REPORTS OF THE NATIONAL CENTER FOR SCIENCE EDUCATION

DEFENDING THE TEACHING OF EVOLUTION IN THE PUBLIC SCHOOLS

Volume 21, Numbers 3–4 MAY–AUG, 2001

CONTINUES *NCSE REPORTS* & *CREATION/EVOLUTION*

CONTENTS

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Cover: Engraving, "Behold Now Behemoth Which I Made With Thee" from the Complete Proof Edition of Book of Job, 1825 by William Blake, courtesy of Fine Arts Museums of San Francisco, William H. Noble Bequest Fund, 1979.1.11.16

FROM THE EDITOR

How complex is complexity? Can known natural processes account for it? Does complexity imply design? Does it require design? And just what is design, after all? In this issue we present several views on these questions.

Michael Behe responds to the article by Shanks and Joplin on "redundant complexity" in *RNCSE* 2000; 20 (1-2): 25-30. He reiterates the point that "intelligent design" is scientifically detectable in an irreducibly complex system. Shanks and Joplin reply that there are several plausible natural routes to irreducible complexity, so that its presence does not require the conclusion that it is the product of "intelligent design".

Unrelated to this exchange are three other features on various aspects of Behe's work. The first, by Hubert Yockey, argues that Shanks and Joplin let Behe off the hook too easily. He points out that information theory is no friend of "intelligent design" theory and the related notion that the complexity in living systems is so improbable that it requires the help of some intelligent agent to make it happen. The second, by Robert Pennock, is a response to Behe's review of Pennock's *Tower of Babel*. Pennock argues that ID advocates are, indeed, creationists in the broad sense, even if some of them are not biblical literalists or young-earthers.

Finally, Glenn Morton has allowed us to adapt a piece from his web page in which he looks at 19th-century natural theology and compares its foundations to Behe's idea of irreducible complexity. Morton argues that Christians should rely on neither the 19th-century nor the 21st-century versions of the argument from design.

In the News

Despite all hopes and indications to the contrary, when the Alabama Board of Education adopted a new, evolution-friendlier, version of its science education standards, it did not rescind the policy of placing disclaimers inside the covers of biology textbooks to warn students about evolution. The text of the disclaimer is modified, but it is still a warning to students about evolution. We are pleased to be able to publish a note adapted from a letter to the editor written by a high-school student (and son of an NCSE member) to the Alabama Board of Education taking the board to task for its actions.

In Pennsylvania, evolution education was protected in new state education standards. The Pennsylvania Independent Regulatory Review Commission considered and approved a motion to accept the revised science education standards — standards that had reinstated strong support for teaching evolution. The entire proceedings lasted 10 minutes. After a short time for celebration, we received notice that the House Education Committee is still deciding whether to re-open consideration of these standards. More in future issues. Meanwhile, one strong advocate of teaching evolution, Connie Williams, will leave the Pennsylvania House (and the educational committee) to assume a vacated seat in the state senate.

Nationally, the Department of Education reports on test performance in several subjects. In the sciences, there is no significant change in the average exam scores between 1996 and 2000. Some conditions apply, as they say.

NCSE News

We have the proverbial good news and bad news to report. The good news is a run-down of what some of our members are doing around the country. Read about some of your fellow members, and don't be shy about dropping NCSE a line to let us know what you are doing.

The sad news we report is that Stanley Weinberg has died. Those of you who have been around NCSE for its entire life (or who remember life before NCSE) will recognize Stan as the founding father of locally organized and supported opposition to creationism in the science curriculum. Although Stan had been keeping a lower profile lately, his loss will be deeply felt.

Notes From All Over

Tim Berra writes about his adventures on the lecture circuit. Shortly before he was to appear at a small, conservative college in Ohio, he received an e-mail note advising him against discussing his "controversial" book *Evolution and the Myth of Creationism*. He had the option of canceling the lecture, but Tim made the trip anyway and has a tale to tell.

Arthur Neuburger wonders why people accept scientific theories about gravitation, but not evolution. For all of us who promote evolution to the public, Art reminds us that there are more than two views on creation/evolution issues.

Book Reviews

Finally, don't miss our book reviews. Daryl Domning reviews four books that accept evolution and try to help theologians incorporate it into new theological scholarship. Michael Zimmerman reviews *Death of a Rat*, an accessible overview of the nature of contemporary science, and Susan Branch has a look at Matthew Chapman's *Trials of the Monkey*. We printed an excerpt of this book in *RNCSE* 2000: 20 [5]: 31-33, which Susan says is the best part of the book. Finally, I review Robert Wright's *Nonzero* and Daniel Povinelli's *Folk Physics for Apes* — both of which promote novel interpretations of scientific data. The difference is that Povinelli succeeds in developing a scientific research program to support his challenge to the prevailing wisdom, and Wright does not.

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NEWS

Alabama Upgrades Disclaimer

Eric Meikle
NCSE Outreach Coordinator

The Alabama State Board of Education voted on November 8, 2001, to continue to require that a statement referring to evolution as controversial be inserted in biology textbooks. Since 1995, a state-mandated evolution disclaimer (see below) has been pasted in Alabama's approved texts. Early this year the Board of Education adopted a new K–12 science education framework, the Alabama Course of Study: Science (ACOSS). Some observers had thought the board might simply drop the idea of a disclaimer, given the changes in ACOSS since 1995. However, it voted instead to require a new insert consisting of four paragraphs from the Preface to the 2001 ACOSS.

As published in the *Birmingham News* (2001 Nov 9; corrected for some obvious typographical errors), the new evolution insert reads:

> The word "theory" has many meanings. Theories are defined as systematically organized knowledge, abstract reasoning, a speculative idea or plan, or a systematic statement of principles. Scientific theories are based on both observations of the natural world and assumptions about the natural world. They are always subject to change in view of new and confirmed observations.
>
> Many scientific theories have been developed over time. The value of scientific work is not only the development of theories but also what is learned from the development process. The Alabama Course of Study: Science includes many theories and studies of scientists' work. The work of Copernicus, Newton, and Einstein, to name a few, has provided a basis of our knowledge of the world today.
>
> The theory of evolution by natural selection is a controversial theory that is included in this textbook. It is controversial because it states that natural selection provides the basis for the modern scientific explanation for the diversity of living things. Since natural selection has been observed to play a role in influencing small changes in a population, it is assumed that it produces large changes, even though this has not been directly observed. Because of its importance and implication, students should understand the nature of evolutionary theories. They should learn to make distinctions between the multiple meanings of evolution, to distinguish between observations and assumptions used to draw conclusions, and to wrestle with the unanswered questions and unresolved problems still faced by evolutionary theory.
>
> There are many unanswered questions about the origin of life. With the explosion of new scientific knowledge in biochemical and molecular biology and exciting new fossil discoveries, Alabama students may be among those who use their understanding and skills to contribute to knowledge and to answer many unanswered questions. Instructional materials associated with controversy should be approached with an open mind, studied carefully, and critically considered.

For comparison, this disclaimer had been used in schools since 1995:

> This textbook discusses evolution, a controversial theory some scientists present as a scientific explanation for the origin of living things, such as plants, animals and humans. No one was present when life first appeared on earth. Therefore, any statement about life's origins should be considered a theory. The word evolution may refer to many types of change. Evolution describes changes that occur within a species. (White moths, for example, may evolve into gray moths.) This process is microevolution, which can be observed and described as fact. Evolution may also refer to the change of one living thing to another, such as reptiles into birds. This process, called macroevolution, has never been observed and should be considered a theory. Evolution also refers to the unproven belief that random, undirected forces produced a world of living things. There are many unanswered questions about the origin of life which are not mentioned in your textbook, including: Why did the major groups of animals suddenly appear in the fossil record (known as the Cambrian Explosion)? Why have no new major groups of living things appeared in the fossil record in a long time? Why do major groups of plants and animals have no transitional forms in the fossil record? How did you and all living things come to possess such a complete and complex set of instructions for building a living body? Study hard and keep an open mind.

Someday you may contribute to the theories of how living things appeared on earth.

Department of Education: Science Scores Show No Significant Change Since 1996

Andrew J Petto
NCSE Editor

On November 20, 2001, the Department of Education's National Center for Education Statistics released the 2000 National Assessment of Educational Progress (NAEP) test scores for the year 2000. NAEP — also called the "Nation's Report Card" — conducted tests nationwide in grades 4, 8, and 12, and also state-by-state for grades 4 and 8. In the sciences — just one of the areas that the assessment examines — students' scores show no significant changes for grades 4 and 8 and a slight decline in the average score for grade 12, compared to the original results from 1996.

The national assessment includes students from both public and nonpublic schools, but the state-by-state data are limited to students in public schools. The national sample included 47 000 students from 2100 schools, and the state samples included 180 000 students from 7500 schools.

Scores are based on a 0 to 300 NAEP science scale for every grade, then grouped into three achievement levels: basic, proficient, and advanced (*see Table 1 for a comparison between the results for 1996 and for 2000*). Highlights from the NAEP 2000 Science Assessment follow:

In grade 8, the percentage of students reaching the proficient level or above increased 3 percent.

In grade 12, the percentage of students at or above the basic level dropped 4 percent.

TABLE 1 COMPARISON OF 1996 AND 2000 NAEP RESULTS

YEAR	GRADE	AVERAGE SCORE
1996	4	150
2001	4	150
1996	8	150
2000	8	151
1996	12	150
2000	12	147

2000 scores for major racial and ethnic subgroups were not different from those in 1996 across all three grade levels. However, Native American students in grade 8 and Euroamerican students in grade 12 had lower scores in 2000 than in 1996.

In grade 8, the average score for males was 3 points higher in 2000 than in 1996. In grade 12, the average score for males declined 5 points from 1996 to 2000.

In 2000, males outscored females in all grade levels tested.

8th grade students whose teachers majored in science education had higher average scores than students whose teachers did not.

4th grade students whose teachers reported using computers for playing learning games had higher scores than 4th graders whose teachers did not use computers. 8th grade students scores were higher when their teachers used computers for simulation and models or for data analysis.

In the state-by-state results for 4th grade, of the 44 states and other jurisdictions that participated, 20 had scores higher than the national average, 11 had scores not different than the national average, and 13 had scores lower than the national average.

In the state-by-state results for 8th grade, of the 42 states and other jurisdictions that participated, 18 had scores higher than the national average, 11 had scores that did not differ from the national average, and 13 had scores lower than the national average. Only Missouri and Department of Defense schools showed significant score gains for grade 8 since 1996.

For more information on the assessment, go to <http://nces.ed.gov/nationsreportcard>. To view the performance in your own state, go to <http://nces.ed.gov/nationsreportcard/states/>.

[*This report was prepared from a news release at the NAEP website. See the original report by connecting to <http://nces.ed.gov/Pressrelease/rel2001/11_20_01.asp>.*]

Kansas Citizens for Science Refutes "Design"

In collaboration with the MAINstream Coalition, Kansas Citizens for Science (KCFS) hosted a public education event on July 11, 2001, in response to and shortly after the "Darwin, Design & Democracy" conference promoting the teaching of "intelligent design theory" in science classes. KCFS has set up a website for those interested in learning more about the event and the KCFS response to "intelligent design". To learn more, connect to <http://www.kcfs.org/id>.

[Contributed by Liz Craig.]

Flat Earth Society President Dies

John R Cole
Contributing Editor

Charles K Johnson, president of the International Flat Earth Society for almost 30 years, died in March at age 76. Johnson succeeded the late Samuel Shenton of Dover, England, as head of the often-ridiculed organization, which steadfastly opposed evolution and most of the physics, geology, and astronomy of the past half millennium.

As former NCSE president Bob Schadewald stressed, Charlie was "on the level". He sincerely believed that a literal reading of the Bible required one to recognize that the world is flat. His flamboyant newsletter was contemptuous of fellow creationists who accepted GREASEBALL EARTH THEORY (he tended to capitalize every third word or so) because they were not true biblical literalists. "Greaseball" was his universal term for round-earthers who, he noted, would obviously slide off a spherical earth.

Many creationists resented being lumped with Johnson, but they actually shared his logic and approach to science, relying on scripture as the ultimate authority in science and demanding that "common sense" and direct observation were the only tools needed or even allowed in scholarship. Johnson often showed people a photograph of his wife in Australia, noting that she was standing upright and not hanging upside down by her toes as she would have to have done had the world been a GREASEBALL. He had proof he was eager to share that the sun is 32 miles wide and 3000 miles from earth (just a bit closer than Heaven) and that John Kennedy and his close friend "Nicky" Khrushchev worked together to foment the hoax of a space race and moon landing in order to make a fortune for their friends. (The moon landing was a Hollywood stunt actually filmed near Johnson's trailer home in the Mojave Desert or perhaps in Arizona. It was scripted by Arthur C Clarke.)

The Flat Earth Society traced its roots to the Universal Zetetic Society, founded in England in 1832 by Sir Birley Rowbotham, author of *Earth Not a Globe*. Robert Schadewald befriended Johnson and his wife Marjory, writing several articles on the movement that illustrated the intellectual history and themes linking the creationist movement with both flat-earth and geocentrist belief (*see, for examples, Schadewald's "Looking for lighthouses" in* Creation/Evolution *1992; 12 [2]: 1-4 and his "The evolution of Bible-science" in* Scientists Confront Creationism, *ed. Laurie Godfrey, New York: WW Norton, 1983, 283-99*).

Marjory Johnson's death several years ago and a fire that destroyed Society mailing lists and documents to severely limit Johnson's activities in his last years. At his death he was attempting to reconstruct the 2000 names in the FES membership — some of whom (such as this writer) were not believers.

Evolution Remains in PA Science Education Standards

On November 15, 2001, the Pennsylvania Independent Regulatory Review Commission (IRRC) unanimously approved the latest version of the Science and Technology education standards proposed by the state's Board of Education (BoE). This is the last step before adoption and implementation of the standards, which will be reviewed again in five years.

The revised standards were produced by the BoE after the IRRC rejected an earlier version, which contained several statements singling out evolution as a theory in need of special questioning by students and included requirements for teachers to present "evidence against evolution" (*see* RNCSE *2000; 20 [4]: 13-5)*. The IRRC ruled in July 2001 that these proposed standards were unclear and their implementation was likely to be burdensome. Furthermore, they did not clearly relate to the stated intent of their proposers — to promote critical thinking. They were redundant and unnecessary, given that the BoE had also provided a separate section on critical thinking about the process and outcome of scientific investigation.

The IRRC's ruling exactly paralleled comments made by NCSE members and allies in the Pennsylvania Science Teachers' Association, the ACLU of Pennsylvania, the Freedom to Learn Network, the Pennsylvania Alliance for Democracy, the Pennsylvania State Education Association, and numerous other organizations and individuals interested in science education. NCSE members and allies in Pennsylvania are now preparing to support the BoE in its development of statewide mastery exams that include evolution as a fundamental concept in the life sciences.

See the July 2001 IRRC report on the science education standards at <http://www.irrc.state.pa.us/PA_Exec/IRRC/comments/comments.html>.

The "Wright" Stuff

Andrew J Petto, NCSE Editor

Robert Wright's *Nonzero: The Logic of Human Destiny* (*reviewed on page 40*) was the impetus for "Does Evolution Have a Direction? An Inter-Disciplinary Workshop in Science and Religion", which took place on September 30, 2000, at the Washington Theological Union (WTU) in Washington DC. WTU cosponsored the conference with the Mid-Atlantic Office of the CTNS (Center for Theology and the Natural Sciences) Science and Religion Course Program. The purpose was to engage scientists, theologians, ethicists, educators, and other scholars in a "wide-ranging discussion" of Wright's book, characterized as a "self-described contribution to natural theology suggesting a 'larger purpose' at work in both organic and human evolution."

The Program

Robert Wright opened the conference with a brief review of two main points in *Nonzero*. First, he proposed that evolution favors non-zero-sum interactions — those in which the success of one participant does not require the failure of the others. The history of human cultural evolution and of organismic evolution in general, Wright argued, is a record of increasing the extent of "non-zero-sumness" (NZS). Second, he proposed that this record indicates a purpose in the universe demonstrated by a tendency to increase NZS in living systems.

In the question period, several participants pressed Wright on the issue of purpose. Wright replied that a rock may be in a wall, but it was not "designed" to be in a wall, and it could realize its essential nature in any location. In contrast, a brick was designed to be used in a structure such as a wall and could not equally well fulfill its purpose in any environment. He added that NZS avoids the teleological aspects of the anthropic principle. Finally, in response to a question about randomness of mutations, Wright noted that there are other evolutionary mechanisms, many of which, such as directional selection, are decidedly nonrandom.

William Shropshire, a PhD biophysicist and the pastor of a United Methodist Church, spoke second. This was a wide-ranging and unfocused presentation. For much of the time, it was unclear whether Shropshire's intent was to support or refute NZS. Shropshire described the life of a young American woman who had given up a middle-class life in the US (and any prospects of starting her own family) in order to improve the health, education, and general welfare of impoverished children and their families in a Guatemalan barrio. Shropshire did not explain what evolutionary benefit she gained from the interaction — a condition of the NZS model for producing this sort of unselfish behavior.

In the response period, Wright explained that this was an example of humans' putting to use in one situation a set of traits evolved in another — the extended investment in children. He added that NZS predicts that it is the fate of humans to become more intertwined and not that every *individual* would benefit from the interactions. But Shropshire's presentation illuminated a serious problem: the difficulty of devising a measure to evaluate whether the interactions among participants result in greater NZS (*see review on page 40*).

The third speaker, neurosurgeon and neuroscientist Ayub Ommaya, seemed to recognize this difficulty, noting that the game-theory models that underlie NZS have difficulty in keeping track of interactions and outcomes involving more than a few individuals and events. His presentation began with a promising discussion of NZS as a homeostatic mechanism meant to preserve a trajectory, rather than to promote a specific outcome — comments that were reminiscent of Waddington's work over 5 decades ago.

After a lengthy overview of what he called "Islamic science", Ommaya argued that human emotions are the basis of consciousness, which is what allows us to process information. Without the emotions, he argued, the "bureaucratic" neocortex would only perform basic organismal housekeeping functions. Unfortunately, Ommaya never explained how his discussion of emotions and consciousness connected with the main theme of NZS.

The clearest presentation of the day was delivered by John Haught, Professor of Theology at Georgetown University. Haught proposed a "theology of nature" instead of a "natural theology" as the starting point for understanding the consonance between scientific and theological perspectives on the universe. This theology of nature begins with a confessional faith, but is not "obsessed with design" and thus allows an "unfinished" universe, which may change significantly over time. Perfection is not required, and the universe can have a future quite different from its current state.

A theology of nature asks, "What kind of universe should we expect if we follow the promise of our faith?" Haught's answer was that the Bible promises us perfectability, not perfection; it gives us a promise of becoming. The promise of faith is also one that allows contingency, temporality (the occurrence of specific historical events within a particular time frame), and predictability (as the laws of nature operate consistently and produce coherent outcomes with the limits set by these laws). Haught also noted that materialism is rooted in the past in contrast to this theology of nature; it is difficult to apply strictly materialistic models to a model consonant with theological views of the future.

He went on to criticize the "intelligent design" (ID) movement. ID, he argued, requires perfection, which, he pointed out, is rare. He recommended a recognition of the changes over time in both the physical universe and our understanding of it. Although he did not address NZS directly, he seemed to be comfortable with the thought that NZS might contribute to our understanding of how contingent events in the natural realm could contribute to a larger trajectory intelligible only in nonmaterialistic terms.

Theologian Joseph Wimmer's presentation was also not clearly related to the NZS theme. He argued for the theological position that although Scripture is the word of God, it is recorded in the words of humans. Scripture explains our relationship with God and describes the creation as an "act of wisdom" that brought order and pattern out of chaos. However, Wimmer never explicitly connected his theological position and NZS.

Finally, Thomas King, Professor of Theology at Georgetown, took up the predictable task of rehabilitating Pierre Teilhard de Chardin's idea that human evolution is directed toward some defined end — such as the Omega point. According to King, Teilhard's model is consistent with NZS — both imply a consistent direction in organic change. However, King

argued that Teilhard's position, in contrast to NZS, was that this direction can never be confirmed scientifically, for Teilhard considered consciousness — at least the variety that we humans experience — to be an epiphenomenon that is not reducible to natural components. King in effect provided the connection between NZS and Haught's theology of nature — a specific goal for the trajectory of life, expressed in terms of the future of human evolution. However, King did not explore the connection explicitly.

