits are weeded out: "This preservation of favorable individual differences and variations, and the destruction



The implications of Darwin's theory have much to excite the scientific enterprise and the world beyond. But it would be cold comfort to leave it at that. Christian faith provides another voice – not contradictory, but with a deep perspective that balances the terror of Darwinian systems.

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of those which are injurious, I have called Natural Selection, or the Survival of the Fittest."⁷

Darwin's observations threw up many shocking implications, not least was his competitive picture of the world of nature. Darwin's nature is a savage place of predation, violence, competition unto death. Both animal and plant inhabit kingdoms where the strong survive at the expense of the weak and individuals are caught in a terrible fight for existence. No fiercer battle is fought than against members of one's own species. His is a nature of jagged teeth and razor-sharp claws, the world of Skull Island without Kong as king.

Darwin's picture of nature explicitly overturned everything that was presumed in late nineteenth-century society about the natural world. Even more upsetting were the implications for the class-ordered society in which people lived. Disturbing questions arose such as: Do Darwin's laws of nature also apply to humankind? Are we driven by instinct to compete unto death? What of the heaving masses of the lower class—rather than a well-ordered society where each knows their place? Are the structures of society merely veiling the tumult beneath? And probably most disturbing of all, what justified claim on privileged life have those who, rather than selected through competition, simply inherit wealth and status as a "birthright"?

If Victorian England struggled to accept the implications of Darwin's work, this system of thought that reconciles deterministic materialism and the idea of progress was much better received in the United States. The inherent individualism of Darwin's theory was very congenial to American minds.⁸ Indeed, "survival of the fittest" became quite the catchphrase among an emerging generation of American business magnates. Rockefeller explained the growth of large business as "survival of the fittest" and used the analogy of the American Beauty rose which could "be produced in the splendor and fragrance which bring cheer to its beholder only by sacrificing the early buds" which grew around it.⁹ The American business scene in the late nineteenth century bore a close resemblance to the natural world Darwin had described.

The implications of Darwin's theory have much to excite the scientific enterprise and the world beyond. But it would be cold comfort to leave it at that. Christian faith provides another voice—not contradictory, but with a deep perspective that balances the terror of Darwinian systems.

Shared Praxis As an Approach That Honors Faith and Reason

Shared Praxis is a comprehensive approach to religious education and pastoral ministry developed by Thomas Groome in the 1980s. A shared praxis approach invites people to bring their lives to faith, and their faith to life, in order to come to a lived faith. In the context of religious education, the dynamic moves from people reflecting on their own lives, to the resources of a religious tradition, to return to life with more faith-filled praxis. In the context of science education, students would be given access to scientific knowledge in the context of their own lives and interests, with the specific intention of enhancing their human living, including their spirituality. This approach reaches beyond knowledge in the objective information sense toward wisdom for life. Its pedagogical circle closes (and begins again), inviting participants to see for themselves and make decisions (cognitive, affective, or behavioral) about what to "do" with their newfound knowledge/wisdom. In this sense, a shared praxis approach to science education can reach beyond depositing data toward enhancing people's lives, including their spiritual lives.

Groome's shared praxis approach consists of a focusing act and five subsequent (but often overlapping) movements built around a generative theme. After each movement, Groome encourages participants to write down their thoughts, and to share them with conversation partners or the whole group. In that moment, participants get a chance to reflect, to pull their thoughts and feelings together in an environment of engaged, active communal learning.

The success of Shared Praxis is evidenced by the wide use of the approach. From its inception twenty-five years ago, it has become the standard approach to religious education in the United States and beyond.

The grade school Catholic religious education curricula of the three major publishers in that field—Sadlier, Silver Burdett, and Resources of Christian Living—are all based on Shared Praxis. Likewise, the Unitarian Church of America and the Baptist Church have national curricula rooted in this approach. The Catholic Church in Australia and the Catholic bishops of Canada as well as the Alive-O series in Ireland all produce series overtly based on Groome's pedagogy. Moreover, the success of Shared Praxis extends far beyond the English-speaking world. For instance, religious education series from Lithuania, Sweden, and Korea all claim Shared Praxis as their pedagogical foundation.

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There are obvious openings for this approach right across the biology curriculum. As a practical example, I apply a shared praxis approach to Darwin's theory of natural selection.¹⁰

Focusing Act: Groome suggests that the focusing act is tied to interests, not just honoring the existing interests of participants, but also generating interests, as long as they actively engage people. Therefore, I might begin the session by turning students to the natural world with a field trip to a local ecosystem. Any ecosystem—a forest, seashore, woodland, grassland, backyard, even the town dump—will provide ample evidence of competition, interdependence, and the struggle for life. What is important is that students get a feel for the lived reality of "wild" life in both supportive and adverse conditions, and what the different organisms, plant and animal, might need to survive in that ecosystem.

Movement 1: Groome describes the essential task of the first movement as offering "an expression in present praxis of the theme, so that participants can perceive what is going on ... regarding this issue in their lives."¹¹ Students' own thoughts and feelings about the field trip are crucial here; how it engaged them personally. I invite initial expression from life around the theme by asking

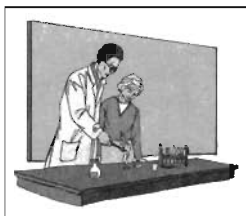
questions that evoke people's consciousness of what they have experienced such as: what plant and animal organisms did you notice in the ecosystem we visited; what ways are they dependent on/independent of each other; are any organisms vulnerable or threatened in this habitat; did you experience this habitat as a peaceful/turbulent place and why? In this way, I introduce the notions of competition and interdependence, with a hint toward responsibility.

Movement 2: The aim here is to bring participants "beyond recognition to some level of critical reflection" regarding present praxis.¹² Groome advises that such reflection can draw from reason, memory, and imagination so a variety of questions that engage all of these faculties should be crafted. In this case I start by prompting some social analysis and critical reflection on their experience of the field trip; what of society supports or threatens this ecosystem; why they saw what they saw and what they think it means. We might then consider their interpretations in light of Darwin's theory of natural selection using questions such as: does Darwin's picture of the natural world help you to understand the ecosystem of the field trip; does it help you to relate to your experiences of life in general; how long do you imagine that you could survive living "wild" in this habitat?

Movement 3: The aim of the previous movements is to enable people to come to recognize their own stories and visions of the learning experience that they now bring into dialogue with both Darwin's theory and an exposition of Christian faith. Movement 3 involves seeking the practical wisdom of the learning; it does not ask people to defend their positions, rather it seeks to go a little deeper and examine the hopes, expectations, images, and stories they hold that influenced what was brought to mind and heart.

The substantive element of movement 3 is Darwin's theory of natural selection. Every species—plant, animal, and micro-organic—produces many more young than could possibly survive. Only those who are best adapted to their particular environment will survive into adulthood, mate, and produce offspring. In this way, the strongest prevail. Movement 3 initially sets up a dialectic between this theory and student's own experience by asking questions such as in what ways did your field trip experience confirm or refute Darwin's theory; how does your experience of life confirm/contradict Darwin's view of nature; does the theory of natural selection apply equally to human beings as to animals and plants?

At this point, opportunities need to be taken to raise up a Christian vision, so that rather than merely learning about natural selection, we learn from it, and in line with Groome's great paradigm of learning, we see the implications for ourselves. In addition to the sources of Scripture and tradition, material for Christian vision can be drawn from the world of poetry, prose, art, or any aspect of



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popular culture that brings the content of the science lesson into conversation with Christian faith. For this lesson, the two stories of creation from Genesis 1 and 2 respectively are appropriate. I propose to lift up both accounts on the advice of Hebrew scholarship: "the contrast and interaction of the creation accounts offer a richer understanding of the relationship of God to human kind than we would have if the accounts were read in isolation."¹³

Genesis 1: ²⁴ God said, "Let the earth bring forth every kind of living creature: cattle, creeping things, and wild beasts of every kind." ... ²⁶ And God said, "Let us make man in our image, after our likeness" ... ²⁷ And God created man in his image ... male and female he created them. ²⁸ God blessed them and God said to them, "Be fertile and increase, fill the earth and master it."

Genesis 2: ⁷ the Lord formed 'adam' from the dust of the earth. He blew into his nostrils the breath of life ... ¹⁸ The Lord God said, "It is not good for man to be alone; I will make a fitting helper for him." ... ²⁰ And the man gave names to all the cattle and to the birds of the sky and to all the wild beasts; but for Adam no fitting helper was found. ²¹ So the Lord God cast a deep sleep upon the man; and, while he slept, he took one of his ribs ... and [he] fashioned the rib that he had taken from the man into a woman; and he brought her to the man.

After the creation accounts are read, a shared praxis approach would ask, what did the passage say to you on this occasion; how did it make you feel; what memories did it evoke; what images came to mind? Engaging the faculties of memory, reasoning, and imagination can elicit many and varied responses. A key theme from this discussion is that the creation account is not a treatise on scientific origins. Here the language of faith speaks of something lying behind or beyond human experience: the origination and ordering of all that exists by the will of the Creator.

The central learning of the Genesis accounts is that humanity is set apart from other animals. Unlike every other species of animal and every species of plant, humans

are conscious beings, not bound to live by the force of instinct. This theme reaches climactic expression with the creation of humanity, commissioned with a special role in God's creation, and gifted a special relationship with God the Creator. Each of us is loved uniquely; we are aware at our deepest core of this love and we search for its source and origin.

Movement 4: Although we have heard them many times, the biblical accounts still evoke a sense of wonder before the mystery and marvel of creation. During the first human voyage around the moon, millions listened on Earth as Apollo 8 commander, Frank Borman, read the first ten verses of Genesis (Christmas Eve, 1968). The key intention of movement 4 is to invite students to create a dialectic between the Darwinian "struggle for existence" and the loving Creator God of the Genesis creation accounts, coming to "see for themselves" where they stand or the wisdom emerging.

Movement 3 has set out the resources for students to enter into a conversation between a Darwinian view and a view of Scripture. Movement 4 asks people to engage in this conversation and rather than simply correlating the message, to integrate it, coming to their own insights and positions. Again, this can be done by a series of reflective questions such as; how is Darwin's theory resonant or dissonant with a faith perspective; could God's providence be "working" through natural selectivity; what does this mean for our free will, for human agency, for our responsibility for neighbor; can Darwin's theory be applied to human society, even if it is true of nature; what about Christian outreach to people who are poor and weak; what insights emerge for you from this conversation? In one way or another, these questions ask "what are you coming to see for yourself?"¹⁴ The message of the creation accounts can provide a welcome counter voice to that of survival of the fittest, but the reassurance it promises also denotes responsibility. Movement 4 focuses on people coming to their own positions; each student is encouraged to figure out what they really believe and the wisdom this learning has for their lives.

Movement 5: A shared praxis style invites participants to make decisions—cognitive, affective, or behavioral—around the

generative theme. Ours is not the view of a hyperactive God who created all things in a fever of activity and then withdrew to admire from a distance. Rather, we belong to a world that is radically dependent on God for its origin, continuation and development. God calls us into partnership as stewards of creation (Gen. 2:15); movement 5 helps students to consider that responsibility and how it pertains to each one of them.

Groome's advice is to "pose questions that invite participants' own praxis like decisions and responses" such as what are you thinking; what does this mean for how you live your life?¹⁵ Therefore, we might reflect as a group on how difficult it can be to live in appreciation of the created world, to face our obligations to it, or on how it relates to a holistic view of living that includes the spiritual and how this can be sustained by a consciousness of nature.

Shared Praxis also challenges us to look beyond the content of our teaching, which often seems to be our primary concern, to take equal care of who we are teaching, where this takes place, and how we go about it. Too often in our state-imposed, syllabus-oriented classrooms and exam-driven high schools, we focus primarily on content to the exclusion of all these other worthwhile factors. The goal of Shared Praxis is that, whatever the topic, students find spiritual wisdom for their lives.

Further Opportunities for Shared Praxis in Teaching-Learning Biology

Any biology curriculum provides scores of opportunities for a shared praxis approach. For example, the proposed Massachusetts Biology High School Standards (March 2006) outlines how:

At the high school level, students study life by examining systems from the molecular level through cell biology and genetics, to the tissue and organ level in vertebrate anatomy and physiology, and at the level of organisms and populations through ecology. A solid understanding of the processes of life allows students to make scientifically informed decisions related to their health, and to the health of the planet. Unifying these diverse topics of study is the concept of organic evolution, which is fundamental to understanding modern biology.

This document goes on to stress the importance of scientific inquiry as an integral part of a well-planned biology curriculum. Inquiry is essential to the shared praxis approach of reflecting critically on life by remembering, reasoning, and imagining, and of asking good questions in a manner that engages the student in active learning, while adopting an open posture to the spiritual wisdom to be gleaned from their encounter with science.

There are a multitude of curricular opportunities for Shared Praxis in this proposal: cell biology and genetics with implications for genetic engineering and cloning; how artificial nutrition, hydration, and reproduction has changed our view of human anatomy and physiology; the complexity of systems, organs, and tissues, and the causes and effects of breakdown; organism populations and the effects of different types of pollution; the pressing concerns of ecology and conservation; and the bioethics involved in the decisions we make regarding our own health and the health of the planet. All of these offer opportunity for placing explicitly Christian spirituality in dialogue with the practical wisdom to be gained from science—for life.

No pedagogy or curricular choice is value-free; we inevitably transmit values in the education process, either by design or default. It is against this background that I envisage the teaching of biology in a life-giving way that might make a difference to the learners themselves and to the world about which they are learning and in which they live by encouraging them to let their faith permeate their science and their sciences enhance their faith.

Conclusion

Influenced by the prevailing climate of postmodernism, our understanding of science has changed; no longer do we believe that merely examining the cells of life through a microscope can give us the measure of the wonder and mystery of life. But if the consciousness of scientists has shifted, so too has the language of faith. It has become much less the dogmatic language of certainty. This article proposes that it is possible to have distinct scientific understandings but deep faith. As educators in Christian schools, we need to reclaim the deep convictions between our faith and our science.

Monsieur Jourdain, in Molière's *Le Bourgeois Gentilhomme*, startles himself with the discovery that he had been speaking prose all his life and had not known it—his teacher had given him only a word and not an insight. Even in teaching science, what we wish to pass on is more than a set of facts; it is a way of knowing that honors the complexity of life and the holistic nature of humanity, and nurtures a spiritual wisdom that is life-giving for self, others, and the created order. It moves beyond information to wisdom. It supports an outlook and perspective that honors science as a rigorous discipline whose fruits have advanced the human family in ways unimaginable to our ancestors yet at the same time places science in dialogue with the wisdom of Christian tradition. ★

Notes

¹Elizabeth Barrett Browning, *Aurora Leigh* (London: J. Miller, 1864). <http://digital.library.upenn.edu/women/barrett/aurora/aurora-7.html>.

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- ⁵Ernest Lucas, "Science and the Bible: Are they Incompatible," *Science and Christian Belief* 17, no. 2 (2005): 137-54.
- ⁶Alexander Wolsky, "A Hundred Years of Darwinism in Biology," in *Darwin's Vision and Christian Perspectives*; [papers] ed. Walter J. Ong (New York: Macmillan, 1960).
- ⁷Charles Darwin, *The Origin of Species By Means of Natural Selection, or, The Preservation of Favored Races in the Struggle for Life*, Modern Library ed. (New York: Modern Library, 1993), 108.
- ⁸Vincent C. Hopkins, "Darwinism and America," in *Darwin's Vision and Christian Perspectives*.
- ⁹Cited in Richard Hofstadter, *Social Darwinism in American Thought* (Boston: Beacon Press, 1955).
- ¹⁰It is not my intention here to examine the Evolution/Intelligent Design controversy that has beset some public schools, nor is it my intention to directly address the literal value of the creation myth or the theory of common ancestry. Such debate is outside the scope of this paper. However, as these are issues that might be of concern to our students, we need to be prepared to allow them into classroom discussion. Therefore, I have chosen material for movement 3 that will provide a space for discussion of these issues if they arise.
- ¹¹Thomas H. Groome, *Sharing Faith: A Comprehensive Approach to Religious Education and Pastoral Ministry* (Eugene, OR: Wipf & Stock, 1998), 376.
- ¹²Ibid.
- ¹³Jewish Publication Society, *The Jewish Study Bible* (Oxford; New York: Oxford University Press, 2004), 15.
- ¹⁴Groome, *Sharing Faith*, 378.
- ¹⁵Ibid.

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Using Galileo to Teach Darwin: A Developmental and Historical Approach

Craig A. Boyd



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In the spring of 2003, I was asked to create and teach an upper division general education course entitled "Science and Christianity," an interdisciplinary course I team-taught with biologist Eugene Dunkley and psychologist James Zahniser.¹ Since my own area of expertise is in the history of philosophy and the intersection of science and Christianity, I was selected to lead the team through the portion of the course that considered the historic conflicts between faith and science. As we prepared the course, we realized that in teaching Darwinian theories of evolution, we would encounter resistance because it has the potential to cause distress among students, parents, faculty, and administrators at Christian colleges. Theories of evolution, it is assumed, challenge Christian views of creation—and maybe more importantly—the idea that the Bible is the uniquely inspired word of God.

Darwin's advocacy of evolution, however, was not the first great crisis to confront people who were both scientifically literate and deeply religious. Galileo's famous encounter with the Church provides a helpful model for faculty members in negotiating the science-religion terrain since there are so many similarities in the two cases. In his incisive study of Galileo's *Letter to the Grand Duchess Christina*, Ernan McMullin examines the various hermeneutical principles employed by Galileo in his controversy with the Church. These principles can also apply to the Darwinian controversy. Although Galileo's own attempt to use these principles is ultimately inconsistent, it provides a helpful approach to negotiating science-theology conflicts.²

Since the geo-centric model of the cosmos is no longer widely accepted, it presents a fairly safe starting place for professors who

wish to discuss issues concerning the broader science-religion relationship, but also the more specific issue of evolution and the Christian faith. This approach to teaching Darwinian evolution has the following advantages: (1) it considers the problem of Darwinian evolution and Christian faith within a larger historical context; (2) it helps faculty and students attempt to see that both religious texts as well as the natural world require interpretive tools; and (3) it introduces the materials in an appropriate developmental manner.

As one would expect, students had little difficulty negotiating the conflict between Galileo and the Church, but they did not realize that the same hermeneutical principles could be applied, *mutatis mutandis*, to the Darwin controversy. Our interest was not in proving Galileo or Darwin right or wrong. These issues were secondary to the methodological issues involved in giving a fair hearing to a scientist and theory that has often been misunderstood. Our intent in presenting the material in this way was not to convert students to one particular way of thinking about Darwinism, but to help them see the theories of evolution in the most positive light while giving them "the good news" and "the bad news."

The various hermeneutical principles employed by Galileo in his controversy with the Church ... can also apply to the Darwinian controversy.

Craig A. Boyd received his Ph.D. in philosophy from St. Louis University in 1996 and was appointed professor of philosophy and director of faith integration at Azusa Pacific University in August of 2005. He currently has two books in press: *Contemporary Challenges to Natural Law Morality* (Brazos Press) and *Visions of Agapé: Problems and Possibilities in Human and Divine Love* (Ashgate Publishing). He has published articles in *New Blackfriars*, *American Catholic Philosophical Quarterly*, *Zygon: Journal of Religion and Science*, and *the Modern Schoolman*. His research interests lie in natural law morality, divine command theory, the ethics of love, and sociobiology. Boyd has also been a visiting scholar at Oxford University and St. Louis University.



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(1) young-earth creationism,

(2) old-earth creationism,

(3) theistic evolution, and

(4) naturalistic evolution. After these brief presentations, we gave a short survey and asked the students to self-identify with one of the theories.

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To get a handle on the students' beliefs about Darwinian thought and its compatibility with Christian faith, we decided that we would collect some data from them. Before considering the materials on evolution, we presented them briefly with four views on evolution and creation: (1) young-earth creationism, (2) old-earth creationism, (3) theistic evolution, and (4) naturalistic evolution. After these brief presentations, we gave a short survey and asked the students to self-identify with one of the theories. These surveys were anonymous. At the close of the unit, we give them the survey again. An interesting result was the move from the extremes (options 1 and 4) to the middle (options 2 and 3). Most surprisingly, we had students move from nontheistic evolution to one of the theistic models even though our primary concern was not evangelism.

Primary and Secondary Texts

As a general introduction to various theological, historical, and scientific issues, Gary Ferngren's *Science and Religion: A Historical Introduction* and Ian Barbour's *Religion and Science* prove to be helpful texts. Barbour's work is especially valuable in at least two respects.³ First, it provides a helpful historical background to both Galileo and Darwin and students find this material readily accessible. Second, Barbour provides four helpful models for considering the interaction of science and religion. The conflict model views science and religion in competition and so if one view is true then the other must be false. The contrast between the fundamentalism of creation scientists as well as the atheistic fundamentalism of Richard Dawkins helps students see the conflict model in stark relief. The independence model—one that Galileo seems to adopt at times—can be seen in the work of Stephen Jay Gould's NOMA thesis as well as the work of neo-orthodox theologian Langdon Gilkey.⁴ Defenders of the dialogue model see science raising certain "limit questions" that science does not have the resources to answer. McMullin seems to represent this view. And finally, Barbour considers a model of integration where science and religion can be integrated into a coherent whole.⁵

As a background to the issues, we used Thomas Kuhn's *The Copernican Revolution*. Kuhn provides an excellent understanding of Ptolemaic cosmology and Aristotelian philosophy of nature that shaped the medieval synthesis, which was the context for Galileo.⁶ These materials are easily converted to lecture materials and are especially helpful for lecturing on Ptolemaic and Copernican cosmologies.

