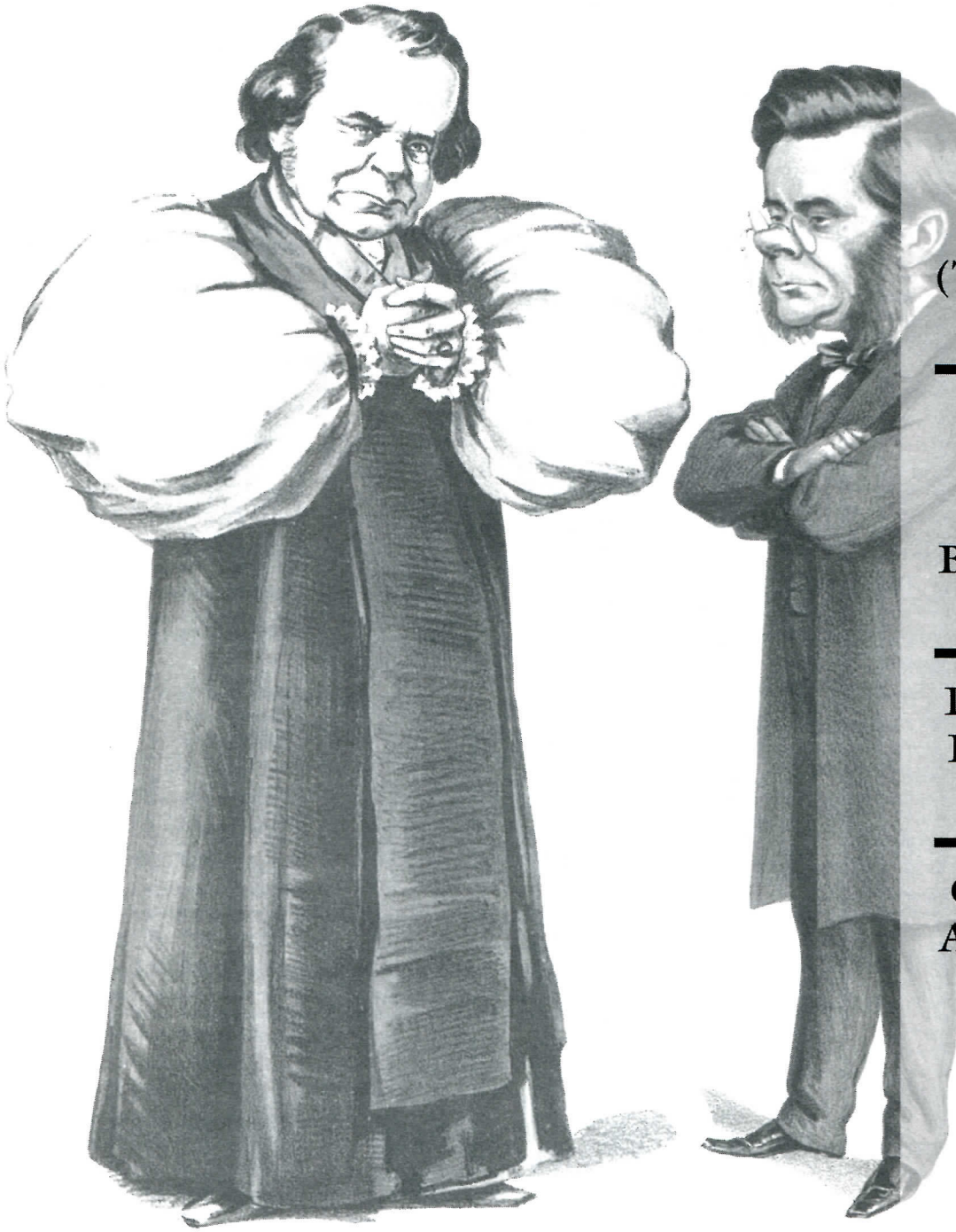
REPORTS OF THE NATIONAL CENTER FOR SCIENCE EDUCATION

Volume 18, Number 2

MAR/APR, 1998

CONTINUES
NCSE REPORTS &
CREATION/EVOLUTION



Denton Becomes a (Teleological) Evolutionist

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CONTINUES *NCSE REPORTS* & *CREATION/EVOLUTION*

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COVER: TH HUXLEY AND BISHOP WILBERFORCE

FROM THE EDITOR

The interface of science and religion is a "hot" topic these days. *The Quarterly Review of Biology* recently devoted half of a regular issue to the October 1996 comments of Pope John Paul II on evolution and reactions to it by a number of scientists and other scholars, including NCSE's Executive Director Eugenie Scott. The Center for Theology and the Natural Sciences at UC-Berkeley recently hosted a conference entitled "Science and the Spiritual Quest" (SSQ). The magazine *Free Inquiry* recently devoted a major portion of an issue to the topic, and there are increasing numbers of articles in the popular press and other media. There is so much happening on this front that we have pulled together most of the contributions that we have had on this topic and compiled them into this issue. Of course, most of what we present here has to do specifically with *evolution* and religious belief, but the current attention to this topic is much wider than that.

Robert Russell gave us permission to reprint his introductory remarks to the SSQ conference at Berkeley in which he gives us both the foundations for the conference and for the ongoing dialog among scientists, philosophers, and theologians on the interrelationships between these different ways of knowing. Genie Scott reflects on recent articles in the popular press and in *Nature* describing the religious beliefs and sentiments of scientists and asks whether the research lives up to the headlines. Mike Salovesh explains in a letter to a concerned parent why he has no conflict in teaching evolution and practicing his religious faith. We hope that these perspectives will be valuable for our readers as we consider the significance of our limiting scientific study to natural mechanisms.

Philip Spieth has provided us with an in-depth look at the latest book by Michael Denton, *Nature's Destiny: How the Laws of Biology Reveal Purpose in the Universe*. Our readers may best remember Denton as the author of the book that called evolution a "theory in crisis". Now he is back with a new book, but wait...Denton seems to have evolved! Spieth tells us that Denton seems to be embracing the concept of evolution, although in a way that owes more to "Intelligent Design" theorists than to evolutionary biologists. Evolution, you see, is okay as long as it is clear from the design of the universe that it *had* to lead to *us*—the only organisms "designed" to appreciate it. The parallel with Chambers's *Vestiges of the Natural History of Creation* does not escape Speith's notice.

Genie Scott also reports on the NCSE-sponsored trip to the Galapagos. "Awestruck" is not too strong a word to describe the feeling of walking the islands that were so important for giving shape to Darwin's ideas about natural selection. But there is more! Next year NCSE will sponsor a "Creation/Evolution" trip through the Grand Canyon. Mark your calendars for August 7-14, 1999 and read all about it!

And this issue features a 4-page "centerfold" because the topic is evolution! If you don't have a book list or don't visit the NCSE sales page on the web, then you should pull out and post this reminder of the many resources on evolution that NCSE has to offer. The expanded centerfold means that you can pull the page out the center of this issue and not lose any pages from the adjacent articles.

Don't miss the latest installment of our ongoing bibliography on resources related to important ideas in evolutionary biology. Frank Sonleitner scours the literature for us and sends us 3-4 bibliographies each year for our readers to use. Beginning in Volume 18, we have begun to lead the list with the summaries and secondary stories that are written for nonspecialists. For those interested in the original research articles, these are listed later in the paragraph following the "See also" header. Many thanks to Frank for providing this ongoing service.

We here at *RNCSE* are also interested in how to make this list more useful and friendly to our readers. Would you like it organized by topic? Would you like a searchable archive? Please let us know what would be most useful to you in the individual issues where the bibliographies appear and in an archive for later perusal.

Finally, please remember that as of September 1998, the editorial offices are moving. To reach us at our new location write:

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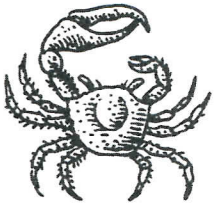
Because of our relocation, contributing editor John R Cole will be the guest editor for *RNCSE* volume 18, number 3. I will be back on the job for 18(4).

Anj Petto

NEWS

Sidney Fox Dies



On August 10, 1998, Dr Sidney Fox died in Daphne, Alabama, at the age of 86. Fox was a prominent origin-of-life researcher and remained active until his death. Over his long career, he published numerous papers and books in the fields of amino acid sequencing and evolutionary biology. Fox lectured widely throughout the world, including three appearances before the Pontifical Academy of Sciences, presenting his work on the synthesis of life to Pope John Paul II. As early as 1945 Fox pioneered amino acid sequence determination and was the first to synthesize a protein by heating amino acids under conditions found here on Earth. According to his friend, Sheldon Gottlieb, "He was the first to show that these new thermal proteins, when placed in water, would self-organize into a living cell. More recently he has demonstrated that this first protocell is also a protonerve cell."