The conference would have benefited from a reflective perspective on the presentations. Although Wright responded to each presentation, in most cases, it seemed that he was hearing the material for the first time, so his comments were often not well-formulated, and he missed the opportunity to clarify the connections between the presentations and NZS. In short, evolution may have a detectable direction, but this conference certainly did not.

The Summer of Our Discontinuity

Discontinuity: Understanding Biology in the Light of Creation was the title of a conference held August 15–17, 2001 at Cedarville University in Cedarville, Ohio. Cosponsored by the university, Bryan College, and the Institute for Creation Research (ICR), this conference set for its participants the lofty goal of removing evolution as the fundamental concept in biology. The pre-conference publicity declared:

> Theodosius Dobzhanksy declared that "Nothing in biology makes sense except in the light of evolution." Christian biologists today are strongly challenging that statement.
>
> Biology can be understood in light of creation of discontinuous groups of organisms, organisms that share no ancestry with each other. Cedarville University, in conjunction with the Baraminology Study Group, presents *Discontinuity: Understanding Biology in Light of Creation*, a three-day research conference presenting the cutting edge of creation biology.
>
> Despite theological disparity regarding the age of the earth, Christian biologists who reject macroevolution hold one thing in common: We believe that all living creatures do not share a single common ancestor; that is, we believe in a fundamental discontinuity of life. Rather than descending from a single ancestor, the diversity of life on earth form discontinuous phylogenetic units that were created by God. It is clear, then, that discontinuity may well become the unifying principle of creation biology. Discontinuity is certainly the concept that most sharply contrasts the practice of evolutionary and creation biology. The importance of building and elaborating the principle of discontinuity cannot be overstated.
>
> *Discontinuity: Understanding Biology in the Light of Creation* will bring together scholars of intelligent design, creation biology, and typology so that the principle of discontinuity may be elaborated (*description from <http://www.creationequation.com/Discontinuity.htm>*).

According to ICR president John Morris, "The purpose of this conference was to bring together scholars of creation biology so that the principle of discontinuity (the proposal that life does not show a continuous evolutionary line) would be elaborated" (<http://www.icr.org/pubs/president/prz-0110.htm#2>).

There were 13 plenary speakers and a number of other presentations. Morris reported that the speakers addressed discontinuity as evidenced in "biological universals, classification systems, structures and types, hybridization studies, taxonomy, research programs, biochemistry, cytokinesis, developmental biology, and the fossil record". However, four of the first five speakers concentrated on historical, philosophical, and theological foundations for the proper study of biological discontinuity.

According to Morris, the highlights of the conference were:

1. A general consensus that created kinds lie close to the family level of Linnaean classification.
2. Evidence for discontinuities in all major disciplines of life science.
3. Indications from hybridization studies of a relatively small number of basic types.
4. Paleontological evidence for a young fossil record.
5. Confirmation from origin-of-life studies that information theory explains why life cannot arise from non-life.
6. A growing data base on discontinuity under construction at Bryan College.

UPDATES

Idaho: On June 16, 2001, the Idaho State Board of Education adopted the achievement standards for grades K–8. The science standards include evolution (and no creationism). Two local NCSE members testified in favor of the standards at a statewide videoconference hearing on May 18. No creationists testified. The current version of the standards will go to the legislature in January for final approval and are expected to take effect for Idaho's 169 000 elementary students in fall 2002.

The standards may be viewed at <http://www.sde.state.id.us/osbe/exstand.htm>.

[Contributed by Gary Bennett.]

Pennsylvania, Montgomery County: The November 6 special election for State Senate in Montgomery County was won by Representative Connie Williams (D). Williams was an active supporter of evolution education during the recent controversy over the state education standards and defended evolution as a member of the House Education Committee. While her activity in the House on behalf of education will be missed, she leaves behind strong, committed colleagues who confer often with NCSE members on matters relating to science education. Williams's presence in the Senate will add a strong voice for evolution education and will cut into a Republican majority that supported weakening the standards and requiring teachers to present so-called "evidence against" evolution.

Despite John Morris's optimism, however, a consensus that "created kinds lie close" to the level of taxonomic families does not represent much progress. After all, taxonomists find that families contain nested lineages of species, genera, tribes, and subfamilies, and are themselves nested into superfamilies, orders, classes, and kingdoms. There is no biological boundary that makes the distinctions at the level below the family any different than those about it — except, perhaps, that the biological continuity of those organisms below the family level is so obvious that it is impossible to deny and still hope to retain any scientific credibility.

Presbyterian Denomination Allows Nonliteral Views

Leaders of the 300 000-member conservative Presbyterian Church in America (PCA) voted on June 21, 2001, to reaffirm church doctrine on several issues, including a literal interpretation of the Bible. However, delegates to the 29th annual Assembly voted to "allow ministers to hold varying interpretations of creation". The PCA uses the 17th-century Westminster Confession of Faith as its chief doctrinal standard. That document reads, in part: "It pleased God the Father, Son and Holy Ghost ... in the beginning to create ... the world ... in the space of six days; and all was very good."

The Assembly debated whether the book of Genesis means that God created the world in six 24-hour periods or six "figurative" days, which could be seen as a concession to evolution and modern science. At issue was whether those holding the figurative view were qualified to become ordained ministers in the church. In the end, the 1500 delegates rejected an effort to require candidates for ordination to declare such "exceptional beliefs" — as a condition for ordination. For now, PCA ministers may accept modern scientific views of the history of the universe and life on earth without concern that these views may threaten their ordination or their continued acceptance as ministers in the PCA.

Read more about the Presbyterian Church in America and the issues addressed at the annual Assembly at <http://www.pcanet.org>.

[Contributed by John R Cole.]

NCSE NEWS

News from the Membership

Glenn Branch
NCSE Office Manager

From time to time we like to report on what our members are doing. As the following list shows, they have a lot to be proud about!

Karen E Bartelt, Professor of Chemistry at Eureka College in Illinois, discovered that the Institute for Creation Research's Frank Sherwin was scheduled to visit her college to lecture on "The scientific evidence supporting creation" in April 2001. She accordingly sent an e-mail to the entire campus warning of the ICR's shoddy scholarship. She also attended Sherwin's lecture, sponsored by the local chapter of Campus Crusade for Christ, and was unsurprised to find that it consisted largely in wholescale misrepresentation of mainstream science, as she explained subsequently to the audience at her own public presentation. Bartelt describes Sherwin's visit and her reaction to it in a two-part article, the first part of which appeared as "Quote mining: The tradition continues", *The REALL News* 2001 Aug; 9 (8): 1, 3-5, 7.

After the National Association of Scholars devoted a brief article in its *Science Newslist* (2001 Apr; 6 [1]: 2-3) to applauding the reintroduction of evolution to Kansas's state science standards, **David Blank** hastened to recommend NCSE to his fellow NAS members. The editor of *Science Newslist* accordingly mentioned NCSE and its web site in the following issue's report (2001 Jul; 6 [2]: 9) on Louisiana's proposed bill linking evolution and racism (*see* RNCSE *2000; 20 [5]: 9-10 and 20 [6]: 6*). Blank hopes that the result will be an upswing in interest among NAS members in helping to oppose creationism.

Responding to a creationist's letter to the editor, which claimed that "scientific conclusions" disprove evolution, **JS Bullion Jr** referred to NCSE's web site and the National Academy of Sciences publication *Science and Creationism* in rebuttal (The Bellingham [WA] *Herald*, 2001 Aug 19, B5). He also provided a lengthy list of scientific and educational organizations that endorse the theory of evolution. Bullion ended by referring to creationism as "an obstacle to science teaching uncontaminated by scientific belief or discredited 'scientific' objections." *[Thanks to Gilbert D McCollum Jr for the news.]*

Rodger W Bybee, executive director of Biological Sciences Curriculum Study, received the first Education Award from the American Institute of Biological Sciences. The AIBS Education Award will be presented annually to individuals or groups that have significantly contributed to education in the biological sciences. Bybee was presented with a plaque, as well as lifetime membership in AIBS, during the AIBS annual meeting in Washington DC in March 2001. In his acceptance speech (later published as "Teaching about evolution: Old controversy, new challenges" in *Bioscience* 2001 Apr; 51 [4]: 309-12), Bybee reflected on the creationism/evolution controversy:

> The protean forms creationists have taken include state laws banning evolution, requirements to teach creationist science, equal time for creationism and evolution, disclaimers in textbooks, standards and assessments that omit evolution, laws that forbid purchase of instructional materials that present as factual information which has been proven false, and, most recently, intelligent design. ... Although the forms of creationism have varied, the goal is always clear — the creationists wish to exclude evolution and to include their religious views in school science programs.

Following the airing of episode 7 of the PBS series *Evolution* — "What about God?" — **Robert Dennison**, a biology teacher at Jersey Village High School in Houston, Texas, participated in a panel discussion broadcast by Houston's KUHT public television station. The other panelists were James Lester, Professor of Biology and Environmental Science at the University of Houston at Clear Lake and Director of the Environmental Institute of Houston, Ben Young, Associate Pastor of the Second Baptist Church of Houston, and William A Dembski, Associate Research Professor at Baylor University and Senior Fellow of the Discovery Institute's Center for the Renewal of Science and Culture. Asked what they thought of the show, Dennison expressed approval, while Dembski, apparently referring to segments featuring Ken Ham of Answers in Genesis, complained that "the only controversy seems to be coming from religious nuts". Dennison was assiduous in challenging Dembski's claims on behalf of "intelligent design". For example, after Dembski stated that Michael Behe's ideas have been discussed in peer-reviewed journals, Dennison asked whether they were discussed favorably, whereupon Dembski admitted that they were not, but added — somewhat lamely — that there are lively discussions about "intelligent design" on the internet. *[Watch for Dennison's article describing the experience from his perspective in an upcoming issue of RNCSE.]*

Following the publication of Roger Downey's "Darwin hits back" in the June 14–20, 2001, *Seattle Weekly* (see <http://www.seattleweekly.com/features/0124/news-downey.shtml>), **David Fletcher,** Chairman of the University of the Pacific's Department of Civil Engineering, wrote in to applaud Downey's trenchant critique of the "intelligent design" movement, commenting:

> Phillip Johnson can rail on about "methodological naturalism", Michael Behe can assert "irreducible complexity", and William Dembski can claim that evolution fails on the basis of information theory until the cows come home. Their arguments will not be, nor should they be, taken seriously until the proponents battle it out in the scientific arena instead of the ignorant court of public opinion. When I read the ID arguments in refereed scientific journals, I'll begin to consider them worthy. Until then, it's all just so much anti-intellectual drivel.

Fletcher's letter was published in the June 21–27 issue of *Seattle Weekly*.

Noting that "students in many states are all too often the victims of narrow thinking of members of their communities" and that "[a] number of school boards across the country have been very successful in limiting student access to current scientific and cultural perspectives", **Susannah and Tom Graedel** wrote to the editors of the Madison, Connecticut, newspapers *The Source* (20 Sep 2001) and *Shore Line Times* (19 Sep 2001) to announce that they had contributed their tax refund check to NCSE. The Graedels explained that "NCSE's goal is to increase public understanding of evolution, science overall, and general critical thinking. All of these topics are crucial to the creation of a well-educated citizenry." The headline on their letter in *The Source* was "Lessons in clever spending" — we agree!

In the wake of PBS's *Evolution* series, the creationists were out in force, including David Buckna, who published an op-ed piece in the Lafayette, Indiana, *Journal and Courier* on October 4, 2001, recommending the Discovery Institute's critique of the series as well as the Institute for Creation Research's proposed policy on teaching about evolution, and criticizing a 1987 biology textbook for presenting misleading information about the neck of the giraffe. Purdue University biologist **Mark Levinthal** responded in a letter to the editor published on October 8, in which he not only debunked Buckna's various criticisms but also affirmed the compatibility of evolution and Christianity, writing "The PBS program showed that scientific evidence convinced the students from Wheaton College that they needed to accept evolution if they wanted a profession in medicine or geology. These students found that their Christian faith allowed them to accept both science and the Bible."

After the Baltimore *Sun* pub-

Radiometric Dating Still Works!

Doing a bit of thinking about radiometric dating this morning, I decided to try a little research on the exact ages and distances apart for the Hawaiian Islands with a view to using estimated drift rates to crosscheck the radiometric dates. A site at a Hawaii university gives details on both distance from the current hot spot (Kilauea crater is the actual zero point used) and radiometric dates derived by potassium-argon (K-Ar) dating for every major island in the chain from the Big Island to Midway and beyond.

Taking the age estimates for the islands based both on drift rates and on K-Ar dating methods, a graph from a simple spreadsheet clearly shows strong agreement between the two methods. The estimates are not identical for any of the 11 volcanoes or volcanic islands, but most are close in the absolute estimate of age. However, both methods produced the same pattern of age-distance relationships: Age increases consistently from southeast to northwest — no volcano is out of sequence in either method. Anyone who wants to claim that radiometric dating does not work is going to have a hard time explaining these data away.

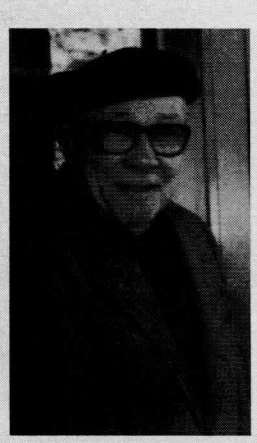
[Contributed by Jonathon Woolf]

lished an article uncritically praising the "intelligent design" movement ("Theory backs Darwin, adds the Designer", 2001 Mar 28), **Richard H Lessard** wrote (2001 Apr 14) to explain that "intelligent design" is simply old-time creationism covered with a thin veneer of scientific language." He pointed out that the article employed two rhetorical standbys inherited from creationism by the "intelligent design" movement: the claim that acceptance of evolution requires atheism and the claim that it is only fair to present "both sides" of the evolution debate to students. A letter from **Douglas E McNeil** criticizing the article was also published (2001 Apr 14); McNeil remarked that the *Sun's* article "did not call 'Intelligent Design' creationism what it really is — pure pseudo-science." *[Thanks to Gregory S Paul for the news.]*

Jere H Lipps, Professor in the Department of Integrative Biology at the University of California, Berkeley, and Alexander V Altenbach were awarded a 15 000 DM Bavaria-California-Technology Center Grant for the environmental study of foraminiferal relationships through DNA sequencing. Lipps's most recent article for *RNCSE* was "Hammed!" (*RNCSE* 2000 Jan-Apr; 20 [1-2]: 52-3).

[Publications, achievements, honors? Tell RNCSE so we can pass on the good news to all of our members. Call, write, or e-mail.]

Stanley Weinberg, NCSE Founder, Dies



Eugenie C Scott
NCSE Executive Director

Stanley L Weinberg, a founder of NCSE, died in Ottumwa, Iowa, on March 28, 2001. He was 89 years old. He had not been active in NCSE affairs for several years, having suffered from a stroke. Stan is survived by his wife Irene and his two daughters, Ellen and Susan Weinberg.

Stan was born in New York City on August 21, 1911. He received a bachelor's degree in biology from City College of New York in 1933 (*cum laude*) and was inducted into Phi Beta Kappa. He had graduate training at Columbia, New York University, and the Marine Biological Laboratory, and received a masters degree from Northeast Missouri State University in 1971. He was a high school science teacher in New York from 1935 to 1957, interrupted by World War II, during which he was a captain in the Army Air Corps. After publishing a high school biology textbook, *Biology: An Inquiry Into the Nature of Life* (Allyn and Bacon), Stan retired to Irene's home town of Ottumwa, Iowa, in 1967.

Among his many awards are the Iowa Academy of Science Distinguished Service Award (1982), election to honorary membership of the National Association of Biology Teachers (1985), the Iowa Intellectual Media Association Intellectual Freedom Award (1987), and the American Association for the Advancement of Science Scientific Freedom and Responsibility Award, which he shared in 1987 with Francisco Ayala and Norman Newall. He also received an award from the Friends of Education of the Ottumwa Education Association for his "lifelong commitment to the educational community and defense of legitimate scientific inquiry." He was a fellow of the Iowa Academy of Science and of the American Academy for the Advancement of Science.

Stan's concern with the creation and evolution controversy went back to the early 1970s, when the high school biology textbook he had authored was submitted for adoption in Texas. Because of its strong presentation of evolution, the book was denounced by creationists. His textbook was adopted, but the experience made Stan acutely aware of the importance of the political side of the creation and evolution controversy. *continued*

During the late 1970s, the "creation science" movement appeared as a national force in science education. In May 1979, the Institute for Creation Research (ICR) published a resolution encouraging school districts and state legislatures to promote "balanced presentation of evolution and scientific creationism" (*Impact* 1979; 71: 1). Although the ICR stated that "this is a suggested **resolution**, to be adopted by boards of education, not **legislation** proposed for enactment as law" (emphasis in original), South Carolinian Paul Ellwanger developed sample legislation to enact the ICR's resolution. Clones of the Ellwanger bill soon began appearing in states all over the country; by March 1981, 15 states had introduced "equal time" bills.

Stan and many other teachers and scientists were concerned about this legislation and began planning how to oppose it. Stan's genius was recognizing the quintessential grassroots nature of both the legislative action and the anti-evolution movement itself. There was, in fact, no national push to promote this legislation — the Ellwanger model legislation circulated privately to individuals and organizations with which Ellwanger was familiar, and grassroots interest took over from there. But anti-evolution sentiment in the American public is easily tapped, and ordinary citizens in at least 26 states approached their legislators to introduce Ellwanger's or Ellwanger-like legislation: Alabama, Arizona, Arkansas, Colorado, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New York, Oklahoma, Oregon, South Carolina, South Dakota, Tennessee, Washington, and West Virginia.

Stan had been a former president of the National Association of Biology Teachers (NABT), an organization that understandably took the anti-evolution movement very seriously: biology teachers are on the front line in the creationist wars! NABT had been a plaintiff in a 1975 lawsuit in Tennessee regarding the inclusion of creationism in textbooks, and had worked for many years to educate its members about the problems of the teaching of evolution. In 1978, *The American Biology Teacher* published an article by Stan entitled "Two views on the textbook watchers", in which Stan proposed that teachers and scientists engage in public education about evolution and the nature of science, and also in political action.

Stan's dream was to organize a grassroots network of scientists and teachers who would respond to local creationist initiatives. Many scientists and teachers already independently were engaged in combating state legislative efforts. In a 1980 *Bioscience* article, Moyer suggested that this network paralleled the Committees of Correspondence in the Revolutionary War, colony-wide groups of patriots who shared information (corresponded) about the British and what strategies worked best against them. The citizen network envisioned by Weinberg thus took on the name Committees of Correspondence (CCs).

In July 1980, Stan and Jack A Gerlovich, an Iowa state science consultant, published a letter describing the Iowa CC in *Science*. Shortly afterwards, several individuals who had independently developed similar grassroots organizations contacted Stan, and the CC network was on its way. A pivotal symposium on "Creationism and Evolution" was held at Rockefeller University in December 1980, organized by the New York Academy of Sciences and a New York teachers' group, the Committee for Scientific Freedom. Speakers included Niles Eldredge, Isaac Asimov, and Stephen Jay Gould. The New York CC was organized, with Eldredge as its first president.

In January 1981, Stan began circulating a newsletter to activists around the country — the "Memorandum to Liaisons for Committees of Correspondence". He wrote, "There is no prescribed form of organization for a Committee of Correspondence. Each CC is fully independent and autonomous. The most usual form will probably be a single CC in each state, with a single liaison." In the early 1970s, the Genetics Society of America and the American Society of Naturalists had solicited names of members willing to support evolution education. This list was made available to Stan and he in turn provided it to state liaisons to help to build the network. NABT also provided names of teachers who were willing to work on the issue.

Stan also promoted the network by asking officers of a number of scientific organizations to inform their members about the existence of the network. These included the Society for the Study of Evolution, the American

Association for the Advancement of Science, the American Association of Physical Anthropologists, the American Association of Biological Sciences, and many others. Many of these scientific organizations responded with small donations — but by and large, Stan supported the CC network in the early years out of his own pocket. The amount of time he devoted to this issue was monumental.

The network of teachers and scientists grew quickly. By March 1981, there were CCs in 17 states; by April, 22; by May, 24; by August, 35; by December, 42. The first national meeting of CC representatives was held at the American Association for the Advancement of Science meeting in Washington, DC, on January 3, 1982. (I was there representing the Kentucky organization.) During that meeting, we celebrated the US Supreme Court decision striking down the *McLean v Arkansas* "equal time for creation science" legislation, but we also realized that the struggle was not over. At that meeting, a committee was formed to investigate setting up a national organization to coordinate the CCs.