McMullin's Interpretive Principles

The Galileo Affair, as it has come to be known, has been well documented, especially by Stillman Drake and Richard Blackwell.⁷ The first trial in 1615 focused primarily on the scientific, philosophical, and theological issues concerning Copernicanism while the second trial was concerned primarily with whether Galileo had violated the terms of the agreement negotiated by Cardinal Bellarmine, who unfortunately died years before the second trial.

Galileo's classic defense of Copernicanism can be found in his *Letter to the Grand Duchess Christina*, a work that was circulated as an apologetic for his own views and as a means to sway those who might be open to a heliocentric cosmology. In our course, we placed Drake's *Discoveries and Opinions of Galileo* on reserve at the library and required the students to read Drake's translation of the *Letter* along with McMullin's essay "Galileo on Science and Scripture" in Peter Machamer's *The Cambridge Companion to Galileo*. McMullin observes in the *Letter* that Galileo appeals to the work of Augustine because it is a shrewd political ploy⁸ but also because Augustine seems to offer some helpful hermeneutics to address the problem.

McMullin has compiled five of the hermeneutics that Galileo used in his famous letter and uses them to unravel the affair in order to show where Galileo's arguments are the strongest and where they lead to his undoing. The principle that lies behind Galileo's hermeneutical principles is the *Principle of the Unity of Truth*:

Since an all-truthful God is the author of both the book of nature and the book of revelation; then it is not possible in principle for there to be a contradiction

between a religious truth and a scientific truth when each is properly understood.⁹

This principle anticipates the phrase “All truth is God’s truth,” which has become a shibboleth at most evangelical Christian institutions of higher learning. The principle itself is not too controversial and students readily accept it otherwise they are forced into the attitude that it “may be true in theology but it’s false in science” which seems to violate the basic realism that underscores both scientific method as well as common sense intuitions.

The five hermeneutical principles that McMullin lists can all be found in the earlier work of St. Augustine since the great father of the church also had to negotiate difficult issues that arose between Christian faith and the “science” of his day.¹⁰

1. *Principle of the Priority of Prudence:*

- When trying to discern the meaning of a difficult Scripture passage, one should keep in mind that different interpretations of the text may be possible, and that, in consequence one should not rush into premature commitment to one of these, especially since further progress in the search for truth may later undermine this interpretation.¹¹

This principle, we might say, requires a prior commitment to noetic humility, since it means that we must keep in mind that there is a distinction between what we *read* in the Scriptures and what it *means*. Another way of stating this for students is that our arguments are not about the Scriptures themselves but about our *interpretations* of the Scriptures. It is, of course, possible that students can remain pedagogically incorrigible about this issue but the principle of accommodation seems to cure them of this attitude.

2. *Principle of Priority of Demonstration:*

- When there is a conflict between a proven truth about nature and a particular reading of Scripture, an alternative reading of Scripture must be sought.¹²

This principle seems at times to shape Galileo’s views more than the others. The assumption Galileo makes here is that demonstration itself can “prove” the truth of his own perspective along the lines of a modified Aristotelian notion of demonstration wherein a major premise, followed by a minor premise produced a conclusion in a deductive manner. For Galileo, “demonstration” included this idea but instead of appealing to Aristotelian essences in the reasoning process, he employed mathematics and sense observation. Today we no longer accept this view of demonstration and therefore Galileo’s commitment to this method would ultimately undermine his arguments since on this view neither truth nor demonstration are possible since “scientific method” proceeds inductively.

3. *Principle of Priority of Scripture:*

- When there is an apparent conflict between a Scripture passage and an assertion about the natural world grounded on sense or reason, the literal reading of Scripture should prevail as long as the latter assertion lacks demonstration.¹³

What Galileo means by “sense” and “reason” is a strict Aristotelian form of demonstration, i.e., a deductive proof of the matter that does not admit of alternative possibilities. What Galileo *does not intend* is a reference to a naive realism where things simply are the way they appear to us. Indeed, the whole Copernican enterprise is based upon an understanding of “sense” that is modified by an appeal to “reason” which employs mathematical explanations.¹⁴ What Galileo means by “literal reading of Scripture” is a consideration of the text in its appropriate context.

4. *Principle of Accommodation:*

- The choice of language in the Scripture is accommodated to the capacities of the intended audience.¹⁵

When combined with the prior principle, we see the idea that a “literal reading” for Galileo is not what our students understand it to be. Any literal reading presupposes the genre of the scriptures and the particular context. Again, this is not too controversial since centuries later Bernard Ramm would appeal to the principle as well.¹⁶

5. *Principle of Limitation:*

- Since the primary concern of Scripture is with human salvation, texts of Scripture should not be taken to have a bearing on technical issues of natural science.¹⁷

This is probably the most controversial of the principles as far as our students were concerned. Why is it, they want to know, that Scripture should not speak to technical issues in science? Their reasoning is as follows. If the Bible is the authoritative word of God anything it addresses must be true. The Bible seems to address issues concerning the natural world. Therefore, the Bible addresses scientific issues. The faulty logic lies in the ambiguity of terms such as “truth” as well as the anachronistic problem of twenty-first century ideas superimposed on ancient texts. Of course, carefully explicating the nature of linguistic accommodation can help defuse this potential problem. Nonetheless, the principle is problematic for other reasons since miracles seem to be held true by faith but seem impossible from a strictly scientific (i.e., naturalistic) perspective.

Questions on Galileo

After lecturing on McMullin’s hermeneutical principles and after students have read the materials from Galileo’s *Letter*, selections from Barbour’s text, and the selections on



Galileo Galilei



An interesting result was the move from the extremes (options 1 and 4) to the middle (options 2 and 3). Most surprisingly, we had students move from nontheistic evolution to one of the theistic models even though our primary concern was not evangelism.

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"The Copernican Revolution" and "Galileo Galilei" from Ferngren's *Science and Religion*,¹⁸ they are required to write a brief paper that answers the question, Which is the most important of the interpretive principles in the Galileo Affair? Stated in this way the question leaves open the possibility for students to consider the issue from historical, scientific, philosophical, or theological perspectives.

A key philosophical issue that stands behind much of the debate concerns the nature of interpretive models and epistemological perspectives. We contrast naive realism and critical realism. Naive realism is the view that the world is exactly the way it appears to us and that there is no interpretation of our perceptions. Certainly the Ptolemaic view comes closer to naive realism than the Copernican model since the sun certainly appears to move and we do not! This is one of Cardinal Bellarmine's key arguments presented in his brief but pointed letter to Foscarini.¹⁹

Critical realism, however, is the perspective that interpretive models mediate the world of reality to us. As a realist perspective it assumes that there is a real world, independent of our perceptions, that we encounter and that science, no matter what various postmodernists might say, is a fairly reliable guide to knowing the world.

In order to engage the students in class discussion with regard to the intersection of philosophical, theological, historical, and scientific issues involved in the Galileo Affair, we used the following questions:

1. Which interpretive principle was the most important in the Galileo Affair? This can be considered from Galileo's perspective, the Church's perspective, a scientific perspective, a theological perspective.
2. What is the weakest element of his argument in the *Letter*?
3. Where do his arguments break down?
4. Is the *Principle of Limitation* a good principle for negotiating conflict? Why?
5. When must you adopt the *Principle of the Priority of Scripture* and when must you adopt the *Principle of Accommodation*? How do you know when to do this?

These questions require the students not only to master the nature of the hermeneutical principles but also to evaluate their validity as applied to situations of potential conflict between religious and scientific authority.

Interpreting Darwin

When introducing Darwin's materials, we used the *Origin of Species* as the basis for our lectures. We supplemented these materials with materials from Ferngren,²⁰ as well as Ernst Mayr's *What Evolution Is*²¹ and Michael Ruse's *Can A Darwinian be a Christian?*²² Of course, Darwin did not feel the same need as Galileo did to make his theories acceptable to Church officials. Therefore we do not find protracted theological defenses of his scientific theories. That is not to say that he did not have his theological defenders such as Asa Gray.²³

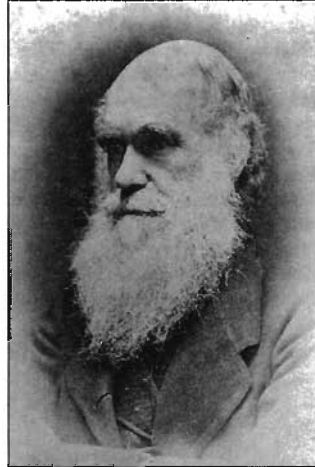
The first question we ask is the converse of Ruse's question: Can a Christian be a Darwinian? Or rather, can a Christian embrace some form of evolution? This is really a question that probes Galileo's underlying principle. Does the principle of the unity of truth extend to evolution? The prior question of course is: Is some form of evolution true? And if it is, does this challenge the principle? Pedagogically, we do our best to present both micro- and macro-evolution in the strongest light possible so that students avoid "straw man" fallacies.

Our second line of questioning concerns the *Principle of the Priority of Scripture* as well as the *Principle of Prudence*. We ask whether the Bible speaks unequivocally about six day, 24-hour creation? Or is it possible to remain thoroughly orthodox in belief and view the Genesis creation passages in more than one light? This question touches on the *Principle of the Priority of Prudence*. Should we categorically exclude all other interpretations outright simply because we are committed *a priori* to a theology that forces us to beg the question of our interpretation?

In this way we can simultaneously ask two questions. First, should Christians leave open the possibility for alternative interpretations of the Genesis narratives? And if not, what is the compelling reason to foreclose other avenues of interpretation? Second, how do we know what the literal meaning (in Augustine and Galileo's sense of the

term) is? That is, do the narratives interpret themselves for us or are we forced to admit that there may be rules that govern how we should interpret them?

The *Principle of the Priority of Demonstration* triggers the most intense response from the more theologically conservative students as they have a tendency to dismiss evolution as “just a theory.” But a quick consideration of philosophy of science can demonstrate that all scientific theories can be considered “just theories.” Moreover, the incredibly high standard of demonstration demanded by Aristotelian natural philosophers simply is not possible. Here, Ruse’s distinction between evolution as fact and evolution as path or cause becomes particularly helpful.²⁴ If all science is mere theory then knowledge is unattainable.



Charles Darwin

Conversely, if we agree that knowledge is possible, then we must credit some of this to genuine work that theories do. Here again it is important to point out the value of a critical realist approach in scientific reasoning.

When we get to the question of what is the status of the theory (or theories) of evolution, we are quick to point out that there is more than one theory. Ruse’s explication is particularly helpful here since he raises the issue of competing theories of evolution. When engaging evolutionary theorists, do we use Richard Dawkins’ radical neo-Darwinian theory or Stephen Jay Gould’s theory of punctuated equilibrium? These two theorists are also particularly helpful as they represent two of Barbour’s approaches to the science-religion relationship: that of conflict and independence respectively. Here it is important to draw out the distinction between what Darwin himself had to say on the theory of natural selection and how his twenty-first century interpreters use the theory for their own purposes.

As we engage students in class discussion on Darwin and the subsequent modifications of his theories, we begin by reminding them of the hermeneutical principles from the Galileo Affair. We then engage them in discussing the following questions:

1. If the *Principle of the Unity of Truth* holds, how do we resolve the issue between Darwinian (or more contemporary versions of) evolution and Christian faith?
2. To what extent should we adopt the *Principle of the Priority of Prudence* with regard to the creation narratives?

3. To what extent can any evolutionary theory lay claim to be “demonstrative?” That is, to what extent is evolution “just a theory”—as students hostile to the theory are inclined to say—and to what extent is it “more than a theory”—as the late Pope John Paul II said?
4. The *Principle of Limitation* seems to work for Copernicanism but does it work for Darwinian evolutionary theory? Why?

With regard to exam questions, we expect students to be able to articulate the strengths and weaknesses of evolutionary theory but we also believe that in requiring students to represent arguments they disagree with is a healthy exercise; one that enables them to see the issue from another perspective. For their exams we ask them to respond to the following:

Construct two arguments (make sure to employ theological, philosophical, and scientific evidence):

1. Argue that evolution is consistent with Christian faith.
2. Argue that evolution is inconsistent with Christian faith.

Conclusion

It may be that teaching evolution and Darwinism will never be an entirely painless process. However, in presenting materials in historical sequence, students seem to more readily engage the materials and give evolutionary thought a fairer hearing. Moreover, when certain hermeneutical principles are established in the Galileo Affair, students can apply them in an analogous fashion to the Darwinian controversy as well. The upshot should be that they develop a noetic humility in which they have a greater desire to understand the historical, philosophical, theological, and philosophical issues that shape our understanding of both situations. ★

Notes

¹We taught this course at Greenville College (IL), which is a small liberal arts college affiliated with the Free Methodist Church of North America. The college is also a member of the Christian Council for Colleges and Universities.

²For example, if science and theology belong to entirely separate and discreet domains—as Galileo claims—then no defense of scientific reasoning is necessary; yet Galileo insists on defending it.

³Ian Barbour, *Religion and Science: Historical and Contemporary Issues* (San Francisco: Harper Torchbooks, 1997); Gary B. Ferngren, ed., *Science and Religion: A Historical Introduction* (Baltimore: The Johns Hopkins University Press, 2002). Another text we used as supplemental material was Alister McGrath, *Science and Religion: An Introduction* (Boston: Blackwell Publishing, 1998), which has a number of helpful diagrams and charts.

⁴Stephen Jay Gould, *Religion and Science in the Fullness of Life* (New York: Ballantine Books, 1998). NOMA stands for “Non-Overlapping Magisteria,” the idea that the authorities of religion and science in no way share the same content for their “disciplines”; Langdon Gilkey, *Nature, Reality, and the Sacred: The Nexus of Science and Religion* (Philadelphia: Augsburg/Fortress, 1993).

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⁵Barbour further subdivides this model into three others: (1) natural theology, (2) theology of nature, and (3) systematic synthesis.

⁶Thomas Kuhn, *The Copernican Revolution* (Cambridge, MA: Harvard University Press, 1959).

⁷Richard J. Blackwell, *Galileo, Bellarmine, and the Bible* (Notre Dame, IN: University of Notre Dame Press, 1991); also see Richard J. Blackwell, *Behind the Scenes at Galileo's Trial* (Notre Dame: University of Notre Dame Press, 2006).

⁸Dating back three centuries before Galileo, Thomas Aquinas realized that anyone writing on theological matters needed the authority of Augustine buttressing his own work. Furthermore, since the authority of tradition was, and still is, very important in Roman Catholic theology, it was wise to cite Augustine since he represents the most significant authority of that tradition.

⁹Ernan McMullin, "Galileo on Science and Scripture," *The Cambridge Companion to Galileo*, ed. Peter Machamer (New York: Cambridge University Press, 1998), 271-347.

¹⁰Augustine, *The Literal Meaning of Genesis*, 2 vols., trans. John Hammond Taylor, SJ (Mahwah, NJ: Paulist Press, 1982).

¹¹McMullin, "Galileo on Science and Scripture," 292.

¹²*Ibid.*, 294.

¹³*Ibid.*, 295.

¹⁴William Wallace, "Aristotle and Galileo: The Uses of *Suppositio* in Scientific Reasoning," *Studies in Aristotle*, ed. Dominic O'Meara (Washington, DC: Catholic University of America Press, 1981): 44-77.

¹⁵*Ibid.*, 296.

¹⁶Bernard Ramm, *The Christian View of Science and Scripture* (Grand Rapids, MI: Eerdmans, 1954).

¹⁷*Ibid.*, 298.

¹⁸Ferngren, *Science and Religion*.

¹⁹An English translation of Bellarmine's letter to Foscarini can be found in Blackwell, *Galileo, Bellarmine, and the Bible*, 265-7.

²⁰James Moore, "Darwin"; Peter J. Bowler, "Evolution"; Ronald Numbers, "Creationism Since 1859"; and Edward J. Larson, "The Scopes Trial" in Ferngren, *Science and Religion*.

²¹Ernst Mayr, *What Evolution Is* (New York: Basic Books, 2001).

²²Michael Ruse, *Can a Darwinian be a Christian? The Relationship between Science and Religion* (New York: Cambridge University Press, 2001).

²³Asa Gray, *Darwiniana* (New York: 1877).

²⁴Ruse, *Can a Darwinian be a Christian?* 12-24.

A Call for Book Reviewers

The readers of *PSCF* have long appreciated the many insightful reviews published within its covers. Reviews have been assigned to whoever requested a particular book first. Out of fairness to ASA members with different post delivery times and to assure the best fit between reviewer and book, *PSCF* is planning to **initiate book reviews by invitation**. If you would be open to being asked to contribute to this interesting and important service of writing a book review, please send a brief email to psfranklin@gmail.com that describes your areas of interest and expertise, preferred mailing address, and phone number. This information will be entered into a database that will bring you to the book review editors' attention when a book of interest to you and *PSCF* readers becomes available for review. Of course, when a book is offered to you by email or phone for review, you would still be able to accept or reject the mailing of the book at that time.

Book Review Editors

Rebecca Flietstra (Point Loma Nazarene University)
3900 Lomaland Dr.
San Diego, CA 92106
rflietst@pointloma.edu

James C. Peterson (McMaster University Divinity College and Faculty of Health Sciences)
1280 Main Street West
Hamilton, ON L8S 4K1 Canada
peterso@mcmaster.ca

Arie Leegwater (Calvin College)
1726 Knollcrest Circle SE
Grand Rapids, MI 49546-4403
leeg@calvin.edu



Theories of Origins: A Multi- and Interdisciplinary Course for Undergraduates at Wheaton College

Stephen O. Moshier, Dean Arnold, Larry L. Funck, Raymond J. Lewis, Albert J. Smith
John H. Walton, and William R. Wharton

Scientific theories for the creation of the universe, earth, life, diversity of life, and humankind are explored in Theories of Origins, a science course at Wheaton College. Professors representing the sciences and biblical studies guide the class through origins theories and introduce various approaches for relating scientific and biblical accounts of creation. Most students are nonscience majors, so a major course objective is for students to appreciate the sophistication of modern scientific work on origins problems and to understand the evidence leading to paradigms and paradigm shifts. Tensions perceived by students between scientific and biblical accounts of origins are diffused when the purviews of science and theology are properly defined and the cultural-historical contexts of scriptural accounts are considered. Learning is stimulated by a variety of means, such as illustrated lectures, videos, demonstrations, Internet resources, selected reading materials and integrative writing assignments, a museum field trip, and class discussions.

Theories of Origins (IDS/SCI 322) is an upper-division science course for undergraduates at Wheaton College in which students encounter scientific explanations for the origins of the cosmos, earth, life, species, and humankind. The course is team-taught by faculty representing the disciplines of astronomy, geology, chemistry, biology, physical anthropology, and biblical studies. Accordingly, students get exposed to important scientific concepts in each discipline in addition to the sustained consideration of origins from scientific and theological perspectives. Established in 1860, Wheaton College represents the evangelical Christian tradition in undergraduate liberal arts education. Scientific origins theories are controversial, indeed often considered antagonistic to biblical faith for many people in the evangelical subculture. Surveys of students entering the class reveal a range of positions on origins questions, often tracking the results of national polls.

A major course objective is to give students a background for evaluating the merits of scientific and theological claims

for origins theories. Mainstream scientific approaches to origins are emphasized in the course, but alternative or "anti-establishment" approaches such as creation science and Intelligent Design are presented because of their influence among Christians. Efforts are made throughout the course to diffuse the warfare metaphor for science-faith issues by framing science and theology as complementary means of discovering truth about origins. This course embodies the educational purpose of Wheaton College to combine faith and learning in order to produce a biblical perspective needed to relate Christian experience to the needs of contemporary society.

Objectives, Outcomes and Assessment

Theories of Origins (hereafter, Origins) is a full-semester, non-lab course in the general education curriculum (4 credit hours) intended to follow completion of a lab course (e.g., general geology, biology, chemistry, or physics). Most students in the course are

Efforts are made throughout [Theories of Origins] to diffuse the warfare metaphor for science-faith issues by framing science and theology as complementary means of discovering truth about origins.



Upon
entering
the class,
students
are asked
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influences
on their
personal
views of
origins.

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nonscience majors. Origins was conceived and developed by a committee of science faculty in 1994–1995, at a time when the college was revising the undergraduate general education program. The new program, “Essentials of a Christian World View,” was designed with the purpose to “introduce men and women to an understanding and appreciation of God, his creation and grace, and to our place of privilege and responsibility in the world.” The Christian liberal-arts project of faith and learning integration is embedded in specific goals for all general education curricula. Objectives for Origins reflect the goals that were developed for all science courses in the Nature Cluster of the General Education program. Specific outcomes for students who complete Origins are listed in Table 1.

Student demand for this course has influenced us to raise the class size from 40 to 60 students. There is sufficient interest in the course to justify increasing the cap, probably

to 75 students or more. However, additional students would burden the process of reading and evaluating written assignments and exams and returning them in a timely and formative manner.