In a 1997 public presentation in Mobile, Alabama, he said of his work:

> The second step toward a cell after amino acids is the formation of protein. This is where we came in, in a context of protein, not thinking at that time of this as a stage of life's origin. As a young professor of chemistry, I wanted to know if it were possible that amino acids such as had been produced by Herrera, and later by Miller, could yield proteins on the primitive Earth even before there were living cells to make protein. So we tried heating amino acids, even though heat was known to decompose amino acids. We learned we could avoid the decomposition if we included in the mixture to be heated a sufficient proportion of one or both of two amino acids: aspartic acid and/or glutamic acid.
>
> The main product of heating the amino acids is protein,...thermal protein. The expectation of protein chemists, which we shared, is that thermal protein, then called proteinoid, would be randomly disordered. What the experiments and analyses showed is almost the opposite....The arrangement of amino acids in thermal polymers is and was orderly....When brought into contact with water, all tested thermal polymers of amino acids, without exception, have been found to organize themselves into cells [called microspheres].... We had just begun to study the kind of responsiveness to stimuli that is followed by implanting microelectrodes into microspheres as if they were nerve cells. By displaying growth, metabolism, reproduction, and response to stimuli, the microspheres meet definitions of life in some textbooks and in Webster's Dictionary.... Hundreds of types of microspheres made from thermal protein all exhibit electrical activity [excerpted from *The Harbinger* 1997 May 17; 15(15): 6].

Fox's views were at variance with some more recent research proposing a DNA or RNA world preceding the origin of the first cell, and he vigorously opposed them. Still, he is rightly remembered as an important researcher in the origins of life field.

A native of Los Angeles, Fox received his BA degree from UCLA and his PhD from the California Institute of Technology. The chairman of his PhD dissertation committee was the famous evolutionary biologist and geneticist Thomas Hunt Morgan. Fox had a long and very distinguished career at Iowa State University (1943-55), the Oceanographic Institute at Florida State University (1955-61), and the Institute of Molecular and Cellular Evolution at the University of Miami in Coral Gables, Florida (1955-89). Fox was also the director of the Institute of Bioscience at Florida State University from 1961-64.

Fox's first formal retirement was in 1977. Following his second retirement in 1989, he departed Miami to become Distinguished Research Professor in the Department of Plant Biology at Southern Illinois University in Carbondale. In 1993, he moved to the University of South Alabama, where he was Distinguished Research Scientist in the Department of Marine Sciences.

Fox was active in public science education, both as a member of NCSE and as a participant in local science fora. He was keenly concerned about the creation and evolution controversy. Writing in a 1997 letter to NCSE Executive Director Eugenie Scott, he noted with some relish that "Dr Sheldon Gottleib and I battle the Alabama disclaimer!" NCSE has lost a friend.

[*Sheldon Gottlieb, John Cole, and Eugenie Scott contributed to this remembrance.*]

Evolution Researchers Plan Education Program

Molleen Matsumura
Network Project Director

The Society for the Study of Evolution (SSE), an international association of scientists, ordinarily devotes its annual meeting to the presentation of research papers. This year saw a new addition to the program—a special session for discussion of educational issues. The session was organized because many American college students—like half of all adult Americans—doubt the theory of evolution and base their doubts on a number of misconceptions.

One speaker at the session was Dr Brian Alters, a science education specialist at Harvard and McGill

Universities and contributing editor of *RNCSE*. Alters reported on his survey finding that a large percentage of college undergraduates share common misconceptions, such as the belief that mutations are never beneficial and that the methods used to date fossils are inaccurate. Other presenters described methods for improving evolution education, plans for public outreach and assistance to K-12 teachers, and an evolution education workshop and information booth that will be at the November 1998 meeting of the National Association of Biology Teachers (NABT) in Reno, Nevada.

NCSE Executive Director Eugenie C Scott, who will participate in the NABT workshop, commented, "This is a very welcome development. Both I and members of the NCSE Board have worked hard to encourage just this sort of involvement by researchers and academics. K-12 teachers really need and welcome such assistance, and I hope the SSE's planned collaboration with NABT creates a model that other professional societies can follow."

SSE is also planning a special session on teaching evolution to undergraduates at its June 1999 meeting in Madison, Wisconsin. Among the NCSE members involved in the planning are Alters and *RNCSE* editor Andrew Petto.

Updates

Idaho, Post Falls: On Monday, July 13, the Board of Education voted against a resolution suggested by local citizens which proposed giving equal time for "creation science" in the science curriculum. According to the Spokane *Spokesman Review*, a letter from "the Idaho School Boards Association warned that 'the district should not even consider attempting to see if scientific creationism can be taught without using religious doctrines,' because it violates the state Constitution and could cause the district to lose public funds". The same article reports that the superintendent of schools presented the board with a possible position statement, commenting "We think we can improve what we are doing when we talk about the origins of life, but we are going to stay away from the actual teaching of creationism." NCSE will continue to monitor the situation (Local news coverage of this story can be found at <http://www.VirtuallyNW.com/news-story.asp?date=071498&ID=s421045>, accessed July 14, 1998).

Indiana, Kosciusko County: The Tippecanoe Valley School District adopted a policy on "Origin of Life Curriculum" that reads:

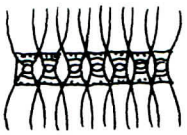
> **ORIGIN OF LIFE CURRICULUM**
>
> The board recognizes that it is educationally sound and important that students be presented opportunities to discuss a variety of ideas and viewpoints. The board further recognizes that this includes scientific theories about the origins of humankind with the intent of enhancing the effectiveness of instruction as important for a balanced education. The teaching of the origin of life will include the theory of evolution, the theory of creation, and other theories. The board also recognizes the role of the family in teaching values and making choices in decision making. The superintendent shall establish procedures for ensuring a balanced curriculum.

NCSE Executive Director Eugenie Scott notes the stated "intent of enhancing the effectiveness of instruction" echoes the language of the Supreme Court's 1987 *Edwards v Aguillard* decision striking down a balanced treatment law—except that the *Edwards* decision stated there must be a "clear *secular* intent" for teaching a "variety of theories" (emphasis added).

Kansas, Shawnee Mission: Some parents and students have objected to a mural in the social sciences hallway at Shawnee Mission Northwest High School. The mural depicts evolution and the school's science faculty says it illustrates what students are learning in the classroom. There are other thematic murals in the school. One is a historical mural which includes depictions of the Big Bang, Michelangelo's image of God touching Adam, and the births of Jesus and Mohammed. Another is a mural of nature scenes located outside the environmental sciences classroom. Petitions for and against the mural have been circulated in the school.

Oklahoma, Harrah: Middle school students in this suburb of Oklahoma City complain that a teacher took away their textbooks and handed out creationist pamphlets, telling them that a person who believes in evolution cannot believe in God. School district officials refused to comment to reporters; NCSE is investigating the incident and relevant state policies.

[*We thank Ron Jones, Doug McNeil and Frank Sonleitner for information used in this article.*]



NCSE NEWS

Ask A Busy Person

Molleen Matsumura
Network Project Director

There is an old saying that goes, "If you want something done, ask a busy person." That certainly seems to be true of the NCSE members we're featuring in this issue!

John Banister-Marx is a dedicated science teacher who took an active part in the effort to restore evolution to Arizona's science content standards (see "Substandard Standards in Arizona" *RNCSE* 18[1]:7). He frequently gives evolution workshops at science education conferences. John called recently to tell us that, at his workshops, he distributes NCSE materials if they are relevant to the topic and offers trial memberships in NCSE.

Rich Trott is a name that may look familiar. Rich is a consulting editor of *RNCSE* and also contributes articles refuting creationist arguments to the "Talk.origins" archive founded by another NCSE member, *Brett Vickers*. Rich moved to the San Francisco Bay Area recently, and he'd barely settled in before he dropped in at the NCSE office, asking, "What else can I do for you?" Rich went right to work rounding up donations of computer hardware and software. He also agreed to take on the painstaking job of proofreading the optically scanned versions of back issues of *Creation/Evolution* to prepare them for our web page and electronic archives. *Frank L Fire*, who devotes much of his free time working on church-state separation issues, is the volunteer who has devoted hours to scanning these articles, making it possible for NCSE to have computer files of back issues.

Many members will remember that *Betty McCollister* edited the first edition of NCSE's *Voices for Evolution*. Betty is a consulting editor for *RNCSE* and works continually to promote evolution education in her Iowa community. She frequently uses her weekly newspaper column to delve into various aspects of the issue.

Mary Beth Thomas of North Carolina's Academy of Science and *Charles Keeling* were among activists who worked hard opposing anti-evolution legislation in North Carolina last year (*see "Near Miss in North Carolina"* RNCSE *17[2]:5-6*). Now they have produced a booklet discussing "arguments against evolution" that are used in educational settings. The booklet will be distributed to North Carolina teachers.

NCSE Members Enjoy Galapagos Islands

Eugenie C Scott
NCSE Executive Director

From February 22 to March 7, 1998, eighteen NCSE members experienced the Galapagos trip of a lifetime. Not only did they spend 14 days on Darwin's islands themselves, but they also witnessed a spectacular full solar eclipse. It was truly an event that we will remember forever.

"El Niño" had affected the islands in dramatic ways, benefiting some animals and presenting hardships to others. Islands that are normally barren and dry or sparsely foliated were lush and green and jungly in appearance.

Seed-eating and insect-eating birds were thriving, but the warm coastal waters reduced feeding opportunities for sea lions, who experienced higher than normal mortality. Seabirds faced problems finding offshore fish because many food species had moved to deeper, cooler, waters.

On the other hand, the warmer water temperature made for wonderfully pleasant swimming and snorkeling for us *Homo sapiens*, and the undersea plant and animal life living on and about the edges of the islands was fascinating. The irregular volcanic debris offshore reminded me of coral beds, and the small, brightly colored fish that darted among the miniature pinnacles and canyons of this jumble were similarly reminiscent of reefs. Even for an El Niño year, the variety of underwater life was impressive.