This organization came to be called the National Center for Science Education, and it was incorporated in 1983. Stan went to work to raise funds for NCSE, and by the summer of 1986, he had secured $250 000 in start-up funds from Carnegie Corporation of New York, the Esther E and Joseph Klingenstein Fund, the Richard Lounsbery Foundation, the Deer Creek Foundation, and an anonymous foundation. The NCSE Board of Directors instituted a nationwide search for an executive director and hired me in November 1986 to open the national office. In January 1987, the national NCSE office began carrying on Stan Weinberg's dream of coordinating grassroots opposition to creation science and defending evolution education.

The CC network was highly active during the early- to mid-1980s. Many local issues were resolved, unfortunately resulting in local activist groups' dissolving. By the end of the 1980s, the original CC network had largely faded away, but NCSE continues to carry on Stan's original idea of combating the grassroots nature of creationism with grassroots opposition. Over the years we have seen the formation of ad hoc groups that assemble to combat a particular problem and then dissolve — sometimes only to re-form a few years later, unfortunately! NCSE is a permanent storehouse of information and advice to the activists in the trenches, monitoring the problems of evolution education and creationism. Although the CC network did not work out as Stan had originally planned, his dream of a union of scientists and teachers working together to defend the integrity of science continues. All of us in this effort owe Stan a great deal for his foresight in understanding better than anyone what the real issues were.

He will be missed, especially by those of us at NCSE.

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A Student Responds to the Alabama Disclaimer

[Luke Collins, a high-school student in Alabama, wrote this letter to the editor in response to the decision by the State Board of Education to continue the use of disclaimers in science textbooks. This letter is reprinted with permission.]

By continuing an infamous "Evolution Warning Label" in textbooks, the Alabama State Board of Education has made life more difficult for me, a high-school junior looking forward to a career in the life sciences, as well as for thousands of other students with similar aspirations.

The intent of this disclaimer, which is mandated for every biology textbook, is to discourage teachers from teaching evolution — the basis for all biology. This is roughly equivalent to teaching chemistry by saying "No one has seen atoms, so their existence remains controversial." Just how does the board expect students to master a subject without learning its foundation?

We hear a lot about how students are supposed to respect authority. But the board has disrespected itself, as well as every teacher and student in the state.

My dream is to attend a renowned college such as Duke or Washington University. I can see myself sitting down with the admissions committee and worrying whether they are thinking, "Oh, this is that kid from Alabama, where the school board mandates 17th-century biology."

One thing is sure. The board has guaranteed that "brain drain" — the loss of Alabama's best and brightest — will continue. Just as soon as I am able, I am emigrating to a state where the board is as serious about giving an education as I am about getting one.

Luke Collins

Ignorance Can Be Funny: Anti-evolutionary Tales from an Evolutionary Biologist

Tim M Berra
The Ohio State University

I recently gave a public lecture at a small fundamentalist college in Mount Vernon, Ohio. I had been invited to speak about my Australian fish research because a faculty member had heard me give a talk on that subject at the Columbus Zoo and thought that I would be a nice addition to the college's Lecture and Arts Series. The arrangements were made 10 months in advance, and flyers and posters were printed.

But apparently a few weeks before my scheduled lecture, the Lecture and Arts Committee discovered just whom they had invited. Two weeks before the lecture, I received an e-mail informing me that the college has a conservative constituency, heritage, and student body whose views on creation/evolution might be rather divergent from my own. They wanted to hear of my travels and research, but did not want to promote inflammatory dialogue. The committee and administration would offer for sale and signing my new book, *A Natural History of Australia* (1998), but not my other book, *Evolution and the Myth of Creationism* (1990) (*see p 24*). After a few more sentences about courtesy, respect, non-confrontational style, and so on, I was told that if I felt affronted by this or would rather not be placed in a position that compromised my integrity, the college would be willing to pay my full lecture fee whether or not I showed up.

My first reaction was, "Wow! This creates a whole new career path for me! I can threaten to speak at fundamentalist colleges, then accept a fee not to come. Is this a great country or what?" However, I was not about to cancel. I suspected that the evening would hold a few chuckles for me, and it did.

This lecture marked the first time I have ever been introduced with a disclaimer — something to the effect that the views expressed by tonight's speaker do not represent the views of the college or the church. I had not spoken a word yet, and they did not know what I was going to say, but whatever it was, it was not the view of the college. Man, I felt dirty — like a cigarette pack. Maybe I should get a t-shirt with the disclaimer printed on it.

I was then introduced as Professor Emeritus of The Ohio State University, but apparently my department's name, Evolution, Ecology, and Organismal Biology, could not be spoken. My Australian book and publication record were mentioned, but not "that other book". My talk was very similar to what is contained in Berra (1997) about megamouth shark and salamanderfish — just what I was asked to cover. My talk was very well received by about 150 people and all my Australian books were sold. Someone produced 3 copies of my evolution book from somewhere, asked me to sign them, and thanked me for writing the book. But such gratitude is not always the rule.

I was doing a book signing at a book store in a shopping mall near Mansfield, Ohio, shortly after *Evolution and the Myth of Creationism* was published. I was at a table surrounded by piles of my books and a large sign. About an hour into the evening I noticed a middle-aged woman with an enormous beehive hairdo pacing nearby. Eventually she screwed up her courage and came storming over demanding to know what kind of name Berra was. "Are you Jewish?" she screamed. I replied, "No, many names that end in a vowel are of Italian origin. Why do you ask?" She replied that no Christian could write such a book and that she understood why I would be an evolutionist because I had such "apish features". I am not making this up, folks. I was able to paraphrase Huxley's famous retort to the Bishop of Oxford that, if given a choice between a bigot such as her or an ape for an ancestor, I would unhesitatingly choose the ape. This sailed right over the beehive, but I felt very good.

Of course, there are times when the comic mixes with the tragic. One academic quarter, two introductory biology students complained to the dean that I spent too much time on Darwin and evolution. "He even asked us the name of Darwin's dog on a test!" During my annual review, the dean wanted to know what was going on. Why would I do that? Answer: I did not. There was a section of matching questions, with Thomas H Huxley matching with "Darwin's Bulldog". These students were so upset about hearing all this Darwin and

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RECAPITULATIONS

Shanks and Joplin (RNCSE 2000; 20 [1-2]: 25-30) disputed Michael Behe's irreducible complexity challenge to evolution, arguing that there was at least one way for evolutionary change to accomplish this task. Their article prompted a response from Michael Behe, and a reply from Shanks and Joplin.

BEHE RESPONDS

In their article "Of mousetraps and men: Behe on biochemistry" (*RNCSE* 2000; 20 [1-2]: 25-30), which has just come to my attention, Shanks and Joplin appear mistakenly to attribute to me the contention that irreducibly complex biochemical systems must have been created *ex nihilo*. I have never claimed that. I have no reason to think that a designer could not have used suitably modified pre-existent material. My argument in *Darwin's Black Box* was directed merely toward the conclusion of design. How the design was effected is a separate and much more difficult question to address. Although creation *ex nihilo* is a formal possibility, design might have been produced by some other means that involved no discontinuities in natural law, even if the designer is a supernatural being.

One possibility is directed mutations. As noted by Brown University biologist Kenneth Miller in *Finding Darwin's God* (New York: HarperCollins, 1999), "[t]he indeterminate nature of quantum events would allow a clever and subtle God to influence events in ways that are profound, but scientifically undetectable to us. Those events could include the appearance of mutations..." (p 241). I have no reason to object to that as a route to irreducibly complex systems. I would just note further that such a process amounts to "intelligent design", and that while we may be unable to discern the means by which the design is effected, the resultant design itself may be detected in the structure of the irreducibly complex system.

The core claim of intelligent design theory is quite limited. It says nothing directly about how biological design was produced, who the designer was, whether there has been common descent, or other such questions. Those can be addressed separately. It says only that design can be empirically detected in observable features of physical systems. As an important corollary, it also predicts that mindless processes such as natural selection or the self-organization scenarios favored by Shanks and Joplin will not be demonstrated to be able to produce irreducible systems of the complexity found in cells.

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evolution stuff that they could not think straight (at least that is the charitable interpretation). By the way, Darwin did own a dog — a white, rough-haired female fox terrier named Polly, originally belonging to his fourth child Henrietta, inherited by him when she married in 1871 and moved out of Down House (Freeman 1978). However, this sort of literalism about Darwin and associated canines would be out of place in a biology curriculum.

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SHANKS AND JOPLIN REPLY

A traditional Christian explanation of the origin of things is supernatural design and creation *ex nihilo*. We are grateful for Michael Behe's suggestion that we give consideration to alternative hypotheses concerning design — perhaps through the modification of pre-existing materials. Behe cites Kenneth Miller, who asks us to envision supernatural intelligent design proceeding by some cunning manipulation of events at the quantum level *"scientifically undetectable to us."*

The qualification that the *way* design is effected be *"scientifically undetectable to us"* is crucial. The trouble here is that there is an infinity of alternative design hypotheses (one designer did it, two designers did it, three did it, and so on), and an imaginative theorist could no doubt come up with many design scenarios, all of which are *scientifically undetectable to us*. Being scientifically undetectable, they are, of course, evidentially ungrounded.

Notwithstanding this, Behe's central claim is that the fact of design (regardless of how it was effected) can be empirically detected in observable features of physical systems. Such features cannot be explained, he contends, on the basis of mindless natural processes. In our earlier essays on Behe's ideas, we introduced the idea of biochemical *redundant complexity*. A redundantly complex biochemical system is one that contains redundant subsystems — subsystems that can be removed without complete loss of function achieved by the system as a whole. Behe has conceded the existence of redundant complexity (see his "Self-organization and irreducible complexity: A reply to Shanks and Joplin," *Philosophy of Science* 2000; 67: 155–62).

The admission is crucial. Reduce the redundancy in a redundantly complex system to the point where the further removal of a subsystem causes the system as a whole to lose function completely, and a redundantly complex system has evolved into an irreducibly complex system. Irreducibly complex systems are thus limiting cases of redundantly complex systems. Mutations resulting in gene duplication can give rise to redundancy. Mutations transforming functional genes into pseudogenes can reduce redundancy to the point where a system once manifesting redundant complexity is now irreducibly complex. (An extended discussion of these ideas can be found in our essay, "Behe, biochemistry, and the invisible hand", *Philo* 2001; 4: 54–67.) There is no need for any additional mechanisms and agents, be they supernatural or merely of the space alien variety, that are *scientifically undetectable to us*. Contrary to Behe, the design hypothesis cannot simply be validated by pointing to physical systems manifesting irreducible complexity.

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Whose God? What Science? Reply to

Robert T Pennock
Michigan State University

In his recent review of my book *Tower of Babel: The Evidence against the New Creationism,* published in *The Weekly Standard* under the title "The God of science: The case for intelligent design" (Behe 1999), Michael Behe takes me to task for criticizing the "intelligent design" group, of which he is a member, in the same pages in which I criticize Genesis literalists and other religious anti-evolutionists. He writes:

> Unfortunately, whatever merits exist in Pennock's analysis, they are obscured by biased rhetoric. His term "creationism," for instance, is one that readers will typically take to mean biblical literalism: a "young earth" created as recently as 4004 BC, Adam and Eve, Noah's Ark, and all the rest. But Pennock applies "creationist" to writers who believe in none of this. His actual opponents turn out to have doctorates in things like embryology, biochemistry, the philosophy of science, and mathematics from places like the University of Chicago, Cambridge, and Berkeley. And they write books and articles that engage, rather than avoid, serious issues in science and philosophy.

Behe would have us believe that members of his group have disavowed classic "young-earth" views and do not base their "theistic science" in the Bible, but this is not so. I tried to be very careful in my book not to misrepresent the views of those I criticized, as Behe has misrepresented my discussion in his review.

Behe is not himself a young-earther, but he must know that other leaders of his movement are — Percival Davis, Paul Nelson, and John Mark Reynolds, among others. Moreover, Behe and the old-earthers in his movement are creationists in the core sense of the term, namely, that they reject the scientific, evolutionary account of the origin of species and want to replace it with a form of special creation. Even Phillip Johnson accepts that "creationism" is, as he puts it, "not simply biblical fundamentalism, but *any* invocation of a creative intelligence or purpose outside the natural order" (Johnson 1990). Intelligent-

Michael Behe

design creationists (IDCs) try to disassociate themselves from other creationists, but the difference is mostly one of political strategy.

Henry Morris, founder of the young-earth Institute for Creation Research (ICR), writes that the idea behind the "intelligent design" movement is to begin with the design argument and postpone talking about the bedrock biblical doctrine. He explains:

> Any discussion of a young earth, 6-day creation, a world-wide flood and other biblical records of early history will turn off scientists and other professionals, they say, so we should simply use the evidence of intelligent design as a "wedge" to pry them loose from their naturalistic premises. Then, later, we can follow up this opening by presenting the gospel, they hope (Morris 1999).

Morris, of course, does like the design argument (he has been promoting it for decades), but he knows that, contrary to Behe's assertion in his review, it never convinced Fred Hoyle or anyone else to throw out atheism and become a theist, let alone a Christian.

In *Darwin's Black Box*, Behe trumpets his version of the design argument as one that "must be ranked as one of the greatest achievements in the history of science." Heady stuff! However, anyone not distracted by the self-congratulatory fanfare will recognize that what Behe has dished up is not a revolutionary scientific discovery, but warmed over 19th-century natural theology. Despite their vaunted "doctorates from places like the University of Chicago, Cambridge, and Berkeley", IDCs have made no conceptual advance over William Paley's failed argument.

I spent several dozen pages in *Tower of Babel* showing errors in Behe's own arguments, but in his review he conveniently ignores these and (as predicted) chooses to "engage" only a single sentence. Behe tells origin-of-life researchers that they should throw in the towel, and accept his "finding" that biomolecules were miraculously created. Oparin inaugurated origin of life studies in the 1920s, but it is only in the last few decades that molecular biology has begun to develop the tools that will allow it to investigate the kinds of examples Behe cites. Behe knows full well that such research continues to reveal clues to unravel the mystery, just as he surely knows that origin of life experiments have done far more than produce what he claimed was merely "goo at the bottom of the test tube". Creationists' rhetorical campaign against evolution has done nothing to undermine the overwhelming evidence in its favor. (Interested readers might check the June 25, 1999, issue of *Science* for a small taste of some of the exciting recent findings by evolutionary biologists, including a review of research on the chemical origin of RNA structure.) If Behe's objection to me is that I am not sufficiently pessimistic about the prospects of such ongoing research, I plead guilty.

Although he fails to defend himself, Behe does attempt to come to the aid of Phillip Johnson and tries to justify IDCs' reliance upon negative argumentation. It is fitting that he does so in terms of political advertising, in that IDCs rely upon propaganda rather than scientific research. He writes: "[E]vidence against Darwinism does count as evidence for an active God, just as valid negative advertising against the Democratic candidate will help the Republican, even though Vegetarian and One World candidates are on the ballot, too."

But the fallacy should be clear even here. Even if a voter were to be misled by false negative ads against the Democrat candidate, that will not automatically help the Republican. For instance, depending upon the details of the candidates' positions, the ad could hurt the Republican as well. Negative advertising could also cause a voter to be so disgusted as not to cast a vote for *anyone* on the ballot and wait for a better alternative. Moreover, Behe's voting analogy does not even apply to the case at hand, because IDCs consistently refuse to identify party affiliation or even the name of their candidate. No one is going to vote for a shadowy Mr X if it is impossible to check his (its?) credentials or even existence. As for God, he gracefully declines to put himself on the ballot in opposition to real candidates, allowing voters (if we may stretch the political analogy) to render unto Caesar what is Caesar's.

Like Johnson, Behe presumes that God and evolution are mutually exclusive options, but we have no scientific evidence to back up

that assumption — nor is it easy to imagine what such evidence could even look like. The point is that even political candidates have to earn their votes by offering a positive program and a proven track record. In science, the standards are higher still, for the program must be supported objectively by the evidence and pass the test of peer review. IDCs call for a revolutionary "theistic science", but offer no details of their positive platform and so, like a weak political candidate, take the low road of slinging mud (or in this case "goo").

Behe also defends Phillip Johnson from another of my criticisms, arguing that Johnson should be excused for not having made careful distinctions, because he was writing "not for philosophers but for the general public". But that is a feeble excuse, especially given that IDCs purport to be engaging in a scholarly, philosophical debate. Moreover, I doubt that many in the general public will agree that it is "logic-chopping", as Behe calls it, to distinguish the evangelical's conception of "the True God of the Bible" from a universal life force or other view of God. Without argument, Johnson and company blithely dismiss entire traditions of Christian theology (not to mention non-Christian views), presuming that only the evangelical view matters. Behe says he is a Roman Catholic, but the Pope's recent statement supporting evolutionary biology and reiterating the Church's view that evolution does not imperil the faith seems not to have sunk in. "The God of science"? — one detects no science in Behe's "Case for intelligent design", and it is clear that he and other IDCs recognize only their own particular notion of God.

IDCs, like other creationists, hold that one must choose between evolution and Christianity. William Dembski, the mathematician/philosopher with the University of Chicago PhD to whom Behe referred, wrote that IDCs are "no friends of theistic evolution" (Dembski 1995). In *Tower of Babel*, I defended a view of science that eschews both the strong atheist and creationist extremes and hews to methodological naturalism — a moderate view that upholds what is necessary for scientific inquiry and sets aside metaphysical possibilities about God for theologians and philosophers to debate and the faithful to believe in as they may.

Let me make one last comment about Behe's closing appeal to the mid-20th-century positivist physicist Percy Bridgman. Chiding me for being a scientific "gatekeeper", Behe quotes Bridgman to the effect that "The scientific method, as far as it is a method, is nothing more than doing one's damnedest with one's mind, no holds barred." Behe concludes: "No holds barred, even though that may force us to conclude that the universe reveals, in its intelligent design, traces of its intelligent designer."

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Behe's Irreducible Complexity and

Hubert P Yockey

In his well-worn example of the mousetrap, Behe is looking at Rorschach ink blots, so to speak, and describing what he wants us to see. Behe overlooks the Venus flytrap (*Dionaea muscipla*) and other carnivorous plants with their specialized functions dependent on complex, integrated structures. The lure is a sweet-smelling nectar. The insect prey, upon entering the head of the flytrap seeking the source of the nectar, touches one or more of the trigger hairs located within the jaws of the trap. The trap snaps shut, enclosing the victim. An enzyme dissolves the insect, turning it digestible. After a few days, the flytrap opens, awaiting the next victim. It does indeed have all the components of the mousetrap made by humans, in addition to a means of disposing of the victim, which is lacking in Behe's mousetrap. Darwin was much concerned with "missing links" and based much of his "one long argument" on comparative morphology. The old arguments based on "missing links" proposed in opposition of Darwin's theory are no longer relevant. Recent work on the genomes of many organisms proves that there is indeed a phylogenetic evolutionary tree from which all organisms have branched.

Behe takes his discussion of "complexity theory" from Stuart A Kauffman (Kauffman 1993, 1995). As Behe explains: "In brief, complexity theory states that systems with a large number of interacting components spontaneously organize themselves into ordered patterns" (1996: 189-90). Both Behe and Kauffman are barking up the wrong tree; they confuse "ordered" sequences with "complex" sequences.

Complexity is a scale with orderliness at one end and randomness at the other (*see Figure 1*). Thus when we speak of the amount of complexity in a sequence, we are speaking about the amount of its randomness as well. The units of measurement of information content, orderliness, complexity, and randomness are the bit and the byte, which are familiar to computer users as the units used to measure how much information their computers can process or store.

Evolutionary Theory

Furthermore, this confusion leads Kauffman to deny that the genome plays an essential role in the process of evolution.

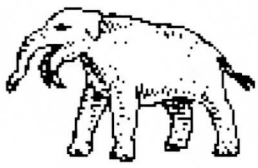
> Since Darwin's theory of evolution, Mendel's discovery of the "atoms" of heredity, and Weismann's theory of the germ plasm, biologists have argued that evolution requires a germ plasm. False, I claim (Kauffman 1993: 285).

The history of contemporary molecular biology argues otherwise. The starting point in modern theoretical biology — the moment of truth, as it were — came in 1953 when Watson and Crick discovered that the formation of biomolecules is controlled by the sequences of nucleotides recorded in the double helix of DNA (or RNA in some viruses). Thus the *genetic message* is segregated, linear, and digital. The transmission of the original genetic message for more than 3.8 billion years since the origin of life (Mojzsis and others 1999) with modification and diversification by evolution would be quite impossible if the message in the genome were not digital.