Students in the course are given opportunities to learn and be evaluated in different ways. Most lectures are illustrated with computer-generated slide shows and some lectures include demonstrations or specimens that are passed around the class. All slide shows, plus other learning resources, are available to students outside of class on the course web page. Examining fossil evidence for the history of life on earth is facilitated by a class field trip to the Chicago Field Museum of Natural History. Questions are welcomed in class and spontaneous discussion is encouraged. There are two designated discussion sessions, at the beginning and end of the semester, in which all faculty participate as a panel. Students’ understanding of scientific content is measured by exams

Table 1. Outcomes for Theories of Origins

1. Mastery of content and method necessary to raising and solving integrative problems characteristic of the scientific approach to origins.
 - a. Describe the scientific findings and theories regarding the origin of the cosmos, earth, life, species and humankind.
 - b. Understand the basis and function of ways of knowing, e.g., science and theology.
 - c. Comprehend the nature of scientific evidence and reasoning in theory development.
 - d. Discuss strengths and weakness of various scientific theories of origins.
2. Development of a sense of biblical and philosophical relationship to interpretation of theories of origins.
 - a. Evaluate various views of origins held by Christians using appropriate scientific and theological criteria.
 - b. Perceive the basis of strengths and weaknesses of integrative models in order to form a rationally satisfying personal approach.
3. Practice the analysis and synthesis of certain topics by written assignments.

All seven authors are current or emeritus professors at Wheaton College, IL. **Stephen O. Moshier** is associate professor of geology. His education and professional background includes LSLI (Ph.D. 1986), Mobil Oil Corp., and University of Kentucky, with research in sedimentology and geoarchaeology. **Dean E. Arnold** is professor of anthropology. He received his Ph.D. from the University of Illinois in 1970, taught at Pennsylvania State University, held Fulbright Lectureships in Central and South America, and is active in research on ceramic ethnoarchaeology, specifically the organization and technology of ceramic production. **Larry L. Funck** is professor of inorganic chemistry. His education and professional experience includes Lehigh University (Ph.D. 1969) and Fulbright Lectureships in Africa with research on solution equilibria involving transition metal coordination compounds. **Raymond J. Lewis** is associate professor of botany. He completed his Ph.D. studies at University of California at Santa Barbara in 1991, followed by a post-doctorate experience at the University of Nebraska, with research in genetics and physiology of marine algae and applied phycology. **Albert J. Smith** is emeritus professor of biology. He completed his doctorate at University of Chicago in 1972 and was active in forest ecology research and science teacher education. **John H. Walton** is professor of Old Testament. His education and professional background includes Hebrew Union College-Jewish Institute of Religion, Cincinnati, Ohio (Ph.D. 1981) and Moody Bible Institute, with research on comparative studies between the Old Testament and the ancient Near East and particular interest in Genesis. **William R. Wharton** is professor of physics. He completed a doctorate in nuclear physics at the University of Washington in 1972 and has researched and taught in the areas of cosmology, observational astronomy, meaning of time, and interpretation of quantum mechanics. Zachary Moshier designed the graphic accompanying this article.

and homework assignments. Students' critical thinking on matters of faith-science integration is assessed by their work on study questions relating lecture and assigned reading material. Course assessment is based upon student evaluations of the course, percentage of correct responses on selected exam questions, and results of an assessment exam administered by the science division for all students in the college (after they have completed their Nature Cluster courses).

Textbook and Supplementary Reading

We are not aware of a single text that treats scientific theories of origins according to the content objectives of our course. Articles were selected for a course reader that is reproduced by the college print shop and sold to students at the college bookstore (Table 2). The bookstore secures permission from publishers for articles in the reader. Through the years we have tried various "trade books" (generally, by evangelical authors and publishers) on faith, science, and origins issues to supplement lecture content

and to stimulate class discussions (Table 3, p. 292). *Species of Origins: America's Search for a Creation Story* by Giberson and Yerxa is an excellent summary of various approaches to origins questions with some scientific content and excellent historical and sociological perspectives.

Student Backgrounds

We routinely collect information on the students' educational backgrounds and what they consider influences on their views about origins. In this section, we report results from surveys conducted in 2004, 2006, and 2007, about 150 students. Students were mostly educated in public high schools (66%) and private Christian academies (24%) with fewer students with backgrounds in private secular academies (5%) or home schools (5%). The prerequisite lab-science courses taken by most students are Physical Geology (51%) and Introductory Biology (28%), followed by General Physics (11%) and General Chemistry (11%). We have discovered that students with chemistry and physics as prerequisites are actually majors in those sciences who are taking the course for elective credit.

Table 2. Assigned Readings and Web Resource Links

1. PHILOSOPHICAL REFLECTIONS ON SCIENCE AND THEOLOGY

"The Natural Sciences at Wheaton College: Understanding Their Significance in Light of Our Christian Educational Mission." Wheaton College Division of Natural and Social Sciences (2003)

Bube, Richard H. "The Relationship between Scientific and Theological Descriptions." *Journal of the American Scientific Affiliation* 38 (3): 154-163 (1986)

"American Scientific Affiliation Commission of Creation Statement." (August 2000)

Van Till, H., Young, D.A., & Menninga, C. *Science Held Hostage*. Downers Grove: IV Press, pp 16-25 (1988)
2. THEOLOGICAL PERSPECTIVES ON ORIGINS

Seely, Paul H. "The First Four Days of Genesis in Concordist Theory and in Biblical Context." *Perspectives on Science and Christian Faith* 49 (2): 85-95 (1995)

Walton, John H. "Creation." In: T. D. Alexander and D. Baker, (eds.). *Dictionary of the Old Testament: Pentateuch*. Downers Grove: Intervarsity Press, pp 155-168 (2002)

Walton, John H. "Genesis." *NIV Application Commentary*. Grand Rapids: Zondervan, pp 82-105 (2001)

Internet:

Walton, John H. "Genesis and Cosmology." (www.wheaton.edu/physics/conferences03/index.html). Slide show / audio lecture.

Lamoureux, Denis. "Beyond the Creation vs. Evolution Debate." (www.ualberta.ca/~dlamoure/beyond.html) Slide show / audio lecture.
3. THE COSMOS

Astronomy information compiled by Dr. Wharton

Internet:

"Nick Strobel's Astronomy Notes." (www.astronomynotes.com)

"Cosmology 101." (NASA WMAP site) (map.gsfc.nasa.gov/html/web_site.html)
4. THE EARTH: ORIGIN AND HISTORY

Walton, John H. "Extent of the Flood." In: *Chronological and Background Charts of the Old Testament*. Grand Rapids, MI: Zondervan, pp 100-101 (1994)

Walton, John H. "Flood." In: T. D. Alexander and D. Baker, (eds.). *Dictionary of the Old Testament: Pentateuch*, Downers Grove: Intervarsity Press, pp 315-326 (2002)

Young, D.A. "The Discovery of Terrestrial History." In: Van Till, H.J., Snow, R.E., Stek, J.H. and Young, D.A. *Portraits of Creation: Biblical and Scientific Perspectives on the World's Formation*. Grand Rapids: Eerdmans, pp 26-81 (1990)

Brand, Leonard A. "Catastrophic Theory of Earth History: General Principles." In: *Faith, Reason, and Earth History*. Berrien Springs: Andrews Univ. Press, pp 267-283 (1997)

Morris, Henry M. "Uniformitarianism or Catastrophism?" In: *Scientific Creationism*, 2nd Ed. El Cajon, CA: Master Books, pp 95-130 (1985)

Internet:

Wiens, Roger. "Radiometric Dating: A Christian Perspective." (www.asa3.org/ASA/resources/Wiens.html)



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Upon entering the class, students are asked to rank influences on their personal views of origins (Table 4, p. 293). Personal study was ranked as the primary influence for 37% of the class. Bible/Theology or pre-requisite science courses at Wheaton College were more typically of secondary influence, even though the topic of origins is given some consideration in those courses. High school science courses were considered of least influence. Surprisingly, students showed a slight tendency to rank lower the influence of their church experience (preaching and Sunday school). Student responses to questions on origins showed greater degree of acceptance of evolution than respondents in national polls by the Gallup Organization. Only 29% of the students agreed that "God created people in their present form about 10,000 years ago," in contrast to 44–47% of Americans in recent years. The statement,

"evolution occurred, guided by God," was affirmed by 66% of the students, in contrast to the affirmative response of 35–40% in national polls. Students discover that results of such poll questions are difficult to interpret because the questions are often poorly written or open to various interpretations by the respondent.

Introductory Lectures: Philosophical and Theological Foundations

The first three class periods are devoted to providing the students with philosophical and theological foundations for approaching questions of origins. From the very beginning we stress that the course is designed to familiarize students with scientific theories of origins that are widely accepted by the contemporary scientific community. This

Table 2. Assigned Readings and Web Resource Links (continued)

5. ORIGIN OF LIFE

- Deamer, David W. and Gail R. Feischaker. *Origins of Life: The Central Concepts*. Boston: Jones and Bartlett, pp 3–4, 133–136, 147–148, 337–340 (1994)
- Zubay, Geoffrey. *Origins of Life on the Earth and in the Cosmos*, 2nd Ed. San Diego: Academic Press, pp 85–105, 182–192 (2000)
- Behe, Michael J. *Darwin's Black Box: The Biochemical Challenge to Evolution*. New York: The Free Press, pp 238–243 (1996)
- Dickerson, R.E. "The Game of Science: Reflections after Arguing with some Rather Overwrought People." *Perspectives on Science & Christian Faith* 44: 137–138 (1992)
- Ross, Hugh. "Earth: The Place for Life." In: *The Creator and the Cosmos*. Colorado Springs: NavPress, pp 131–145 (1995)

6. ORIGIN OF SPECIES AND DIVERSITY OF LIFE

- Wicander, R. and J.S. Monroe. "Evolution." (Ch. 5) in *Historical Geology: Evolution of the Earth and Life Through Time*, 2nd Ed. St. Paul: West Publ. Co. pp 100–129 (2000)
- Internet:
- Miller, Keith. "Taxonomy, Transitional Forms, and the Fossil Record." (www.asa3.org/ASA/resources/Miller.html)

7. ORIGINS DEBATE IN PUBLIC EDUCATION

- Scott, Eugenie C., and Branch, Glenn. "Evolution: what's wrong with 'teaching the controversy.'"
Trends in Ecology and Evolution 18: 449–502 (2003)
- Letters in response by Langen, Meyer, and reply by Scott and Branch. *Trends in Ecology and Evolution* 19: 449–502 (2004)
- Three opinions on ID and education in *Chicago Tribune*, November 27, 2005

8. ORIGIN OF HUMANKIND

- Wicander, R. and J.S. Monroe. "Evolution of the Primates and Humans." (Ch. 19) in *Historical Geology: Evolution of the Earth and Life Through Time*, 2nd Ed. St. Paul: West Publ. Co. pp 510–527 (2000)
- Young, Davis A. "The Antiquity and Unity of the Human Race Revisited." *Christian Scholars Review* 24 (4): 380–396 (1995)
- Arnold, Dean E. "How do Scientific Views on Human Origins relate to the Bible?" In Dorothy F. Chappell and E. David Cook, eds. *Not Just Science: Questions Where Christian Faith and Natural Science Intersect*. (2005)

Table 3. Books Covering Faith-Science and Origins Issues

1. Karl W. Giberson and Donald A. Yerxa, *Species of Origins: America's Search for a Creation Story* (Rowman & Littlefield, 2002), 272 p.
2. Robert B. Fischer, *God Did It, But How?* 2nd Ed. (ASA Press, 1997), 121 p.
3. J. P. Moreland & John Mark Reynolds, (Eds.), *Three Views on Creation and Evolution* (Zondervan, 1999), 296 p.
4. C. John Collins, *Science & Faith: Friends or Foes?* (Crossway Books, 2003), 448 p.
5. Hugh Ross, *Creation and Time* (NavPress, 1994), 187 p.
6. Richard Bube, *Putting It All Together* (University Press of America, 1994), 224 p.

Notes: Book 1 is currently used in the course. Books 2–6 were used various years between 1996 and 2005.

clarification is important because some students come expecting a blow-by-blow comparison of "Christian" vs. "secular" theories of origins. Yet, in a Christian liberal arts setting, the faculty and students are free to explore relationships between faith and science and come to a more informed understanding of what we can learn about origins from nature and Scripture.

In the first class period, students watch the television documentary, "What about God?" from the 2001 PBS network series "Evolution." The program features Wheaton College students who share their personal experiences reconciling the theory of evolution with their evangelical Christian faith. Students in the class can see that their questions and intellectual struggles on origins issues are not unusual and that exploring them can be a meaningful experience.

The second class period is presented by a scientist on the teaching team. Basic tools of *doing* science and theology are compared. The illusive scientific method is discussed and concepts of laws, hypotheses, models, and theories are defined. Using Robert Fischer's scheme in *God Did it, But How?* science and biblical theology are cast as means of organizing and interpreting systematized knowledge of what is discovered in nature and revealed in Holy Scripture, respectively. Other topics introduced in this lecture (but not covered exhaustively) include methodological vs. philosophical naturalism, miracles and natural laws, and chance and design.

Richard Bube and Ian Barbour, among others, have identified patterns for relating scientific and theological descriptions, or put more simply, patterns for relating claims of science and faith. Some would hold either theology or science in the position of authority. Others would keep theology and science compartmentalized or independent of one another. Still others would strive for complementarity between theology and science. Students are asked to keep these patterns in mind as they explore different approaches to origins questions. As a guest lecturer one year, Denis Lamoureux (St. Joseph's College, University of Alberta) recounted his personal journey thorough the various positions on the "creation-evolution continuum." His lecture has been available to subsequent classes

on the Internet (see Table 2, p. 291). Students are asked to apply Richard Bube's categories for relating science and theology to the positions described by Dr. Lamoureux, and then determine which category fits their personal approach to questions of origins.

Having introduced the framework for the discussion of origins, in the next class period our biblical scholar (J. Walton) considers the Genesis creation account. The message to students is that we are not just starting with science and then going back to the text in order to bring it into conformity with scientific investigation. Instead we communicate very forthrightly the need to understand the biblical account in its context against the cultural environment of the ancient Near East and on its own terms. Many students are concerned that the Bible be interpreted "literally" and while that word can be understood in a multitude of ways, we affirm the importance of reading the biblical text as its author intended and as its audience would have heard it. It is thus made clear that the Bible is not intended as a scientific text, and we demonstrate that, on many levels, God's revelation did not offer any new scientific perspectives, but communicated to the ancients within their conceptual world. We then proceed to introduce the concept that many of the ways we moderns think about the world, nature, and origins did not apply to the ancient world. As an example, for them existence was not defined by having material properties, but by having a function in an ordered system. This is demonstrated from the Bible as well as from the ancient Near Eastern literature. This being the case, we find that creation is not an act of physical manufacture, but of assigning function. Consequently the seven days, understood "literally," are concerned not with material origins, but with functional origins. By this interpretation, the Genesis week has nothing to do with the material age of the cosmos.

Even if students are reluctant to consider new ways to approach the issues, we succeed in communicating to them that (1) the account in Genesis One may not be as transparent to them as they may have thought and (2) they become aware that they have to recognize how easy it is to impose our worldview on the biblical text and, in the process, risk distorting its meaning.

Table 4. Relative Significance of Influences for Views on Origins

	Most 1	2	% 3	4	Least 5
1. My own reading ...	30	20	19	17	14
2. My church (preaching and Sunday school) ...	18	16	18	18	29
3. Science classes at Wheaton College ...	21	25	15	15	18
4. Bible/Theology classes at Wheaton College ...	19	26	20	20	9
5. High school science classes ...	13	18	23	23	25



*In their final
question set,
students
are asked
to evaluate
each [Origins]
position and
identify one
that conforms
to their
view ...
[Their
responses
showed]
marked shifts
in positions
over the course
of the semester.*

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Origin of the Universe

The cosmology segment, presented in five class periods by our physicist (W. Wharton), begins with consideration of the enormous expanse of the universe. As we look out to different distances in space, we see slices of the Universe at each time period back to the Big Bang. We show the Moody Institute video, "The Milky Way & Beyond." Next, the Big Bang model is presented with a summary and evaluation of supporting evidence. Techniques to measure distance are presented, that is, stellar parallax and the inverse square law using so-called "standard candles." Evidence for a dominance of dark matter and dark energy in our universe is briefly summarized.

One lecture is given on stars, their history and general characteristics, since most of the elements in living organisms were generated in stars. Explaining the historical process of paradigm shift to Big Bang cosmology from a timeless, static universe model, provides a good opportunity to discuss how scientists deal with anomalies within their existing paradigm. We also discuss a few earlier problems with Big Bang cosmology, which were resolved with additional data. The cosmology segment is framed in the context of the Anthropic Principle, as directed to the characteristics of the universe as a whole. The concept of Earth as "Privileged Planet" is also discussed as another attempt to see evidence of design in nature (The Discovery Institute video of the same name is shown). Students are evaluated with an hour exam and completion of a quantitative assignment covering Hubble expansion.

Earth History

Since the origin of the earth is described in the preceding cosmology segment, the geology segment (S. Moshier) focuses on how geologists interpret Earth history after it formed. The first presentation, during half of a class period (and after the cosmology exam), includes case studies of radiometric dating of rocks and minerals. Assumptions concerning the stability of decay constants over time, initial isotope ratios, and processes that can effect resultant dates, as well as tests for the assumptions are explained.

In the following class period, our biblical scholar explores the flood account in Gene-

sis, because of its influence in pre-modern understanding of Earth history and its importance in contemporary creation science. As in the study of Genesis One, we stress the practice of reading the text as an ancient reader. For the flood account, this primarily involves a recognition of how people in the ancient world understood cosmic geography. We point out some of the significant obstacles to a global flood interpretation and identify other options, including a "universal" flood (the known world), a "regional" flood (e.g., Tigris-Euphrates Basin), or a "local" flood. By introducing a greater variety of options, we reduce the tendency to caricature extreme positions as if they were the only options.

Three more class periods are devoted to Earth history. Basic principles used to interpret rocks are explained by reviewing the history of modern geology; especially its beginnings in the late eighteenth century to the middle of the nineteenth century. This was a period when the prevailing view of geology shifted from catastrophism to uniformitarianism. Geologists were confronted with emerging evidence for the antiquity of creation as they discovered that observable, gradual or episodic processes explained sedimentary rocks and landforms better than a brief, catastrophic deluge. Students are shown field examples of sedimentary rock sequences that can be compared with modern sedimentary environments such as rivers, deltas, swamps, and reefs. To understand the resurgence of Flood Geology in fundamentalist Christianity, students are assigned papers by creationists Henry Morris and Leonard Brand. Student learning is evaluated by their answers to study questions (instead of an exam) that bear upon important facts and concepts in the lectures and assigned readings.

Origin of Life

A pivotal point in the course is reached at the halfway mark when attention is turned to the question of the chemical origin of life. It is generally admitted among authorities, and also emphasized in the first lecture on life's origins, that this is the most difficult to answer of all the origins questions, primarily because of the virtual absence of available data. This segment is presented over five class periods by our chemist (L. Funck). We

begin from a historical vantage by reviewing the long-standing controversy over the question of spontaneous generation, culminating in its death knell through the work of Louis Pasteur. Next the Oparin-Haldane theory is presented, again in a historical context, followed by discussion of the Miller-Urey attempt at synthesis of life's building blocks through simulation of presumed primordial atmospheric conditions. The serious problems of abiogenic synthesis of monomers, polymers, and complex functioning systems are discussed with a continuing emphasis on the increasing degree of complexity required as one moves toward systems that might be considered living. The question of the chemical definition of life is raised early and repeatedly as an important consideration and a source of controversy. Brief attention is given to the currently popular scenario, the RNA World, as the "egg first" hypothesis in contrast to the "chicken first" hypothesis of metabolic cycles involving protein catalysis. We end the lectures with a discussion of the importance of molecular information and its origin as a key issue in origin of life science. This discussion leads into a brief consideration of the contrast between an Intelligent Design approach and that of methodological naturalism. Students are evaluated in this segment with an hour exam.

Origin of Species and Diversity of Life

Our exploration of the origin of the diversity of life, led by our biologist (R. Lewis) for four class periods, begins by surveying the hierarchical pattern of similarity in living organisms that forms the basis for Linnaean classification. While Linnaeus held that kinds were static, Lamarck and Darwin proposed theories of evolution to explain evidence that species change over time. While Lamarck's theory was discredited, Darwin's theory has been generally accepted by scientists as providing an explanation for the hierarchical classification of living organisms. Darwinian evolution is defined in terms of (1) common descent and (2) natural selection, the mechanism proposed by Darwin for evolution.

Since his theory of evolution was found to be incomplete by subsequent discoveries in genetics, the students are introduced to genetics and the Neodarwinian or Modern Synthesis which incorporated genetics. Current formulations of the scientific theory of evolution lean heavily on this synthesis of population genetics, mutations, natural selection, and accumulated change to result in macroevolution. Overall patterns in the fossil record are used to trace hypothetical phylogenetic pathways, and a visit to the Field Museum of Natural History in Chicago helps the students to explore this evidence more fully. The Cambrian explosion, mass extinctions, and patterns of fossil stasis (as explained by punctuated equilibrium) are explored as challenges to the traditional concept of Neodarwinian gradualism, leading to a new, but developing synthesis

of evolutionary and developmental biology. Each year we invite Intelligent Design theorist Paul Nelson to spend one session with the class to offer a scientific and philosophical critique of evolutionary theory and advocate the design inference as a fuller explanation for the origin and diversity of life.

By exploring these developments in biology and paleontology, students learn about the nature and process of science while they learn about successive attempts to scientifically explain the origins of species. We also consider how these topics are taught in the public school classroom, emphasizing that science should not prescribe a philosophical or religious worldview. Thus, evolution should be taught as science, not as an attack on religion or an establishment of an atheistic philosophy.