We were extraordinarily lucky to have a skilled Ecuadorian guide and the expertise of retired biology teacher Mickey Cohen, who guided the trip. But NCSE members themselves are a well-educated lot: we were fortunate to have geologists Brent Dalrymple, Wilfred Elders, and Bill Benson with us—so there were more zoology, botany and geology than any one person could possibly absorb! We all learned a lot, however—especially geology!

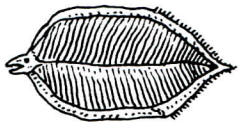
Of course, being able to witness a total solar eclipse was another treat, and our worries about possible rainy weather were assuaged as we were able to motor to a northern site among the islands and witness the eclipse under absolutely cloudless skies. The deck of the boat bristled with tripods and cameras, and, yes, it's DARK during an eclipse!

The Galapagos archipelago is a fascinating natural wonder, but I think that NCSE people, more than the average Galapagos tourists, appreciated the fact that it was on the Galapagos Islands that Charles Darwin first recognized the biogeographic phenomena that helped lead him from the idea of Special Creation to "transmutation", as evolution was called then.

Animals living on islands are similar but not identical to those on the closest mainland, which would not necessarily be the case if all varieties were specially created. And why on the Galapagos did each island have roughly the same sorts of animal life, but some species were clearly distinct from island to island? The Spanish vice-governor of the islands had remarked that he could distinguish tortoises from different islands by their shell shapes, but Darwin didn't collect carapaces because he considered the tortoises to be introduced species rather than natives. The mockingbirds, however, were similar to Chilean mockingbirds, and Darwin noted that they differed from island to island. He was not a good enough ornithologist to distinguish the varieties among the little black and brown finches—we could see why that was confusing!—so he didn't keep track of where his finch specimens came from. The mockingbirds helped Darwin realize that the island-specific variation shown in these similar-but-different birds would make Galapagos zoology "well worth examining; for such facts would undermine the stability of Species." In fact, the simplest explanation for Galapagos mockingbird variation would be that they had a common ancestor from which they had diverged. They had "descended with modification"—a phrase that was to become synonymous with "evolution".

So when NCSE members saw our first Galapagos mockingbird, it was truly something special! The ancestors of these bright-eyed, quick-moving grey-and-black birds planted the seeds of evolution in the mind of Charles Darwin who braved heat, thirst, exhaustion—and considerable seasickness and other discomfort—to bring them home to England for study. We thought about Darwin often as we walked some of the same trails he walked and saw the same "broken field of basaltic lava, thrown into the most rugged waves, and crossed by great fissures."

For me, what was as enriching as the wildlife, the geology, and the history, was getting to know an extraordinary group of people: my fellow NCSE members. I treasure the friendships I made, and thank my fellow participants for having made our trip to the islands so special. I look forward to the next NCSE trip—which will be a little closer than the Galapagos Islands and equally interesting in its own way for us evolution students! Look for information about NCSE's Creation/Evolution trip to the Grand Canyon!



Come With NCSE to the Grand Canyon!

Why Should Creationists Have All The Fun?

Eugenie C Scott
NCSE Executive Director

For many years now, the Institute for Creation Research (ICR) regularly has sponsored summer trips to the Grand Canyon. During these trips, the par-

ticipants learn the field evidence to support ICR's claims that the whole geological column from the Precambrian to the recent was laid down in a year and that the whole mile-deep, several-hundred-mile-long Grand Canyon (visible from the Moon) was cut in a couple of weeks' time, after Noah's Flood receded.

NCSE, a much smaller operation than the ICR (alas), has also sponsored member excursions to important geological and ecological locations. Participants enjoyed our two trips to the Galapagos Islands enormously, and we were looking around for other possibilities. Dr Wilfred Elders, a geologist at the University of California-Riverside, suggested a Grand Canyon raft trip. What a great idea!

Now, since this would be an *NCSE* trip, we wished to offer more than the typically grand float down the Canyon, with the spectacular scenery, exciting rapids, delicious meals, good companionship—we're going to give you creationism, too!

Consider joining NCSE for the first *Creation/Evolution* tour of the Grand Canyon!

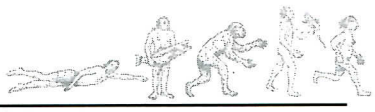
Eat Your Heart Out, ICR!

Yes! Why take the ICR trip and learn only nonsensical Flood Geology when you can learn nonsensical Flood Geology *and* real geology too?! Dr Elders, a PhD geologist, has made several trips down the canyon and can discourse knowledgeably on its geological wonders. Having seen him in action in the Galapagos, I can vouch for his being a master teacher to boot. I, your humble Executive Director, will provide the all-important "equal time" for creationism. The fact that I have never had a geology class in my life should certainly be no barrier to discoursing on geological facts that have been hidden by scientists who don't want you to know the weaknesses of evolution. Did you know, for example, that Mississippian Redwall limestone and Cambrian Muav limestone are interbedded—thus disproving "gradualist" evolution. Hah! What's your answer to THAT, Wilf!??

So, if you think a Creation/Evolution Grand Canyon trip would appeal to you, write me at the address below. Our tentative plans are for an 8-day motorized raft trip down the Canyon from Lee's Ferry to Lake Mead. The cost for NCSE members will be $1825 (all inclusive to and from Las Vegas, which gives you 8 days on the river). The cost for nonmembers will be $1875, so encourage your friends to join NCSE (membership is only $30 per year!). The trip will take place August 7-14, 1999, and we'll have room for up to 24 people *including* your esteemed creationist and evolutionist instructors.

Let me know the following: Are you interested? Shall I send you a color brochure with exciting photographs of shrieking people splashing through high rapids in magnificent canyon country that will doubtless make you immediately mark your calendar for the dates of our trip? Would you want university credit, if it could be arranged? Would you like to bring family members on the trip (12 years minimum age)? Would you like to help me figure out what the dickens the creationists are saying about the Grand Canyon??! Write me at Eugenie C Scott, 925 Kearney St, El Cerrito CA 94530-2810, or <scott@natcenscied.org>.

My prediction (which is more accurate than my statements about the Precambrian): the boats will fill up fast!



What do Christians *Really* Believe about Evolution?

Molleen Matsumura
Network Project Director

Recently a California teacher requesting help from NCSE wrote:

> I am a high school biology teacher trying to find information on the official positions of Christian denominations and other major world religions on evolution for use in my classes. I have many creationist students in my classes who assume anyone who believes in God agrees with the literal creationist beliefs on this. Can you help?

This teacher also felt he needed more information about the legal rights and responsibilities of teachers who are teaching evolution.

These are questions which arise for teachers all across the country. NCSE had already produced a flyer summarizing court decisions (*see "Resources for Members: Brochures and Flyers from the National Center for Science Education", p 21*).The NCSE brochure "Seven Significant Court Decisions Regarding Creation/Evolution Issues" outlines the relevant legal issues.The position statements of science teachers' professional associations published in NCSE's *Voices for Evolution* also confirm that science teachers can honestly tell their students, "Legally, I cannot teach you 'creation science' *or any other religious explanation* of life on earth."

However, although they cannot teach religious doctrines, teachers are permitted to teach *about* religion. The topic is usually reserved for social studies classes, but many science teachers, like the one whose questions are quoted above, want to be better informed about evolution/creation beliefs and may find that sharing such information with students and their community clears the way for teaching about evolution.

What Do Christians Believe?

While a number of recent surveys give us some information on how many Americans express beliefs compatible with literal interpretations of the Bible, they don't tell us whether such beliefs are, in fact, required of Christians by their denominations. Even though the numbers of those polled in the US who say that they accept evolution is about equal with those who accept special creation of humans, the majority of Americans professing to be Christians belong to denominations that accept evolution.

Table 1 is adapted from a 1998 article released by the Religion News Service and lists the twelve largest denominations in the US in order of size. It also shows which denominations have in some manner officially supported the teaching of evolution in public schools.The percentages listed in the second column represent the percentage of that denomination's members in relation to the total membership of those listed in the table (not in relation to all Christian denominations). A mark in the column entitled "Voices" indicates that the leaders of this denomination have contributed an official statement which we have published in NCSE's *Voices for Evolution* (Matsumura 1995).

Some denominations have subsequently issued additional statements. The column headed "Joint Statement" shows which denominations endorsed "Religion in the Public Schools: A Joint Statement of Current Law" (American Jewish Congress and others 1995), an interfaith statement that declares:

[O]f Americans in the 12 largest Christian denominations, 89.6% belong to churches that support evolution education!