The segregated, linear, and digital character of DNA is what distinguishes living organisms from inanimate matter. In inanimate matter, there is no trace of messages determining the results of chemical reactions. Gregory Chaitin (1979) has shown that a definition of complexity that can be measured and is not irreducible, appropriate to all sequences from a finite alphabet, is applicable to DNA and protein sequences.

Chaitin (1979) discussed the role of complexity in biology:

> In discussions of the nature of life, the terms "complexity", "organism" and "information content" are sometimes used in ways remarkably analogous to the approach of algorithmic information theory, a mathematical discipline that studies the amount of information needed for computations. We submit that this is not a coincidence and that it is useful in discussions of the nature of life to be able to refer to analogous precisely defined concepts whose properties can be rigorously studied. We propose and discuss a measure of degree of organization and structure of geometrical patterns which is based on the algorithmic version of Shannon's concept of mutual information. This paper is intended as a contribution to von Neumann's program of formulating mathematically the fundamental concepts of biology in a very general setting, [that is], in highly simplified model universes (p 477).



A sequence of symbols, such as the genome, is highly "complex" when it has little or no redundancy or "order" and cannot be described by a much shorter sequence or calculated by an algorithm of a length shorter than the sequence itself. A sequence that is random has the highest degree of complexity, has no redundancy, and cannot be described by a sequence shorter than the sequence itself. A sequence is "highly ordered" only if it has regularities *and can be described by a much shorter sequence.* It is impor-

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However, Behe has taken Bridgman's comment out of context, implying that Bridgman proposed that there are no methodological rules in science. This could not be farther from the truth. Indeed, a crucial element of Bridgman's approach was that theoretical terms in science must be given an "operational definition" if they are to have any cognitive significance. I have yet to see Behe or any other IDC give an operational definition of their vague "intelligent designer", let alone of God. Without such a definition, Bridgman would have judged their creation hypothesis to be literally nonsense.

IDCs quote a bit of positivist philosophy in one breath and a bit of postmodernism in the next as it suits their immediate purposes, and the result is an incoherent conceptual mess. Both science and religion deserve better.

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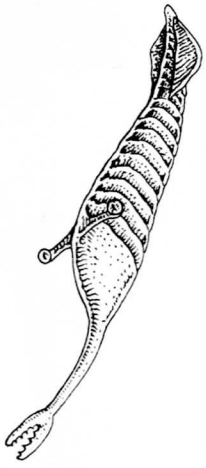
FIGURE 1

INFORMATION CONTENT IS A MEASURE OF COMPLEXITY

ORDERLINESS		RANDOMNESS
small information content	LESS COMPLEXITY — MORE COMPLEXITY	large information content

tant to realize that an ordered sequence contains *only* the amount of information in the algorithm needed to calculate it (Traub and others 1983). Crystals, for example, are highly ordered structures containing little information — just a single set of instructions repeated many times.

Living organisms are not crystals, however; they require a great deal of information, which is encoded in their genome. The genome contains, in the form of amino acid sequences, all the information in principle necessary to bridge the gap between genotype and phenotype — whether the phenotypic outcome is gross morphology or the 3-dimensional structure of biological molecules. There is nothing in the physicochemical world that remotely resembles organic reactions determined by a sequence and codes between sequences.



The origin of biological complexity

Bohr (1933) argued that life is consistent with but undecidable by human reasoning from physics and chemistry. In other words, it may be that we cannot now — or perhaps ever — devise the methodological and technical innovations that will allow us to retrace the pathways from nonliving to living systems. Accordingly, on this view, the existence of life must be considered as an elementary fact (or axiom) that cannot be explained, but must be taken as a starting point in biology (Bohr 1933; Yockey 1992; Makous 2000).

The universal phylogenetic tree is the basis of the relationships among all organisms — those from which extant organisms evolved as well as those to be evolved in the future (Woese 2000). The root of the phylogenetic tree represents the first stage in molecular evolution. As one attempts to follow the tree to its root by vertically derived sequences — counting sequence changes "down" through the generations — one encounters the effects of horizontal gene transfer — sharing of genes within a single generation, not just handing them down from parent to offspring.

Horizontal gene transfer appears to have been pervasive and dominating in the early history of life, and its vagaries limit the ability of genomic sequencing to follow the phylogenetic tree to the universal ancestor. On the other hand, the nearly universal structure of the genetic code and the handedness of proteins and nucleic acids is preserved in horizontal gene transfer and attests to the existence of a universal ancestor. Nevertheless, horizontal gene transfer has substantially erased the record of the earliest genetic sequences. This means that the earliest branches of the tree are probably not knowable.

Behe, Kauffman, and creationists alike assume to the contrary that all phenomena of nature can be known by humans. However, there is no requirement that nature's laws be intelligible, plausible, or even known to mankind. As Hamlet said: "There are more things in heaven and earth, Horatio, than are dreamt of in your philosophy." (*Hamlet*, I:v). JBS Haldane (1892-1964) expanded this sentiment in 1927: "The universe is not only queerer than we suppose, but queerer than we can suppose." Darwin's Great Chain of Being has indeed produced the genome of the Venus flytrap, which is a better trap than Behe's man-made mousetrap, even if the processes and pathway that produced this particular result can never be fully known.

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Nineteenth-Century Design Arguments

Glenn R Morton

George Taylor was a 19th-century American design advocate. His book, *The Indications of the Creator or, The Natural Evidences of Final Cause*, had first been published in the US and then re-published in Glasgow somewhere around 1860. The latest reference in the book is to a January 1850 article by Charles Lyell, which indicates the probable publication of this undated book to the early 1850s. Taylor also makes no mention of Darwin or his *On the Origin of Species*.

Taylor is so fascinating because he presents the arguments for divine design based upon the best science of the 1850s, which, of course, sound very unconvincing to the modern ear. Yet, he made a remarkable statement which was very suggestive of Michael Behe's concept of irreducible complexity:

> It is our present object to trace the progress of these discoveries in the different sciences, and to ascertain, if possible, how far they deny the theories referred to [Lamarck's development theory and the nebular hypothesis] and to what extent they go in proving the existence and ever-active presence and goodness of a GREAT INTELLIGENT FIRST CAUSE. In doing this we have been led to notice the agreement and adaptation of the infinitely varied parts of the universe, and how each part is inseparably interwoven with every other; and how all work together as some mighty piece of mechanism, in which nothing is wanting, neither can anything be taken away. ...If there were no beautiful adaptations — no pre-arrangement of parts to secure general and particular ends, there would be much more difficulty in refuting the arguments of scientific infidelity. But fortunately for truth and faith, all nature is full of these arrangements (1860: 19–20).

Compare this with Behe's definition of irreducible complexity:

> By irreducibly complex I mean a single system composed of several well-matched, interacting parts that contribute to the basic function, wherein the removal of any one of the parts causes the system to effectively cease functioning. An irreducibly complex system cannot be produced directly (that is, by continuously improving the initial function, which continues to work by the same mechanism) by slight, successive modifications of a precursor system because any precursor to an irreducibly complex system that is missing a part is by definition nonfunctional (1996: 39).

The conclusion of intelligent design for physically interacting systems rests on the observation of highly specified, irreducible complexity — the ordering of separate, well-fitted components to achieve a function that is beyond any of the components themselves. Although I emphasize that one has to examine molecular systems for evidence of design, let's use Miller's essay as a springboard to examine other problems with the argument from imperfection (1996: 223).

Seeing that Taylor uses an almost identical definition of design as Behe, it is fascinating to examine the arguments for design that he uses. Behe looks for multi-component biological molecular systems and claims that they are evidence of design. Taylor, too, was looking for multi-component, interacting parts of a system that would fail if one component were removed. Since he knew nothing of molecular biology, his examples are drawn from other fields of science. As we shall see, none of his design arguments would get much of a hearing today.

Interactions of the planets as evidence of design

As evidence of design, Taylor cites the interaction of the 8 planets he knew. All the planets must have been set in motion at just the right velocities, positions, and so on to maintain the stability of the solar system. He had rejected the nebular formation of the solar system and in doing so, rejected the explanation for the stability of the solar system and its formation via natural law:

> But as the orbits differ very little from circles, the momentum of the planets, when projected, must have been exactly sufficient to insure the permanency and stability of the system (1860: 43)

and

Glenn Morton has a BS in physics and has worked in the oil industry for 30 years, holding, among others, positions as the geophysical manager for the Gulf of Mexico, chief geophysicist for China, and the geophysical manager for the North Sea. He has published more than 60 items on creation-evolution issues.

This important and necessary arrangement has always been considered an interesting and conclusive evidence of original design; because it depends on conditions arbitrary in themselves. The quantity which secures the stability for the system depends on the uniform motion of the planets, their circular orbits, and the smallness of their eccentricities; all of which might have been different from any thing we can discover in the laws pervading the universe (1860: 43).

Interactions of the earth's orbit and climate

Taylor correctly believed that the earth's climate was controlled by the earth's orbit but, because he knew nothing about the precession of the equinoxes, he assumed that the present state of the earth's orbit was one of absolute stability and proclaimed that this was an evidence of design. What we know today is that the orientation of the earth's axis and related planetary conditions vary cyclically over thousands of years, changing the climate from one of warmth (today) to one of glaciation (20 000 years ago). The eccentricity varies over a 100 000-year period; it has assumed in the past, and will assume in the future, very different values from those we see today. But lacking this knowledge, Taylor was led to proclaim the unexplained (at that time) observation as evidence of divine design:

> During our near approach to the sun (for the earth is about one twenty-ninth of its whole distance from the sun nearer to it during its perihelion than it is during its aphelion), its velocity is increased in proportion to the decrease of the square of its distance. It is this increased angular velocity of the earth when at its perihelion, that protects us from the excess of heat to which our comparatively near approach to the sun would otherwise expose us. "Were it not for this," says Sir John Herschel, "the eccentricity of the orbit would materially influence the transition of the seasons. The fluctuation of distance amounts to nearly one-thirtieth of its mean quantity, and consequently, the fluctuation in the sun's direct heating power to double this, or one-fifteenth of the whole. Now the perihelion of the orbit is situated at the place of the northern winter solstice; so that, were it not for the compensation we have just described, the effect would be to exaggerate the difference of summer and winter in the southern hemisphere, and to moderate it in the northern; thus producing a more violent alternation of climate in the one hemisphere, and an approach to perpetual spring in the other." ... This, then, for we can arrive at no other conclusion, must have been designed originally for the important offices it performs, by the POWER that created it; and that POWER must have been intelligent and all-powerful, for no other could have foreseen the necessity of this condition and established it as a law (1860: 56–70).

Knowing nothing of continental drift or the origin of the mountains rimming the Pacific Ocean, Taylor argues that the topography is evidence of design. Today the mountains along the Pacific coasts of North and South America are known to be uplifted through the effects of the subduction of the Pacific oceanic plates. However, according to Taylor:

> The mountains descend gradually towards the Atlantic and Frozen Oceans; while their slopes are rapid and precipitous towards the Pacific and Indian Oceans. "If this order were reversed," says Professor Guyot, "and the elevation of the lands went on increasing toward the north, the most civilized half of the globe at the present, would be a frozen and uninhabitable desert." This disposition of the slopes is most uniform and remarkable. There is nothing in the formation of the continental masses better adapted to impress the mind with the idea of original design (1860: 137).

He also assumes that the current arrangement of the Gulf of Mexico and the Rocky Mountains are permanent. Both act to funnel moisture into the mid-continent of the US, allowing it to be the breadbasket of the world rather than a desert. He is correct that the arrangement acts in this regard, but given continental drift, this arrangement is temporary. Taylor put it this way:

> Thus in the case of North America, the effect of the long northern slope, by which we are exposed to the polar currents of wind, and the influence of the Rocky Mountains, which turn these currents back upon the Mississippi Valley, is controlled in a great measure by the action of the immense chain of lakes on the north, over which these currents must pass, and the gulf of Mexico on the south. This deep cut, as observed by Professor Guyot, opens the southern portion of our continent to the wet winds of the tropics. The return trade winds, coming directly from the sea, water the Atlantic coast, the western slope of the [Alleghenies], and the Valley of the Mississippi. Owing, therefore, to this "broad gate", we are more highly favoured with rains than could be expected from our situation and continental reliefs. A different disposition of the Rocky Mountains would change the character of our climate and country. The Rocky Mountains and Gulf of Mexico act and react

continued on page 27

Evolution, Creation, and Science Education
Answers to Ten Common Questions

Molleen Matsumura

THE SCIENTIFIC ISSUES

Why should evolution be taught in science classes?

Evolution is currently the best, most accurate explanation available for the variety of life we see in the living world. It is the result of the research and experimentation of thousands of scientists for over a century. And it is important. Children need to know about evolution because it is a key to understanding the biological sciences, from genetics to animal behavior.

But what about equal time for other scientific viewpoints, such as scientific creationism?

"Scientific creationism" is not a genuine scientific theory. It is an attempt to use scientific-sounding arguments to uphold a religious belief, the belief that the creation story told in the Bible is literally true. Science uses natural causes to explain natural events, never invoking miracles. "Scientific creationism" depends on miracles; its explanations assume that there have been exceptions to the laws of nature. This means that "scientific creationism" is unscientific by definition.

What about the flaws in the theory of evolution? If there are problems with this theory, doesn't that prove we should pay attention to creationism?

In the first place, finding a problem in one theory does not prove that another is correct. Moreover, the "flaws" that creationists claim to find in evolutionary theory simply do not exist. They are based on misunderstanding evolution or misrepresenting the evidence for it.

THE LEGAL ISSUES

What do the courts say about the teaching of evolution and of scientific creationism?

In 1968, in *Epperson v Arkansas*, the Supreme Court ruled that states may not forbid the teaching of evolution. Then, in 1987, in *Edwards v Aguillard*, the Court ruled that states may not require the teaching of "scientific creationism". To do so would be to teach a religious doctrine, in violation of the First Amendment to the Constitution, which forbids the government to do anything that inhibits or advances religion. Public schools may teach about religion; for example, a social studies teacher may tell students about the beliefs of the people in a country they are studying. But a teacher may not advocate a religion — that is, tell students that they should adopt particular religious beliefs.

What about the teacher's freedom of speech?

Outside of school, the teacher is as free to advocate religious beliefs as any other citizen. In school, these rights are limited by the teacher's professional responsibilities. Another Supreme Court decision, *Palmer v Board of Education*, says, "There is a compelling state interest in the choice and adherence to a suitable curriculum.... It cannot be left to individual teachers to teach what they please." The science teacher's responsibility is to teach accurate and up-to-date science that is accepted by the scientific community. This responsibility is affirmed by a number of teachers' organizations that also work to protect teachers' rights. Policy statements of many educational organizations may be found in the NCSE book *Voices for Evolution.*

What about the rights of parents to have their beliefs taught to their children?

Nobody denies the right of parents to teach their beliefs at home, or to have their children taught their beliefs in churches, synagogues, summer camps, and so on. Public schools have to teach children from a variety of religious and ethnic backgrounds, and teachers must use curricula that avoid promoting or denying religious beliefs. Teachers must meet curriculum requirements designed to assure that children learn what they will need to know. The schools could not function at all if they taught every belief of every parent. The schools do their best to teach the most accurate information available.

But if a majority (or at least a very large number) of people wanted scientific creationism to be taught, wouldn't it be more democratic to do that?

The decision we have made in our democracy is to try to give all children the best education possible. We know that sometimes a great number of people have misconceptions. Sadly, large numbers of people do not know that the earth revolves around the sun, how electricity works, or what causes tides. Is it fair to the children to omit teaching things because a lot of people do not understand them, or to teach them something that is not true just because a lot of people believe it?

THE MORAL ISSUES

Doesn't the idea of evolution go against religion?

Many religious groups have no problem whatever with the theory of evolution or other scientific findings. NCSE's book *Voices for Evolution* contains statements from several major religious organizations, explaining why their faith is not harmed by the idea of evolution. In fact, many feel that a deeper understanding of nature's wonders actually enriches their faith.

Doesn't teaching evolution destroy morals by telling children it's okay to act like animals?

Which animals are we talking about? Every pet owner knows that dogs act like dogs and cats act like cats. Humans act like humans. Like other animals, humans have innate behaviors. What is special about human beings is that we do not act only on instinct. Each new generation must be taught how to behave morally. The older generations develop codes of manners and morals, and pass laws, enforce them, and teach the children to obey them. Understanding evolution reinforces the message that all people are important parts of the web of life, and each person is unique and valuable.

Isn't it true that by teaching "survival of the fittest" evolution is used to justify cruelty?

No. In the late nineteenth century, a philosophy called "Social Darwinism" misguidedly attempted to apply the lessons of biological evolution to society, teaching that colonized nations, or poor people and disadvantaged minorities within a country, must deserve their situations because they were "less fit" than those who were better off. The fact is that the idea of biological evolution has stood the test of time, but "Social Darwinism" has not. We now know that "fitness" means more than just brute strength. For many kinds of animals, and certainly for humans, cooperation and kindness help the survival of individuals and of groups.

Abridged from "Evolution, creationism, and science education", on the NCSE web site at <http://www.ncseweb.org/resources/articles/3117_evolution_creation_and_scien_12_7_2000.asp>.

Confronting Creationism

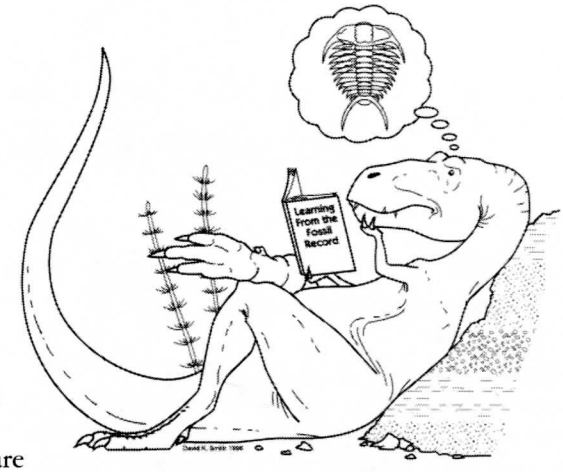

Illustration by Dave Smith, used with permission of the University of California Museum of Paleontology

Thomas Henry Huxley famously praised those "to whom the satisfaction of throwing down a triumphant fallacy is as great as that which attends the discovery of a new truth". So it is certain that Darwin's bulldog would have been delighted to read the books listed below, which argue in detail — and from various points of view — against the pernicious fallacy of creationism and warn against the danger of its being allowed to triumph. Some are tried-and-true classics; some are hot off the press. And all of them are now available on the NCSE web site: <http://www.ncseweb.org/bookstore.asp>. And remember, every purchase benefits NCSE!

Classics

Evolution and the Myth of Creationism: A Basic Guide to the Facts in the Evolution Debate
by Tim M Berra
Praised by Paul R Ehrlich as "a powerful antidote to those who imagine there is a controversy in the scientific community over evolution", this clear, comprehensive survey describes the theory of evolution and the evidence on which it rests while also answering "arguments against evolution". The closing chapter on "Science, Religion, Politics, Law, and Education" discusses the opposition to evolution and why it must be resisted. Berra, a member of NCSE, is Professor Emeritus in the Department of Evolution, Ecology, and Organismal Biology at the Ohio State University at Mansfield.

Science on Trial: The Case for Evolution
by Douglas Futuyma
Michael Ruse describes NCSE Supporter Douglas Futuyma's *Science on Trial* as "the book to show someone who is worried about the threat of creationism. ... It can be read for pleasure and profit by people at all levels of biological sophistication." Originally published in 1982, *Science on Trial* was reissued in 1995 with extensive notes bringing it up to date. Futuyma writes in the 1995 preface that "in an age in which some understanding of science is a virtual necessity for everyone, it is incredible that the single most fundamental principle of biology and one of the most fundamental in modern thought should still be an object of controversy and disbelief."