Origin of Humankind

We begin the consideration of human origins with a discussion of the scriptural account, led by our biblical scholar. Again, we are interested in offering a carefully nuanced understanding of the biblical text. This involves investigating what precisely is the interest of the text in presenting human origins. Key points made are that the biblical text, like all ancient Near Eastern texts concerning human origins, is focused on archetypal issues. "Dust" and "rib/side" are not intended as chemical or anatomical references; all people are made of dust and womankind is intimately related to mankind. These archetypal elements do not address the question of historicity, though we also point out that the archetypal representations in the rest of the ancient, Near Eastern world are accomplished through accounts that deal with corporate humanity, whereas Genesis focuses on a single human couple. We offer and consider a complex analysis in which the various aspects of the account are parsed (materials, divine endowment, physical environment, and human actions) and consider different approaches to relating historical, scientific, and biblical information. In this way we strive to deepen the students' awareness of some of the alternatives that exist within the text itself as an ancient document.

Two class periods are devoted to an overview of human origins from the perspective of our anthropologist (D. Arnold). Distinctive biological and cultural characteristics of humans are reviewed in an attempt to answer the question, "What are humans?" Skeletal and cultural artifacts and the geographical ranges of Plio-Pleistocene hominid fossil groups are interpreted. What is known of the earliest history and cultural development of skeletally modern humans (*Homo sapiens sapiens*) is summarized with emphasis on the great leap in human culture evident some 40,000 years before present. The question, "Who was Adam?" is considered in light of Scripture, time, fossil record candidates, and cultural clues. Students' comprehension of the science content in the segments on

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biological evolution and human origins is tested in a one-hour exam taken during finals week.

In his provocative article, "The Antiquity and Unity of the Human Race Revisited," Davis Young identified three approaches to the issue of Adam and Eve: (1) recent ancestors (created *de novo* some 10,000 years ago), (2) ancient ancestors (either *de novo* or evolved greater than 100,000 years ago), or (3) recent representatives of evolved *Homo sapiens* some 10,000 to 40,000 years ago. In their final question set, students are asked to evaluate each position and identify one that conforms to their view (Table 5). At the end of the course, a minority of students align themselves with the more fundamentalist view of recent, *de novo* creation. A significant population of students chose the recent representative view, a position in tension with the Wheaton College Statement of Faith affirming Adam and Eve as the historical parents of the entire human race (other humans could not precede them). In 2007 we started polling the class on these positions upon entering the class. We think it is probable that the 2007 response was typical of previous years, showing marked shifts in positions over the course of the semester.

Student Evaluations and Course Assessments

We use a question on the final examination to help us understand how students are responding to the topics of origins, while giving them an opportunity to describe what they have learned. This question asks students to describe a topic or question that has been fairly definitively described or answered by the scientific and theological evidence, and then to pose a question that still remains open because of a lack of evidence or conflicting evidence. The most common topic that is identified as definitively answered (in light of scientific and biblical understanding) is evidence for an old age of the universe and the earth. Students regularly choose human origins and the origin of life as two of the most open questions.

Because the theory of evolution is often avoided in science education at the secondary level, some students are surprised to discover the power of this theory in mak-

ing sense of patterns and processes in biology. Students exiting the course exhibit levels of skepticism toward scientific explanations of origins ranging from full acceptance to complete rejection (with a majority positioned toward acceptance). Perhaps we should be encouraged that many students maintain an appropriate level of skepticism tempered by an understanding that scientific theories undergo a continual process of modification based upon accumulating evidence.

Students are asked for written evaluations of the course. Many students explicitly state that the course helped them to think about origins issues in a different way and that they better understand the relationships between science and theology as applied to questions of origins. Others appreciate that while their preconceptions may have been challenged by the course, their foundational beliefs are affirmed or strengthened. Some students feel that professors should be more skeptical of mainstream science and present more options for interpreting science in light of Scripture. Students would like more time for open discussion in the class, and many feel that there is too much content for a single course. Some students liked the "revolving door" of the teaching team, while others would have appreciated more consistency in teaching style. Assessments over the years have led to changes in required texts and reading materials, focus and content of the study questions, and adjustments in lecture content.

Conclusions

Over the decade since it was introduced, Theories of Origins has become an effective and popular course at Wheaton College. It is distinctive in its multi- and interdisciplinary content and approach to origins issues, involving faculty from the sciences and biblical studies. Using a variety of lecture styles, Internet and print resources, the teaching team attempts to appeal to students' different learning styles, aptitudes, and interests in order to promote understanding of scientific theories origins and how they relate to biblical accounts of origins. We believe the course has achieved the outcome objectives as assessed by student performance and their course evaluation comments. ★

Table 5. Positions on Human Origins (Classes 2004–2007 by % of students)

Model	Entering ... 2007 n = 56	Exiting Class 2004, 2006, 2007 n = 155
Recent Ancestors— <i>H. sapiens</i> created ~10,000 ago	34	9
Ancient Ancestors— 1st <i>H. sapiens</i> >100,000 years ago	25	40
Recent Representatives— 1st of <i>H. sapiens</i> as image bearers 10,000–40,000 years ago	18	38
No or mixed opinions	23	13



The Dangers of Neutrality in the Origins Debate

Jerry Bergman

One lesson learned through bitter experience in history is that the pursuit of knowledge in all fields, and especially science, requires the freedom to explore new ideas and areas of knowledge without hindrance from state or church authorities. The classic example is Lysenkoism which the Soviet government concluded was "the only truly scientific and materialistic theory of heredity constructed on the basis of dialectical materialism."¹ Lysenko marched "under the banner of reconstruction of biological science on the basis of Darwinism raised to the level of Marxism."² In the end Lysenkoism had disastrous consequences not only for agriculture, but for "the whole of biology" and for the "national economy" in the Soviet Union and several eastern block countries.³ This concern was drummed into us students in both my undergraduate and graduate training at Wayne State University in Detroit. For these reasons, a major professional concern of mine is academic freedom. This communication explains one more reason why over thirty years later I am still concerned about academic freedom.

Around 1976 I wrote a monograph on the creation-evolution controversy. After several revisions, including a review by several American Scientific Affiliation (ASA) members, the monograph was published in 1979 by the first publisher that I sent it to—Phi Delta Kappa, the education honor society⁴ located in Bloomington, Indiana. Titled *Teaching About the Creation/Evolution Controversy*,⁵ the publication was very successful; a recent Worldcat search⁶ located a copy in over six hundred libraries. Probably more than six hundred libraries in fact have copies because the 45-page monograph was published as part of a series called Fastbacks in which the monographs on a wide variety of educational topics are often not cataloged

separately. Part of the reason why so many copies are in libraries is because the Fastback series was well received; the publisher informed me that my monograph in particular was one of the best selling of the series. In the monograph, I tried to objectively review the origins controversy, providing both historical and scientific information. I did not advocate teaching creation in the monograph but, as the title says, focused on teaching *about* the controversy. This communication explores the personal repercussions that resulted from the publication of this monograph.

When I started writing the monograph, I was an agnostic and an evolutionist exploring this issue and, for this reason, had an interest in the topic. My personal position at this time was in flux, although by the time the monograph was published my doubts about both Christianity and orthodox Darwinism were beginning to solidify. Endeavoring to avoid an advocacy position for either side, I maintained the neutral tone of the original monograph during the final editing process. The reviews were very favorable to my approach, and this is one reason why Phi Delta Kappa wanted to publish my monograph.

Under the title "Bergman Scores with a Fastback," Iowa State University biochemist



Jerry Bergman

*A major
professional
concern of
mine is
academic
freedom.*

Jerry Bergman, a fellow of ASA has been an active ASA member for over thirty years. He has found his involvement in ASA a very rewarding part of his career. Bergman has taught biology, genetics, chemistry, biochemistry, and anthropology for over thirty-five years. His nine degrees, including from the Medical University of Ohio, Wayne State University in Detroit, University of Toledo, and Bowling Green State University, all in the sciences. Many of his over 700 publications in twelve languages and twenty books and monographs deal with the creation/evolution controversy. He has taught at the Medical University of Ohio where he was a research associate in the department of experimental pathology, and at the University of Toledo and Bowling Green State University. He is now an adjunct professor at the Medical University of Ohio.



I wrote a monograph on the creation-evolution controversy titled Teaching About the Creation/Evolution Controversy which was published in 1979 by Phi Delta Kappa. In the monograph, I tried to objectively review the origins controversy, providing both historical and scientific information.

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Walter Hearn wrote in the *Newsletter of the American Scientific Affiliation*:

Jerry Bergman's latest publication is a winner. Entitled *Teaching About the Creation/Evolution Controversy*, it's a 45-page booklet in the "Fastback" series put out by the Phi Delta Kappa Educational Foundation. Phi Delta Kappa is a prestigious organization in educational circles. Something like 20,000 copies of each Fastback are printed initially, with copies sent to most educational journals for review.

We ... recommend it as a thoughtful discussion of the philosophical and educational aspects of the controversy. Jerry argues for teaching alternative concepts of origins, concluding: "The schools should be forums for debate and discussion of all topics. To exclude discussion of life's origins because they involve religious views does not do justice to the educational enterprise. Some feel that anything related to religion and politics should not be discussed because it arouses emotions and feelings and cannot always be discussed rationally. I would argue that these are the important matters of life and they should indeed be studied, discussed, and debated in the neutral forum of a classroom and under the guidance of a teacher who can remain objective."⁷

Professor Hearn later wrote that he recognized Jerry Bergman as an ASA member (recently elected a Fellow) with one Ph.D. in educational research and psychology and almost another one in sociology. His activities have been reported in this Newsletter from time to time. We recommended his open minded booklet, *Teaching About the Creation/Evolution Controversy* ...⁸

Typical of the other favorable reviews was that of Dr. Walter Harrison, who wrote that the monograph was "interesting and informative, a nice piece of work."⁹

Conversely, the monograph was severely criticized by those who felt that I should have advocated their view of the controversy. I ended up with an inch-high pile of letters, mostly from people who condemned the monograph. Some even demanded that

Phi Delta Kappa withdraw my monograph from circulation in the Fastback series. Many letter writers were adamant in their condemnation, which included frequent name calling, a response which at that time, I had totally unanticipated from well-educated academics. Some letter writers even stated that they had once respected Phi Delta Kappa, but were going to end their relationship with this organization if this Fastback was not immediately withdrawn.

The strident tone expressed in many letters especially surprised me in view of the fact that a review of the entire set of correspondence reveals that not one person was able to, or even tried to, point out any errors of fact. The monograph is still available on the internet, albeit at inflated prices.

Some backhanded compliments were included in the demand to censor the monograph. Carl Rexroad, a paleontologist with the Indiana Geological Survey, wrote to the Fastback editor:

There is absolutely no point in passing my comments on to Jerry Bergman. He is a skilled writer who knew exactly what he was doing and how to do it. I do make the strongest recommendation that Phi Delta Kappa tighten its review and critical reading procedures and that it make itself more aware of national issues in the field of education. No further critical mistakes like publication of this Fastback can be allowed.¹⁰

He added that my Fastback

is an outstanding example of propaganda for a position absolutely without scientific merit and in my opinion without religious merit either. The paper is so carefully constructed that its subtlety makes it particularly vicious. It is unfortunate indeed that a legitimate educational organization published this paper, thereby lending credence to a position being pushed by hard core zealots and accepted by many Christian fundamentalists who are not sufficiently educated to understand the significance of the pseudo-choice offered.¹¹

These and other comments condemned a group of people neither defined by the respective authors nor mentioned by my

Fastback. Petroleum geologist Dr. James Cunliffe wrote that he agreed with the Fastback from "a legal point of view" but added that "fundamentalist Christianity ... is made up of anxious, confused, and scientific ignorant Christians."¹² The monograph never once discussed fundamentalist Christianity or any other religious group, although one could infer from the monograph that I was a Christian.

Fastback editor Dr. Derek Bursleson, in response to Cunliffe's letter, wrote that Phi Delta Kappa published the Fastback

because Bergman makes his case on strictly pedagogical grounds. Since we are in the business of education, we think it is a viewpoint that needs to be discussed and debated. Bergman is no creationist. He does believe that in areas of great controversy, the school has an obligation to provide a forum where competing ideas can be studied, analyzed, and the arguments balanced and weighed on both sides. American education has a long tradition of dealing with such controversy in the schools, whether the topic be birth control, communism, or abortion. It is on the basis of this tradition that we think Bergman's ideas deserve thoughtful consideration.¹³

I also wrote to Dr. Cunliffe, explaining that I am clearly not advocating "discussing Genesis in the classroom" but rather discussing only the "purely scientific" issues while eschewing the "topic of religion."¹⁴ Another critic, Garry DeYoung wrote:

Frankly, the title is just about as valid as would be one for a book titled *Teaching About the Round Earth/Flat Earth Controversy*. Most candidly, "creation" or "creationism" or any of that hokum has no place at all in educational circles and I suspect you have done yourself a great disservice by permitting yourself to be identified with those who would even dignify such revolting and sophistic views. Education in the sciences is difficult enough without having the Phi Delta Kappa Educational Foundation adding more confusion.¹⁵

Jack Carter, professor of biology at the Colorado College, who I suspect did not read the monograph very carefully, if at all, wrote:

It is really too bad that Phi Delta Kappa allowed such a poorly written statement on such a far reaching topic to be printed under their name ... It only serves to destroy the image of the organization among the scientific community. It also makes it much more difficult for those of us in science who are also members of Phi Delta Kappa to speak out to our friends in science on behalf of the organization. I find it difficult to believe a knowledgeable editorial board within Phi Delta Kappa would sacrifice the credibility of the

organization by permitting such a ludicrous statement to be published. You would think the editorial board would at least call on several competent scientists to read the article before they allow it to be published. And what frightens me even more in this situation is that school administrators, many of whom need all the help they can get in facing the fundamentalists and creationists in their communities, will interpret Bergman's position as a valid approach of the scientific community in dealing with this issue. The educational community will never know of the support and assistance they can get from the scientific community and organizations such as the National Association of Biology Teachers, the American Institute of Biological Sciences and National Science Teachers Association to keep such myths out of science classrooms.¹⁶

Some letters were openly insulting, such as the following from Dr. William V. Mayer, of the Biological Science Curriculum study:

I have read Fastback 134 and simply do not have the time to dissect its many errors and misrepresentations. The author is in no way either a qualified biologist or familiar enough with the theory of evolution to be considered a serious commentator on the situation. This Fastback should be distributed in missions and brought to your door by the fundamentalist analog of the religious group that distributes the "Watchtower."¹⁷

Mayer then demeaned Phi Delta Kappa as an organization, claiming that my Fastback

is not much more than a religious tract, and the fact that Phi Delta Kappa evidently considers it a serious piece of writing and a contribution to an understanding of an issue makes me recommend that the Fastback series either be discontinued or identified as propaganda rather than as unbiased information. I hope for your sake that there will not be too many references in the literature to this embarrassing publication, which can only indicate that whatever else Phi Delta Kappa stands for, its unfamiliarity with science, at least, is unlikely to provide helpful guidance on controversial topics.¹⁸

Mayer also condemned other anti-creation groups that did not do things the way he thought they should be done.¹⁹ I then wrote to Mayer noting that I was surprised at his response because, of those I talked to who actually read my Fastback,

mostly biology teachers, administrators and professional biologists, stated to me they agreed with most of the material presented, and the basic theme espoused. In addition, before it was published I had it reviewed by a number of biologists teaching at various colleges and universities. I simply do not



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*I was
a candidate for
tenure at
Bowling Green
State
University
when the
monograph
was published.
The faculty
openly objected
to my Phi
Delta Kappa
monograph. ...
My peers
openly denied
my tenure
on the basis
of this and
similar
publications.*

know how to respond when I am confronted with an almost open attempt to censor ... Perhaps, if you would be so kind, you could mention the "many errors and misrepresentations" which you evidently found and the other dozen reviewers or so did not find.²⁰

I added that I wanted to correct any errors it contained because it was my intention to write a book on the controversy, using the monograph as the foundation for a larger and more fully documented work. This book project remains unfinished, and it is for this reason that I saved all of the correspondence relating to the monograph.

Repercussion from the Monograph

Some of my colleagues at Bowling Green State University (BGSU) where I was teaching at the time, likewise disagreed with the monograph. As a result, I experienced often irrational personal antagonism from academics that I formerly believed were scholarly and objective. Long and sometimes emotional conversations resulted in which I saw another, very nasty, side of my colleagues. As far as I knew, none of them had read the entire monograph, a fact that openly came out in court—not one testified who had read the whole monograph.²¹ This bitter experience revolutionized my previous ideas about the objectivity of academics, a view inculcated in me in my graduate training in the area of measurement and evaluation.

I was a candidate for tenure at BGSU when the monograph was published. The faculty openly objected to my Phi Delta Kappa monograph.²² Tyner, discussing the reasons for my subsequent loss of tenure, wrote "most often mentioned is a Fastback written for the Phi Delta Kappa educational organization titled 'Teaching About the Creation/Evolution Controversy.'"²³ My peers openly denied my tenure on the basis of this and similar publications. BGSU Professor Gerald Rigby wrote that he was very concerned about my tenure case because it suggests the

relevancy of a religious-orthodoxy test for tenure at this University. Insofar as Dr. Bergman's views on religious

matters, be they correct or incorrect, conventional or non-conventional ... were taken account of by those casting tenure votes ... the record speaks quite clearly to this point—such views were considered in the decision process ... [T]he Fastback, "Teaching About the Creation/Evolution Controversy," which Dr. Bergman authored for Phi Delta Kappa, entered into the decision ... I have read this presentation ... while I, too, find myself supporting the "conventional wisdom" about evolution, this little booklet is a superbly done consideration of the issues involved. I can find no fault with Dr. Bergman's analysis and presentation; it is excellently written (as are all his publications I have been privileged to read), soundly reasoned, and eminently fair in its approach. No one could legitimately cite this as support for ... adverse judgment on Dr. Bergman's scholarship ... the University is a forum for exploration and exchange of ideas. Even the most unacceptable ought to have a fair hearing in a University, and the advocates of all views ought to ... receive the opportunity to explore, expound, and advocate their ideas.²⁴

Dr. Wallace DePue, then a full professor at BGSU, wrote that he was

shocked to learn that Dr. Jerry Bergman had been dismissed ... because of his religious beliefs, namely his espousal of creationism. It is clear to me from reviewing information and talking to individuals about the case that Dr. Bergman, in violation of the University Charter, articles 1, and 4C, was dismissed solely because of his religious beliefs ... The University Charter clearly guarantees academic freedom, so termination on the grounds of espousing creationism in one's publications is surely a violation of this article.²⁵

A BGSU colleague, Dr. Gusweiler, testified in court that a mutual colleague, Dr. Jim Davidson,

showed me a pamphlet from Phi Delta Kappa that Dr. Bergman had written on creationism. ... He threw it on my desk and said this is what Jerry was

teaching. ... He was very adamant it [the pamphlet] was based on religious views and Jerry was teaching religion in the classroom.²⁶

It was clear from my conversations with Dr. Davidson that he had never read it.

The Monograph Goes to Court

The case commenced in the US district court in Toledo, Ohio, on March 12, 1985, and was heard in a one week trial. The court upheld my tenure denial, deferring to the judgment of my colleagues, citing their allegations about the "quality" of my publications, never noting which of my over two hundred publications, including around a dozen in the *American Scientific Affiliation Journal*, was a concern.²⁷ My publications included a textbook in the area that I taught²⁸ as well as articles in the following journals: *New Directions in Teaching*, *Quarterly Journal for the North Carolina Association for the Gifted and Talented*, *Journal of Scholarly Publishing*, *Sociological Analysis*, *Ohio Reading Teacher*, *The Creative Child and Adult Quarterly*, *Journal of Technical Writing and Communication*, *Journal of Instructional Psychology*, *American Secondary Education*, *Journal of Gifted, Creative, and Talented*, *The Creative Child and Adult Quarterly*, *Suicidology and Life Threatening Behavior*, *Art Education*, *Clearing House*, *Journal of Family Therapy*, *Psychology: A Quarterly Journal of Human Behavior*, *The Guidance Clinic*, *Texas Secondary Education Research Journal*, *Journal of Educational Public Relations*, and *College Press Review*.

I have since learned that courts virtually always side with the university, particularly in tenure disputes. One study of seventy-eight important discrimination decisions found that the court sided with the university 88% of the time, and none of the cases where the professor prevailed involved religious issues.²⁹ Another selective study of discrimination in academia of women found the same thing, noting that "the burden of proof for plaintiffs is onerous."³⁰ One of the most extensive studies of tenure discrimination and the courts found that the "few religious discrimination suits affecting faculty members have arisen at private colleges and universities" and the rare case against a public college or university usually involves Jews or Muslims.³¹ Thus, little case law exists in the area of religion, partly because many aggrieved religious professors do not have the money or support to pursue litigation and many universities have enormous funds.³²

One reason why I am recounting this over twenty-year-old case is that the similar experience of others in many recent cases has motivated me to bring this problem to the attention of the academic community. I have completed an over 800-page manuscript on this problem that is due to be published soon. The manuscript documents over one hundred cases similar to my own, in which tenure was denied or other discrimination occurred based primarily on the religious views of the professor.

My experience has taught me that some attention should be given to the "other side of science" to help prepare researchers for the possibility that their conclusions, even in their line of research, may be unpopular and could result in derailing their career. This awareness may help researchers and professors become aware of the possible consequences that can result from expressing their privately held viewpoints, particularly as they may relate to certain unpopular conclusions in science.