> 5. Students may be taught about religion, but public schools may not teach religion....
>
> 6. These same rules apply to the recurring controversy surrounding theories of evolution. Schools may teach about explanations of life on earth, including religious ones (such as "creationism"), in comparative religion or social studies classes. In science class, however, they may present only genuinely scientific critiques of, or evidence for, any explanation of life on earth, but not religious critiques (beliefs unverifiable by scientific methodology). Schools may not refuse to teach evolutionary theory in order to avoid giving offense to religion nor may they circumvent these rules by labeling as science an article of religious faith. Public schools must not teach as scientific fact or theory any religious doc-

MEMBERSHIP AND ACCEPTANCE OF EVOLUTION IN 12 LARGEST US CHRISTIAN DENOMINATIONS

Denomination	Membership (millions)	Percent	*Voices*	Joint Statement	*McLean*
Roman Catholic Church	61.2	49.0	•		•
Southern Baptist Convention	15.7	12.6			•
United Methodist Church	8.5	6.8	•	✪	•
National Baptist Convention USA	8.2	6.6		✪	
Church of God in Christ	5.5	4.4			
Evangelical Lutheran Church in America	5.2	4.2		⁕	
Church of Jesus Christ of Latter-Day Saints (Mormons)	4.8	3.8			
Presbyterian Church (USA)	3.5	2.8	•	⁕	•
National Baptist Convention of America	3.5	2.8		✪	
African Methodist Episcopal Church	3.5	2.8		✪	•
Lutheran Church-Missouri Synod	2.6	2.1			
The Episcopal Church	2.5	2.0	•	✪	•

• Indicates statement issued by official body of this denomination.
✪ Indicates statement signed by the National Council of Churches of which this denomination is a member.
⁕ Indicates that this denomination was listed as an "endorsing organization".

trine, including "creationism", although any genuinely scientific evidence for or against any explanation of life may be taught. Just as they may not either advance nor inhibit any religious doctrine, teachers should not ridicule, for example, a student's religious explanation for life on earth.

Finally, official representatives of some denominations were plaintiffs in the famous *McLean v Arkansas* case. Official denominational opposition to the law requiring the teaching of "creation science" is recorded in the column headed "*McLean*".

Table 1 demonstrates that of Americans in the 12 largest Christian denominations, 89.6% belong to churches that support evolution education! Indeed, many of the statements in *Voices* insist quite strongly that evolution must be included in science education and "creation science" must be excluded. Even if we subtract the Southern Baptist Convention, which has changed its view of evolution since *McLean v Arkansas* and might take a different position now, the percentage those in denominations supporting evolution is still a substantial 77%. Furthermore, many other Christian and non-Christian denominations, including the United Church of Christ and the National Sikh Center, have shown some degree of support for evolution education (as defined by inclusion in *Voices* or the "Joint Statement").

However, many Americans, including your students, may not know the position of their denominations. Several science teachers have told NCSE staff, "When I tell my students to check with their ministers, they are surprised to find out that it's okay for them to learn about evolution!" Seeing the information in Table 1 might give some students just such a surprise.

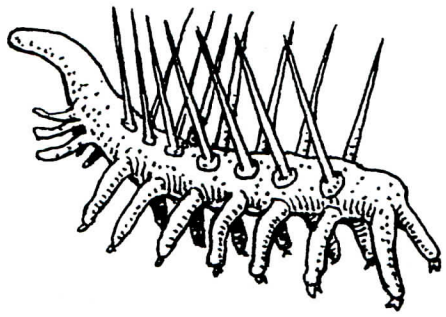
While it isn't a science teacher's job to tell students or the community at large "what they should believe", clearing away their misconceptions may help a teacher get on with the job of teaching science. By all means tell them that what most Americans believe and most Christian denominations teach is this: "Teaching evolution is okay!"

REFERENCES

American Jewish Congress, American Civil Liberties Union, American Jewish Committee, American Muslim Council, Anti-Defamation League, Baptist Joint Committee, Christian Legal Society, General Conference of Seventh Day Adventists, National Association of Evangelicals, National Council of Churches, People for the American Way, Union of American Hebrew Congregations. *Religion in the Public Schools: A Joint Statement of Current Law, April 1995*. [Note: The "authors" listed here are organizations represented on the drafting committee. An additional 22 organizations are listed as "Endorsing Organizations". The entire statement may be found on the worldwide web at <http://www.nlrc.org/public/docs/joint1.htm> (last accessed June 4, 1998) or by contacting any organization represented on the drafting committee.]

Matsumura M. *Voices for Evolution*. Berkeley (CA): National Center for Science Education, 1995. [*Voices* can be viewed on the worldwide web at <http://www.natcenscied.org/voicont.htm>. See centerfold for information on ordering printed copies].

Religion News Service. Believers: Dynamic Dozen. June 1998, <http://www.religionnews.com/arc98/b_060198.html> (last accessed June 4, 1998.) [Note: This source cites, in turn, the *1998 Yearbook of American and Canadian Churches*.]



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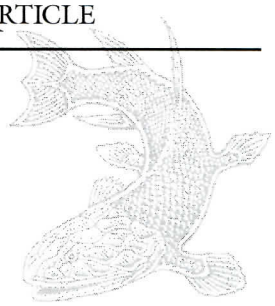


Denton Becomes a (Teleological) Evolutionist:

Rejects Special Creationism and Evolution

***Nature's Destiny*: *How the Laws of Biology Reveal Purpose in the Universe* by Michael J Denton. New York: The Free Press, 1998. 454 p.**

Review Essay by Philip T Spieth

In the tree of intellectual genealogies, natural theology and natural science share a recent common ancestry. As recently as 150 years ago natural theology played a prominent role in British biology, especially in the debates between the teleological "adaptationists," who saw purpose and adaptedness as the organizing principle of biology, and the anti-teleological "structuralists," who looked to homology and Unity of Type as the central principle (see Amundson 1996: 22-7). The famous Bridgewater Treatises marked a high point for the teleological adaptationists.

Denton's transformation from biological typologist in 1985 to anti-Darwinian evolutionist in 1998 is not as surprising as it might seem at face value. In actuality he is in step with the group of neocreationists whose tenets are denoted by the term "Intelligent Design".

The work of Charles Darwin changed the situation dramatically and irreversibly. While drawing upon the insights of the structuralists to provide evidence for the fact of evolution, Darwin firmly established adaptation at the center of biology. However, he did so "in the most radical way possible—by naturalizing the concept of adaptation, thus removing from it all implications of finalism, reversed causation, and intelligent contrivance. Adaptation was restored, but in a way which made it useless to its old theological champions" (Amundson 1996: 49). Divergence between natural theology and natural science was firmly established. Ancestral concepts such as teleological explanations, anthropocentrism, and purposefulness were no longer part of natural science.

Michael Denton wants to undo the divergence between biology and natural theology, and he wants to impose once again the teleological worldview of natural theology upon the methodology of biological science. *Destiny* is his attempt to do so. He ends the book with the wish:

> As I hope the evidence presented in this book has shown, science, which has been for centuries the great ally of atheism and skepticism, has become at last, in these final days of the second millennium, what Newton and many of its early advocates had so fervently wished—the "defender of the anthropocentric faith" (p 389).

In addition to his general purpose of attempting to impose "a rapidly emerging new teleological worldview" upon evolutionary biology, Denton has a more specific (and astonishing) agenda item. He sets it forth in the following statement from his "Note to the Reader" and reiterates it at the book's conclusion:

> I believe the evidence strongly suggests that the cosmos is uniquely fit for only one type of biology—that which exists on earth—and that the phenomenon of life cannot be instantiated in any other exotic chemistry or class of material forms. Even more radically, I believe that there is a considerable amount of evidence for believing that the cosmos is uniquely fit for only one type of advanced intelligent life—beings of design and biology very similar to our own species, *Homo sapiens* (p xiii; see also p 389).

Destiny is Denton's second book. In 1985 he published *Evolution: A Theory in Crisis* which was characterized by outmoded typological thinking, bashing Darwinism in a form and style typical of the "creation science" literature of the 1980s, and by Denton's development of a spurious concept of "equidistance" based upon a misunderstanding of genealogical relatedness (Spieth 1987). It has become a staple of anti-evolutionists who use it as "proof" that "scientists are rejecting evolution". *Destiny* differs from *Crisis* in a remarkable way: although remaining a staunch anti-Darwinian, Michael Denton has become an evolutionist!

Design and Adaptation

In *Destiny* Denton fully accepts the genealogical relatedness of all organisms, including *Homo sapiens*, and even titles one chapter "The Tree of Life". Judging from his unabashed anthropocentrism, Denton's "tree" is an old-growth redwood with humans represented by the apical meristem at the top of the main trunk. In any event, the *fact* of evolution is stipulated. Denton's issue is entirely with the processes of evolutionary change. When it comes to the *processes* of biological evolution, Denton has problems with the contingencies of evolutionary change, and biologists will have problems finding Denton's alternative explanations to be either adequate or convincing.

Denton's transformation from biological typologist in 1985 to anti-Darwinian evolutionist in 1998 is not as surprising as it might seem at face value. In actuality he is in step with the group of neocreationists whose tenets are denoted by the term "Intelligent Design" (Scott 1997: 279-5). The themes, tone, and style of *Destiny* are characteristic of other "Intelligent Design" works.

Although the book is fundamentally about evolution and is filled with fascinating scientific facts from the physical sciences and molecular biology, the first thing to be recognized is that *Destiny* is *not* a scientific treatise. Rather, it is a book about natural theology. As a treatise on natural theology it is flawed by its (deliberate?) failure to comprehend and incorporate modern evolutionary biology.

Destiny begins with an exposition of the "anthropic principle" that has recently received substantial treatment by natural theologians coming from the perspective of physics. The anthropic principle is based on the notion that the physical properties of the universe and its components are incredibly finely tuned to the point that if they were even slightly different from what they are the world would be a very different place, and we would probably not exist. Denton carries his exposition of the anthropic principle into the realm of biology, and the result is that *Destiny* becomes what Denton personally describes as "an essay in natural theology in the spirit and tradition of William Paley's *Natural Theology* or the Bridgewater Treatises" (p xii).