Scientists Confront Creationism
edited by Laurie R Godfrey
"This scholarly, richly documented anthology is also a slashing, two-fisted attack on the scientific imbecility of today's ... creationists", writes Martin Gardner: "It won't alter the opinions of any leading creationists — their mind sets are unalterable — but for anyone open to reason and overwhelming evidence, it couldn't be more effective." Contributors include Alice B Kehoe, John R Cole, George O Abell, Stephen G Brush, Russell F Doolittle, John W Patterson, Thomas H Jukes, Stephen Jay Gould, David M Raup, Joel Cracraft, Laurie R Godfrey, Steven D Schafersman, C Loring Brace, Robert J Schadewald, and Frederick Edwords. *[NCSE Supporter Godfrey and NCSE Editor Andrew J Petto are currently preparing a revised edition for publication in 2002!]*

Abusing Science: The Case Against Creationism
by Philip Kitcher
In the words of Stephen Jay Gould, "a brilliant book by a gifted scholar." Martin Gardner, writing in *Discover*, raves, "*Abusing Science* does more than just explode moldy arguments.... As a philosopher concerned with the way science operates, Kitcher is good at showing how creationists distort Karl Popper's views on scientific method, and how they misuse such books as Thomas Kuhn's *Structure of Scientific Revolutions*." Well-written and understandable even by those with little or no scientific or philosophical background. The author, a professor of philosophy at Columbia University, is a Supporter of NCSE.

But Is It Science? The Philosophical Question in the Creation/Evolution Controversy
edited by Michael Ruse
Prompted by his experience testifying for the plaintiff's side in *McLean v Arkansas*, the eminent philosopher of biology and NCSE Supporter Michael Ruse assembled *But Is It Science?* As the reviewer for the *Journal of Church and State* wrote, "Ruse has performed a great service." Judiciously selected essays and excerpts present infor-

<http://www.ncseweb.org/bookstore.asp>

mation on the nineteenth-century background, the state of evolutionary theory, the nature and source of the creationist challenge, and the philosophical aftermath of the decision in *McLean* (consisting of exchanges between Ruse and his fellow philosophers Larry Laudan and Philip L Quinn).

Science and Earth History — The Evolution/Creation Controversy
by Arthur N Strahler
In his massive *Science and Earth History*, the distinguished geologist Arthur N Strahler systematically demolishes not only the geological claims of young-earth creationism but also its claims about cosmology and astronomy, the fossil record, human evolution, and the origin of life, concluding that "the fundamentalist creationist view of the universe, based on the literalist interpretation of the book of Genesis ... constitutes pseudoscience." First published in 1987 and reprinted in 1999 with a new preface.

The Latest

Defending Evolution: A Guide to the Creation/Evolution Controversy
by Brian J Alters and Sandra M Alters
Defending Evolution is an unequivocal must for anyone concerned with evolution education. Ernst Mayr writes, "This book should be in the hands of every educator dealing with the subject of evolution." Eugenie C Scott, executive director of NCSE, agrees: "At last a book for teachers to help them cope with anti-evolutionism. Clearly written and filled with practical advice about the underlying religious and scientific issues prompting student questions, *Defending Evolution* should be on every teacher's bookshelf." Brian J Alters is a Contributing Editor of *RNCSE*.

The Triumph of Evolution and the Failure of Creationism
by Niles Eldredge
As Kenneth R Miller explains, "*The Triumph of Evolution* destroys any notion that evolution is a theory in crisis or that science is a closed activity driven by philosophical agenda." Eldredge, a Supporter of NCSE, is a Curator in the Department of Invertebrate Paleontology at the American Museum of Natural History, and a prolific author. NCSE is proud that he dedicated *The Triumph of Evolution* "to the inspired and unflagging efforts of Eugenie Scott and her entire staff at the National Center for Science Education — frontline defenders of quality science education in America." Thanks, Niles!

An Evolving Dialogue: Theological and Scientific Perspectives on Evolution
edited by James B Miller
In the introduction to his anthology, Miller explains that "the articles collected herein provide a basic introduction to contemporary evolutionary biology, provide historical and philosophical perspectives on the relationship between evolutionary biology and religious thought, and consider the intelligent design movements from scientific, philosophical and religious perspectives." Among the contributors who will be familiar to readers of *RNCSE* are Francisco J Ayala, Douglas J Futuyma, Ursula Goodenough, Stephen Jay Gould, John F Haught, Ernst Mayr, and Kenneth R Miller — as well as intelligent design proponents Michael J Behe and William A Dembski.

Finding Darwin's God: A Scientist's Search for Common Ground Between God and Evolution
by Kenneth R Miller
As an ardent evolutionist and a devout Christian, NCSE Supporter Kenneth R Miller argues in *Finding Darwin's God* against both those who deny evolution — devoting chapters to the anti-evolutionary animadversions of Henry Morris, Michael Behe, and Phillip Johnson — and those who take evolution to entail materialistic atheism. "Yet", as Francisco J Ayala remarks, "it is a book for all readers. I know of no other that would surpass it in being mindful of different views, while still forceful. Miller has an uncanny gift for expressing profound ideas in clear and graceful prose."

Tower of Babel: The Evidence against the New Creationism
by Robert T Pennock
Simply the most comprehensive treatment to date of the intelligent design movement, *Tower of Babel* was described by Frederick Crews in *The New York Review of Books* as "... comprehensive and consistently rational ... the best book opposing creationism in all of its guises" and by Evan B Hazard in *Choice* as "[e]ssential reading for all social and natural scientists (especially secondary and college teachers), and also concerned pastors, seminarians, and seminary professors." The author, a member of NCSE, is Associate Professor at the Lyman Briggs School and in the Department of Philosophy at Michigan State University.

Intelligent Design Creationism and its Critics
edited by Robert T Pennock
According to the publisher, Pennock's new anthology on "intelligent design" creationism (IDC) "contains articles previously published in specialized, hard-to-find journals, as well as new contributions. Each section contains introductory background information, articles by influential creationists and their critics, and in some cases responses by the creationists. The discussions cover IDC as a political movement, IDC's philosophical attack on evolution, the theological debate over the apparent conflict between evolution and the Bible, IDC's scientific claims, and philosopher Alvin Plantinga's critique of naturalism and evolution. The book concludes with Pennock's 'Why Creationism Should Not Be Taught in the Public Schools.'"

NCSE on the Road

A Calendar of Special Events, Presentations, and Lectures

Date	February 16, 2002
City	Boston MA
Presenter	Eugenie C Scott
Title	Genomics and the Creationism Controversy
Event	Genomes Around Us: What Are We Learning?
Time	3:00 PM
Location	Sheraton Boston
Contact	Eugenie C Scott, scott@ncseweb.org

Date	March 1, 2002
City	Detroit MI
Presenter	Eugenie C Scott
Title	Teaching Evolution (and Surviving)
Event	MABT/MSTA annual meeting
Time	10:00 AM
Location	Marriott Hotel
Contact	Lynda Smith, lsmitih@remc11.k12.mi.us

Date	March 24, 2002
City	Arlington VA
Presenter	Eugenie C Scott
Title	What's New in the Anti-evolution Movement?
Event	AIBS annual meeting
Time	8:30 PM
Location	Key Bridge Marriott
Contact	Richard O'Grady, rograd@aibs.org

Date	March 26, 2002
City	New York NY
Presenter	Eugenie C Scott
Title	Evolution and Education
Event	Presentation in "Intelligent Design" Series
Time	8:30 PM
Location	American Museum of Natural History
Contact	Nathaniel Johnson Jr., natj@amnh.org

Date	March 27, 2002
City	San Diego CA
Presenter	Eugenie C Scott
Title	Teaching Evolution
Event	National Science Teachers Association meeting
Time	TBA
Location	TBA
Contact	Eugenie C. Scott, scott@ncseweb.org

Date	October 25, 2002
City	San Francisco CA
Presenter	Eugenie C Scott
Title	The Big Ideas of Human Evolution
Event	California Science Teachers Association meeting
Time	TBA
Location	Bill Graham Civic Auditorium
Contact	Judy Scotchmoor, jscotch@uclink4.berkeley.edu

[Check the NCSE web site for updates and details — <http://www.ncseweb.org>.]

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continued from page 22

> on each other, and are equally necessary in making up our continental character (1860: 139).

The seasons and light from the sun become an object of design:

> Vegetation is regulated by the seasons; but what agency does light, and especially the harmonious action of these distinct principles, perform? This question was before the British Association last year, and submitted to Mr Hunt for investigation. From his report, it appears that light transmitted through yellow glass has little or no influence on the germination of seeds, from the fact that the chemical portion of the ray will not pass through that colour. Every vegetable requires a certain portion of all these principles, and will not survive without them. And it is upon the changes in the proportion of them that germination, growth, and fructification, depend. These changes are in harmony with the seasons, and may result from them. "It is now an ascertained fact," says Mr Hunt, "that the solar beam during spring contains a large amount of the actinic principle, so necessary at that season for the germination of seeds and the development of buds. In summer there is a large proportion of the light-giving principle, necessary to the formation of the woody parts of the plant. As autumn approaches, the calorific or heat-giving principles of the solar rays increase. This is necessary to harden the woody parts, and prepare them for the approaching winter. It is thus that the proportions of the different principles are changed with the seasons, and thus that vegetation is germinated, grown, and hardened by them." We know not how these facts may act on the minds of others, but in the axis of the earth, so arbitrary yet so essential; in the distinct principles of solar light, so mysterious, yet so powerful and important in their action on vegetable life; and in the adaptation in the proportion of these principles to the seasons and necessities of the kingdom, we recognise the strongest evidence of the existence of an INFINITE WISDOM and an ever-active GOODNESS (1860: 111).

Of course, none of this is true. The same spectral energies are output by the sun throughout the year and light has no effect on hardening wood. Yet this was among the best of the 19th-century evidence for design.

The Meaning of "Design"

Of course, these design arguments fail to make a case today, because subsequent scientific investigation has invalidated them. It is perhaps most important to note that it is precisely this aspect of these arguments that should make us careful about modern arguments from design. How will our 21st-century arguments appear to those 150 years hence? Will the advance of knowledge make them appear as odd then as Taylor's arguments do to us today? How will they view Behe's irreducible complexity argument? We should live so long.

Should the reader, then, conclude that the universe is not designed? No. The reason for this is that, while we cannot prove design scientifically, we also cannot disprove it. As Edward Hitchcock (1857) argued, no matter what laws we find or postulate as having been involved in the origin and subsequent history of the world, one can always ask if those laws themselves were created by a divine being. No matter how many layers of laws or how long the list of laws, this question can always be postulated. When science finally settles unanswered questions about the existence of the universe, this question will still exist.

I do not present this account to destroy or discount the design argument, but merely to point out that Christians "walk by faith, not by sight". As such, we cannot *prove* scientifically that God designed the earth — to do so would be walking by sight and not walking by faith. Instead, what I hope to do is to point out, based on the history of and our experience with this idea, that the argument for design is not a very strong argument upon which to rest one's faith. Christians should not expect to find proof of their faith in the design of the universe (or any part of it).

Even if we find that the universe *could* organize itself on its own, this self-organization does not mean that God did not create it. One can always postulate that God created the laws for that organization. In the heyday of the argument from design in the 19th century, Hitchcock recognized this point:

> Even though we admit that God has communicated to nature's laws, at the beginning, a power to execute themselves (though the supposition is quite unphilosophical), no event is any the less God's work, than if all were miraculous (1857: 295).

Thus God can no more be excluded from the universe by scientific investigation, than He can be proven to exist. This means that Christians who see a justification of their faith in the argument from design (or, in modern terms, "intelligent design" theory) need to realize that they are cultivating a vine that will not bear fruit.

[Adapted from a web page with the same title at <http://www.glenn.morton.btinternet.co.uk/design.htm>.]

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Making Peace With Evolution

Arthur K Neuburger
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Judging Evolution by a Double Standard

Scientists have long enjoyed the privilege and borne the burden of being believed. At least when scientists in a particular discipline reach consensus on an issue, the rest of society is likely to accept their view. In the US, perhaps the most important departure from this pattern is the widespread rejection of the theory of biological evolution. Evolution is one of the most compelling ideas in all of science — supported by a vast amount of empirical evidence, based on virtually unassailable logic, and serving as the central unifying principle of biology. Yet in typical opinion surveys, virtually half of the US public indicates its disbelief in evolution or agrees that it is "only a theory". Why do so many people disagree with the biologists about evolution?

It is tempting to explain this disagreement using the admittedly elitist, but clearly supportable, contention that biologists understand evolution better than nonbiologists do. Certainly biologists become more familiar with the evidence for evolution and gain a greater appreciation for the power and elegance of evolutionary processes. But since the basic evidence and arguments confirming evolution are generally available and accessible, it might be expected that informed laypersons would also generally adopt the evolutionary view. Furthermore, nonscientists are often willing to defer to scientific authority with little critical thinking. Practically everyone believes that the earth orbits the sun rather than vice versa, but how many can describe the evidence that favors the heliocentric over the geocentric view of our solar system? Similarly, inability to present a cogent argument for the atomic theory does not prevent most people from believing in invisible units of matter. Why are people so willing to accept the core theories of astronomers and chemists (and most other scientists) but so reluctant to accept the core theory of biologists — evolution?

Assuming that biology is just as sound as the other natural sciences (a contention favored by biologists at least), explanations for the relatively low level of public acceptance of evolutionary theory must lie outside of science. In other words, people refuse to accept evolution not because of a lack of scientific evidence (although they may convince themselves that this is the reason), but because of other, nonscientific reasons.

Following Barbour (1966, ch 4), these nonscientific ulterior motives can be classified into four predominant categories: (1) preference for personal interpretations of religious accounts of the history of life over competing evolutionary reconstructions, (2) belief that accepting evolution necessarily leads to a devaluation of human life, (3) fear of the supposed ethical consequences of belief in evolution, and (4) conviction that using natural selection to explain the apparent design of nature leaves no room for divine involvement. The following analysis attempts to show why these four nonscientific objections to evolution are mistaken on philosophical grounds and is intended primarily as a guide for people (especially younger ones) who are struggling to accommodate evolution with other beliefs. Perhaps this treatment might also inspire some rethinking of their positions by those who have chosen to reject evolution for one or more of these reasons or who have abandoned religious beliefs that they suppose are incompatible with evolution.

Evolution and Creation

Many religions include narratives that serve to describe or explain the origins of the universe, the earth, life, and humans. Interpreted literally, these stories invariably make naturalistic claims that are in direct conflict with scientific views of life's history. For example, in the Judaeo-Christian tradition, a standard literal reading of Genesis suggests that the earth is only several thousand years old and that each kind (a vague term, usually somewhat broader than species — except in the case of humans) of organism arose separately and nearly simultaneously. This picture contrasts dramatically with the evolutionary view that life arose almost 4 billion years ago ("only" about half a billion years after earth itself formed) and that all living things have descended from a common ancestral form in a branching process over a long period of time. How can such an apparent contradiction be resolved?

For young-earth creationists the resolution is simple: religious authority takes precedence over scientific evidence, making the literal biblical account right and the evolutionary account wrong. After thus deciding the issue, creationists generally try to give their choice some scientific respectability by presenting supposed evidence for their view or (more often) presenting supposed evidence *against* evolution. This approach is not scientific because

it makes evidence subordinate to authority. Calling it "scientific creationism" has only created an oxymoron that confuses matters.

If the issue is really to be decided scientifically by careful examination and objective interpretation of the evidence, the resolution is also simple. Radiometric and other dating techniques demonstrate that life really has existed for billions of years on earth; the fossil record reveals the emergence of various groups of organisms at different times in earth's history; and the relatedness of all living things is established by homology, patterns of shared and uniquely-derived traits among species — especially patterns in nonfunctional or vestigial traits — and the biogeographic clustering of similar organisms. These and other standard lines of evidence for evolution are summarized nicely in general textbooks of evolution, as well as in several books written as responses to creationist attacks on evolution (for example, Kitcher 1982, Futuyma 1995). Actually, the issue of whether or not evolution *occurs* was virtually settled in the scientific community with the publication of *On the Origin of Species* in 1859, and most biological research ever since Darwin has explicitly or implicitly confirmed his conclusion.

What then are Christians and Jews who accept evolution to make of the two, rather different, Genesis creation stories? Creationists tend erroneously to dichotomize the issue, forcing a choice between believing in God and believing in evolution. Unfortunately, this approach implies that people with the intellectual integrity to accept evolution then ought to deny God. But accepting scientific truths no more justifies rejecting religious truths than vice versa. The existence of millions of people who believe in God as well as evolution demonstrates that another approach is possible.

The alternative approach simply acknowledges that Genesis, or any other religious text containing creation stories, need not be interpreted literally. These stories may be interpreted not as factual accounts of historical events, but rather as what anthropologists call myths: stories the real significance of which lies in their moral teachings. The creation myths of Genesis are thus important *not* for their scientific content but instead for the moral insights they provide on the relationships between God and nature, God and humans, humans and nature, and men and women. Fundamentalists may be quick to condemn such nonliteral interpretations, claiming that if one cannot believe *all* of the Bible then one cannot believe *any* of it. But it is not a matter of belief, it is a matter of interpretation, and even *literal* interpretations are *still* interpretations, just as surely as figurative ones are.

The trick is to figure out which interpretation is most appropriate. It should also be noted that figurative interpretations of the Bible originated long before Darwin (at least as early as Augustine in the 4th Century) and did not arise specifically as reactionary accommodations of evolutionary thought. Therefore, a non-literal view of the Bible is not just a cowardly accommodation to the "scientific priesthood", as biblical literalists assert. Instead, it is the current expression of a long and honorable theological tradition that does not rely on any scientific model for its justification.

Evolution and Humanity

A lot of people are unable to accept evolution because they regard the concept as degrading to humanity. The contention that our own species evolved from apelike ancestors and we are biologically related to even the "lowest" life forms conjures up images that for many people are too much even to contemplate. There are also those who are willing to accept an evolutionary view of the *rest* of nature but then inconsistently refuse to apply the same ideas to humans. Alfred Russel Wallace, who formulated the idea of natural selection independently of Darwin, even denied his own mechanism as an explanation for the origin of human intelligence, falling back on divine intervention in this one instance.

Of course even if it were true that evolutionary thinking changes our view of ourselves as the pinnacle of creation, this consequence would not be a *scientifically* acceptable reason for rejecting evolution. We would simply have to learn to live with this reduced opinion of ourselves, as we have with other hard truths. We have adjusted to Copernicus's revelation that our planet does not occupy a central position in the universe, and we could presumably also get used to a demotion in our status among other organisms.

But is such a demotion really called for by the evolutionary view? It certainly seems possible to appreciate the unique human capacities for self-awareness, rational decision making, conscious forethought and planning, use of language, intentional design of artifacts, cultural transmission of information, and so on, without regard for their mode of origin. Furthermore, on an individual level, people who rise from humble beginnings and by virtue of their own efforts and abilities become rich, famous, or powerful are generally regarded as even more admirable than those who merely *inherit* such status. An analogous perspective at the species level would credit *Homo sapiens* for evolving to a position of unmatched capabilities and influence in the organic world. A similar reasoning at the species level might lead us to a *higher* rather than a lower opinion of ourselves.

Another welcome (to many) consequence of evolutionary thinking about the relationship of humans to other animal species might be to increase our appreciation of other life forms. If humans are seen as an outcome of the same process that has produced all organisms, then it becomes plausible to regard nonhuman species

as only quantitatively different from us and worthy of some degree of the respect which we generally grant members of our own species. Instead of lowering our opinion of ourselves, evolutionary thinking can elevate our opinion of all life.

Evolution and Ethics

Opponents of the evolutionary view of life often blame it for the purported decline in ethical standards that it supposedly fosters, holding evolution responsible for virtually every real or imagined social evil in modem society. The tragic consequences of so-called Social Darwinism, a movement to pattern social policies after evolutionary processes, are often used as the primary cautionary tales about where such thinking can lead.

This criticism is the easiest of the nonscientific objections to evolution to dismiss because it is based on the well-known naturalistic fallacy: the philosophical error of attempting to infer the way things ought to be from the way things in fact are. This faulty reasoning supposes that if some condition or process exists in nature, then humans are right to copy it in their own affairs. Thus, if natural selection is seen as "survival of the fittest" (a phrase coined by Herbert Spencer, a leading advocate of Social Darwinism), then various sorts of ruthless competition among humans can be condoned with a clear conscience. But misusing science to determine how humans should behave is a blatant *abuse* of an enterprise dedicated to understanding how nature works. Along with the storied beauty and harmony of nature, there is much that is ugly and cruel by most human standards. Developing such ethical standards is one of the appropriate functions of philosophy and of religion, but not of science. According to Wright (1994, ch 16), the perspective provided by what is now called evolutionary psychology may even help us from committing the naturalistic fallacy by alerting us to the likelihood that natural selection has programmed us uncritically to accept our natural feelings as good.