Conclusions and Lessons Learned

The letters that I have cited indicate only the opinions of those who took the initiative to write. As far as I can determine, the general response from most readers, judging by my interactions with them, was very positive. Therefore, it is difficult to judge how representative the general view of my monograph was from these letters, which is not a representative sample. It is significant that many of the letter writers who condemned my monograph were well-known scientists teaching at major universities.

For this reason I surmised that their feeling may be typical of well-known scientists, a speculation that has been confirmed by at least three academic studies. Ecklund and Scheitle found that only 7.8% of the natural science professors at major research institutions "have no doubt about God's existence" and the rest were atheists or agnostics of some type.³³ Greg Graffin's Ph.D. dissertation on the religious beliefs of leading biologists found, of the 271 scientists surveyed, 98.7% rejected the historical theistic belief in a personal creator God as taught by the Christian, Jewish, and Moslem religions.³⁴ The majority were openly atheists, and most of the rest were agnostics or new age spiritualists of some type.

My monograph experience was a very rude awakening to the intolerance of well-known scientists on the subject of origins. No one was able to point out a single erroneous factual claim in my monograph, even though I consistently asked for specifics in order to improve a planned revision of the monograph. They openly objected to its neutral tone, insisting that I had harmed the Darwinian position by not condemning its critics. Little concern existed for an objective discussion of the issues; instead the critics wanted me to advocate one side to ensure the indoctrination of students in one world view.

My Fastback publication was also an important lesson for me because it was my first indication that scientists, even well-known scientists from major universities, are at times irrational and have no qualms about book banning or censoring information that they disagree with. In this case, the censoring was of a viewpoint that I was endeavoring to convey to readers, namely that, regardless of which side of the origins controversy they were on,



My monograph experience was a very rude awakening to the intolerance of well-known scientists on the subject of origins ... They openly objected to its neutral tone, insisting that I had harmed the Darwinian position by not condemning its critics.

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The Dangers of Neutrality in the Origins Debate

they should, and could, understand the key issues. Critics were especially vehement about my citing a number of creation sources which they felt readers may review and influence them toward the creation position. These references were, in fact, added only at the suggestion of my editor. Since this experience I have wisely avoided discussing the whole issue with Darwinists colleagues connected with my employment even though this is a subject that I relish discussing especially with those who can challenge my thinking. My BGSU experience also ended my career in education. I had to start over, earning five more graduate degrees in the life science area to begin a new career. ★

Notes

- ¹W. Gajewski, "Lysenkoism in Poland," *The Quarterly Review of Biology* 65, no. 4 (1990): 425.
- ²N. Roll-Hansen, *The Lysenko Effect: The Politics of Science* (Amherst, NY: Humanity Books, 2005), 218–20.
- ³S. M. Gershenson, "Difficult Years in Soviet Genetics," *The Quarterly Review of Biology* 65, no. 4 (1990): 447.
- ⁴Phi Delta Kappa is the premier membership professional association for all educators dedicated to improving education. They achieve this goal by several means including by the publication of monographs and journals, sponsoring professional meetings, and working at the local and national level in the interests of educators. It boosts serving more than one-half million members since it was founded in 1906.
- ⁵Published as a Fastback, number 134 (Bloomington, IN: Phi Delta Kappa Educational Foundations, October 1979), 45 pp.
- ⁶A library internet site that includes the book catalogs of most academic libraries in the world.
- ⁷W. Hearn, "Bergman Scores with a Fastback," *Newsletter of the American Scientific Affiliation* 21, no. 6 (December 1979/January 1980): 2–3.
- ⁸W. Hearn, "Bergman Sues over Dismissal," *Newsletter of the American Scientific Affiliation* 26, no. 1 (February/March 1984): 4–5.
- ⁹W. Harrison, personal letter to Jerry Bergman, January 11, 1980.
- ¹⁰C. Rexroad, personal letter to Derek L. Burleson, editor, Special Publications, Phi Delta Kappa, November 12, 1979, p. 2.
- ¹¹*Ibid.*, 1.
- ¹²J. Cunliffe, letter to the Fastback Editor, Phi Delta Kappa, April 5, 1980.
- ¹³D. Burleson, letter to Dr. James Cunliffe, April 22, 1980.
- ¹⁴Letter from Jerry Bergman to Dr. Cunliffe, April 28, 1980.
- ¹⁵G. DeYoung, Minnesota Institute of Philosophy, Hull, Iowa, letter to Jerry Bergman, November 25, 1979.
- ¹⁶J. Carter, Professor of Biology, The Colorado College, Colorado Springs, Colorado, letter to Phi Delta Kappa, January 28, 1980, p. 1.

¹⁷W. V. Mayer, Letter to Derek L. Burleson, Editor, Phi Delta Kappa Fastback Series, April 4, 1980.

¹⁸*Ibid.*, p. 1.

¹⁹H. Park, "The Politics of Anti-Creationism: The Committees of Correspondence," *Journal of the History of Biology* 33 (2000): 349–70.

²⁰Personal letter to William V. Mayer, April 14, 1980.

²¹The monograph was "exhibit C" number 19189 in U.S. district court case number C80-390, that involved the monograph.

²²See trial transcript, US district case number C80-390, 293.

²³M. A. Tyner, "Bergman: The Professor Who Lost His Job," *Liberty* 80, no. 1 (1985): 5.

²⁴Affidavit of Dr. Rigby, October 24, 1983.

²⁵Affidavit of Dr. Wallace DePue, September 16, 1983.

²⁶Deposition of Judith Ann Gusweiler, taken in Toledo, Ohio, October 18, 1982, case number C80-390, 330, 334.

²⁷I now have twenty-one publications in the ASA journal.

²⁸J. Bergman, *Understanding Educational Measurement and Evaluation* (Boston, MA: Houghton Mifflin, 1981).

²⁹R. Amacher and R. Meiners, *Faculty Towers: Tenure and the Structure of Higher Education* (Oakland, CA: The Independent Institute, 2004).

³⁰*Tenure Denied: Cases of Sexual Discrimination in Academia* (Washington, DC: AAUW Educational Foundation, 2004): 54.

³¹T. Leap, *Tenure, Discrimination, and the Courts* (Ithaca, NY: Cornell University Press, 1995), 29.

³²See G. LaNoue and B. Lee, *Academics in Court: The Consequences of Faculty Litigation* (Ann Arbor, MI: The University of Michigan Press, 1990).

³³E. Ecklund and C. Scheitle, "Religion among Academic Scientists: Distinctions, Disciplines, and Demographics," *Social Problems* 54, no. 2 (2007): 296.

³⁴G. Gregory, "Monoism, Atheism, and the Naturalist Worldview: Perspectives from Evolutionary Biology," (Ph.D. diss., Cornell University, 2003).

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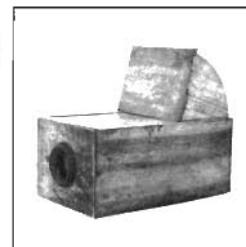
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Through the Eye of a Needle: The Science, Art, and Stewardship of Pinhole Photography

Dennis R. Venema

Pinhole photography, an endeavor with a noble scientific heritage, is enjoying a renaissance as a serious art form in our hasty, digital age. This form of photography has numerous features that mesh well with a Christian worldview. It is almost a “monastic” form of photography in its simplicity, patience, and spurning of technology. Most pinhole photographers make their own cameras from recycled materials; this fits wonderfully with environmental stewardship and a non-

materialistic ethic. There is something quite marvelous about an old lens camera, or a discarded cookie tin, or wood scraps becoming an object with renewed purpose and usefulness: as an instrument to record beauty. It is very fitting to capture the majesty of God’s creation in a way that is sensitive to its well-being. Pinhole photography is also an excellent way to teach the basic properties of light in a manner that inspires wonder at God’s design, especially to young people. ★



This image was taken on the Trinity Western University campus after a heavy snowfall. With the pond frozen over, this great blue heron is patiently waiting out the cold spell – and it was patient enough to wait for a three-minute exposure with almost perfect stillness. My camera was a simple plywood box constructed from scraps and fitted with a handmade pinhole drilled into scrap aluminum sheeting with a sewing needle.

Dennis R. Venema holds a Ph.D. in cell biology and genetics from the University of British Columbia. He is an assistant professor of biology at Trinity Western University, where he teaches courses in introductory biology, classical genetics, and cell biology. He and his wife Valerie have two young children (son Elijah and daughter Davin). Elijah has decided that daddy’s strange cameras take “pretend pictures” – since there is no immediate digital result to examine.



Art Eyes Science

Celestial Lights

Lois Yoder

Andromeda

great star mother

plucking her womb

casts

novae

millions

glowing

to

earth

Great Nebula in Orion (close up)

Theta's

little

star

lamb's

grazing in corral

glisten . . .

diamond

wool

Hercules

mighty giant's gift

million mile

bridal veil

glimmering

blue-green

emerald

glory

Moon

faded

earth-kin

sucked

dry

now

hides

her

mystery

under

blanket

of

dust

Lois Yoder, a writer from Harrisonburg, VA, earned her B.A. and M.A. in composition and rhetoric from the University of the District of Columbia. She states that "the spiritual is my life" which leads her to inquire into God's universe, including the human story, through poetry. The title of her inquiry is "From Bud to Blossom." Her poems are arranged in seventy poem cycles and many are in dramatic form. Her other works include children's stories and a cookbook.



Book Reviews



ENVIRONMENT

THEOLOGY THAT MATTERS: Ecology, Economy, and God by Darby Kathleen Ray, ed. Minneapolis, MN: Augsburg Fortress Publishers, 2006. 245 pages, notes, index. Paperback; \$22.00. ISBN: 0800637941.

Ray, associate professor of religious studies and director of the Millsaps Faith and Work Initiative, Millsaps College, Jackson, Mississippi, wrote the prologue to this book and a chapter entitled "It's About Time: Reflections on a Theology of Rest." The remaining eleven chapters are written by different authors, many of whom are listed as professors of constructive or feminist theology. Sallie McFague, whose own theological commitments, style, and vision inspired the collection, wrote the final essay.

The book is a symposium on three themes critical to Christian thought and practice: the nature of God, the relationship between theology and ecology, and the relationship between theology and economics. The first section of the book includes essays that focus on theology proper with all of the authors sharing several theological presuppositions. First and foremost is a shared commitment to constructive theology. This form of "theology that matters" is in active conversation with biblical texts and the church, and with other "vital discourses of this or any other age." These vital discourses include non-Christian religious traditions, modern day scientific explanations, and the "theological virtue of individual imagination." Most, if not all of the authors, seem heavily influenced by process theology and a panentheistic understanding of God's relationship to the natural world.

Many process theologians believe that an agential-organic model of God is compatible with the portrait of the cosmos provided by postmodern science. This model is described as panentheistic rather than pantheistic since "the universe is dependent on God in a way that God is not dependent on the universe." However, several of the authors lean toward pantheism by advocating various impersonal models and metaphors of divinity. For example, Gordon Kaufman describes God in his essay as the "serendipitous creativity" manifest throughout the universe. Ellen Armour's elemental theology refocuses attention from an invisible, disembodied-but-agential transcendence to a (more or less) visible, embodied, impersonal transcendence. Catherine Keller draws from the whirlwind experience of Job to develop a concept of God as the "inconceivable edge," the Spirit that can only materialize at the edge of chaos. These are but a few of the examples of the ways in which these authors move beyond the traditional, biblical images of God to embrace metaphors and models that (they believe) are more appropriate for life in the twenty-first century.

While some readers may disagree with the theology of the authors, the practical suggestions they offer are worthy of consideration. The major premise of this book is that theology needs to make a difference in the everyday prac-

tices of regular people. The essays that are centered upon ecology highlight the need for Christians to help heal the human race's exploitative environmental habits. If theology is to be responsible, it must actively foster a relationship of care and authentic connection with the earth and its nonhuman inhabitants. As the essays in section two suggest, theology that matters is theology that makes ecology a primary partner.

The essays in section three focus on "economy" and urge readers to reject consumerist values like individualism, self-interest, and short-term gratification. The authors oppose the community-diminishing values of neoliberal economics and embrace "old fashioned" priorities such as care for the earth, intergenerational wisdom, communal values, social justice, and long-term flourishing. They argue rightly that consumerism is a distorted form of spirituality which must be replaced by an alternate vision of "life abundant for all members of God's household." The church is encouraged to articulate, demonstrate, and propagate this vision so that theology in the form of "God-talk" can become theology that matters in the form of "God-action."

The summary on the back cover suggests that the book is specifically formulated for undergraduate and seminary courses. Theologians and students who are sympathetic to process theology, panentheism, and Sally McFague's organic model of the earth as the Body of God will certainly enjoy reading this book. Those who disagree with these perspectives should still read it. The practical applications derived from these models and metaphors are thoroughly biblical and genuinely Christian. The authors admonish us to put our faith into practice by living more lovingly, more humbly, more simply, and more ecologically. This is a message that the church must proclaim and that all Christians must heed.

Reviewed by J. David Holland, Biology Instructor, Springfield College in Illinois, 1500 North Fifth Street, Springfield, IL 62702.

RELIGION AND THE NEW ECOLOGY: Environmental Responsibility in a World in Flux by David M. Lodge and Christopher Hamlin, eds. Notre Dame, IN: University of Notre Dame Press, 2006. xiv + 325 pages, index. Paperback; \$40.00. ISBN: 9780268034043.

The editors, professors of biological sciences and history, respectively, at the University of Notre Dame, have assembled nine chapters by authors mostly from secular universities, developing presentations and discussions from a 2002 conference (www.nd.edu/~ecoltheo/). A foreword by Peter H. Raven and the editors' introduction "Beyond Lynn White" emphasize that environmental ethics now must discard the concept of a stable balance of nature as an ideal, because a new view of nature in flux replaced it around 1970-1990. Yet half a century earlier the Canadian botanist Brother Marie-Victorin, of the Roman Catholic order Frères des Écoles Chrétiennes, wrote: "Floras are dynamic units undergoing constant transformations. Their apparent static condition is a delusion ..." (*American Midland Naturalist* 19 [1938]: 489).

Chapters 1-3 are by historians. Elspeth Whitney (chap. 1) asserts that claiming Christianity to be the root of the eco-

Book Reviews

logical crisis, Lynn White's thesis, oversimplifies how this crisis has developed from pre-Christian through medieval to modern times. Mark Stoll (chap. 2) provides evidence that the Protestant, particularly Puritan, beliefs of founders of ecology led them to advocate moral responsibility for the environment. Eugene Cittadino (chap. 3) extends this argument to how these early ecologists and their successors sought to influence social policy in the United States. In these latter two chapters, present-day ecology is seen as shaped by the personalities and ideas of its leaders, rather than as a body of knowledge that strictly describes and explains natural phenomena.

Chapters 4–6, more technical, are by ecologists. Kyle S. Van Houtan and Stuart L. Pimm (chap. 4) give a valuable analysis of four Christian worldviews on species conservation: earthkeeping, skeptic, priority, indifferent. In a table and a list of fifty-one web sites and publications, they associate many denominations, organizations, and individuals with one of these worldviews. Gary E. Belovsky (chap. 5) analyzes ancient climatic and environmental processes as the background for Old Testament events. Readers will need to study his sources to understand his three complex figures on population dynamics. Belovsky's statement about Mediterranean waters rushing into the Black Sea (Noah's flood? p. 153), does not reflect the caution with which conflicting data are discussed in the peer-reviewed literature. Peter S. White (chap. 6) reviews disturbance, on various scales in space and time, in environmental processes, with three clear diagrams. Drawing on his own experience in the Great Smoky Mountains National Park, he shows how disturbance affects strategies for conserving biodiversity. Development of sites prone to erosion, flood, or fire is unwise.

Chapter 7, by Patricia Fleming, a philosopher of science, explores the relation between "is" and "ought," between nature and value. Chapters 8 and 9 are by eco-theologians. John Haught (chap. 8) considers three approaches to ecological theology: tradition-centered, sacramental, cosmological-eschatological. Larry Rasmussen (chap. 9) criticizes ecomodernity—transformation and management of nature for human benefit—looking to religious traditions of asceticism, sacramentalism, mysticism, and prophetic-liberative practices as sources for morality. The editors conclude the book with their own essay on how environmental concerns should influence religious faith and practice, using the problem of invasive species as an example; they seek to draw together the themes from the various chapters. This volume is more integrated than a conference proceedings collecting diverse papers, but the chapters are still only loosely related. With some 650 references (none noted from *Perspectives on Science and Christian Faith*), it provides background and depth to support its advice on how people of faith should act in response to the environmental crisis.

Christians in environmental studies can use this book as an additional source of opinions on moral and ethical questions. However, believers who profess Christ to be preeminent in all things will find his lordship over creation only mentioned briefly, in a sacramental context; generally the book does not draw explicitly from the teachings of the New Testament. Indeed, the Bible itself is challenged (chapter 5) on the ground that it is not trustworthy for environmental ethics. While there is much of

value in this book, evangelicals need to question some of what is written here.

Reviewed by Charles E. Chaffey, Adjunct Professor of Natural Science, Tyndale University College, Toronto, ON M2M 4B3.



FAITH & SCIENCE

COSMIC IMPRESSIONS by Walter Thirring. Philadelphia: Templeton Foundation Press, 2007. 163 pages. Paperback; \$19.95. ISBN: 9781599471150.

Walter Thirring is the former director of Vienna University's Institute for Theoretical Physics, which "deals with the traces of God in the Creation." That alone should make the reader sit up and take notice. Given that most physicists are atheists, this is unusual. Thirring's career has had a large impact in physics and math, having published numerous textbooks on both classical and quantum physics and a book (with Lieb) on the stability of matter.

The book has seven chapters and nine appendices. The chapters cover the origin of the world, chance vs. necessity, cosmochemicogenesis, the size of the universe, chaos in the solar system, why life exists and the anthropic principle. Each of these chapters has anecdotes about some of the biggest names in twentieth-century physics as well as short vignettes of lesser known physicists. If the old adage is correct that the number of readers is reduced by half with each included equation, I suspect that this book will have few readers because it contains at least seventy-four equations. But that being said, I learned from this book, and for that I am thankful to the author.

Thirring's discussion of negative specific energy was fascinating, and while he does not draw the conclusion, this feature of gravitational systems is what makes life possible. Basically suns, black holes, and other gravitating bodies heat up the more radiation they emit. When first thinking along these lines, one is tempted to say this is absurd, but such is not the case. As a proto-star emits energy, gravitational collapse ensues, raising the temperature of the object. Ultimately after the star has become a black hole, Hawking radiation becomes hotter and hotter as the black hole emits radiation and shrinks in size, with the final evaporation of the black hole being the hottest. One can only describe this system as one having negative specific energy. Without it, stars, and thus you, dear reader, would not exist.

Thirring's chapter on randomness does not seem to hit home. He calculates the unlikeliness of the present universe, and mentions ergodicity, Boltzmann's problem of the eternal return, but only in passing. He notes that biological systems are equally unlikely. But his only stab at a solution is to say that in biology it is conceivable that natural selection follows a path which was once "chosen." While that may be true, it is neither science, nor evidence, a charge Thirring throws at the concept of the multiverse.

The biggest drawback is one I find in many modern attempts to unite science with religion. Religion becomes an irrelevant add-on as is illustrated by the chosen path Thirring mentions in biology, as well as the claim in the Foreword that physics deals in the traces of God. One can certainly cite counter-examples. For Stephen Weinberg,

physics traces no god; for Thirring, there is the Divine add-in. Unlike Tipler's *Physics of Immortality*, Thirring provides no grand view of how science and religion meet and support each other, nor is there any explanation of why one should believe that Thirring's God is the God of the Bible, rather than Spinoza's God, or even Ahura Mazda. Even if the grand view is ultimately proven wrong, as was the case with Tipler, it would be a worthwhile exercise.

An interesting thing is the rejection of the anthropic principle as being of much use, which is contrary to most anthropic discussions, including those of atheists like Susskind who try to avoid such design implications by postulating the multiverse. Surprisingly, Thirring does not see it as Susskind does. While the book is a difficult read, it is interesting, and I am pleased to recommend it.

Reviewed by Glenn R. Morton, 10131 Cairn Meadows Dr., Spring, TX 77379.



HISTORY OF SCIENCE

JOHN CALVIN AND THE NATURAL WORLD by Davis A. Young. Lanham, MD: University Press of America, 2007. 250 pages. Paperback; \$35.00. ISBN: 0761837132.

ASA Fellow Davis A. Young is professor emeritus of geology at Calvin College. A life spent in Calvinistic culture and a long interest in a reformed approach to the scientific challenges of the Genesis creation account brings depth to his thinking.

John Calvin's theology of creation, including issues ranging from animal rights to natural theology, was actively debated in the last century, often casting Calvin in a negative light. Recent work by Schreiner,¹ Helm,² and Huff³ has moved the discussion from ideological concerns to what Calvin actually said.

Young's quest to catalog Calvin's writings on nature has three goals: (1) to examine Calvin's use of nature in Scripture, (2) to show how he viewed the science and scientists of his day in sermons and theological works, and (3) to discuss how Christians should view nature.

The Preface demonstrates the diversity of scriptural references to nature. Chapter one sets forth Calvin's views on science, the arts, and learning. Although a few comments seem to have a negative tone, the context of these quotes and many positive references suggest Calvin's approval of science, scientists, and liberal learning in general as a gift of God — worthy of praise and to be valued as useful in enjoying and preserving life. He praised heathen philosophers who skillfully treated the secrets of nature.