Destiny is divided into two parts. Part 1, entitled "Life", is devoted to an elaboration of the anthropic principle. In it Denton provides extended and detailed descriptions of the critical properties of a long list of physical, chemical, and biological entities that play significant roles in organic life as we know it. The catalog begins with the physical constants of the forces of nature, moves on to the properties of water, light, carbon, DNA, and so forth, and continues all the way to the ability of humans to manipulate fire. For those who crave technicalities, a 20-page appendix adds more details. Actually, this part of the book makes fascinating reading. Denton does an excellent job of providing illustration upon illustration of how amazing and awesome nature in general and life in particular truly are. The value of *Destiny* will be determined by the degree to which it enhances the general public's awe and appreciation for nature.

The difficulty in reading this section arises from the repeated references to the "fitness" of **A** that is attributable to **A**'s having property **x**, where the concept of being "fit" refers to being valuable or essential for biological life (for example, water is uniquely "fit" for life because of its anomalous expansion below 4°C). The words *fit*, *fitness*, and *adaptation* are used *ad nauseam*. Never have so many paragraphs owed so much to so few words.

This difficulty is more than a simple matter of literary aesthetics. In the first place, Denton's concept of fitness is different from the biological concept. Second, there is a problem of polarity. Does **A** have property **x** in order that life might exist in its current form (Denton's view)? Is life the way it is in part because **A** has property **x** (a biologist's view)? Is the human nose an adaptation for the purpose of supporting spectacles (Dr Pangloss's view)? Reading *Destiny* requires an ability to endure 428 pages of pan-adaptationism at it worst.

Part 1 of *Destiny* takes up two-thirds of the book. Nevertheless, it is only the introduction. Part 2, entitled "Evolution", is the heart of Denton's contribution. In it he attempts to make the case that "if the laws of nature are so finely tuned to facilitate *life's being* in the form of a unique set of carbon-based organisms [the anthropic principle set forth in Part 1], ...then it seems conceivable that *their becoming* through the process of evolution might have been determined also by natural law" (p xiv; italics in the original). In other words, he suggests that organic evolution is a pre-ordained consequence of "natural law". He dismisses out of hand the Darwinian concept of evolution through natural selection on the grounds that organisms are so complex and so "finely tuned" to their environments with such incredible adaptations that their evolution can only be explained as a directed, purposeful process. Natural selection and "non-directed models of evolution" are not up to the job in Denton's view. In this respect he echoes the views of "Intelligent Design" advocates such as Behe (1996) and Morris (1998).

From reading *Destiny* one would have no clue that evolutionary biology has progressed one whit from the time Darwin published *Origin*.

Denton's arguments need to be assessed on two distinct levels. First, what is the basis for his categorical rejection of the explanations provided by modern evolutionary biology? At least 3 problems in this book bear on this question: Denton ignores modern evolutionary biology. He has a naive view of adaptation. He does not think "probabilistically". Second, what are the merits of the alternative mechanisms that he suggests?

Denton's View of Biology

Michael Denton is a molecular biologist. When he discusses topics involving the physical sciences or molecular biology, he does reasonably well and pre-

sents current information. On the other hand, when the discussions turn to biology above the organismal level or to the theoretical basis of molecular evolution, he appears to be out of his league and is out of date. From reading *Destiny* one would have no clue that evolutionary biology has progressed one whit from the time Darwin published *On The Origin of Species By Means of Natural Selection*. The three major architects of the New Synthesis—Ernst Mayr, Theodosius Dobzhansky, and George Gaylord Simpson—receive exactly one trivial citation each. JBS Haldane gets two citations, neither of which directly relates to evolutionary biology. Sewall Wright and RA Fisher are not mentioned, nor are Ledyard Stebbins or EB Ford. He does manage a brief mention of Eldredge and Gould's theory of punctuated equilibria (p 297). However, his discussion is devoted to the typical anti-Darwinian tactic of presenting punctuated equilibria as a "problem" for Darwinian evolution.

[R]are events do occur—rarely. ...[I]n a historical science such as evolutionary biology there are many cases in which...one, or a few, specific... unique events, especially if they are of low probability, can have a significant impact

When Denton introduces specific topics of molecular evolution, he ignores contemporary theory. For example, he introduces the phenomenon of molecular clocks (p 290-2) but never mentions Motoo Kimura or John Gillespie. Elsewhere he discusses the topic of genetic redundancy (p 337-9) but makes no reference to current theoretical treatments by Thomas (1993) or Nowack and others (1997).

Adaptation is the central theme of *Destiny*, woven throughout the entire fabric of the book. The view of adaptation that Denton presents is, however, the naive view that was espoused by pre-Darwinian natural theologians such as Paley and Whewell. After Darwin, however, biologists changed the way they think about adaptation:

> Natural theologians had always studied adaptation, but only (so to speak) after the fact. On theological understanding the cause of adaptation (divine contrivance) had occurred at inaccessible times and places. Darwinians could study adaptations as a process and inspect the bits and pieces of which that process was made. Darwin did not invent the study of adaptation, but he invented a way to study adaptation *from within* (Amundson 1996: 32).

Modern biology, especially in the last few decades, has further refined our thinking about adaptation and has brought substantial rigor to its study. The complexities of genetic systems—pleiotropy, epistatic interactions, redundancy, and so forth—as well as concepts such as design constraints and empirical phenomena such as the widespread conservation of underlying genetic mechanisms are recognized and incorporated in contemporary views of adaptation (see, for example, Rose and Lauder 1996). Uncritical adaptationism, whether invoked in the name of natural selection or divine contrivance, is inappropriate to modern biology. *Destiny* abounds in uncritical adaptionism.

Probability and Determinism

In *Crisis* Denton repeatedly used the phrase "mere chance" when discussing Darwinian evolution. In *Destiny* his adjective of choice is *contingent*. In both cases, the context in which Denton uses these words gives them a pejorative connotation. He clearly abhors any suggestion that "chance" played a significant role in human evolution. This may well be Denton's Achilles' heel. Regardless of one's views about adaptations or the efficacy of natural selection, a fundamental, indisputable, fact of the world we live in is that life is a chancy business.

Many important processes are stochastic: their outcomes can be predicted only in terms of probabilities. Genetic recombination and Mendelian segregation are classic examples. If that is not bad enough, many fundamentally deterministic processes are chaotic: minute variations in current conditions can lead to widely divergent future results. Five-day weather patterns are examples with which everyone is familiar. Humans typically are uncomfortable with uncertainty (Perhaps the result of an evolutionary trade-off in the processes that led to a mind capable of discerning patterns, organizing information, and doing science?). Nevertheless, thinking in terms of probabilistic outcomes is essential in many arenas of human endeavor, not the least of which is evolutionary biology.

Evolution moves one step at a time, and each change is conditional upon the current state of affairs. Each move, however, changes the existing state of affairs and thereby changes the possibilities for subsequent changes. The conditional probabilities are constantly changing. The result is that evolution is a cumulative process with its history heavily embedded in its present state. The polarity of adaptation is crucial. The evolution of biological entities is conditional upon their environment and their history—not the other way around! It makes no sense to speak of physical factors' being uniquely "fit" for organisms whose evolution was conditioned by those very factors. Denton's attempt to extend the anthropic principle into the realm of organic evolution reflects his failure to recognize the cumulative nature of evolutionary change and his inability to think in terms of conditional probabilities.

One of the things about probabilistic processes is that rare events do occur—rarely. In cases for which the law of large numbers applies—for example, most cases of natural selection or a casino's profits from its roulette tables—rare events have little importance. Statistical means and variances are what count. On the other hand, in a historical sci-

ence such as evolutionary biology there are many cases in which our interest is in one, or a few, specific realizations of a stochastic process, no two of which are ever identical. In such cases the law of large numbers is inapplicable, and unique events, especially if they are of low probability, can have a significant impact upon the trajectory of the particular stochastic process in which they occur. A reigning example is the extinction of the dinosaurs as the apparent consequence of the earth's collision with a large extraterrestrial object. Had that particular event not occurred the history of life on earth would certainly have been different. Advocates of "Intelligent Design", including Denton, who believe that "replaying the tape of evolution" will produce the same song are invoking the law of large numbers in a situation to which its application is, at the very least, questionable.

The principal theme in *Destiny* is the assertion that teleologically directed evolution can better explain evolutionary phenomena than can contingent, non-directed Darwinian evolution by natural selection. We should note that in Denton's usage "directed" implies direction but is not synonymous with "directional", since he refers to natural selection as an "undirected evolutionary mechanism." (see, for example, p 364).

Evolutionary Mechanisms

The concept of directed evolution raises several questions. What precisely is Michael Denton's notion of directed evolution? What mechanisms provide the direction? At the beginning of Part 2 Denton states:

> The laws of nature...give every impression of having been pre-ordained for life as it exists on earth. The concept of directed evolution is therefore no longer an anomaly in a nonbiocentric world. On the contrary, it is merely a logical deduction from a rapidly emerging new teleological worldview (p 275).

It seems, therefore, that directed evolution, in Denton's scheme, is the product of some external agent that has a purpose and a goal for life on earth. He never specifies what that agent is; the reader is left to fill in the blank with the name of some entity of choice.