Of course many people, including some scientists, have committed the naturalistic fallacy and overstepped the bounds of science, and they deserve to be criticized for doing so. But it is no more fair to condemn and reject a scientific idea because of distortions of its proper use than it is to condemn and reject a religion because of misinterpretations and misapplications of its tenets. Proponents of evolution should not be expected to repudiate their science because of Social Darwinism and other excesses, just as Christians should not be expected to abandon their faith because of the abuses of the Crusades and the Inquisition. It is also appropriate to point out that Charles Darwin never endorsed Social Darwinism and, in fact, politically opposed many of its doctrines. Furthermore, contemporary studies of the evolution of ethics suggest that our ethical impulses themselves have an evolutionary foundation. (*Ed: Evolutionary ethics books are featured in* RNCSE *20 [5].*)

Evolution and Design

Modern science received much of its impetus from the Judaeo-Christian notion, developed during the Scientific Revolution, that the creation was not only orderly but also understandable by humans. The doctrine that came to be known as "natural theology" was based on this premise; its practitioners sought to catalog examples of design in nature in order both to prove that God exists and to further our understanding of the divine plan. Among all the examples of design cited in natural theology, by far the most exquisite and convincing were those associated with living organisms. This paradigm remained virtually unchallenged until Darwin rendered it obsolete by showing that natural selection accounts for the *apparent* design of the organic world. But choosing to explain organic complexity and diversity with a mindless, blind, uncaring process rather than a designing, goal-directed, loving creator requires both abundant scientific support and substantial theological adjustment.

The scientific support is overwhelming. Natural selection is an algorithmic process that results from three empirically-verified but probabilistically-assured phenomena — mutation, heritability, and differential reproductive success — to produce phenotypic changes in populations that respond to long-term environmental shifts. Starting with self-organized, self-replicating entities and acting cumulatively and in a self-influencing manner on a vast number of populations over geological time, natural selection largely accounts for life's astonishing diversification and the marvelous array of adaptations shown by each species. Anyone who doubts the creative power of natural selection should read the accounts of Dawkins (1986) and Dennett (1995) before proclaiming its limitations.

The usurping of design by natural selection presents the most difficult challenge from evolutionary thought for traditional forms of theism. The principal task is to define what role is left for God to play in nature (*see p 34*). At least four distinct responses are possible, but each response has its own difficulties: (1) metaphysical naturalism, (2) deism, (3) directed evolution, and (4) process theology.

Adoption of metaphysical naturalism — the belief that the natural, material, mechanistic universe constitutes all of reality — means abandoning belief in the supernatural, not only as a force in nature but also as a spiritual reality. This position implies atheism, at least on most conceptions of God. Metaphysical naturalism should not be confused with *methodological* naturalism, which does not deny the existence of the supernatural but simply excludes it from consideration by science. It should thus be understood that adopting metaphysical

naturalism is a philosophical, not a scientific, decision. Science can place restrictions on the observable results of God's activity in nature (as natural selection excludes fiat design) but cannot, by definition, bring empirical evidence to bear on the question of the supernatural.

Deism assigns God the role of a founder or lawgiver rather than that of an architect/engineer. Instead of maintaining that God designed organisms and other aspects of nature through separate acts of creation, deists often view God as the original creator of the universe and of its natural laws, which have since acted to produce historical conditions and events. Such a God does not fine-tune the universe as it unfolds, but rather allows the preordained laws to take their predicted course. This view avoids the rather uncomfortable image of God's specifically tinkering with the creation in order to get it right. The catch to which many people object is that the God of deism also seems to be excluded from intervening in their personal lives; a God who is detached from nature is not the loving, involved God of many traditional religions.

The concept of directed evolution also accepts the evolutionary view of nature, but retains God as an immanent force to give the process direction and purpose. Evolutionary biologists usually find this view untenable because they cannot discern any directionality, purposiveness, or long-term progress during evolutionary history (Gould 1989, 1996). This empirical reading of the evolutionary record accords well with prevailing theoretical formulations of natural selection as a nonteleological process of local adaptation to contingent environmental conditions.

Although process theology is primarily the outgrowth of the thought of Alfred North Whitehead, its major ideas are more accessible through his interpreters. Barbour's (1990, ch 8) exposition is particularly clear and helpful. Like deism, process thought confines God's physical role in the universe to its establishment, maintenance, and governance by preordained natural laws, pointedly excluding separate acts of physical intervention — miracles. Like directed evolution, process thought allows for God's immanence in nature, but this immanence is confined to the spiritual realm. God is not able to directly alter the course of history but can influence it through the spiritual power of persuasive love. Such influence is directly proportional to the level of awareness of the entity being influenced. Process theology also provides a decidedly nontraditional view of God, but it does retain the central notion of God's loving, personal involvement with the created universe. Some will balk at the absence of omnipotence in the God of process thought, but this absence is viewed as God's voluntary way of expressing confidence in the established natural order, allowing indeterminacy while avoiding capriciousness, and ensuring the emergence of free will. Lack of omnipotence has the additional benefit of absolving God from blame for the existence of evil. Rather than somehow causing our suffering, God suffers with us (as exemplified in the life of Jesus). Whitehead developed his theology in the context of evolution, and it seems to me to coexist more peacefully with modem evolutionary concepts than many alternative religious frameworks.

Conclusions

The concept of organic evolution, based on compelling theoretical considerations and supported by massive amounts of empirical evidence, is central to understanding the diversity of life and the adaptive nature of particular organisms. However, supposed incompatibilities between evolution and important nonscientific beliefs often cause people to reject evolution despite its firm scientific foundation. Alternatively, people may abandon religious and philosophical beliefs that they suppose are discredited by established evolutionary ideas. Without denying the difficulties involved, it still seems possible to make peace with evolution by finding intellectually satisfying solutions for the major nonscientific objections to this central biological concept. Non-literal interpretations of the Bible and other sacred texts allow retention of fundamental religious truths while accepting evolutionary interpretations of life's history. Belief in evolution, rather than devaluing human life, can actually foster reverence for all life and still maintain a special respect for humanity. Although ethical standards should not be derived from evolutionary principles, an understanding of evolution can offer insights on how our ethical beliefs have arisen. Finally, accepting evolution does not deny divine participation in the process, although the nature of such involvement may depart considerably from conventional religious beliefs.

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How Many Species Were There?

In a recent issue of *Proceedings of the National Academy of Sciences*, Alroy and others have tackled the problem of estimating the diversity of living things throughout the earth's history. This study proposes a method for improving the reliability of these estimates. This new method looks at a large number of localities with well-characterized fossil inventories and constructs a database that can be examined under different models of variation through time in the number and types of taxa present. The authors are optimistic about this method, but recognize that a final assessment of its contribution to the study of global species diversity in the past must await further data collection and testing.

See the original article at <http://www.pnas.org/cgi/content/full/98/11/6261>.

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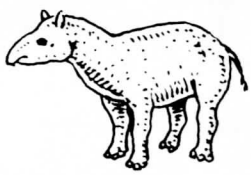
Genomics Gateway Open at BioMedNet

BioMedNet, the on-line biomedical information service, recently announced a new service for those interested in current information on genomics and biotechnology. An email announcement described the service this way: Compiled by the editors of *Trends and Current Opinion Journals*, the gateway provides a weekly view of the latest news, reviews, and opinions in genomics, bioinformatics, and proteomics To learn more about the service and to register, visit the gateway on-line at <http://reviews/bmn.com/genomics>.



Natural Selection Picks Optimum Communications Satellite Orbits

Andrew J Petto

Researchers at Purdue University have tested a new computer-based "genetic algorithm" based on Darwinian models of natural selection to improve satellite communications. The goal of the program was to identify the best altitude for communications satellites in order to balance costs, area of coverage, and the risk of temporary loss of connections. These satellites currently provide service for civilian uses, such as pagers and cellular phones, and various military uses.

The satellites orbiting at the same speed as the earth about 22 000 miles high can be in constant contact with about half the planet, but are very expensive to get into orbit. Orbits as low as 80 to 300 miles are much less expensive, but cannot contact their terrestrial stations for much of their 90-minute orbit around the planet, so these satellites require a team of about 4 units to work in shifts.

William Crossley led the team that devised a program to compare a wide array of possible configurations (constellations) of satellites. The algorithm selected the best-performing constellations by interchanging variables such as how far apart the satellites are from each other, the heading of the satellites as they cross the equator, and their altitude above the earth's surface.

Unlike constellations designed by humans, the best-performing configurations discovered by the genetic algorithm did not space the satellites uniformly — what our "intelligence" might designate the ideal or perfect design. "For example, the constellations might have two satellites spaced very far apart, and the third one will be very close to the second one", said Crossley.

The measure of "fitness" — minimum satellite blackout time — was improved significantly, though not perfected, for the less expensive low-flying satellite constellations.

A research paper about the findings is in the July-September 2001 issue of the *Journal of Astronautical Sciences*, published by the American Astronautical Society.

[*See the original press release posted on October 16, 2001 at Space.com by connecting to <http://www.space.com/news/darwin_satellites_011016.html>.*]

Little Things Caused Triassic–Jurassic Mass Extinction

The Triassic-Jurassic mass extinction occurred about 200 million years ago and destroyed at least half of the species on earth. This mass extinction occurred just before the breakup of Pangaea, when all the land on earth was joined in a single supercontinent. According to a University of Washington research team, the extinction took place in less than 10 000 years (very quickly on a geological time scale), and the chief indicator of the ecological collapse that led to the extinction is demonstrated in the fossil record by the disappearance of one-celled organisms called protists.

The team leader, Peter Ward, said that the massive die-off was linked with an abrupt drop in productivity — the rate at which inorganic carbon is turned into organic carbon through processes such as photosynthesis. Organic carbon produced in photosynthesis is the ultimate source of most of the carbon contained in living things on earth. Ward described the process as analogous to an algal bloom in reverse. Samples from sites in Northern Canada showed a sharp decline in the presence of organic carbon, even at places where levels of inorganic carbon rose. The organic carbon decline correlated with the decline of radiolarians, one-celled organisms that serve as a food source for a number of marine species.

Although the ultimate cause of the Triassic-Jurassic extinction is still not known, Ward said that the suddenness of this event is similar to that in two better-known mass extinctions — the Permian extinction about 250 million years ago and the Cretaceous-Tertiary extinction about 65 million years ago, best known for ending the "Age of the Dinosaurs".

The Triassic-Jurassic extinction killed the last of the mammal-like reptiles that once roamed the earth and left mainly dinosaurs.

Details of the research can be found in Ward P, Haggart J, Tipper H, Carter E, Wilbur D, Evans T. Sudden productivity collapse associated with the Triassic-Jurassic boundary mass extinction. *Science* 2001 May 11; 292: 1148-51. (Abstract also available on line at <http://www.sciencemag.org/cgi/content/abstract/292/5519/1148>.)

[Thanks to Paul Heinrich for letting us know about this article.]

BOOKREVIEWS

Evolutionary Theology Comes of Age

Theology of Creation in an Evolutionary World

by Karl Schmitz-Moormann
in collaboration
with James F Salmon, SJ.
Cleveland (OH): Pilgrim Press,
1997. 205 pages.

Evolution and Eden: Balancing Original Sin and Contemporary Science

by Jerry D Korsmeyer.
Mahwah (NJ): Paulist Press, 1998.
170 pages.

God After Darwin: A Theology of Evolution

by John F Haught.
Boulder (CO): Westview Press,
2000. 221 pages.

The God of Evolution: A Trinitarian Theology

by Denis Edwards.
Mahwah (NJ): Paulist Press, 1999.
144 pages.

Reviewed by Daryl P Domning, Howard University, Washington DC

Today's creationism is mainly a Protestant phenomenon, an extreme 19th- and 20th-century development of biblical literalism stemming ultimately from the Reformation's emphasis on "Scripture alone" as the source of Christian faith. A lesser, but apparently growing, challenge to science education comes from Catholics such as Michael Behe (1996), George Sim Johnston (1998), and Anthony Zimmerman (1998), who accept evolution only with major, religiously-inspired reservations about "Darwinism" — defined as the thesis that natural selection and random mutation are the main forces that produce evolution — or other crucial details. It thus behooves defenders of good science to understand some of the thinking on this other side of Western Christianity, where the interpretation of Scripture is tempered by the tradition of church teaching. The latter approach to theology also has its pitfalls, especially under the present papacy, in which efforts to impose uniformity of thought from above are pursued with a vigor unprecedented in recent times. But the news from this ecclesiastical neighborhood concerning evolution is much more good than bad.

Four recent books on this theme show that progressive theology is indeed being done in Catholic circles. These books not only accept, but enthusiastically embrace, evolution as a positive source for the development of theological ideas. Those who regard "theistic evolution" as some pallid compromise or limp accommodation between the rock-hard extremes of creationism and materialistic evolutionism will instead find here a muscular, assertive body of thought, with a clear vision of where it is headed, and with few or no reservations about the conclusions of science. Together with Catholic biologist Kenneth R Miller, whose 1999 book *Finding Darwin's God (to be reviewed in RNCSE 2002; 22 [1])* has received more prominent notices, these writers confidently bang together the heads of creationists, materialists, and "intelligent design" aficionados, and stuff them all in the trash can of intellectual history. Scientific materialists in particular, to whom "cutting-edge theology" is an oxymoron, may be surprised at how much sharper that edge is than that of the theology they may vaguely recall from Sunday school.

In any case, all these books will be abundantly quoted in the creation–evolution debate, and they may persuade some committed Christians who are sincerely trying to make up their minds to accept evolution.They are worth knowing about.

Karl Schmitz-Moormann was perhaps best known as an editor (with his wife Nicole) of the collected works of the Jesuit paleontologist and mystic Pierre Teilhard de Chardin. In his posthumously published book *Theology of Creation in an Evolutionary World* (written in collaboration with Jesuit chemist and theologian Jim Salmon), Schmitz-Moormann presents "a theological vision of creation" within the evolutionary world that Teilhard envisioned. At the very outset, he states his position with startling clarity: "The debate over creation or evolution has ceased. Hence the task of theology is to read the evolving universe as creation. In this text we accept the fact of evolution as the way creation is" (p xi).

He goes on to summarize scien-

tific conclusions about the history of the universe, for the benefit of "most theologians and many Christians" who are inadequately informed on this topic. This follows the tradition of medieval scholastic theology, in which "nobody was admitted to study theology without having acquired a solid scientific background" (p xiii). Schmitz-Moormann himself has certainly done so; the breadth and depth of his knowledge of contemporary science is impressive, especially in a non-scientist. Drawing constantly and heavily on scientific data of all sorts, he discusses in successive chapters the progressive evolutionary emergence of union, consciousness, information, and freedom, with a view to asking how each of these characteristics "makes intelligible God's intention in creation" (p xiv). In the final summary chapter, he reflects on insights about God (and in particular the Trinity) that can be inferred from our knowledge of the evolving creation.

Those who wonder what the result of using science, or evolution, as a "positive source" for sophisticated theology might look like in practice will find in this scholarly book an excellent and thought-provoking example. It even comes equipped with extensive, field-tested study questions that make the book especially suited for use in college courses or ecumenical adult study groups.

There is, unfortunately, one flaw in this otherwise commendable work. Educated in Germany, Schmitz-Moormann shared with many other Continental thinkers a strong skepticism about, indeed an aversion to, Darwinian explanations of the evolutionary process — hence his view that existing theories of how evolution works are "far from satisfactory" (p 16). Indeed, he finds no other theory in the whole realm of science to be deserving of the vitriolic criticism he levels at "Darwinian dogmatists" (p 83-4, 171-2). His only real objection to neo-Darwinism, however, is the elementary canard that evolutionary change comes about ultimately by "chance". I (one of those "Darwinian dogmatists"!) made his acquaintance shortly before his sudden death in 1996, and we enjoyed several marathon arguments over this topic. He was quite immovable on this point, which I found regrettable, because I think that details of the Darwinian selective process have implications of immense importance for theology (see Domning 2001). Perhaps not coincidentally, natural selection was also a blind spot for Teilhard, who seems scarcely to have discussed it.

Jerry Korsmeyer earned his doctorate in theology only after a successful career in physics and nuclear engineering. His book *Evolution and Eden* is slightly shorter than some of the others reviewed here, and possibly more approachable by the scientist who has little or no prior knowledge of theology. To the author's credit, he avoids the specialist's predilection to overemphasize his own discipline, neither belaboring marginally relevant expositions of physics and cosmology nor hesitating to venture into the field of biology. He stays on course by setting his sights clearly on the one key obstacle, in the official Catholic view, to a thoroughgoing evolutionary theology: the traditional understanding of original sin (from which the Church's official catechism has still not departed, despite over half a century of theological progress).

The first half of the book helpfully reviews the history of Catholic thought on original sin and evolution. These chapters should be required reading for anyone seeking to understand the roles played by Adam, Eve, and the Garden of Eden in the thinking of Christians past and present, and why evolution seems threatening even to some theologically literate people who have no across-the-board commitment to biblical inerrancy.

Next, Korsmeyer quickly recapitulates the evolutionary story, developing the idea that God created the world not by instantaneous coercion, but through a sharing of power with creatures and a process of "persuasion" extended over geological time. This idea (which owes much to the process philosophy of Alfred North Whitehead and is central to most of the evolutionary theology now being done) is a tricky one, because it is hard to explain what this "persuasion" is without seeming to open a door for direct tweaking of creatures by the Creator, in the way implied by "intelligent design" theory. The problem arises simply from the fact that (as in the case of Haught's book, discussed below) this new way of envisioning creation is itself still a work in progress. But it is clear that the "intelligent design" model of ongoing divine intervention is not what Korsmeyer has in mind; in fact he makes no reference to the argument from design or the work of Behe or similar writers. Instead, he emphasizes that God has "no detailed preordained plan for our existence, because our response, and that of all God's creatures, [to God and creation] cannot be coerced or exactly predicted" (p 104).

As in visiting any work in progress, it is easy to stumble over the things that lie around in seeming disarray; Korsmeyer himself stumbles over this idea of "persuasion" at one point in discussing the origins of physical evil. "Our God of persuasive power calls into existence creatures who have some power of self-determination", he says, and because these evolving creatures "resist the divine call and seek selfish ends, natural evil is produced" (p 123). Whereas Schmitz-Moormann emphatically rejected the testimony of Darwinism, Korsmeyer here seems merely to overlook it — as though evolution could occur without competition. But it cannot be meaningful to say that the Divine calls these non-human creatures to be anything other than the selfish seekers of survival and self-replication that natural selection has

made them to be. In the end, Korsmeyer's explanation of original sin is mostly satisfactory, but his treatment of the closely related problem of physical evil still needs to be reworked to take the biological data into full account.

Georgetown University theology professor John Haught has written a book, *God After Darwin*, which aims for a wide-ranging theological synthesis. It takes us back more in the direction of Schmitz-Moormann's work, rather than continuing Korsmeyer's quest for a solution to the specific problem of original sin. This is not to say that Haught is less interested in or informed about science, although he rightly sees no need to devote space in this theological book to strictly scientific exposition. He is well acquainted with the modern understanding of evolution, and thoroughly convinced of its theological importance — even going as far, here and in earlier works, as to forthrightly call it "Darwin's gift to theology".

Haught's theology is heavily indebted to Whitehead's process philosophy for its underlying metaphysics, which Haught calls a "metaphysics of the future". From the outset, he argues that an adequate evolutionary theology can be based neither on a metaphysics of the past (represented both by the materialist and the creationist views, in which history either unfolds deterministically according to physical laws, or goes downhill from the perfection established by the Creator) nor on a metaphysics of the eternal present (represented by the Platonic view, according to which the natural world is an always deficient reflection of, or deviation from, a perfection existing in a timeless realm "above" creation). The unifying theme of Haught's book is this: a metaphysics of the future is needed because the heart of evolution is emergent *novelty* — genuinely new things come about in the course of evolution which could not, even in principle, be predicted.

This metaphysics of the future is not easy to grasp. As noted above, it is still a problematic concept, with logical difficulties yet to be ironed out. It may be easier to understand for those who accept (or are familiar with) religious traditions, like Taoism, that already resonate with it; Haught concedes that the notion has "an irreducibly religious origin" (p 89). But Haught's vision of ultimate reality and the source of novelty as being, in some subtle and nontrivial sense, "found most characteristically in the constantly arriving and renewing future" (p 88) is intuitively appealing in comparison with the alternatives presented.