Calvin wrote more about astronomy than any other science. This would be natural because of the prominence of the heavens in Scripture, because of the practical value of astronomy (sometimes called astrology), and because astronomy was more advanced. Although Calvin condemned a false astrology (astronomy) which claimed to predict the future, he claimed that the Moon influences the growth of organisms noting that

oysters become full or empty as the Moon waxes and wanes, as does the marrow in bones ... [and] ... that

the heavens may influence human health and that knowledge of the heavens could aid the physician in choosing the appropriate time to order blood-lettings, infusions, pills, or other medical necessities (p. 41).

However, the stars were not the primary cause of effects on the body.

Calvin's views regarding the heliocentric theory of Copernicus have provided much controversy and fodder for the claim of anti-science on the part of the reformers. Young traces the discussion across the years concluding that Calvin took no definitive position. Calvin's alleged anti-science has been a prominent part of the warfare model exemplified by A. D. White, Paul Kocher, Bertrand Russell, and Thomas Kuhn.

Calvin followed Aristotle's views on the sublunar world including such ancient themes as the four elements. Calvin viewed the parts of nature as subject to God's will rather than simply parts of a natural machine. He offered a scientific case for the belief that the earth was at the center of the universe; Calvin was willing to bring biblical text and scientific thinking together. Rain, hail, thunder, lightning, rainbows (which he thought occurred prior to the Flood) could be explained by natural causes. He was critical of weak prevailing theories and was not unwilling to consider the providential intervention of God in the natural order. Everything owes its existence and maintenance to God.

Chapter four considers the physical properties of the earth in the pre-geology era. He accepted the conventional view of a 6,000-year age for the earth and generally followed Aristotle.

Fossils were not of organic origin but grew in rocks as a result of the influence of heavenly bodies. He conceived of the Flood as a global event and discussed the entry of various animals into the ark without mentioning the animals of the Americas. He shared the view that vast regions of subterranean water were present at creation.

The topic, "Calvin on Living Things," ranges from the ostrich to the elephant, from the unicorn to thorns in an intriguing sweep of the living world. Calvin was cautious in committing himself to mechanisms of divine creation and believed in a future restoration of nature to a pre-Fall vegetarian state. B. B. Warfield's suggestion that Calvin may have been a proto-evolutionist is carefully examined (pp. 130–3).

Chapters six and seven consider many aspects of the history and nature of humans and the place of Scripture in earth history. Young emphasizes Calvin's extensive use of the principle of accommodation in relating Scripture and nature.

The chapter, "Calvin and Contemporary Science," may disturb postmodern views on the nature of historical study. However, Young is able to tease out elements of Calvin's thought that are relevant to our time.

This book is comprehensive in terms of Calvin's thinking about creation, nature, and the world. It is indeed a groundbreaking contribution.

Notes

¹Susan E. Schreiner, *The Theater of His Glory: Nature and the Natural Order in the Thought of John Calvin* (Durham, NC: Labyrinth Press, 1995).

²Paul Helm, *John Calvin's Ideas* (Oxford: Oxford University Press, 2004).

³Peter A. Huff, "Calvin and the Beasts: Animals in John Calvin's Theological Discourse," *Journal of the Evangelical Theological Society* 42, no. 1 (March 1999): 67-75.

Reviewed by J. W. Haas, Jr., Emeritus Professor of Chemistry, Gordon College, Wenham, MA 01982.



NATURAL SCIENCES

THE PHYSICS OF CHRISTIANITY by Frank J. Tipler. New York: Doubleday, 2007. 336 pages, index. Hardcover; \$27.50. ISBN: 0385514247.

Over a decade ago, mathematical physicist Frank Tipler wrote *The Physics of Immortality*. It was a bold book of "science speculation" which *Esquire Magazine* likened to "2001: A Space Odyssey meets *The Divine Comedy*." In it Tipler predicted that universal computer intelligence will eventually evolve into a scientific—some would argue science fiction—equivalent of God. At the core of his thinking was a cosmological concept he called the Omega Point, a singularity outside space and time, and beyond the laws of physics to which the expansion of intelligent "life" inevitably leads. In *The Physics of Christianity*, Tipler refines his argument. The result is another imaginative, idiosyncratic, and often disturbing attempt to provide scientific explanation for Christian dogma.

In layperson's terms—necessitated by my own lack of expertise—Tipler argues that God is the "Cosmological Singularity" consisting of three Hypostases (which he identifies with the Trinity): the Initial Singularity (Holy Spirit); the All-Presents [the plural is very significant] Singularity (Christ), and the Final Singularity (God, the Father). Knowing what "He" wanted to accomplish in universal history, God/Cosmological Singularity created all that exists including the physical laws.

Miracles, Tipler insists, never violate physical laws, only human misunderstanding of how those laws ought to operate. Consequently, he views miracles as inevitable—there is a strong teleological/determinist bent to Tipler's project—from the standpoint of what God/Cosmological Singularity intends in universal history. Tipler includes detailed discussions of how miracles like the Incarnation, the Virgin Birth of Jesus, and the Resurrection make sense scientifically utilizing, respectively, the mathematical procedure known as the Cauchy completion, our knowledge of genetics and the DNA derived from the Shroud of Turin, and the baryon-annihilation process combined with electroweak quantum tunneling. Such a shorthand summary does justice neither to the sophistication nor the problematic nature of Tipler's argument.

Tipler's professional pedigree in theoretical physics is impeccable; he studied under John Wheeler, one of the preeminent American physicists of the twentieth century. [Wheeler collaborated with Einstein and Bohr, and his work on dying stars led to our current understanding

of black holes.] But Tipler has a habit of incorporating debatable scientific notions into the very core of his project. For example, his argument is utterly dependent on the contested concept of the multiverse, which oddly enough is often the resort of those seeking naturalistic alternatives to the religious implications some draw from the Anthropic Principle. Contra many, if not most, cosmologists, he also believes that the universe must, at some point, experience a "Big Crunch," even though the expansion of the universe would argue for the reverse. But I leave such matters to those better equipped to raise them.

What concerns me most about Tipler's approach is that he flattens out reality so that there is no room for the supernatural. For him, it does not exist by definition, save in a naturalistically tamed fashion as Cosmological Singularity. The predictable result is that the mystery and pathos of dogmas like the Incarnation and Resurrection get recast into very technical scientific explanation. And so much is lost in translation. Eternal life, just to mention one example, becomes a computer simulation conceptually not much different from that depicted in *The Matrix*.

As scholars like Roy Bhaskar and Basarab Nicolsecu note, reality is multi-layered, stratified. And when we fail to appreciate this, ordinarily we allow methodology to dictate ontology. To be sure, Tipler is not guilty of this. If nature (even if re-conceptualized in Christian categories) is all there is, then the overall scientific approach he employs is indeed appropriate. But Christians in overwhelming numbers believe "nature is not enough." [For a superb discussion of this, see John Haught's recent book with the same title.] And because it is not, there are other ways of knowing. Thankfully so; otherwise, we might have to agree with Tipler that Christianity should become a branch of physics.

Readers interested in a sci-fi-like version of Christian theology will certainly be entertained and stimulated by Tipler's creative essay. But those wanting a more thoughtful and satisfying exploration of the complementary relationship of physics and Christianity should consult John Polkinghorne's *Quantum Physics and Theology* (Yale, 2007).

Reviewed by Donald A. Yerxa, editor of *Historically Speaking*, *The Historical Society*, Boston, MA 02215-2010; Professor of History, Eastern Nazarene College, Quincy, MA 02170.

THE BIG TREE AT GEORGE AND CHARLOTTE'S HOUSE by Tomm Stanley. Golden, CO: Chelsea Green Publishing, 2007. 30 pages. Paperback; \$11.95. ISBN: 9780473116118.

If you like trees, books with facts about trees, books with artist's pictures of trees, this book is for you. This intriguing book is for children and the curious of all ages. The author has 150 acres near Christchurch, on New Zealand's South Island, where he practices tree ecology. In this short book, he shares what he has learned about trees, and it is considerable.

At the bottom of each page, he shares a tree fact. Here are three of them: More than a quarter of all medicine comes from plants and trees found in wild forests; a one hundred-foot tall tree, such a pine, produces enough oxygen each year for two people; trees get 90% of their nutrition from the atmosphere and only 10% from the soil.

Since trees cover one-third of the earth, most humans are exposed to an abundance of them. Because this book is illustrated with child-appealing illustrations, it might be concluded that it is written for children. However, "The educational text is written at a pre-teen to early adult level and is perfectly suited to research for school projects, university papers or self-education." A glossary defines each specialized word. For example: "Aculeus is the modified ovipositor or sting of certain hymenopterous insects."

The book is built around a story with informative text covering about one-half of each page. The science may be elementary to those up-to-date on botany. For the rest of us, this delightful book will amuse, entertain, and inform. And if you believe in intelligent design, this book will certainly support your cause.

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



ORIGINS & COSMOLOGY

THE TOP 10 MYTHS ABOUT EVOLUTION by Cameron M. Smith and Charles Sullivan. Amherst, NY: Prometheus Books, 2007. 200 pages, index. Paperback; \$14.00. ISBN: 159102479X.

This book is part evolution apologetic and part "Myth Busters" science writing. It does not present any new arguments about the evolution debate to someone familiar with the controversy, but it does frame the discussion in an accessible manner. Scientists who find themselves defending evolution to nonscientist Christians will find several useful historical vignettes, scientific points, and rhetorical tools in this short book. The arguments against evolution are presented fairly, but it is clear that the intended reader is sympathetic to scientific perspectives.

Smith is an archaeologist and Sullivan is a college writing instructor. *Ten Myths* emerged from an article co-written by the two in the *Skeptical Inquirer*. Published by Prometheus Books, *Ten Myths* is not particularly targeted to believing scientists—rare off-hand remarks are mildly derogatory of Christian fundamentalism—but it does not take much patience on behalf of the reader to extract the authors' salient points. To be fair, criticisms of religion are balanced with a critique of naturism.

In the introduction, Smith and Sullivan cite several reasons why the American public is confused about evolution. Public misunderstanding and ignorance of science is the result of poor science education and a paucity of good science programming in the media. The power of myth—defined as explanatory story-telling—increases in influence in the context of poor background knowledge. In this context, it is most problematic for the authors when religious texts are used to provide scientific answers about the natural world. *Ten Myths* combats the misunderstandings of evolution in concise ten-page arguments that are for the most part freestanding.

The ten myths are presented in a logical order. The first chapters address the history of evolution (Survival of the Fittest, It's Just a Theory, The Missing Link); next are surveys from a philosophy of science perspective (Evolution

Is Random, Nature's Perfect Balance); the last group identifies where evolution science and religion clash (Creationism Disproves Evolution, Intelligent Design Is Science, Evolution Is Immoral). Some of the chapters in this introductory text clarify facts and history, while others present more difficult ideas. In the latter case, it sometimes feels like the conflict is oversimplified. Perhaps those chapters could be expanded in a 200-level defense of evolution course.

To satisfy the authors' goal to provide a handbook that dispels myths about evolution, the chapters are well annotated with an extensive index that will help the reader return to a particular argument long after the initial read. The bibliography for each section is good, but not comprehensive. This is a short read (the body of the book consists of 120 of the 200 bound pages), and each chapter has a clever illustration of the myth to be debunked. This book is inexpensive and could be a useful resource for believing scientists wishing to engage fellow Christians on the topic of evolution, or it could introduce students or other individuals to some of the basics of the evolution debate. Folks with a good knowledge of evolution will have encountered these arguments before, but perhaps not in as concise a form.

Reviewed by Thomas Robey, Graduate Student, University of Washington, Seattle, WA 98115.

CREATION, EVOLUTION AND MEANING by Robin Attfield. Burlington, VT: Ashgate Publishing Company, 2006. 234 pages, index. Paperback; \$29.95. ISBN: 0754604748.

Recent years have witnessed a renaissance of high quality books treating the subject of creation and evolution, many of which have been reviewed in this journal. This latest contribution to the Ashgate "Transcending Boundaries in Philosophy and Theology" series features the mature thoughts of environmental philosopher Robin Attfield, professor of philosophy at Cardiff University in Wales.

Attfield adopts a well-ordered philosophical approach to a series of important introductory topics including verification, analogical reasoning, realism and anti-realism, and falsification as they relate to the subject of creation. Along the way he considers the contributions of philosophers and theologians such as A. J. Ayer, J. L. Mackie, Michael Dummett, Ludwig Wittgenstein, Richard Rorty, Karl Popper, Pierre Duhem, W. V. O. Quine, and Donald Cupitt.

The next section undertakes a detailed look at various conceptions related to thinking about creation including creation and time, chance and contingency, various design arguments, Darwinism and design, theism and evil, and arguments concerning purpose, immanence and the argument from value—an important topic that is frequently ignored altogether by other treatments covering the same terrain. Here Attfield finds the classic arguments of David Hume not as airtight against design arguments as some fellow philosophers have assumed. In addition, he carefully considers the contributions of Richard Dawkins and one of his most sophisticated theological protagonists, Keith Ward. The final section takes up evolution and

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meaning and looks at the work of Daniel Dennett as well as concepts of stewardship and givenness.

This volume is one of the finest short cases for a realist understanding of language about God and a well-argued defense of theism and belief in creation. At the same time, it rejects creationism in both its Young Earth Creationism and Intelligent Design variants for philosophical and theological reasons. The writing is clear with crisp descriptions and linkages to major philosophically oriented treatments of the issues presented. The opinions of opponents are accurately presented and reasons for disagreement are neatly summarized. Anyone seeking a good philosophical grounding for Christian apologetics related to the theme of creation will welcome this excellent summary.

Reviewed by Dennis W. Cheek, Vice President of Education, Ewing Marion Kauffman Foundation, Kansas City, MO 64110.

IN SEARCH OF THE GENESIS WORLD by Erich A. Von Fange. St. Louis, MO: Concordia Publishing House, 2006. 362 pages. Paperback; \$19.99. ISBN: 9780758611000.

Erich Von Fange has been active in the young-earth creationist movement for twenty-five years, having published in 1981 a previous pamphlet, *Time Upside Down*. Von Fange was professor of education at Concordia University, Ann Arbor.

The book is divided into five parts covering epistemology, biblical studies and archaeology, evolution, origins, and the Genesis world. Each of these multi-chaptered parts are filled with the most amazing misinformation one could imagine, but understandable given the lack of scientific training on the part of the author. Most of the book is spent trying to convince the reader that we can know absolutely nothing via science. By using the normal controversies of science, Von Fange claims such disagreements prove we can know no truth. Every time a new dating method appears, he concludes all dating is speculative. If fossilized parts of animals previously found separately and later found fossilized together in proper life order, he criticizes science for not knowing this from the separate pieces. But conversely, when things are put together erroneously, he criticizes them for not knowing that was wrong. One can only imagine the boredom, not to mention irrelevancy, of reading 362 pages of this.

The book is confusing, incoherent, stream-of-consciousness-ish and presents no original ideas. Topics arise and are not tied to any grand view. Each paragraph brings new, unrelated topics to the reader. There is no theme or coherency to the book. He never discusses alternative possibilities. He remarks in amazement that a coal seam shows tree "stumps were all broken off at a uniform height" (p. 229), arguing that Noah's Flood was the cause. What he does not even mention is that the dead wood of trees above the water level will rot, while the waterlogged stumps below the water surface are preserved, explaining why all fossil forests tend to have this "amazing" appearance. Water surfaces are quite flat.

There are many "howlers" in the book and therein lies the main entertainment. We learn the Pleistocene began 13 million years ago (reality 1.8.5 MYR). We are told that satellite photos show metal meteorites embedded in the

earth up to several hundred miles in depth; how photos show us beneath the earth surface is unexplained. We are informed that, if you, like the Osage Indians, live on top of a meteor crater, you too will be big of stature. We further are told that worldwide oceanic travel was widespread for thousands of years before Columbus, which if restricted to the Polynesians would be acceptable, but he has everyone taking cruises around the earth throughout history. Venus was a late addition to the solar system, showing he is a Velikovskian. His "scientific thinking" comes shining through when he informs us that he is skeptical of twentieth-century dinosaur sightings other than those seen in the ocean.

His unfamiliarity with research can be seen with the Litopterns, an extinct order of mammals whose legs had similarities to those of the horse. Evolutionists claim that two lineages converged upon the same locomotor solutions. He claims this example disproves evolution. Going further he asks, if convergence was such a big deal, why do we not see many articles on Litopterns? He claims that "an extensive computer search" turned up only seven articles. My Google Scholar search yielded 260 hits.

The most amazing chapter is his "Irreverent Review of Prehistory," in which he reviews all the nut-case books he has read on topics like Atlantis, Mu, flying saucers and the hollow earth. To his credit, he does not support most of them, but one wonders why he would spend this much space even discussing these and making occasional positive comments. What possible value is there in this to Christian apologetics?

Spend your \$19.99 on coffee for you and some friends, where you can discuss reality rather than this stuff.

Reviewed by Glenn R. Morton, 10131 Cairn Meadows Dr., Spring, TX 77379.

DOUBTING DARWIN? Creationist Designs on Evolution by Sahotra Sarkar. Malden, MA: Blackwell, 2007. xvii + 214 pages. Paperback; \$19.95. ISBN: 1405154918.

Sarkar is professor of integrative biology and of philosophy at the University of Texas at Austin. He has accumulated a distinguished publication record since earning in 1989 his Ph.D. from the University of Chicago with a thesis on reductionism and molecular biology. In *Doubting Darwin?* he draws from his background in molecular and evolutionary biology, philosophy of biology, and philosophy of science to respond to the claims of the "Intelligent Design" (ID) movement.

In the opening pages, Sarkar writes that his book should be read as a sequel to biologist Kenneth Miller's *Finding Darwin's God*. Sarkar focuses especially on the ID literature since the appearance of Miller's book. What is different is that Miller's attempted refutation of ID was sketched against the background of a theistic evolutionary worldview (informed at least in part by Miller's Roman Catholic commitments), while Sarkar's response to ID includes a defense of both methodological and metaphysical naturalism.

Sarkar's critique of ID proceeds at three levels. First, Sarkar engages ID's biological claims, interacting especially with the work of Michael Behe, Stephen Meyer, and

Jonathan Wells (chapters 2–4). His main counter arguments are: the incompleteness of scientific explanations does not count against evolutionary theory; and evolutionary theory remains the only biological “game in town,” not because its critics have been silenced (as ID claims), but because critical perspectives have eliminated false hypotheses and confirmed the theory’s explanatory value. Further, against ID claims that random mutations cannot produce irreducibly complex organisms, Sarkar notes that evolutionary theory is based not only on random mutations but also on natural selection that includes environmental factors and other organic relationships. For those familiar with ID literature, the question arises whether Sarkar and mainstream biologists are reading the same evidence as those in the ID camp, but doing so through the hermeneutical lens of naturalism.

Second, Sarkar engages the mathematical arguments regarding specified complexity (chapters 5–8), arguing that William Dembski’s “explanatory filter,” which concludes to design by eliminating regularity and chance explanations, does not adequately account for combinatorial variables (such as blind variation and selection). More importantly, Dembski is over-zealous since the probability factor of any design is not computable, e.g., with regard to the anthropic argument, the probability that the universe is finely-tuned cannot be compared to the probability that the universe is devoid of design since the latter cannot be meaningfully calculated. Sarkar concludes that ID’s mathematical argument is irrelevant unless ID advocates can both quantify the various probability claims and establish a measurable definition of design.

Finally, Sarkar embraces methodological naturalism and defends a weak or fallibilistic form of metaphysical naturalism (following in the tradition of Ernest Nagel, chapter 9). This third level of engagement is refreshingly honest in terms of confronting ID’s claim that mainstream biology assumes naturalism. Sarkar’s nondogmatic vision matches the rhetorical form of ID defenders like Phillip Johnson. To be sure there are also rhetorically extravagant (and indefensible) claims in Sarkar’s book—such as when he says that the work of Darwin and Alfred Wallace have “permanently removed divinity from nature” (p. 39)—but overall, this is a measured and serious response.

Sarkar’s major blunder may be in the decision to label ID as “creationism.” Only a minority of ID theorists embrace that label for themselves, even as there are some (e.g., Michael Denton) who explicitly reject creationism. While Sarkar is at his best as a micro- and evolutionary biologist and philosopher of biology, he is just as clearly out of his element when dealing with the religious and theological complexities across the spectrum from creation science to ID. But even if Sarkar did not mean to adopt a “guilty by association” tactic (which would have been beneath the level of argument present throughout most of his book), it would nevertheless be a further mistake for those in the ID movement to dismiss or ignore *Doubting Darwin?* because of this “mistaken identification.”

Still, with this volume we have a reputable voice added to those disputing ID’s legitimacy to be counted among the (biological) sciences. If ID is to earn its scientific credentials through the same process as all other scientific proposals—viz., through engaging its critics—then we will

need to be on the lookout for an ID response to *Doubting Darwin?* in the not too distant future.

Reviewed by Amos Yong, Professor of Theology, Regent University School of Divinity, Virginia Beach, VA 23464.

THE SCOPES “MONKEY TRIAL” by Anne Janette Johnson. Detroit, MI: Omnigraphics, 2007. 245 pages, index, Hardcover; \$44.00. ISBN: 0780809556.