Denton does provide some clues about possible mechanisms by which directed evolution supposedly occurs; however, he is vague, and the situation is a bit confusing. In Chapter 12, "The Tree of Life," he advances the notion that everything was preprogrammed:

> The revolutionary new DNA world revealed by modern genetics...is a world which provides the basis for relatively detailed and plausible speculation as to how the whole pattern of evolution might have *been written into the DNA script from the beginning* (p 275; emphasis added).

This statement will come as a shock to anyone who has thought seriously about the amount of information that can be stored in the DNA of primitive prokaryotes. Soon thereafter he states:

> If genes can direct developmental changes, there is no reason why, at least in principle, they cannot also direct evolutionary change....Many other types of programmed genomic reorganization are utilized during development in different species....There is no compelling reason why similar types of changes could not have been genetically programmed to occur during the far longer time course of evolution....It is premature to reject out of hand the possibility that during the course of evolution specific preprogrammed genetic re-arrangements have occurred at specific times (p 280).

These statements have some interesting, and heretofore unthought of, implications concerning the mechanisms of gene action. Is Denton suggesting that molecular geneticists need to rethink the subject?

As the book progresses, the situation concerning the mechanisms of directed evolution becomes more murky. In Chapter 13, "The Principle of Plenitude", Denton attempts to make the case that essentially every kind of biological structure that could possibly evolve has done so. Mechanisms are not considered; rather, teleology and the anthropic principle are asserted:

It seems, therefore, that directed evolution, in Denton's scheme, is the product of some external agent that has a purpose and a goal for life on earth. He never specifies what that agent is; the reader is left to fill in the blank.

> The possibility that life on earth approximates to the plenitude of all possible biological forms is perfectly in keeping with the teleological thesis that the cosmos is uniquely prefabricated for life as it exists on earth" (p 299).

The implication is that all the emergent properties of life are necessary consequences of the intrinsic properties of our particular physical world. Denton deserves an award as one of the ultimate reductionists. "The Dream of Asilomar" (Chapter 14) is a treatise on "Intelligent Design" and elaborates upon the complexities of biology at the genetic, developmental, and physiological levels. At the end it returns to William Paley, asserts the alleged inadequacy of natural selection, and affirms the "necessity for direction" in organic evolution but offers no mechanisms.

Structural Anomalies and Emergent Capacities

Chapter 15 ("The Eye of the Lobster") is curious. In it Denton discusses four "problem cases" for evo-

lution: lobsters' eyes, scallops' eyes, marsupial frogs, and avian lungs. The human brain is added for good measure. These are problem cases in the sense that each is atypical and exhibits dramatic, discrete differences between itself and the corresponding situation found in the closest relatives. These cases represent the kind of supposed anomalies that advocates of special creation love to wallow in. In *Destiny*, however, Denton explicitly distances himself from special creationists. In his "Note to the Reader" he states:

> In large measure, therefore, the teleological argument presented here and the special creationist worldview are mutually exclusive accounts of the world....The more convincing is the evidence for believing that the world is prefabricated to the end of life, that the design is built into the laws of nature, the less credible becomes the special creationist worldview (p xviii).

Informed, rational people came to believe in evolution in the first place despite the fact they were strongly inclined to believe in the existence of the supernatural. They did so on the basis of the strength of the evidence. The evidence today is much stronger.

Following his discussion of the eye of the lobster and similar cases Denton returns to a discussion of the mechanisms of evolutionary change. Presumably, he does so to answer critics from the creationist camp, since the "problems" raised by lobster eyes and other examples apply equally to both directed evolution and Darwinian evolution. Here, however, he waffles on his previous notions of preprogrammed instructions in the "DNA script" and makes a feeble attempt to reintroduce the discredited notion of orthogenesis:

> In the case of remarkable and complex adaptations restricted to small isolated geographical regions, it is not easy to envisage them as being preprogrammed into the order of nature and being part of a "grand design". The question naturally arises, how did such adaptations come about? If neither natural selection nor any other sort of undirected evolutionary mechanism seem plausible, then could they conceivably have been the result of the activities of life itself operating via some as yet undefined type of inventiveness inherent in all life?...The possibility that some degree of adaptive evolution may be the result of an inherent emergent inventive capacity possessed by all living things cannot be ruled out (p 364).

In the concluding chapter, "The Long Chain of Coincidence", Denton declares the anthropic principle fully established for everything in the universe, both organic and inorganic. He thereby demonstrates that "*the cosmos is a specially designed whole with life and mankind as its fundamental goal and purpose*" (*Destiny*, p 389; italics in the original). Apparently the Creation is now complete. Evolution has done its job and can now cease?

Denton opens Part 2 of *Destiny* with a sympathetic attempt to rehabilitate the views presented by Robert Chambers in his famous *Vestiges of the Natural History of Creation*, published in 1840. Denton clearly considers Chambers a kindred soul for the very good reason that, as Denton recognizes, their teleological views of evolution through natural processes are quite similar. Although *Vestiges* was highly popular with the general public of its time, it failed to impress or persuade the scientific community. It would now be totally forgotten but for its having become a standard example in the Darwinian literature of a work that recognized the principle of biological evolution prior to the publication of The *Origin of Species*. The failure of *Vestiges* lay not so much in its anticipation of Darwin by nearly two decades but rather Chambers's failure to provide acceptable mechanisms to explain evolutionary change (See Mayr 1982: 384). Michael Denton and Robert Chambers have more in common than Denton realizes.

References

Amundson R. Historical development of the concept of adaptation. In: Rose MR, Lauder GV, Eds. *Adaptation*. San Diego: Academic Press; 1996. pp 11-54.

Behe M. *Darwin's Black Box*. Chicago: Free Press, 1996.

Denton MJ. *Evolution: A Theory in Crisis*. Bethesda (MD): Adler & Adler, 1985.

Mayr E. *The Growth of Biological Thought*. Cambridge (MA): The Belknap Press of Harvard University, 1982.

Morris SC. *The Crucible of Creation: The Burgess Shale and the Rise of Animals*. New York: Oxford University Press, 1998.

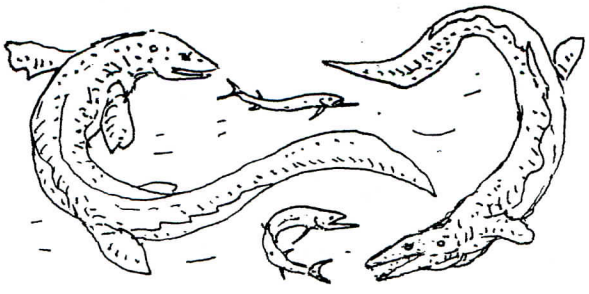
Nowak MA, Boerlijst MC, Cooke J, Smith JM. Evolution of genetic redundancy. *Nature* (London) 1997; 388(6638):167-71.

Rose MR, Lauder GV. Post-spandrel adaptationism. In: Rose MR, Lauder GV, Eds. *Adaptation*. San Diego: Academic Press; 1996. pp 1-8.

Scott EC. Anti-evolution and creationism in the United States. *Annual Review of Anthropology* 1997; 26:263-89.

Spieth PT. Book Review: *Evolution: A Theory in Crisis* by Michael Denton. *Zygon* 1987; 22:252-7.

Thomas JH. Thinking about genetic redundancy. *Trends in Genetics* 1993; 9(11):395-9.



Science and Religion, Methodology, and Humanism

Eugenie C Scott
NCSE Executive Director

[*In May 1998 Dr Eugenie C Scott, NCSE's Executive Director, was awarded the American Humanist Association's 1998 "Isaac Asimov Science Award". What follows is excerpted from her acceptance speech. Ed.*]

In late 1995, the National Association of Biology Teachers (NABT) issued a statement to its members and the public concerning the importance of evolution to biology teaching. Part of the statement defined evolution:

> The diversity of life on earth is the result of evolution: an unsupervised, impersonal, unpredictable and natural process of temporal descent with genetic modification that is affected by natural selection, chance, historical contingencies and changing environments.

Shortly after this statement appeared, I began to see letters to the editor from around the country decrying the "atheism" of the NABT. Anti-evolutionists like Phillip Johnson included broadsides against NABT in their writings. As one Christian said to me, defining evolution as "unsupervised" and "impersonal" implied to many Americans that "God had nothing to do with it and life has no meaning." Reflecting these public concerns, two distinguished theologians, Cornell's Huston Smith and Notre Dame's Alvin Plantinga, wrote a polite letter to NABT's board of directors, asking it to delete the two words "unsupervised" and "impersonal". They specifically noted that the use of the two words

> has two unfortunate and unintended consequences. It gives aid and comfort to extremists in the religious right for whom it provides a legitimate target. And because of its logical vulnerability, it lowers Americans' respect for scientists and their place in our culture.

When the NABT's board convened at its annual meeting in Minneapolis in October 1997, members' initial reaction was that creationists were trying to get them to change the statement, and they weren't about to knuckle under to that sort of pressure. They voted at the end of a 9-hour meeting, after only a brief discussion, not to change the statement.

Why is this story relevant to my receiving this award? You may be surprised to hear that after I arrived at the NABT meeting, I encouraged the board to do as the theologians asked and drop "unsupervised" and "impersonal". I'm pleased to say that the board did discuss the issue at greater length and ultimately altered the statement by dropping the two words.