Haught agrees with Whitehead that the fatalism of materialist metaphysics has "choked out any sense of the emergent novelty in life's evolution" (p 1), and he uses this criticism to argue that Daniel Dennett and Richard Dawkins essentially betray evolution by reducing it to the deterministic working out of physical laws. Even before addressing these familiar opponents of theology, however, he pauses to demolish the argument from design, using much the same considerations. *RNCSE* readers will be particularly gratified by this professional theologian's verdict on Behe's "intelligent design" approach as "both apologetically ineffective and theologically inconsequential" (p 45; see also p 3-5). Like materialism, "intelligent design" ignores the messiness of real life, imagining instead a pervasive orderliness (whether attributed to natural laws or to a Designer) that ends up "leaving out the *novelty* characteristic of living processes" (p 4, emphasis in original). Haught adds:

> Theological fixation on "intelligent design" ... sloughs off the fact that living systems require the continual *breakdown* of fixed order. It ignores the fact that life requires the dissolution of rigid "design", precisely in order to be alive at all. ... What is worse, by associating the idea of God only with the fact of order at the expense of novelty, a theology based on design is likely to attribute nature's disorder to the demonic. By exonerating ultimate reality of any complicity in chaos, such a theology removes God from the flow of life itself (p 5, emphasis in original).

Modern process theology instead proposes a God who "is less concerned with imposing a plan or design" on the universe "than with providing it with opportunities to participate in its own creation." This idea of a novelty-encouraging God is not only "compatible with evolution but also logically anticipates the kind of life-world that neo-Darwinian biology sets before us" (p 6).

Haught then proceeds (brushing aside Phillip Johnson and like-minded creationists along the way) to expound the close correspondence of the evolutionary worldview with the biblical picture of the "humility of God": the image of a vulnerable deity who willingly suffers along with suffering creatures, even (in the Christian view) submitting to incarnation and physical death, and one whose power is manifested not in coercion but in the almost limitless possibilities offered to the world. This is a major theme in contemporary theology, which promises, in the hands of Haught and others, to be a very fruitful one. Here he uses it to explore, in relation to evolution, the diverse topics of information, tragedy, purpose, ethics, ecology, and divine action, in ways that I found generally persuasive as well as readable and thought-provoking.

Of course I have quibbles, mainly about chapter 8, which happens to be one of the few chapters written expressly for this book and not adapted from the author's previous essays. Here I think Haught adheres too closely to the Whiteheadian notion that the ultimate aim of novelty is "beauty",

inadvertently making God sound like a rather callous, coolly detached aesthete. This is a jarring contrast with the biblical character of other parts of the book, which suggest that the Creator would value the "good" (for example, love and justice) over the mere variety so beloved of Haldane's God (the one with the "inordinate fondness for beetles").

Finally, where Haught directly addresses original sin, he asserts without supporting argument that it is "theologically inappropriate to identify original sin simply with the instincts of aggression or selfishness" we have inherited from the animals (p 139). The operative word here is "simply": Haught, with most other Catholic theologians today (and partly in reaction against the genetic determinism of strict sociobiologists), wants to stress our culturally- and environmentally-conditioned nastiness in preference to the genetic legacy that impels us in the same direction. Here, I think, he misses something important, because closer attention to what evolutionary ecologists are saying about that genetic influence on behavior could fill the still-gaping holes in the doctrine of original sin and lead to a much more satisfactory theological-scientific synthesis.

Denis Edwards, an Australian priest and theologian, has written a shorter and just as strictly theological book, *The God of Evolution,* which focuses more narrowly on how the idea of a self-limiting Creator sheds light on the Christian doctrine of the Trinity. Perhaps most relevant to NCSE's concerns is chapter 4, where Edwards briefly reviews current ideas on human origins and some attempts by others to understand original sin in the light of these data. He then offers his own proposal, which resembles the others in identifying original sin merely with our "cultural history of personal and communal sin.... It is not the structure of the human (as a fallible symbiosis of genes and culture) that constitutes original sin, but the inner impact on each human person's free situation of previous human rejection of God" (p 66-7).

The question that instantly occurs to the evolutionary biologist at this point (and which seems not to have occurred to any theologian in the 35-odd years this idea has been around) is this: What could have had this sort of impact on the *first* human persons, when no previous *human* cultural history existed? Our prehuman genetic ancestry, together with the recognition that other higher primates also have "culture" (which evolved out of genetically determined behavior), provides the obvious answer. But this puts us at once on the slippery slope that leads quickly to more genetic and less cultural causality as we go backward in time and phylogeny.

Contemporary theologians peer nervously down this slope into the unfamiliar and scary biological depths below, and turn away on the very brink of stumbling into the problem's solution. But this is clearly a chance for sympathetic biologists to play a helpful role in the science-religion dialogue, as guides to these nether regions for the more adventurous theological Dantes of our time. All of these authors are struggling to fit the Darwinian pieces into the jigsaw puzzle of creation, evil, and the power and justice of God. All the necessary pieces, in my view, are on the table; it is just a matter of turning each one the right way. Natural selection, and the selfish individual behavior it enforces, are pieces absolutely critical to the solution; but these writers — perhaps because they lack first-hand professional experience in manipulating Darwinian concepts — either discount their importance or have yet to hit on the trick to fitting them together. But their success will be our success, because a synthesis that is convincing to church leaders will eventually be communicated to the ordinary faithful, whose objections to evolution (as Pennock [1996] has pointed out) are far more existential and ethical than technical.

To the scientific reader who doubts the relevance of all this God-talk, I repeat: this body of writing is about to change the hitherto bipolar battlefield of evolution and creation into a tripolar one. This is not your father's theistic evolution. Creationists who want to brand all evolution as atheistic, and materialists who want to brand all theism as anti-evolutionary, need to rethink, retool, and redeploy in the face of this challenge. Those in the middle, long caught in the crossfire and drowned out by the louder lungs on either side, are finding their own vigorous voices.

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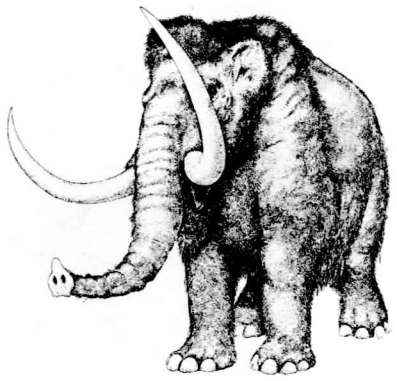


Death of a Rat: Understandings and Appreciation of Science

By William D Stansfield.
Amherst (NY): Prometheus Books, 2000. 360 pages.

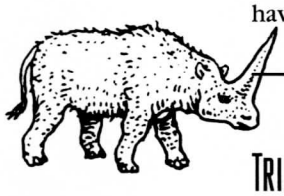
Reviewed by Michael Zimmerman, University of Wisconsin, Oshkosh

In his *Death of a Rat*, William D Stansfield, an emeritus professor of biology at California Polytechnic State University, takes us on a grand tour of science, focusing mostly on the ethical, political, and sociological considerations that are all too often overlooked by others. While doing so, he provides a glimpse into the process of scientific discovery as well as into a number of the personalities who have been responsible for some of our greatest advances and some of our most embarrassing moments.

In his tour, Stansfield ranges widely, presenting chapters on such topics as the discovery of the structure of DNA, the dance-language theory of honeybees, self-deception and outright fraud in scientific investigations, and the role of luck and serendipity in the discovery process. As with most whirlwind tours, there is only time to examine the highlights; just when it might make sense to begin to look behind the scenes, the group moves on to view the next masterpiece. While frustrating to readers who have visited some of these topics on their own, Stansfield's strategy is fully appropriate for the first-time visitor to the land of science. Indeed, many such visitors might well become captivated enough that they will want to return on their own to delve more deeply.

Stansfield selects his topics as much for the morals they furnish as for their scientific importance. His detailed account of Watson and Crick's discovery of the double-helical structure of DNA is a paean to the value of scientific teamwork. Although this particular interlude nicely exemplifies the competitive nature of science as well, it is clear that by working together and using the research of others, Watson and Crick were able to discover the structure of DNA sooner than would have been possible had they been working separately. As a stop on the tour for the uninitiated, this is powerful stuff. Unfortunately, since virtually the only source Stansfield uses is Watson's classic 1968 book *The Double Helix* (although he cites the 1980 edition), most scientifically literate readers will not find anything new.

Similarly, in his chapter discussing the impact that politics can have on science, Stansfield



Trials of the Monkey: An Accidental Memoir

Matthew Chapman.
New York: Picador USA, 2001.

Reviewed by Susan Branch

Matthew Chapman, Darwin's great-great-grandson, has written a peculiar sandwich of a book; it consists of layers made up of a memoir of his unhappy childhood, ruminations about his current life, the story of the Scopes trial and — most interestingly — an account of his visit to Dayton, Tennessee, to attend the annual reenactment of the trial. It is typical of Chapman that he comes to Dayton just too late to see the reenactment.

Chapman actually pays two visits to Dayton. He travels by Greyhound bus — to get some feel for the territory, apparently — from his home in Manhattan, where he is a successful screenwriter, married to a beautiful Brazilian actress and with one cherished daughter. He finds the American South a cultural wasteland, but decides there is enough there to make a book, especially with the reenactment in prospect. Stress about a project he is working on causes him to misread the schedule, and he flies in just after the reenactment has ended for the year.

This leaves him at loose ends. He rides the route with a sheriff's deputy; he interviews noted Bryan College creationist Kurt Wise, and he takes a cave tour with Wise and a number of his students (*See* RNCSE *2000; 20 [5]: 31-3*). Trying to get a video of the reenactment from the director, he curries favor by attending a church service with her family. Over and over again, despite his objections to organized religion, he responds to the simple human warmth of the people he meets — whether the unsuccessful hostess at a failing bed and breakfast, the large, gun-toting deputy sheriff, the sheriff himself, who is tangled in a tight political campaign, Wise, some of the Bryan College students. He is bemused by the conviction of the fundamentalist Christians he meets that all unbelievers are damned to hell and the unease with which they hold that doctrine.

He contrasts the general disbelief in evolution he finds in the area with the attitude that prevailed during the Scopes trial — when those on opposite sides of the court case could behave to each other with civility and even affection. Bryan, however, gets little sympathy from Chapman. Of course, all the details of the case come from some of the usual sources — most notably Edward J Larson's *Summer for the Gods* as well as the trial transcripts.

About Chapman's ruminations,

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makes several wonderful choices in deciding to feature three exemplary situations: Galileo's run-in with the Church; TD Lysenko's control of Russian genetics and the subsequent demise of Russian agriculture; and the growth of 20th-century "creation science". In each case, the general structure of the argument is presented, the importance of keeping scientific inquiry free from political control is articulated, and the appetite of the lay reader is whetted before Stansfield moves his tour party on to focus on the next issue worthy of consideration. Again, for those who have made some version of this trip before, because of his limited array of sources, there is not much fresh information or insight. The Galileo material is largely a précis of Owen Gingerich's 1982 *Scientific American* article, the Lysenko work a summary of Zhores Medvedev's wonderful 1971 book *The Rise and Fall of TD Lysenko*, and the critique of creationism a far too brief rehash of Tim Berra's 1990 book *Evolution and the Myth of Creationism*.

A discussion of fraud and the self-correcting nature of science wisely touches on Austrian biologist Paul Kammerer's early-20th-century "documentation" of some of Lamarck's ideas about the inheritance of acquired characteristics as well as on the contemporaneous Piltdown hoax in England. Because all of the Kammerer material comes from Arthur Koestler's provocative 1971 book, *The Case of the Midwife Toad*, and the Piltdown information is drawn solely from Ronald Miller's 1972 book *The Piltdown Men* and a chapter in Stephen Jay Gould's 1980 *The Panda's Thumb*, those well-versed in the genre will find nothing they have not previously encountered.

Minor tour stops include a recap of the cold fusion affair, summaries of the discovery of the causes of yellow fever, scurvy, and HIV, a sketch of the discovery of penicillin, and a synopsis of the claims of homeopathy, among many others. All are entertaining and informative but none is particularly insightful.

As with most tour books, *Death of a Rat* provides an intelligent, if fairly superficial, overview of what can be expected to be seen. If it serves to attract tourists to the attractions described, it should be viewed as a success, and the fact that it is not a book for the more seasoned traveler should not be held against it.

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perhaps the less said the better. It is hard to know whether to give him credit for showing himself warts and all, or to condemn him for not realizing how shallow he appears to others. He needs to make a lot of money so he can send his daughter to an exclusive private school, though the other parents despise him for not being as wealthy as they are.

His family memoir may be of some passing interest to Darwinists. This type of account is so popular that it is somewhat surprising that Chapman did not devote the whole book to it. His steadfast father, his mother (Darwin's great-granddaughter) — depressed, alcoholic, and unfaithful — and his unhappy experiences with the British educational system seem typical of the genre, although the upper-middle-class ambience does not. Chapman is also quite willing to reveal family secrets — one would hope with the permission of those concerned. To some extent, he blames his academic failings on his Darwin heritage — having decided that he could never live up to the family's level of achievement, he determined to be a successful failure instead.

Although this is not the most interesting part of the book — his experiences in Dayton win that accolade — he does nevertheless grasp at an important truth. His family is badly, if conventionally, dysfunctional, but that does not lessen the love and need that exist there. Families may be dysfunctional, but that does not make them any less family.

His mother, obsessed with past failures and loss of love, nonetheless creates an atmosphere of acceptance that the young Matthew (especially in the light of the abuse he encountered at school) and his siblings need. As her life darkens and her children mature, they still turn to that nurturing symbol, despite her growing incapacity to help them. The story of her death and funeral — further embittered for Chapman by a stubborn local vicar who insisted on running the funeral — is harrowing.

Ultimately, this is not a pleasant book. Chapman's persona — by American standards sexist and possibly racist, though he would indignantly reject as PC-speak both labels — is grating. Yet it is also clear that he grows and changes — from his previous atheism to something closer to his great-great-grandfather's agnosticism — through his contact with decent people who do not understand his beliefs and through the grief of his mother's decline and death. His desire to develop his own godless religion need not be taken seriously, but perhaps he is slowly evolving into a more tolerant person.

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NONZERO: THE LOGIC OF HUMAN DESTINY

By Robert Wright.
New York: Pantheon Books, 2000.
435 pages (including endnotes, appendices, bibliography, and index).

Reviewed by Andrew J Petto
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First impressions are powerful things. Robert Wright's commentaries in the nonscientific media have a decidedly progressivist ring to them and give the impression that Wright expects the ideas in *Nonzero: The Logic of Human Destiny* to produce nothing less than a revolution in the way we think about evolution — at least about human cultural evolution. Although these comments were never meant for detailed scientific scrutiny, they seemed nonetheless to have skipped glibly over some very important problems. Still, there seemed to be an intriguing idea at the foundation of *Nonzero* — that the inexorable self-interest at the foundation of evolutionary models may sometimes be enhanced by a tendency to share benefits of successful adaptations with other organisms.

Wright's starting assumption is that there is a trend in evolution toward more complexity — modern human society is more complex than early human society and, in general, more recent descendants of a biological lineage are more complex than earlier descendants. There is, of course, ample room for disagreement with this premise, but it is not an unusual starting point among those who aim to extract one or a few general directional trends from a complex, long-term record of observations.

In *Nonzero*, Wright uses variable-sum models of game theory to argue that the observed evolutionary trend toward greater complexity is best explained by the benefits of mutual cooperation. Many *RNCSE* readers will recognize this as an extended version of The Prisoner's Dilemma used in the 1960s by Axelrod and Hamilton (among others) to model the evolution of cooperation. In a zero-sum game, there is a loser (-1) for every winner (+1), and the sum of the scores in any contest will be 0. In contrast, participants in a variable-sum (or non-zero-sum) game can end up with a variety of scores. In non-zero-sum situations, certain forms of mutual cooperation provide participants with higher scores than they would realize if they acted only in unchecked self-interest.

Wright argues in *Nonzero* that the property of "non-zero sumness" (NZS) underlies the trend toward complexity in human society — and in biological evolution as well. The variety of economic, sociopolitical, and technological explanations for the appearance of larger and more formal organizations, he contends, are manifestations of a more fundamental principle driving the trend from bands to nation-states. The models are all rooted at their bases in non-zero-sum interactions.

What makes NZS work in human societies, according to Wright, is information. It is easy to ignore other individuals and groups if you do not have to interact with them, but if you do have to interact, then you need a reliable way to know what they know and to find out what they are doing. Wright traces several technological "revolutions" that contribute to the maintenance of NZS in human cultural evolution. This leads ultimately to a reconsideration of Teilhard de Chardin's concept of the noosphere — the universal consciousness that links all living things — as the culmination of the trend driven by extending the non-zero-sum relationship to more and more individuals.

The major problem in the first two-thirds of *Nonzero* is the lack of a clear idea of what Wright means by "complexity". There are lots of examples, but little in the way of a synthesis of the key features of a complex social organization (or biological entity). Indeed, my notes throughout the book repeat this theme often: "Need a working definition of complexity." So, it was with great anticipation that I attended a conference devoted to exploring the issues discussed in the book (*see "The 'Wright' stuff" on p 7*), where I had a chance to ask Wright some questions that arose while I was reading his book and to listen to the perspectives of other researchers on *Nonzero*.

Second impressions can help or hurt. In this case, Wright's answer to the request for a working definition of the main dependent variable — complexity — did not help much. His first reply was that there was a general description in an appendix to *Nonzero* (there is, in Appendix 2). His second reply was that complexity is hard to define, but you know it when you see it (which, it turned out, was a restatement of the description on page 347 at the very end of Appendix 2). Neither of these works very well as a basis on which to build a falsifiable hypothesis.

It is on page 252 that a rubric for assessing complexity (and therefore for testing hypotheses) finally appears. In biological terms, Wright suggests that one might compare the effectiveness in delivering genes to subsequent generations under zero-sum and non-zero-sum strategies. Later, he suggests that complexity is measured by the number of interested parties in the non-zero-sum game (p 253). These two ideas are compatible, but not quite the same. Indeed, defining complexity in terms of the number of players in a non-zero-sum game and modeling NZS as the driving principle that produces complexity has a circular feel to it.

There are other problems with the book that make it difficult to use as the basis for scientific research. First and foremost, this book presents what the subtitle

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Folk Physics for Apes: The Chimpanzee's Theory of How the World Works

By Daniel J Povinelli, in collaboration with James E Reaux, Laura A Theall, and Steve Giambrone.
New York: Oxford, 2000.
391 pages, illustrated.

Reviewed by Andrew J Petto, University of the Arts,

In his early years at the University of Massachusetts, Daniel Povinelli responded to his family's exhortations that he study "real" science by joking that he intended to become a "CE" — a "chimpanzee engineer". *Folk Physics for Apes* is proof positive that he has achieved this goal. This is a serious look at how chimpanzees' behavior can tell us how they perceive the universe to work, and I heartily recommend it for RNCSE readers on several levels.

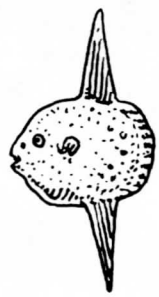
One reason to read this book is that it is so well-written and accessible as it uses experimental evidence to infer what chimpanzees understand about their environments and the people and objects in them. *Folk Physics for Apes* is one of the very best examples of how scientists construct and test hypotheses so that the results can help us to understand processes and phenomena that we cannot observe directly. It is the quintessential course on the scientific method wrapped inside a fascinating account of how a chimp's mind works.

A second reason to read this book is that it provides a lucid discussion — albeit in terms of chimpanzees, not humans — of how folk explanations of the scientific are shaped and sustained. Anyone who has wondered how pseudoscientific notions can persist despite decades of scientific research to the contrary will appreciate the "chimp's-eye-view" that Povinelli and colleagues bring to the discussion. Chimpanzee "folk physics" may be scientifically "wrong", but it does produce reliable and reassuring outcomes for the chimps that rely on them.

By far the most important reason for NCSE members to read this book is to appreciate how a scientist with an alternative model or mechanism really proceeds to challenge a prevailing paradigm — something anti-evolutionists have not accomplished. The prevailing wisdom that Povinelli and colleagues wish to examine is the "argument from analogy". By analogy with the overwhelming similarities between chimps and humans in anatomy, physiology, immunology, behavior, social organization, cognition, communication, and so on, we would expect a high degree of similarity in mental processing as well.