This is one of a series called *Defining Moments* that deals with historical events that challenged, transformed, and/or determined the course of America’s existence during the twentieth century. The series is produced for the teaching of history in grades 8–12. The author is not identified, but the board of editors includes several educators and librarians. They have produced a volume that is engagingly replete with narrative, photographs, biographies, and primary documents.

Readers of *PSCF* should not too easily discount this volume because of its intended readership. There may be no other extant discussion of these issues that includes such a compilation of objective recounting and primary sources. The documents that are included in the appendix range from the full texts of Bishop Usher’s dating of the creation of the world in the sixteenth century to Judge John Jones ruling against Intelligent Design in public schools in 2005.

The trial of the Dayton, Tennessee, high school math/science teacher and football coach, John Scopes, for violation of the Butler Act took place during two weeks of July in 1925. The book includes chapters that consider events leading up to the trial, daily accounts of the court room machinations, and the final guilty judgment of the jury—a judgment reached in only nine minutes! Interestingly, neither the prosecution nor the defense were satisfied with the way Judge Raulson declared an end to the deliberations. He charged the jury to make their decision on whether a state law had been violated rather than on whether evolution and/or the biblical account were true.

Subsequent chapters survey the ways in which the debate about evolution has continued. Although the Butler Act proscribing the teaching of evolution in Tennessee remained on the books for forty years after the Scopes trial, no other teacher was ever charged with its violation.

The main body of the book concludes with the 2005 Dover, Pennsylvania, school debate. The complete text of Judge Jones ruling that Intelligent Design (ID) was not science is included in the Primary Sources section of the book. This statement is balanced by two essays defending ID—one written by Stephen Meyer and the other Tom Bethell. A Chronology of significant events dealing with evolution from Bishop Usher’s creation dating in 1658 to the Dover school board decision in 1905 is also included.

This account of the Scopes trial included a number of historical details that I, for one, had either forgotten or never knew. One had to do with the background of John T. Scopes for whom the trial was named. He was a graduate in pre-law from the University of Tennessee and had decided to teach for a year or two before continuing his education. He was in his first year of teaching at Dayton when his principal became sick and asked him to take over

the biology class using the text *A Civic Biology*—a volume that contained material that supported evolution and called Charles Darwin a “great” man. That part of the book had been overlooked by those that approved Tennessee textbooks.

The second detail I had not remembered was that Scopes was not on a crusade to test the Butler act. Nor was he a strong proponent of evolution. In fact, after the trial was over, he could not remember whether he had actually taught evolution. His involvement occurred because of a decision of the American Civil Liberties Union (ACLU) to pay the legal bills of any Tennessee school teacher who would challenge the Butler Act. George Rappleyea—local mine superintendent who was a firm believer in Darwin’s theory—connived with Frank Robinson—the town druggist interested in promoting business—to see if they could find a teacher who would agree to be the lawbreaker. They invited Scopes down for a soft drink at the drugstore and made the bargain.

One additional historical fact of interest was that the decision of the Tennessee Supreme Court overthrew Scopes’ conviction on the basis that Judge Raulson had determined the fine of \$100 rather than allowing the jury to make this determination. Neither Darrow, the defending lawyer, nor William Jennings Bryan, the prosecutor, was satisfied.

I found this book delightful to read. *PSCF* readers will find the volume interesting and truly informative. These issues remain very important for Christian scientists who may need a reminder of this history.

Reviewed by H. Newton Malony, Senior Professor, Graduate School of Psychology, Fuller Theological Seminary, Pasadena, CA 91100.



PHILOSOPHY & THEOLOGY

ONE WORLD: The Interaction of Science and Theology by John C. Polkinghorne. Philadelphia, PA: Templeton Foundation Press, 2007. 116 pages, notes, glossary, index. Paperback; \$14.95. ISBN: 9781599471112.

This is a re-issue of the book first written in 1983–1985 and originally published in 1986. In the preface, Polkinghorne adds a twenty-first century perspective to what has become, over the years, a genuine classic. The book is one member of a trilogy, the others being *Science and Creation* (1988, 2006) and *Science and Providence* (1989, 2005). All ASA members ought to have these three volumes in their personal libraries. I find myself reading them over and over, for the author has the unique gift of presenting deep thought on few pages in a most entertaining way.

Polkinghorne was a Cambridge University professor of mathematical physics when, in the early 1980s, he resigned to study for the Anglican priesthood. In his new career, he eventually rose to become president of Queens’ College and was knighted by Queen Elizabeth II for his service to science, religion, learning, and medical ethics. He also received the 2002 Templeton Prize.

There are seven chapters to this gem, each building on those preceding. They discuss “The Post-Enlightenment

World,” “The Nature of Science,” “Theology,” “The Physical World,” “Points of Interaction,” “Levels of Description,” and “One World.” Polkinghorne’s overall thesis is that both science and religion attempt to tease out “reality” but each with a different perspective. He explores in-depth (how can he do so well in a scant 166 pages?) creation, miracles, and a future life. In his presentation, he argues that scientific reductionism is a bad idea and natural theology a good one. He describes himself as a “critical realist,” claiming that this philosophy can be said of both science and theology; that it provides a base for mutual interaction between the two. He writes that his thinking structure is “bottom up ... seeking to move from motivating experience to attained understanding in a way that is natural for a scientist ...” (Preface, p. xii). He believes wholeheartedly in the unity of all knowledge; this book is based on this claim.

There are two words, not very much used, that Polkinghorne is fond of, and these may well illustrate his critical realist approach. The first is “corrigible.” As understanding progresses and this is true of both science and theology, our theories must be corrigible, else we stagnate. This, he sees, is the great fault of the young-earth creationists, as well as some scientists who make truth claims about certain theories. The second is “verisimilitude.” Polkinghorne claims that “truth” cannot be our necessary goal. “In fact, we shall have to be content with the more modest claim of verisimilitude. Our understanding of the physical world will never be total, but it can become progressively more accurate” (p. 22).

I usually give my books away when I realize I will likely never read or reference them again. This book will never be among that set. I cannot recommend this book highly enough.

Reviewed by John W. Burgeson, 8119 Bideford Lane, Houston, TX 77070.

SCIENCE, RELIGION AND THE MEANING OF LIFE by Mark Vernon. New York: Palgrave Macmillan, 2007. 193 pages, index. Hardcover; \$35.00. ISBN: 0230013414.

This is a remarkable little book. However, the title is not very apt. A better one in terms of content would be “A Treatise on Agnosticism,” although such a title would clearly be a harder sell. The book does touch on science and religion, although tackling “the Meaning of Life” in 193 pages has to be considered somewhat unrealistic, unless it were to be “the number 42” as *The Hitchhiker’s Guide to the Galaxy* would have us believe.

Mark Vernon has a Ph.D. from Warwick University in philosophy, degrees in theology from Oxford University and Durham University, and a physics degree from Durham University. He was a priest in the Church of England from 1994 to 1996 when he quit, disillusioned with what he saw as hypocrisy, to become a freelance writer, broadcaster and blogger. He now declares himself to be a “Christian Agnostic,” and the book under review is a rambling philosophical discourse of what “agnosticism” means. En route, Vernon touches on ideas of Socrates, Newton, and Darwin among many others. The list of topics dealt with in some depth includes humility and hubris, wonderment, “proofs” of God, and the problem of evil.

This thin book is not easy going. Indeed, the philosophical contortions required to defend agnosticism seem to defeat the author. He closes with a chapter consisting of an alphabet soup of terms vaguely related to the rest of the book. Readers can expect to find an intriguing discourse on Vernon's views on science and uncertainty, but unfortunately no final answer on the meaning of life.

Reviewed by Bill Tyson, Research Scientist, Natural Resources Canada, Ottawa, ON Canada K1Y 3K9.

GOD, THE FAILED HYPOTHESIS: How Science Shows That God Does Not Exist by Victor J. Stenger. Amherst, NY: Prometheus Books, 2007. 287 pages. Hardcover; \$28.00. ISBN13: 9781591024811.

Victor Stenger, an emeritus professor of physics and astronomy at the University of Hawaii, is an adjunct professor of philosophy at the University of Colorado. His scientific career was devoted mainly to elementary particle physics. He witnessed the development of the standard model and participated in a number of experiments including the Super-Kamiokande project in Japan that showed for the first time that neutrinos have mass. He has authored many books and has contributed articles to *Skeptical Briefs*. His interests include quantum mechanics, cosmology, and exposing pseudoscience. The book is indexed and has extensive references at the end of each chapter as well as a bibliography.

The book starts, much like most of us physicists think, with a discussion about models, how we do science, and how we feel confident to publish our work in scientific journals. He points out, as some of us also agree, that the Dover case (creationism vs. evolution) actually has damaged science because the definition of science was put in the hands of the law instead of the hands of scientists (pp. 58–60). Stenger believes that religion should be put to scientific test.

It is from this latter point that the analysis proceeds to run through a gauntlet of examples where religious claims (particularly in the Judeo-Christian religion) have come up short on showing scientific evidence for God. Stenger discusses the supernatural, the anthropic principle, the effectiveness of prayer, revelation, providence, the origin of values, and theodicy. Stenger concludes with suggesting how we would live in a Godless universe.

Part of this diatribe may be understandable. There are instances where Christians have done things to incite this kind of response. However, the book is rather misleading in its science. For example, Stenger ignores serious scientific discussion on the anthropic principle, favoring his view that vacuum energy is zero (pp. 146–52). About the same time as this book was going to press, *Science* presented a News Focus (*Science* 313, p. 750) indicating that this view does not constitute a consensus. The truth is not the issue here; rather it is the even-handed presentation of a controversial topic.

This one-sided presentation contributes toward making this book propaganda. Nevertheless, that should be pause for reflection, because Christians are sometimes one-sided in their presentations, also. Naturally, I cannot agree with everything in this book. However, I can

still recommend it to readers of this journal who desire to become familiar with how a contemporary, secular scientist looks at science and religion.

Reviewed by Wayne Dawson, Research Scientist, Structural Biology Laboratory, Chiba Institute of Technology, 2-17-1 Tsudanuma, Narashino, Chiba 275-0016 Japan.



RELIGION & BIBLICAL STUDIES

HOW SHOULD WE TALK ABOUT RELIGION? Perspectives, Contexts, Particularities by James Boyd White, ed. Notre Dame, IN: University of Notre Dame Press, 2006. 328 pages. Paperback; \$40.00. ISBN: 0268044074.

This collection of fourteen essays grew out of a seminar at the Erasmus Institute at the University of Notre Dame. The central focus of the seminar was to allow persons from twelve different disciplines to shed light on religious thought and action from their particular disciplines.

Written for a diverse audience, each essay describes a particular scholar's current academic study of religion. Subjects considered included whether it is possible to be both Catholic and modern in contemporary Chile, whether a liberal can listen with an open mind to a religious argument, and whether science and religion can successfully interface. Each essayist, reflecting on his or her own biases, discusses how to be pluralistic in approach without descending into a universal relativism.

Readers will be stimulated by the range of issues discussed and how religious experience is shaped by pre-existing conceptions and experiences. The interplay of scholarly, political, sociocultural, psychological, and experiential perspectives which these essays highlight is a valuable contribution in itself and the Erasmus Institute is to be commended for shepherding this book through to reach a wider audience of interested readers.

Reviewed by Dennis W. Cheek, Vice President of Education, Ewing Marion Kauffman Foundation, Kansas City, MO 64110.

THE REFORMATION: How a Monk and a Mallet Changed the World by Stephen J. Nichols. Wheaton, IL: Crossway Books, 2007. 160 pages. Paperback; \$12.99. ISBN: 1581348293.

On October 31, 1517, Martin Luther, with mallet in hand, nailed his "Ninety-Five Theses" to the church door at Wittenberg. This mundane and simple act changed the world forever. "Luther's act brought the world out of medieval times and into the modern age" (p. 11).

History matters to Christians. Not just biblical history, but all history is important. Reformation history captures the origin and growth of the Protestant Church which today has over 500 million adherents. For a person who lived a relatively short life (1483–1546), it is an understatement to say that Luther's achievements are impressive. Luther not only started the denomination that bears his name; his sermons, books, hymns, and Christian activism continue to inspire.

Book Reviews

This book not only outlines Luther's life, but also includes the impact other reformers (such as Zwingli, Calvin, Simons, and Knox) exerted on the Church and culture. The Reformers often disagreed and opposed each other. They all faced the strength and structure of the established church, and some of them met a violent death. But they led a movement which stressed the freedom of the conscience and the individuality of believers which became the impetus for religious freedom.

Many historians believe that modern science is an outgrowth of the liberation of the mind which resulted from the Reformation. Post-Reformation scientists Kepler, Newton, Pascal, and Babbage, all Christians, led in the development of modern scientific fact and theory. This book does not devote time to how science was impacted by the Reformation. What it does is capture the Reformation movement in all its diversity of personalities and beliefs. While the Reformers agreed on the need to reform and redirect the church, they did not agree on the direction in which it should go. The different doctrines and denominations of today illustrate that the tradition of diversity begun by the reformers continues unabated. There are many books on the Reformation. Nichols' book is unique in its succinctness and insights. It is also interesting, entertaining, and sometimes humorous. I recommend it.

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

THE PROTESTANT EXPERIENCE IN AMERICA by Amanda Porterfield. Westport, CT: Greenwood Press, 2006. 296 pages, photos, illustrations, bibliography, index. Hardcover; \$55.00. ISBN: 0313328013. eBook; \$60.50. ISBN: 0313086214.

Amanda Porterfield's book has an Introduction and five chapters. The Introduction indicates the aim of the book is to explain each generation's understanding of Protestantism in America. The first three chapters are chronological. They chart the changing meaning of "Protestantism" from Martin Luther to Tim LaHaye. The fourth chapter covers the relationships Protestants have had with science. The fifth chapter explains the end of Protestantism (but not Christianity). The last section is a bibliography of about 375 mostly contemporary works used as background material. These complement the approximately 225 end-of-chapter citations; one-third of them are primary sources.

Porterfield is qualified to examine this topic. Her specialties are American Protestant Thought, History of Christianity, and Native American Religions. She was president of the American Society of Church History and is currently co-editor of *Church History: Studies in Christianity and Culture*. She has degrees from Columbia University, Union Theological Seminary, and Stanford. Today she directs graduate studies in religion at Florida State University.

This book does not contain a family tree of Protestantism denominations. It is the moments, movements, and people who are key to the changing understanding of the term Protestantism. This narrative is about change, not a complete history or dictionary.

Porterfield does not make judgments as to the Christian orthodoxy of movements or leaders. A persistent theme is that of Protestants viewing themselves as ordained to dominate all land and peoples they encountered, sometimes subtly and often not so subtly—from Native Americans to immigrants.

As Protestants incorporated Evangelicalism, there entered a competing view of relationship to God. Romantics, not interested in what appeared as a rules oriented version, preferred to encounter God through nature. From the Civil War, two kinds of Romantics emerged: one, egalitarian; one, sentimental. Egalitarian Romantics are "more able to resist the recourse to nostalgia to avoid unpleasant realities," while "Sentimentalists... expected reality to conform to their idealistic expectations and took the strength of their feelings about how things should be as evidence of how they would be." Abraham Lincoln is described as a Romantic Egalitarian while George W. Bush is pegged as a Sentimentalist.

The science chapter begins with the positive attitude and vigorous involvement Protestants have had with science. They expanded science education as part of their missionary efforts. But this unity and excitement around scientific experimentation fractured when the Bible began being treated as a myth by German universities and evolution was introduced. The various responses to these developments included wholesale denial, attempt at integration of the new information among various forms of Protestantism, or abandonment of Protestantism. The significant people and concepts include William James, Herbert Spencer, Racism, Protestant Naturalism, Social Darwinism, Henry Beecher, James McCosh, Charles Hodge, Friedrich Schleiermacher, Moody Bible Institute, Scopes Trial, Seventh Day Adventist Church, Fundamentalism, Creation Science, Richard Niebuhr, and the Social Gospel.

The atomic bomb caused another intense re-examination of science. The author explains how the Death-of-God theology was a response of some Protestants to the constant fear of nuclear annihilation and the American love of technological achievement. In this they saw idol worship and rejected it. This subject is not often addressed and adds value to the work.

The last chapter contends that Protestantism, but not Christianity, is finished. Porterfield carefully fleshes out the key points of Luther and Calvin because this is the Protestantism the Puritans brought to America. Her conclusion that Protestantism has ended is based on the idea that what Luther protested no longer exists. Its key ideas have been absorbed into American culture and are no longer associated with Protestantism. Fundamentalism and Pentecostalism she labels as Post-Protestant in that they stray in key ways from the original precepts of Protestantism.

Porterfield implies modern-day Pentecostalism was first seen in the United States. Evidence indicates this is not so. *The Journal of Beliefs and Values* (August 2004) published "Writing the Pentecostal History of Africa, Asia and Latin America" by Allan Anderson. Anderson explains why this myth persists and provides a bibliography of sources supporting Pentecostalism's non-American beginnings.

This book should be added to the libraries of schools that offer a major program in religious studies. The bibliography alone makes it an essential purchase. The unique subject matter does the same. I highly recommend it.

Reviewed by Winifred Flint, Academic Librarian, winifred.flint.info, Lowell, MA 01850.



SCIENCE EDUCATION

GOD IN THE CLASSROOM: Religion and America's Public Schools by R. Murray Thomas. Westport, CT: Praeger Publishers, 2007. 285 pages, index. Hardcover; \$49.95. ISBN: 0275991415.

Murray Thomas, an educational psychologist who for over three decades headed a program in international education at the University of California Santa Barbara, has studied controversies about religion in public schools all over the globe. His earlier work, *Religion in Schools: Controversies around the World*, summarizes his lifelong academic pursuit of this topic. He brings his perspective to bear in very well-conceived and executed discussions of current controversies about religion in public schools.

The opening chapter discusses in general terms the varied roles the state, religion, a concerned secular public, and the public schools have played. A subsequent chapter lays out a historical context for understanding the nature of current controversies. The remainder of the book then employs a single format to discuss nine topical areas with a focus on how the controversy developed and a set of guidelines for educators. The nine topics are God and Darwin, curricula and text materials, prayer and Scripture reading, holidays and celebrations, financial support, the Pledge of Allegiance, released time and school clubs, symbols and maxims, and matters related to sexuality and sex education. The last chapter deals in turn with state, church, the public, and schools.

The discussion around each issue is thorough with many examples of the impact of various policy options provided. The reader is shown how society as a whole balances the many different factors that must be considered. The complexities are presented, along with the ways in which society at large has reached its current position. The guidelines for teachers in public schools are particularly helpful and should also be required reading for school administrators and school boards that sometimes impose improper restrictions on religious freedom. This is an essential resource for anyone interested in this topic and for school, university, and public libraries.

Reviewed by Dennis W. Cheek, Vice President of Education, Ewing Marion Kauffman Foundation, Kansas City, MO 64110.

HERE, EYEBALL THIS! by David Heddle. Saga Books, 2005. 205 pages. Paperback; \$15.95. ISBN: 189493637X.

David Heddle, who received his Ph.D. in physics from Carnegie Mellon, has written this novel about the first two years of the graduate program in physics at that institution. In the acknowledgments he states that the work is entirely fictional, but his familiarity with Pittsburgh and the Carnegie Mellon campus give it a very real air.

How realistic is the picture of graduate study in physics? A lot has changed since I was in the position of Heddle's main character, Aaron Dern, at a different university over forty years ago. The hot topics in physics are, of course, different, and there are many more foreign students in American graduate programs in the field than there were back then. But some things do not change. The picture of a student who at first is somewhat intimidated by the fact that all his fellow first year students seem to have much better preparation than he does, only to find out where he stands after the first exams, was very familiar to me.

There is a current of religious discussion running through the book. It does not dominate the story but does play an important role in subtle ways. Not surprisingly, much of this discussion has to do with the anthropic coincidences and the possible implications of them for design arguments. The setting of those discussions within the story allows the author to present them as more than purely scientific, or meta-scientific, deductions. The comment of one professor that "everything matters" could be simply an abstract statement about a holistic view of the world, but it takes on added force for Aaron when he is confronted with an ethical decision on the eve of the qualifying exam.

Aaron's encounter with a couple of fundamentalists bent on converting him and the way another student calls the bluff of an anti-Christian professor in a comparative religions class broadens the religious picture. It might have been helpful, however, if those chapters could have been connected a bit more with the scientific themes of the book.

The title of the book is eye-catching but it is natural to wonder what in the world it has to do with physics. Suffice it to say that it has to do with some crude humor of one of the students. Heddle's characters generally talk the way real people talk and not in the prissy way that characterizes some "Christian fiction."

Some readers may wonder if the religious arguments in the novel are leading them to a kind of altar call in the last chapter. If so, they will be surprised and sobered to find themselves confronted instead by an event that, in light of those arguments, poses the question of theodicy in a stark fashion. There is a great deal in the novel besides physics and religion—grad student parties, personal relationships, visits to the families of other students, and other aspects of real life. At times it may seem to meander. But when one finishes the book and looks back at the whole story, one sees a narrative that poses some tough basic questions and is not content with easy answers. It is an interesting and helpful complement to the more familiar types of non-fictional work on religion and science.

Reviewed by George L. Murphy, St. Paul's Episcopal Church, 1361 W. Market St, Akron, OH 44313.



SOCIAL SCIENCE

SOMETHING THERE: The Biology of the Human Spirit by David Hay. Philadelphia, PA: Templeton Foundation Press, 2007. 336 pages, index. Paperback; \$19.95. ISBN: 1599471140.