People who know what I do for a living, and who know I am a nontheist, are sometimes surprised to hear this. In fact, a group of about 100 scientists signed a letter decrying the NABT's decision to drop the two words and accusing its board (and Eugenie Scott) of capitulating to political pressure from "fundamentalists." Well, lest you think I have gone "soft on creationism" and thrown the integrity of science to the wolves, let me explain a few things. I'd hate for you to think that you have given this wonderful Asimov award to a closet creationist! I lobbied the NABT board of directors to make the change because of both my respect for science and my respect for the philosophy of humanism that draws so strongly upon it. To explain requires me to reflect a bit upon both religion and science.

First, religion. Some define religion as "world view" or a person's (or a people's) "perspective", but this is too broad to be useful. Anthropologists define religion as a set of rules and attitudes regarding interaction with certain supernatural beings. Not all supernatural beings—elves, the tooth fairy, and Santa Claus are the subjects of folk beliefs, rather than religion. Religion concerns omnipotent entities—gods, A God, the Ancestors—powerful forces that can be (or have to be) supplicated, worshiped, or in some other way, interacted with. Religion does not always determine the rules for how people should behave towards one another (morals and ethics) but religion always has rules for what to do about superior beings. In Judaism and Christianity, there is one deity, which is certainly omnipotent.

Now, what about science? My job requires coping with science illiteracy in the American public. There is widespread ignorance both of the facts and concepts of science, as well as illiteracy in the very nature of science itself—of science as a way of knowing. Often, time is short: TV and radio especially require me to reduce science down to one or two "Big Ideas".

I think I'd be satisfied if Americans would get into two habits. First, ask, "Is there another explanation?" Uncle Fred found water in the back pasture using a forked stick, so there must be forces unknown to science at work. Is there another explanation? Copper bracelets cure arthritis because my neighbor's arthritis got better when she wore one. Is there another explanation? To be a truly critical thinker, one must be especially careful to ask this question when the explanation seems reasonable. Mr X got fired from his teaching job because he teaches evolution. Is there another explanation?

Maybe Uncle Fred found water (assuming he did it more frequently than chance) because after living for 60 years in that kind of country, he has amassed some subconscious knowledge of places where water is likely to be found. Maybe my neighbor's arthritis got better because of

a placebo effect. Maybe Mr X got fired because he is a lousy teacher.

After we get people into the habit of asking, "Is there another explanation?" we next need to get them to ask, "How do I tell which explanation is better?" Deciding which explanation is better requires testing the explanations against the natural world—and therein lies the essence of science. I'd love for the average American to understand the rest of what we associate with the philosophy of science—falsification, parsimony, repeatability, open-endedness—but the public needs to grasp the basics first. What is most important is "testing" and "natural world."

The essence of scientific testing is the ability to hold some conditions constant. To test whether putting fertilizer on my petunias will make them grow bigger flowers, I have to hold constant such things as amount of water, sunlight, weeds, and so on—to control for these factors. Testing means holding some things constant and varying others.

[I]f science is limited by methodological materialism because of our inability to control an omnipotent power's interference in nature, both "God did it" and "God didn't do it" fail as scientific statements.

Now we get down to the nitty-gritty of science and religion, and why I lobbied to take the words "impersonal" and "unsupervised" out of the NABT statement. Consider: If to test something scientifically requires the ability to hold constant certain effects, this means that omnipotent powers cannot be used as part of scientific explanations. Logically, if there are omnipotent powers in the universe, it is impossible to hold their effects constant, to "control" them in the scientific sense. An omnipotent power could interfere, or not interfere, or interfere but make it look like it's not interfering—that's omnipotence for you!

So science must be limited to using just natural forces in its explanations. This is sometimes referred to as the principle of methodological materialism in science: we explain the natural world using only matter, energy, and their interactions (materialism). Scientists use only methodological materialism because it is logical, but primarily because it works. We don't *need* to use supernatural forces to explain nature, and we get farther in our understanding of nature by relying on natural causes.

Because creationists explain natural phenomena by saying "God performed a miracle," we tell them that they are not doing science. This is easy to understand. The flip side, though, is that if science is limited by methodological materialism because of our inability to control an omnipotent power's interference in nature, both "God did it" and "God didn't do it" fail as scientific statements.

Properly understood, the principle of methodological materialism requires neutrality towards God; we cannot say, wearing our scientist hats, whether God does or does not act. I could say, speaking from the perspective of my personal philosophy, that matter and energy and their interactions (materialism) are not only sufficient to understand the natural world (methodological materialism) but in fact, I believe there is nothing beyond matter and energy. This is the philosophy of materialism, which I, and probably most humanists, hold to. I intentionally added "I believe" when I spoke of my personal philosophy, which is entirely proper. "I believe," however, is not a phrase that belongs in science.

We philosophical materialists may all be methodological materialists, but the converse isn't true. Gregor Mendel was a methodological materialist who didn't accept the philosophy of materialism. I think we make a grave error when we confuse philosophical views derived from science—even those we support—with science itself.

Let me give you an example. There exists a group of critics of science about whom Barbara Ehrenreich has written eloquently; they call themselves deconstructionists, or postmodernists, and they can be found in unfortunately large numbers in the humanities and social sciences departments of most universities and colleges. They claim that science is largely responsible for the current destruction of the environment, for social policies based on racism and sexism, for genocide, the Holocaust, for iatrogenic illness. They argue that the very Enlightenment principles that Humanists embrace should be knocked off their pedestals and replaced with more subjective, personal, and allegedly "more humane" ways of making decisions.

Most of us Humanists (being rational, Enlightenment types) would argue vigorously against this position. With Barbara Ehrenreich, we would point out that, yes, indeed, science has been used to promote ideas like genocide that we would consider evil, but that postmodernists are confusing ideologies and ideas drawn from science with science itself. Science has, for example, been used both to promote and to rebut sexism and racism, but the *philosophical view* one draws from science should not be used to raise up or cast down science itself.

The same principle applies to philosophical materialism, the view at the foundation of our Humanism; we may derive this view from science, but an ideology drawn from science is not the same as science itself. Science is an equal opportunity methodology.

Therefore, I agreed with the two theologians who asked NABT to take the words "impersonal" and "unsupervised" from its statement on evolution. NABT was making a philosophical statement outside of what science can tell us. Plantinga and Smith wrote:

> [I]it is extremely hard to see how an empirical science, such as biology, could address such a theological question as whether a process like evolution is or isn't directed by God.... How could an empirical inquiry possibly show that God was not guiding and directing evolution?

And they were right. If we are to say to postmodernist attackers of science that they should not confuse science with positions or philosophies derived from science, then we must be consistent and not equate science with materialist philosophy.

I argue for the separation of methodological from philosophical materialism for logical reasons, and

What's In a Name? Or: Just When You Thought It Was Safe to Name Fossils!

Eugenie C Scott
NCSE Executive Director

British scientist Jennifer Clack recently named a fossil amphibian *Eucritta melanolimnetes*. This move caused chuckles among biologists familiar with an old tradition of naming new plants and animals by inserting puns, cultural references, digs at rivals, and in other ways playfully subverting the strict rules of zoological nomenclature.

Indeed, those with a little Latin background will recognize that *melano-* means "black" and *limnes* means pool or body of water. It could, of course, be stretched to mean "black lagoon". And of course, *eu* is Greek for "true", but the rest is pure American slang. (Come to think of it, isn't "critter" pronounced "critta" in British English?) I'll leave the rest to you.

The Bard is honored with genus names *Puck* and *Iago*, and the genus and species name, *Ytu brutus*, but popular culture is not ignored. The largest remipede crustacean is given the genus name *Godzillius*, and another member of the godzilliid family is *Pleomothra*. A carabid beetle which is "short, fat, and has hairy feet" is *Polemistus bilbo*, but another hairy-footed character is immortalized in a wasp species name, *P chewbacca*. The big bad guy in *Star Wars* gets into the act as *P vaderi*.

This breezy approach is taken by namers of other insects, such as *Heerz lukenatcha, Heerz tooya, Verae peculya*, and *Lalapa lusa*. The entomologist Kirkaldy, working in the early part of this century, either had a lot of girl friends, or an active fantasy life, as he chose the genus names *Ochisme, Dolichisme, Florichisme, Marichisme, Nanichisme, Peggichisme*, and *Polychisme*. (Remember that "ch" in Latin is pronounced with a hard "k" sound.)

The rigors of paleontological field work being what they are, is it surprising that a fossil lizard should be named *Cuttysarkus*? And there are at least 3 fossil taxa from Mexico with variants of *Margarita* as a genus or species name. Maybe entomology field work generates occasional hostility, as with the namers of the chigger, *Trombicula fugigmo*, the species name taken from the well-known (if bowdlerized here) military slang, "Forget you, Jack, I got my orders."

Doubtless there were some scientists who harrumphed over somebody's naming a new fossil amphibian after the Creature from the Black Lagoon, but personally, I welcome it. Sure makes it easier to remember all those binomials!

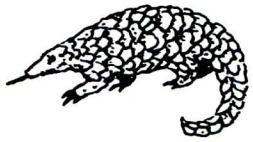
For those interested in other unusual scientific names, Mark Isaak wrote to tell us that he keeps a catalog at <http://www.best.com/~atta/taxonomy.html>.

for reasons based on the philosophy of science. It is also possible to argue from a strategic standpoint. Living as we do in a society in which only a small percentage of our fellow citizens are nontheists, we who support the teaching of evolution in the public schools should avoid the creationist's position of forcing a choice between God and Darwin. Creationists are perfectly happy if only 10% of the population (the percentage of nontheists) accepts evolution. I am not. I want people to understand and accept the science of evolution; whether or not someone builds from this science a philosophical system that parallels mine is logically and strategically independent. An ideology drawn from science is not the same as science itself.