In brief, the authors of these studies ask, "If chimpanzees respond to actions and objects in their environments in the same ways that humans would in the same situations, then can we infer that their understanding of the situation and motivation for their actions is the same as that of humans — given the extremely close evolutionary relationship between our species?" The argument from analogy says, "Yes." Povinelli and colleagues say, "Not necessarily."

Folk Physics for Apes provides us with a series of carefully thought-out and clearly explained experiments meant to reveal the nature of chimpanzees' understanding of the way that their physical environment works. It also provides a road map for how to present and explore an "alternative" model scientifically. The authors did not mine the literature for "anomalous" findings or quotes from prominent scientists. Instead, they did the heavy lifting of setting up experiments and carefully recording their procedures and results. Then they collected their results and interpretations and published them for others to examine and critique. These are original research results based on a competing scientific explanation — exactly what the scientific process is supposed to produce in the course of testing and retesting existing interpretations and theories.



Only time and continued study will tell if the explanations proposed in this book will become widely accepted, but this is the right way to begin that journey. In the end, one may disagree with the interpretations of the results — and doubtless some will. But *Folk Physics for Apes* is science done right — and all the more so because it shows how scientists really proceed to challenge a prevailing wisdom.

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suggests — a logical construction that orders observations and imposes a consistent explanatory pattern on them. For each of the many examples of cultural complexity, Wright presents standard interpretations, discusses their shortcomings, and shows how the principle of NZS does a better job of explaining the observations. Although Wright is very comfortable with the idea of evolution (biological and cultural), the exposition reads much like books written by anti-evolutionists who show (or so they suppose) how the weight of the evidence logically rules out evolution. However, the *scientific* value of a well-constructed explanatory framework is measured by how well it works to support and stimulate research — not just by how neatly it ties up all the threads.

The second major problem is technical. It was apparent from reading the text that Wright had

Answers in Genesis: 35 Anti-evolution Arguments to Avoid

In an article on its web site entitled "Arguments we think creationists should NOT use", Answers in Genesis (AIG) has warned anti-evolutionists to avoid 35 common arguments against evolution (<http://www. answersingenesis.org/Home/Area/faq/dont_use.asp>). The site contains summaries and links to discussions of the various arguments, including the AIG rationale for warning creationists against their use. Some of these arguments are rejected by AIG because they are clearly contrary to the scientific evidence. Others are rejected primarily because AIG finds no scriptural basis for using them (or because the AIG view of scripture contradicts them).

The page describes the content of the article this way: "The first article on this page sums up what the creationists' attitude should be. The other articles provide examples of arguments that should no longer be used; some are definitely fallacious, while others are merely doubtful or unsubstantiated." Well, at least we agree with AIG on that count.

24 arguments not to use

1. Darwin's Deathbed Conversion
2. Moon Dust
3. Joshua's Long Day
4. Flash-Frozen Mammoths
5. Casteneldo and Calveras Skeletal Remains
6. "Java Man" is an Ape
7. Plesiosaur Netted in 1977
8. Second Law of Thermodynamics Began with the Fall
9. Why Are There Still Apes?
10. Women and Men Have Different Numbers of Ribs
11. *Archaeopteryx* is a Fraud
12. Mutations are Never Beneficial
13. No New Species Have Ever Been Produced
14. Earth's Axis Tilted After the Flood
15. Paluxy Tracks Proved Human-Dinosaur Coexistence
16. Darwin Doubted Evolution of the Eye
17. "Earth's Division in Peleg's Day" Relates to Continental Drift
18. Genesis Chronology Provides Reliable Ages
19. Genesis Chronologies Allow an Earth Older than 6000 Years
20. Jesus Cannot have Inherited Genetic Material from Mary
21. "Science Falsely So-Called" (1 Timothy 6:20) Refers to Evolution
22. Heliocentrism is Anti-Scriptural
23. Ron Wyatt's Claims of Archaeological Proof of Bible and Ark
24. Carl Baugh's "Evidences"

11 arguments that are "doubtful"

1. Canopy "Theory"
2. No Rain Before the Flood
3. Hydroplate "Theory"
4. Natural Selection Argues in Circles
5. Evolution is Just a "Theory"
6. Speed of Light Has Decayed Over Time
7. No Transitional Forms Exist
8. Gold Chains Found in Coal
9. Plate Tectonics is False
10. Creationists Accept Micro- but not Macro-evolution
11. Gospel is in the Stars

done considerable research in the appropriate literature to acquire the details of the cultural systems that he described, yet there are no citations in the text. Even though there are over 50 pages of endnotes (including bibliographic and other notes), there are relatively few notations in the text instructing the reader to look to the endnotes for more information. The reader is required either to turn to the endnotes after reading each page in the event that Wright included a relevant note or to read through several pages and then discover that he or she has missed several important notes that were not marked in the text.

Finally, one of the great drawbacks to the book is the chatty, informal passages (praised highly on the jacket blurbs) that punctuate the exposition. The book could have been written either in a chatty, informal style or in a more formal, expository style, but mixing them is a disaster. In a sober discussion of selfishness, for example, Wright suddenly blurts "Then again, aren't we all?" (p 86). Throughout the book, there is the staccato burst of phrases and sentence fragments that would be effective conventions in an oral presentation, but distract mightily from the flow of the argument.

If there are any practical research implications for Wright's

Answers in Genesis: Exploiting September 11

Nathan Zamprogno

The horror of the events on September 11, 2001, has exhausted even my vocabulary. On top of the tragic news that found its way to Australia, I was appalled to find that Answers in Genesis (AIG) was exploiting the terrorist attacks to proselytize for its version of young-earth creationism, in an article by Ken Ham and Jonathan Sarfati entitled "Terrorism and death", posed on the AIG web site at <http://www.answersingenesis/org/news/20010911_wtc.asp>.

The article starts simply enough with an age-old question. "Why does a good God allow such evil acts?" This is a legitimate question — one that evokes a very strong answer from CS Lewis himself in his book *The Problem of Pain*. However, later AIG tells us:

> Sadly, those who teach that the world is millions of years old have no coherent answer as to why there is death and suffering in the world. ...For those Christians who have believed in the supposed millions of years of history, then they have effectively taught that God describes all this death and suffering as "very good" (Genesis 1:31). It's worse if one believes "God used evolution", because evolution relies on death of the "unfit" — this would mean that God actually used [death] as His means to achieve a "very good" creation.

What are they saying? That if you disagree with *their* version of young-earth creationism, then you are basically agreeing with the statement "God is evil". The article goes on, mixing a valid Christian response of compassion to those suffering together with insistence on a narrowminded, divisive, bibliolatrous parody of Christianity.

AIG seems blissfully ignorant of the fact that the Islamic fundamentalists who crashed their planes into buildings on September 11 were creationists who took the same "my way or the highway" approach to the Qu'ran as AIG does to the Bible. The terrorists' isolation from the mainstream world of Islamic faith (which rightly advocates charity and hospitality) reinforces in them the feelings of rejection and "righteous" anger, just as some young-earth creationists complain that they are part of a small, righteous "remnant" of the Church — that so many of the mainstream denominations have had their doctrine "polluted" by the evils of science.

My main concern as a Christian, though, is that AIG has allowed its theological ideology to take precedence to the true Call of Christ — to common sense, decency, compassion, and in this case, tact.

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[This note was revised from a longer piece that can be read in its entirety on the No Answers in Genesis web site at <http://home.austarnet.com.au/stear/aig_and_terrorism.htm>. Read AIG's response at <http://www.answersingenesis.org/news/judasII.asp>.]

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model of NZS-driven increases in complexity, they might suggest that the models of selection and adaptations that we use should be modified to look beyond local, short-term tactics. For instance, some organisms make short-term decisions to forgo reproduction because the prospects for offspring survival are so poor that there will be a greater "payoff" (in terms of the number of genes surviving in future generations) for reproducing later. It is possible to develop a hypothesis that assesses the effect of such "decisions" on NZS. Wright does not go this far, and there are sure to be many problems and pitfalls in defining such an outcome; but the possibility is intriguing, and there just may be some value in trying to create a way to measure NZS in adaptive strategies.

First, however, we need the research to show that NZS does operate consistently in evolutionary ecology. Then we might be able to assess whether it contributes to "complexity" (if we can agree on a working definition of it). Only after these two steps are complete will we be able to consider whether Wright's notion of NZS has anything significant to add to our understanding of the broad sweep of the history of life. It is certainly an intriguing possibility, but the heavy lifting is yet to be done.

SPARKED BY THE SPIRIT OF SCIENCE

James A Haught

The National Youth Science Camp, attended by two top science students from each state, just finished its annual month of advanced learning and outdoor fun at an old 4-H camp deep in West Virginia's mountains. I always visit the session, because it is fascinating to watch the brightest and best America has to offer: top-scoring high school graduates heading to careers in physics, biology, math, medicine, geology, chemistry, engineering, archeology, psychology and the like. They are inspiring, somewhat like dedicated young Olympians.

Every summer, the science campers display exceptional maturity along with their keen minds. There is no vulgar adolescent horseplay or bellowing. They are earnest, and many of them perform classical music, showing skills that required years of hard practice. Yet there is a lot of laughter, hugging and camaraderie. This year's group mirrored the previous ones.

I watched the varied throng from every corner of America. As usual, there was a large number of Asians, along with brainy whites and blacks. I wondered what it is that binds them all together in a common brotherhood (and sisterhood). Then it dawned on me: It is the spirit of science, one of the noblest urges of the human species. The desire to learn more secrets of nature, and use them to improve people's lives, is a magnificent compulsion that has lifted humanity out of caves and huts.

Galileo shared this spirit when he used a primitive telescope to see orbits of the solar system. Isaac Newton shared it when he perceived that the fall of an apple is caused by the same force tethering planets to the sun. Immanuel Kant did so when he sparked thinkers with his great mandate, "*Sapere aude*!" — Dare to know! — helping to spawn the Enlightenment and the Age of Reason. Albert Einstein did so when he perceived that matter and energy are two forms of the same thing.

"Dare to know" is the motivation behind the huge dishes of the National Radio Astronomy Center in a mountain valley a few miles from the National Youth Science Camp. The costly listening post exists only to learn more about the universe. Pure knowledge is just the first phase of science.

The second is "dare to do" — using the discoveries to make life better. Each breakthrough leads to others. For example, Louis Pasteur discovered that bacteria cause disease and fermentation, then Joseph Lister found that killing bacteria could end the hideous infection and death rate from surgery. Helping humanity is the goal: Doctors learned to eradicate mosquitos and wipe out malaria in the southern United States. Jonas Salk found the vaccine that ended polio. Norman Bourlag created the "Green Revolution" and nearly doubled the world's food supply. A coming "dare to do" prospect is using stem cells to regenerate damaged hearts, spinal cords, livers, brains, and so on.

At the start of the 1900s, the US lifespan averaged 48 years (partly because of terrible infant mortality). Today, it is nearly 80. Virtually this entire advance is attributable to antibiotics and other benefits of science. Successes of science brought astounding improvements during the 20th century.

The pace of science is accelerating tremendously. For example, Anton Leeuwenhoek first saw microbes through a homemade microscope in the 1680s — but nearly two centuries lapsed before Pasteur learned their nature and function. Nowadays, the time lag between advances has shortened to lightning speed.

The science campers always make a brief trip to Washington, where Senator Robert C Byrd (D-WV) hosts a luncheon for them. Byrd touched on the snowballing record of science when he told the group:

> Scientific progress is the backbone of our economy, the promise of our health care system, and the foundation of our national security. Even though I have lived through most of them, I still find the scientific achievements of the last century to be, for lack of a better phrase, mind-boggling. From the time that I was your age, we have gone from the two-room country school to the internet. The scientific discoveries of the next century will be just as phenomenal.

Well said.

Since the National Youth Science Camp was created in 1963, nearly 4000 brilliant teens have stayed at the deep-woods retreat. Many return to serve on the camp staff during their summer break from college. Some return as lecturers after scoring success in scientific careers. The graduates form a network of scientists around the world (such as former camper David Thompson, now head of Orbital Sciences Corporation, building and launching commercial space satellites). Many of them donate to the foundation that sustains the camp.

I am proud that my state fosters this institution, standing solidly behind the spirit of science.

[This note is adapted from Haught's column in the Charleston Gazette *which appeared on July 24, 2001. It is used with permission.)*

James A Haught is editor of the Charleston Gazette, *West Virginia's largest newspaper.*

Why Would ARN Promote a Debate Phillip Johnson Did Not Win?

Adrian Melott
Board Member, Kansas Citizens for Science

I received a videotape distributed by the Access Research Network (ARN) entitled "DARWINISM: Science or Naturalistic Philosophy?" It showcases a debate between Phillip Johnson and William Provine entitled "Darwinism: Science or Dogma?" held at Stanford University on April 30, 1994. The tape was sent by ARN to a library in a modest-sized town in western Kansas, which then forwarded it to me.

Before watching it, I guessed that it was a tape of a debate in which Johnson trounced his opponent; why else would ARN have sent it out? I was wrong: I would call this one a tie.

Johnson's opponent, William Provine, was clearly accomplished at dealing in this kind of environment. He was *not* defeated. However, the *nature* of his opposition is what ARN wanted to disseminate so widely. Provine made an essentially seamless argument beginning with the evidence for evolution and running through things such as the meaninglessness of free will. He concluded with the emphatic statement that there is no god, no afterlife, and no absolute basis for ethics.

Whether or not we agree with Provine's conclusions, the real problem is that he presented the entire set as if it followed immediately from the science. In other words, he failed to distinguish between empirically verifiable conclusions and philosophical extrapolations from them. This is a wonderful thing for Johnson and ARN: it plays right into their hands. Since Provine drew no line between science and philosophy, ARN can then use his position to treat Darwinism as a materialistic *philosophy* — one of the strongest suits in the anti-evolution deck for convincing ordinary citizens to worry about their kids' learning evolution.

Furthermore, Provine agreed with Johnson in his condemnation of those who see a possible concordance between science and religion. His comments seemed to accuse scientists who do see such a concordance of dishonesty. As an example, Provine discussed his own "Wedge" strategy in his classroom. He said that at the beginning of his classes, many students see biology and religion as compatible. By the end, very few do. They have either become creationists or "naturalists", with many more going the latter route. Like Johnson, Provine sees the Wedge strategy as advancing his cause. What he does not realize is that, in the culture as a whole, it will not work in the same way it does in a classroom where the evidence is presented in enormous detail (and under the control of the instructor).

I understand why ARN is sending out this videotape. They see Provine as one of their greatest allies in proving that learning evolution will turn your children into "metaphysical naturalists" and materialists who reject the revealed moral authority of their parents' faith.

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Thanks to Wesley Elsberry for operating the NCSE news list.

WEB LOCATIONS VISITED IN THIS ISSUE

NEWS

TOPIC Science Scores Unchanged Since 1996
OWNER US Department of Education
LOCATION <http://nces.ed. gov/nationsreportcard>
LAST VISIT October 4, 2001

TOPIC Evolution Remains in Pennsylvania Science Education Standards
OWNER Pennsylvania Independent Regulatory Review Commission
LOCATION <http://www.irrc.state.pa.us/PA_Exec/IRRC/comments/comments.html>
LAST VISIT October 1, 2001

TOPIC Kansas Citizens for Science Refutes "Design"
OWNER KCFS
LOCATION <http://www.kcfs.org/id>
LAST VISIT November 4, 2001

TOPIC Discontinuity Conference (Program)
OWNER General Title Incorporated
LOCATION <http://www.creationequation.com/Discontinuity.htm>
LAST VISIT December 3, 2001

TOPIC Discontinuity Conference (Reaction)
OWNER Institute for Creation Research
LOCATION <http://www.icr.org/pubs/president/prz-0110.htm#2>
LAST VISIT December 4, 2001

FEATURES

TOPIC Nineteenth-Century Design Arguments
OWNER Glenn R Morton
LOCATION <http://www. glenn.morton.btinternet.co.uk/design.htm>
LAST VISIT November 30, 2001

RESOURCES

TOPIC How Many Species Were There?
OWNER National Academy of Sciences USA
LOCATION <http://www.pnas.org/cgi/content/full/98/11/6261>
LAST VISIT November 4, 2001

TOPIC Genomics Gateway Opened by BioMedNet
OWNER BioMed.Net
LOCATION <http://reviews/bmn.com/genomics>
LAST VISIT October 23, 2001

TOPIC Natural Selection Picks Optimum Communications Satellite Orbits
OWNER Space.com
LOCATION <http://www.space.com/news/darwin_satellites_011016.html>
LAST VISIT November 4, 2001

TOPIC Little Things Caused Triassic-Jurassic Mass Extinction
OWNER American Association for the Advancement of Science
LOCATION <http://www.sciencemag.org/cgi/content/abstract/292/5519/1148>
LAST VISIT December 2, 2001

TOPIC Answers in Genesis: 35 Anti-Evolution Arguments to Avoid
OWNER: Answers in Genesis
LOCATION <http://www. answersingenesis.org/Home/Area/faq/dont_use.asp>
LAST VISIT November 20, 2001

INSTRUCTIONS FOR CONTRIBUTORS

Reports of the National Center for Science Education (RNCSE) welcomes contributions from its readers and from anyone interested in issues related to evolution as the foundation for the biological sciences, to the place of evolution in the science curriculum, or to the public perception of scientific method and practice. These contributions may be submitted in one of two forms.

News, commentaries, and features describe events or experiences that we wish to relate to our readers and members. These may include reports of school-board elections or local organizing by parent and teacher groups, political or governmental decisions and policies, first-person accounts of experiences with anti-evolutionist speakers, curricula, or organizations, other reports of information related to our primary concerns of promoting good science in education and public life, and, of course, humor related to creation/evolution issues.

Articles include book reviews, scholarly articles, and formal essays. These may explore specific arguments raised by anti-evolutionist scholars, relate new information that may be helpful in promoting evolution, or present original research related to the public understanding of evolution. We also welcome case reports and classroom action research that assess the outcome(s) of strategies for strengthening the understanding of evolution in educational practice.

All articles should be written for a general audience, and authors should provide definitions or descriptions for technical terms and concepts that might not be understood by a non-specialist. All article manuscripts are submitted to reviewers for comments on their technical content and suitability for a general audience. Acceptance for publication does not take into account the author's formal academic background or profession. We encourage query letters from any prospective author.

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2. Manuscripts should not exceed 20 double-spaced typewritten pages and must be accompanied by a brief biographical statement identifying the author(s) and giving an address where interested readers may contact the author(s).
3. A printed original and two copies should be supplied by the author(s). Names of the author(s) should appear only on the cover page if blind review is desired. Manuscripts submitted on computer diskette will greatly expedite the editing and publication process. Acceptable diskette formats include WordPerfect 5.1, MS-Word, Rich-Text (RTF), or ASCII formats in DOS/Windows or Macintosh versions. Manuscripts and other notes submitted by electronic mail should be in plain text format. Please contact the editorial office for information about other word processing and diskette formats that might be acceptable.
4. Citations within text referring to reference section should be limited to author, date and (when appropriate) page, for example (Smith 1982: 21). Multiple references within text appear in chronological order, for example, (Thomas, Peters, and others 1925; Smith 1943, 1947; Smith and Jones 1983a, 1983b, 1984). Citations of electronic resources should include author(s) and date accessed. References to internet locations should be enclosed in angle brackets, for example, <http://www.ncseweb.org>.
5. Reference sections are alphabetical and should conform to the citation-sequence format in *Scientific Style and Format: The CBE Manual for Authors, Editors, and Publishers*, 6th ed., illustrated in the following examples:

   Kehoe AB. Modern anti-evolutionism: The scientific creationists. In: Godfrey LR, ed. *What Darwin Began*. Boston: Allyn and Bacon; 1985. p 165-85.

   Kuban GJ. Sea-monster or shark? An analysis of a supposed plesiosaur carcass netted in 1977. 1997; Available from <http://members.aol.com/paluxy2/plesios.htm>. Last accessed March 28, 1997.

   Smith FZ. Geocentrism re-examined. *Journal of Nice Things* 1985; 21 (3):19-35.

   Waters IC, Rivers HI, and others. Swept away in a flood of enthusiasm [editorial]. *Reports of the National Center for Science Education* 2995 Jan-Feb; 1015 (1): 22-9.

   Zubrow E. *Archaeoastronomy*. Orlando (FL): Academic Press, 1985.

   Do not abbreviate names of publications. Include location of book publishers, and use the abbreviation "nd" for undated material. Multiple entries by the same author are listed in the bibliography in chronological order and those in same year are listed as: 1982a, 1982b, and so on.
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