Book Reviews

David Hay, a zoologist, is Honorary Senior Research Fellow in the Department of Divinity and Religious Studies at the University of Aberdeen. He is also a former director of the Religious Experience Research Unit at Oxford University (now known as Religious Experience Research Centre at St. David's College, Lampeter, University of Wales). A committed Darwinian and a religious believer, Hay believes there is a biological basis for human spirituality. Each person has the potential for spiritual awareness, a kind of sense that, because it has survival value, developed through the process of natural selection.

Something There: The Biology of the Human Spirit provides evidence that spiritual experience is common to all of us and is, as Hay argues, a built-in, biologically structured component of all members of the human species. The book contains excerpts from interviews Hay has conducted over the years with individuals, many of them children, who provide illustrations of their spiritual experiences, the kind of data Hay collects and analyzes. Examples of spiritual experience include awareness of the presence of God, awareness of prayer being answered, awareness of a sacred presence in nature, awareness of the presence of the dead, awareness of an evil presence, and awareness of a transcendent providence or a patterning of events.

Despite the noticeable decline in church attendance and participation in Britain in recent years, each of these spiritual experiences, according to Hay, is reported at a higher rate now than they were twenty years ago on national British surveys. This increase in the reporting of spiritual experience reflects a lessening of the social taboo surrounding spirituality today as compared to years past. While the social inhibition of spirituality may be less now than twenty years ago, there is, nevertheless, a tension found in many individuals between how to maintain one's integrity as part of a rational, scientific, and logical culture and at the same time allow for one's spiritual awareness to flourish. This is the tension that Hay finds in his conversations collected and analyzed over the past thirty years.

The book is divided into four parts. In Part 1, *Context*, Hay develops his perspective of how spirituality is prior to religion and is a built-in, biologically structured characteristic of all humans. Then in Part 2, *Conversations*, Hay presents excerpts from some of the interviews he has conducted to illustrate this perspective and out of which Hay identifies the "primordial core" of spirituality, relational consciousness, which allows for the possibility of relationship with God (to the theist) or the sense of relation to the Other (conceived in secular or religious terms) to the non-theist. In Part 3, *Conflict*, Hay discusses some of the history of the study of religion in psychology as well as some of the recent empirical findings coming from psychology, cognitive science, and neuroscience supporting the idea of relational consciousness, and therefore the innateness of spirituality, in humans. (For those unfamiliar with this growing literature on the biology of spirit, there are many studies suggestive of a genetic, chemical, and neural role in the development of spiritual awareness. Although Hay's coverage of this literature is brief, his book does provide a good bibliography for those wanting to dig deeper into this topic.) Finally in Part 4, *Facing the Crisis*, Hay discusses what might be done to address the social inhibition directed against this innate spirituality and emphasizes

the role churches (and other religious institutions) play in society's spiritual recovery.

While it will not convince the religious/spiritual skeptic, the book does present, in a form accessible to the non-specialist, a reasoned argument for proposing that human spirituality has a biological basis. ASA members unfamiliar with recent studies supporting this idea will find Hay's book a good introduction. For another readable book that provides a more in-depth look at Hay's work on spirituality, see his (along with Rebecca Nye) *The Spirit of the Child* (Fount, 1998).

Reviewed by Kevin Seybold, Professor of Psychology, Grove City College, Grove City, PA 16127.

FREUD'S WIZARD: Ernest Jones and the Transformation of Psychoanalysis by Brenda Maddox. Cambridge, MA: Da Capo Press, 2007. 331 pages, index. Paperback; \$26.00. ISBN13: 9780306815553.

Brenda Maddox is the highly acclaimed biographer of a number of other people including W. B. Yeats, D. H. Lawrence, Rosalind Franklin, and Nora Joyce. This is her first venture into the life of a relatively unsung figure in the history of psychoanalysis.

The adjective "unsung" is somewhat a misnomer, however, in that Ernest Jones is well known among psychoanalysts as a central figure in bringing the movement to London, Toronto, New York, and Boston. He was for years the president of the International Psychoanalytic Association and the author of *The Life and Work of Sigmund Freud*, Vol. 1, 2, and 3 published by Basic Books. Further, it was Jones who arranged for Freud to flee Vienna from the Nazi and settle in London for the final few months of his life.

The sequence of the book's nineteen chapters closely follows periods in Jones' life (1879–1958), from his childhood in Wales to his death in London. In a very engaging style (which incidentally she retains throughout the volume), Maddox begins with a Prologue that has the simple title "March 1938." Here she recounts Jones' arrival in Vienna to effect the escape of Freud and his entourage from the dangers of the Nazi. This is perhaps the best known and most dramatic adventure in Jones' life. When he arrived, Jones was arrested but used ingenuity, obstinacy, and determination to talk his way to freedom and secret his mentor safely away to London. This was but the apex of over thirty years of close friendship and collaboration between Freud and Jones. This prologue leads into the first chapter where the sequence of events in Jones' life leads circuitously into the world of psychoanalysis.

The volume's appeal is enhanced not only by Maddox's thoroughness and penetrating analysis of events but by two sets of pictures that carry the reader illustriously from Jones' childhood to old age. The photos include scenes of the major figures in the development of psychoanalysis up to the early 1950s by which time the center of the movement had left Austria and London for the United States. Jones played a significant, even dominant, role in these developments. Hence Maddox's title *Freud's Wizard*!

Like his mentor Freud, Jones decided in his early adolescence to become a doctor but ended up specializing



in the “talking cure” (as psychoanalysis was early labeled) quite unintentionally. Both men emphasized human physiology. Freud even did his doctoral thesis on “the physiology of the sexual behavior of eels in hopes of obtaining a professorship at the University of Vienna”—an appointment that was denied due to his being a Jew. Jones aspired to become a specialist in neurology who would be appointed to the faculty of University College Hospital—his alma mater affiliated with the University of London. Unfortunately, his acerbic staff relationships coupled with accusations of inappropriate relationships with child patients denied him this privilege and forced him, like Freud, into private practice.

Introduced to Freud’s writings several years after their publication, Jones claimed that he began practicing Freud’s method of free association two years before their first meeting in 1908. As a result of attending a congress on psychiatry and neurology in Amsterdam in 1907, Jones met Carl Jung—Freud’s heir apparent who, after the conference, wrote Freud enthusiastically about “a young man from London ... who is very intelligent and could do a lot of good.” Jones and Freud finally met in April 1908 in Salzburg at a “Meeting for Freudian Psychology”—a gathering of forty-two practitioners that turned out to be the first international congress of psychoanalysis. At the conference, Freud asked Jones to write a book on dreams in English.

Ernest Jones became, without doubt, the major voice of psychoanalysis for the next forty years. He mediated a number of the defections, debates, and developments that permeated the movement as it spread throughout the western world. His speaking ability and his winsome personality served him well. He wrote theoretical treatises, edited a number of journals, and was the publisher of the press that made psychoanalysis dominant.

Maddox has made a major contribution in writing this biography of the “man behind the scenes” whose life, heretofore, was relatively unknown. This volume is recommended for ASAers who have an interest in cultural history.

Reviewed by H. Newton Malony, Senior Professor, Graduate School of Psychology, Fuller Theological Seminary, Pasadena, CA 91100. ★

Letters

Coping with Bioethical Dilemmas in the Christian Community

Two articles have appeared over the past 2–3 years in *Perspectives on Science and Christian Faith* on embryonic stem cells, both purporting to espouse a Reformed Christian world view. The one by Robert Boomsma¹ allowed for embryo research and the derivation of embryonic stem cells; the other by Adrian Teo and Donald Calbreath² argued for a prohibition of both activities. In each case, the authors consider they can utilize Reformed theological principles to arrive at a well-defined position on a narrowly focused contemporary bioethical issue. However,

since the authors reach diametrically opposite conclusions, one has to question in what way these viewpoints are actually informed by a Reformed worldview. Indeed what does it mean to be informed by such a worldview when discussing embryo research and embryonic stem cells, since the conclusions arrived at in these two papers reflect well-known positions within general bioethical debate?

On reflection it appears that the respective authors have emphasized different facets of the Reformed tradition. While Boomsma sought to maintain a broad view encompassing dominant themes within the Reformed Christian worldview, Teo and Calbreath underscored what they saw as the all-encompassing importance of the human embryo. The challenge for the Christian community is to decide whether it is possible to choose between these approaches on theological grounds and to conclude that one of them is more in line with Christian thinking than the other. In my view it is not, but this may be regarded as a contentious conclusion.

My reason for reaching this conclusion is that there is ethical and theological uncertainty in this area, since distinctly Christian knowledge and understanding of these topics is limited. What is required are theologically-informed ethics, where theological principles are employed to throw light on perplexing ethical quandaries. These two contributions help throw light on important stipulations from a Christian perspective, all of which should be taken into account in reaching practical conclusions on embryo-related questions. Consequently, they should be viewed as complementing one another, each contributing important facets of a Christian perspective. They should not be expected to provide definitive knock-down answers.

It follows from this that there may well be no one exclusive, unerring bioethical Christian position on contemporary issues that traverse scientific, moral, theological, and social boundaries. Far from being a defeatist stance, this underlines the point that Christians should be characterized by commitment to the flourishing of personal life and by attitudes that seek to bring sustenance and hope.

The issues raised by these two articles bring us to the heart of the relationship between the church and science. Christians have to take seriously the insights of scientific investigations, even if these appear to question cherished Christian conceptions. If God is sovereign, as enunciated so effectively within the Reformed tradition, there is nothing in the scientific arena beyond the scope of his interest and concern. Christians are to rejoice in this and be committed to rigorous thinking and debate, always with an openness to new insights, if these appear to forward the kingdom of God.

Christian contributions to bioethical debate will always be circumscribed. Humility and an awareness of human frailty are crucial prerequisites for Christians as they are for everyone else. Nevertheless, Christian voices should be heard, with an emphasis on the range of basic (Reformed) Christian principles outlined by Boomsma, allied with a stress on human dignity at all stages of human existence and across all societies. If this voice is lacking, utilitarian and functionalist considerations may come to reign supreme. But we should not underestimate the hard work and challenging thinking required of all within Christian

communities. Looking back to well-trodden church and denominational pronouncements may prove less helpful than frequently thought, especially where these have not been informed by nuanced scientific input.

Notes

¹R. Boomsma, "Embryonic Stem Cells and a Reformed Christian World View," *Perspectives on Science and Christian Faith* 56, no 1 (2004): 38–48.

²A. Teo and D. Calbreath, "Embryonic Stem Cells and a Reformed Christian World View: A Response to Robert Boomsma," *Perspectives on Science and Christian Faith* 58, no 3 (2006): 179–88.

D. Gareth Jones
ASA Fellow
Department of Anatomy and Structural Biology
University of Otago
Dunedin, New Zealand
gareth.jones@stonebow.otago.ac.nz

Seeking the Emergence of Created Man and Woman

We continue to seek the emergence of created humans. It has been more than a year since the above article was published in this journal (*PSCF* 58, no. 3 [2006]: 196–215). This theory of human origin was presented, anticipating evaluation from experts in the human-origins fields of study. The article presents evidence for the extinction of *Homo sapiens* during and following the Last Ice Age; and for the repopulation of the earth since 10,000 BC by the descendants of God's created, biblical Adam and Eve. This theory is diametrically opposed to the popular theory that we are all descendants of the apes and *Homo sapiens*.

In the year since publication of the article (which combines evolution and God's creation), we have not seen criticism in favor or opposed (except for one expert who supports Young-Earth Creation; and Peter Rüst's consideration of this theory in his article about the nature of Adam in the September 2007 issue of *PSCF*). However, in the meantime, we have gained some related insight into the academic fields of human origins. That insight comes from writings published in *PSCF* as follows:

- The title of Dean Arnold's December 2006 article, "Why Are There So Few Christian Anthropologists? Reflections on the Tension between Christianity and Anthropology," is self-explanatory.
- Two related conference talks in the June 2007 issue are: "Warfare and Wedlock: Redeeming the Faith-Science Relationship" by Ian Hutchinson; applies the term wedlock to the faith-science relationship for the natural sciences, where reproducibility and clarity (universal agreement) prevail; but also suggests that theories in history (his example, and I would add origin fields) where singular discoveries or events from the past cannot be reproduced, do not always have clarity. In my reading in human-origins fields, discoveries can be interpreted by different theories, e.g., there does not seem to be agreement on what caused the drastic cultural changes that came in the Developed Neolithic (beginning c. 9000 BC) or on why they occurred at that time.
- "The Professor and the Pupil: Addressing Secularization and Disciplinary Fragmentation in Academia" by Calvin DeWitt; suggesting that secularization and frag-

mentation in a study field can detract from addressing the big questions in that field and can result in ignoring ethical and spiritual levels.

Can we conclude from the above insights that when considering a major shift in human origins theory that includes creation by God, it could be difficult and inconclusive to attempt to reject or accept the theory and it would be more practical to ignore the theory?

The essence of "Seeking the Emergence of Created Man and Woman" acknowledges God's creation of the universe taken from Gen. 1:1 and God's creation of first life billions of years later; and accepts the theory of evolution combined with God's creation events of first life and a later creation of Adam and Eve. Extinction of *Homo sapiens* was derived from a different interpretation of published discoveries and theories concerning origins covering the last 15,000 years. The usual interpretation of that period supports cultural continuity of *Homo sapiens*. Support for the timely repopulation of the Earth by God's created humans is taken from convincing indications of God's Spirit being present, as seen in the first art works in different regions around the world beginning c. 8000 BC.

The article has now been placed on the ASA website along with the other 2006 journal articles (www.asa3.org/ASA/PSCF/2006/PSCF9-06dyn.html). We continue to seek expert evaluation from origins and faith sources, but with the assumption of silent approval, the next step is promoting internet exposure of this theory of God's creation to an interested public. Discussion seeking the truth about God's creating acts is needed for comparison to the theory that we humans are descendants of the apes and *Homo sapiens*.

Robert C. Schneider
ASA Member
66 St. Andrews
Hattiesburg, MS 39401
banddschneider@msn.com

The Gap in Creation

As an old earth creationist, I respond to certain issues raised in the Seely-Ross exchange (*PSCF* 59, no. 1 [2007]: 37–54). My view that Gen. 1:1 refers to the creation of the universe and a global earth (cf. e.g., Pss. 121:2; 124:8),¹ on which there was a succession of different "worlds" (Gen. 2:4; Heb. 1:2; 11:3); that there is then an undisclosed gap in time between the first two verses of Genesis (cf. the gap in Isa. 61:1,2 till "the day of vengeance," Luke 4:18,19); that Gen. 1:2a describes a destruction event (cf. similar phraseology in Isa. 34; Jer. 4); and that this was followed by the creation of a new world in six literal 24-hour days (Exod. 20:8–11); accords with the majority gap school interpretation (Thomas Chalmers, et al.). However, my view that the flood of Gen. 1:2 was a local deluge, which was then followed by a local creation on the local earth (Gen. 41:56; Matt. 12:42) under the local heaven (Deut. 2:25; Col. 1:23) of Eden's world (Luke 2:1; Rom. 1:8) in six 24-hour days (Gen. 2:10–14), is a minority gap school view (Pye Smith, Henry Alcock, et al.).² The better known majority gap school view, which is contrary to established scientific facts, is that of a global flood and global creation in Gen. 1:2ff.

I note a serious methodological concern with Seely's view "that the sun, moon, and stars were created on the fourth day, not just made to appear," through reference to "qualified Old Testament scholarship," which in turn, Ross says is a "distortion," at which point the exchange between them bogs down. Certainly neither of them refers to the many gap school proponents of this view. But we should not simply abdicate to so called "experts" in academia, since these people sometimes simply maintain an academic normatively due to their own intellectual or spiritual mediocrity, against more intellectually gifted and spiritually discerning outsiders. We must judge such matters *on their merits*.

For example, on a gap school model is "Let there be light" (Gen. 1:3) reasonably something like, "I form the light, and create darkness," "from the rising of the sun" (Isa. 45:6, 7)? Is the "firmament" of Gen. 1:6-8 reasonably something like, though not identical with, "He causeth the vapors to ascend from the ends of the earth" (Ps. 135:7; cf. Jer. 10:13; 51:16)? Is the phraseology of the fourth day similar to Job 9:7, 9, where we read that God "commandeth the sun, and it riseth not; and sealeth up the stars" i.e., by covering of cloud or dust storm (e.g., Luke 23:44)? But then God "maketh" the stars such as "Arcturus, Orion, and Pleides, and the chambers of the south" (Job 9:9) i.e., by clearing the sky. The word "maketh" in Job 9:9 is Hebrew *'asah*, the same word used for "made" in Gen. 1:16, "And God made two great lights." It can also carry with it the idea of "appoint," e.g., "He appointed (*'asah*) the moon for seasons" (Ps. 104:19). Likewise, the Hebrew word *nathan* translated "set" in Gen. 1:17, "God set them in the firmament," can mean "appoint" (e.g., Exod. 30:16; Lev. 35:6; Josh. 20:2; 2 Kings 8:6; 1 Chron. 6:48; 16:4; Ezek. 45:6). Thus on the fourth day God appointed (*'asah* and *nathan*) them for their purpose in the world of humans that he was about to create, "for signs, and for seasons, and for days, and years" (Gen. 1:14), "and" also "to divide the light from the darkness" in the world humans were to inhabit (Gen. 1:18).

Seely's criticism that a date for Adam "stretches the genealogy in Genesis 5 to unrealistic dimensions" is not a biblically based conclusion. I have previously shown that such dates are within biblical parameters; and that events in Mesopotamia on the genealogies *prima facie* dates are symbolic types pointing backwards e.g., I think the Kish Flood of 2,600 BC (which only covered a part of Kish) types Noah's much earlier flood.³ I also note the teaching of Ps. 105:8 that since a "covenant" was "commanded to a thousand generations," this means that in about 1,000 BC, there had to have been "a thousand generations" who had received the covenant, so that Adam must probably date to somewhere between about 35,000 BC to 70,000 BC. Though I regard this as the covenant of grace, and Jewish interpretations find in it another covenant, I note that one ancient Jewish view, though by no means the only Jewish view of Ps. 105:8, understands it in this type of way.⁴

Seely's criticism that there is a lack of credulity in that "Lamech remembers not only the name of Adam, but the words God spoke to Adam some supposed 45,000 years ago (Gen. 3:17; 5:29)," has a low view of the prophetic gift in Bible times. Why could not God have revealed this to him?

But Seely is on much stronger ground when he says the picture of Gen. 7:19 requires that the mountains be covered with water, upon which the ark comes to rest. He is quite right in recognizing that the Mesopotamian flood plain cannot be meant on Ross' model of the mountains of Ararat. But as I have previously shown, the Flood may be placed in the Persian Gulf which was then dry land.⁵ There are many little islands now there, which may have been the "high hills" first covered, and then uncovered after the Flood. Thus I think "Ararat" originally referred to this region, and was probably later extended to include the Zagros Mountains and present day Ararat mountains. (If anything of Noah's ark survives, and possibly it does not, these islands would be a good place to look for it.)

Another criticism Seely could have made, but did not, of Ross's Mesopotamian flood theory, is that it lacks credibility during the last Ice Age 10,000-70,000 years ago, due to the cold inhospitable Mesopotamian conditions which would not sustain the garden of Gen. 3 or civilizations described in Gen. 4-9. In a manner something like, though not identical with, Eskimos, any human beings in Mesopotamia during the last ice age would have moved in and out of ice conditions as they journeyed around this region.⁶ By contrast, the Persian Gulf was a warm area full of sunshine.⁷

Seely's criticism that Ross's model has "no evidence of" such ancient societies, is not satisfactorily answered in Ross's reply of "40,000 years of natural erosion" in Mesopotamia. But a lost world is a reasonable reply to a Persian Gulf location, since the area has been under water for over 10,000 years in both the region of Eden and Noah's anthropologically but geographically local flood. Researchers reasonably find it hard to investigate anything remaining under the Persian Gulf, so the model can be neither proven nor disproven by present archaeology. But Mesopotamia is sufficiently accessible to archaeology to reasonably disprove the existence of any such society of the type required in Ross's model.

Notes

¹All Bible references are to the Authorized (King James) Version.

²J. P. Smith, *The Relation between the Holy Scripture and Some Parts of Geological Science*, 5th ed. (London: Henry G. Bohn, 1852); E. Hitchcock, *Elementary Geology*, 8th ed., with an Introduction by J. Pye Smith (New York: Newman, 1847), 297-302; H. J. Alcock, *Earth's Preparation for Man* (London: James Nisbett, 1897); J. H. Sailhamer, *Genesis Unbound* (Sisters, OR: Multnomah Books, 1996).

³Gavin McGrath, "Soteriology: Adam & the Fall," *PSCF* 49 (1997): 252-3, 257-8. This was written when I was a theistic evolutionist, but I am now an old earth creationist.

⁴H. Freedman and M. Simon, eds., *Midrash Rabbah*, vol. 9, *Esther & Song of Songs*, *Song of Songs*, trans. M. Simon (London: Soncino Press, 1939), 242-3; Volume on *Ruth & Ecclesiastes*, *Ecclesiastes*, trans. A. Cohen, 211.

⁵McGrath, "Soteriology: Adam & the Fall," 258-9.

⁶W. C. Brice, *South West Asia: A Systematic Regional Geography*, vol. 8 (London: University of London, 1966), 7, 11.

⁷McGrath, "Soteriology: Adam & the Fall," 259.

Gavin McGrath
PO Box 834
Nowra, NSW, 2541 Australia
gmcgrath@easy.com.au

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