Ironically, I find myself being praised and encouraged in my position by conservative Christians and taking flak from some fellow nontheists, including some scientists. I must say, though, that over the last several months I have presented lectures at several universities and two meetings of professional scientists in which I have argued that a clear distinction must be drawn between science as a way of knowing about the natural world and science as a foundation for philosophical views. One should be taught to our children in school, and the other can optionally be taught to our children at home. Once this view is explained, I have found far more support than disagreement among my university colleagues. Even someone who may disagree with my logic or understanding of philosophy of science often understands the strategic reasons for separating methodological from philosophical materialism—if we want more Americans to understand evolution.

Science and Humanism are too important for us not to think very clearly about what they have in common *and* where they are distinct. The most difficult questions for us to think about critically are the ones where one answer better suits our ends, even if another one is truer. As Humanists, we might want to claim the power of science as our own, but we cannot honestly do so. Humanists should be modeling clear thinking, not muddling it—and I think we are up to the task.

Again, I am highly honored to receive this Isaac Asimov Award in Science, and I sincerely thank you for making me its first recipient.



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EVOLUTION!

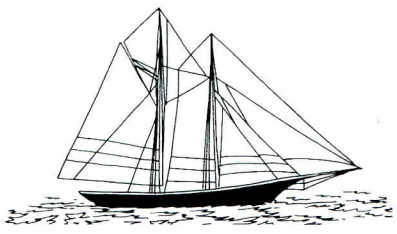
DISCOUNT BOOKS FOR NCSE MEMBERS

NCSE offers members discount prices on books on a wide variety of topics, and in each issue we feature a sampling of books with a common theme—the history of the evolution/creation controversy, resources for combating "creation science" and other pseudoscience, books about evolution, general-interest books about science, humor and literature for the science-minded, and children's books. For a complete list of books available from NCSE, call us at 1(800)290-6006, send a stamped, self-addressed envelope, or visit our on-line catalog at <http://www.natcenscied.org/dbooks.htm>.

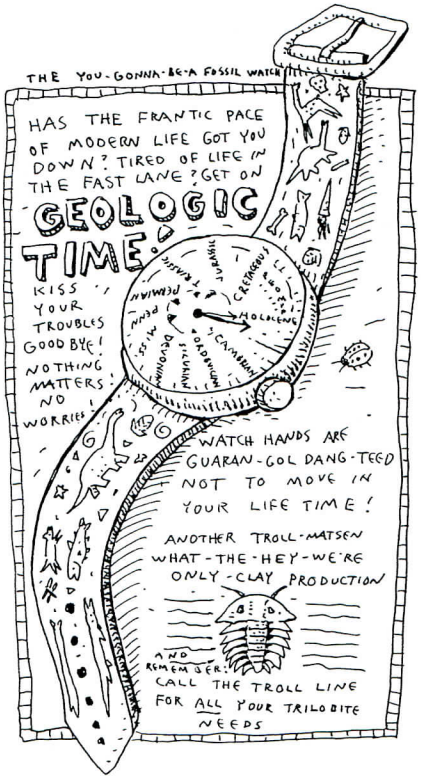
In this issue we highlight books on the science of evolution—the topic that fascinates us all. Here you will find books to help you better understand the organizing principle of biology, geology, anthropology, and astronomy. Check below for books for yourself—and for that person you are trying to introduce to evolution!

HISTORY AND PHILOSOPHY OF DARWINISM

Charles Darwin
by John Bowlby.
A highly-regarded biography described by Frank Sulloway as "[p]erhaps an ideal introduction to Darwin's life and work for the non-specialist." 511 pages, paperback. *List price $14.95, member price $11.95.*



The Darwin Legend
by James Moore.
Did Darwin have a "deathbed conversion" to religion, renouncing evolution, as told to "Lady Hope"? Nope! Read how this early 20th century legend got started, and why Kevin Padian calls this book "engaging and edifying reading". *List price $11.95, member price $9.50* (see "The Darwin Legend" *NCSE Reports* 16[1]:3, 8).



Huxley: From Devil's Disciple to Evolution's High Priest
by Adrian Desmond.
"Darwin's Bulldog" was also a champion of public science education and a major scholar in his own right. Desmond's biography is a detailed but lively presentation of Huxley's life and ideas. 832 pages, hardback. *List price $37.50, member price $30* (see review by John R Cole in *RNCSE* 18[1]:28).

Darwin, CD ROM
by Pete Goldie.
All the "biggies" are here. Darwin's major works, including *On The Origin of Species by Means of Natural Selection*, *The Descent of Man*, *The Voyage of the Beagle*, *The Expression of the Emotions in Man and Animals*, *The Structure and Distribution of Coral Reefs*, and *On the Various Contrivances by which British and Foreign Orchids Are Fertilized by Insects*. Also included are Darwin's 1200-page barnacles monograph and various short papers, such as the 1858 Darwin-Wallace monograph "On the Tendency of Species to Form Varieties" and many others. This is the definitive collection of Darwin's writings. The CD also includes 1500 primary and secondary references, maps and illustrations. Well-illustrated, and easy to get around in. CD-ROM for MACs or PCs. *List price $49.95, member price $40* (see review by Laura McMahon in *RNCSE* 17[2]:28).

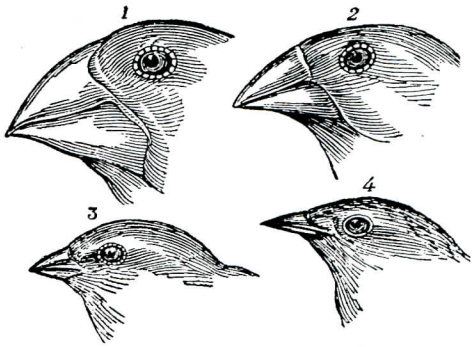
Darwin's Dangerous Idea
by Daniel Dennett.
Dennett thoroughly describes evolutionary science, including current controversies, then goes on to spell out its implications for modern philosophy and modern life. Dennett argues that natural selection "is a universal solvent, capable of cutting right to the heart of everything in sight." Paperback, 587 pages. *List price $16, member price $13* (see review by Danny Yee in *RNCSE* 18[1]:29).

Without Miracles: Universal Selection Theory and the Second Darwinian Revolution
by Gary Cziko.
Random variation and adaptive selection have produced complex life on earth, but the selectionist argument can also be applied wide-

ly to many areas including immunology, neuroscience, ethology, psychology, anthropology, philosophy, education, linguistics, and computer science. New medicines as well as new computer programs are being produced through this "universal selection theory". A good companion piece to Dennett. Hardback, 385 pages. *List price $30, member price $24.*

The Non-Darwinian Revolution
by Peter J Bowler.
Darwinian theory, based on adaptation and natural selection, was not the only mechanism offered to explain evolution during the 19th century. Bowler's readable but scholarly account takes us through the evolution of these "developmental" ideas. Paperback, 238 pages. *List price $14.95, member price $12.*

The Meaning of Evolution: The Morphological Construction and Ideological Reconstruction of Darwin's Theory
by Robert Richardson.
Richardson argues that Darwin's view of evolution reflected the recapitulationist views of his time and was both progressive and teleological. A provocative study. Hardback, 205 pages. *List price $10.95, member price $8.75.*



For the General Reader

The Beak of the Finch
by Jonathan Weiner.
An excellent, readable introduction to the principle of evolution by natural selection, shown by the changes in beak size and biochemistry of Galapagos finches. Weiner demonstrates how the data painstakingly gathered over more than twenty years by Peter and Rosemary Grant and their students brilliantly illustrate evolution occurring as we watch. Paperback, 332 pages. *List price $13, member price $10.50.*

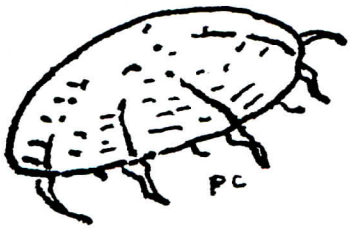
At the Water's Edge: Macroevolution and the Transformation of Life
by Carl Zimmer.
During one important period of life's history, vertebrate creatures left the water to colonize land, and later, some vertebrates re-adapted to the water. Zimmer traces the discovery of both the transition to land of early tetrapods and the later transition to water of the whales. If you are ever having an argument over "transitional fossils", this is the book you want to read! Hardback, 290 pages. *List price $24.50, member price $14.50.*

Digging Dinosaurs
by John Horner and James Gorman.
Horner is well known as the model for the iconoclastic "Jurassic Park" paleontologist, but the real story of his discovery of the stupendous 10 000-specimen *Maiosaur* site, complete with nests, eggs, and hatchlings, is even more impressive than the fictional account. Science writer Gorman keeps the prose moving in a conversational style. Well-illustrated. Hardback, 209 pages. *List price $17.95, member price $14.35.* Paperback, 209 pages. *List price $8.95, member price $7* (limited number of paperback copies available).

Darwin's Dreampond
by Tijs Goldschmidt.
Lake Victoria was colonized by a small fish that speciated into over 200 species, similar to Darwin's Galapagos finches. Goldschmidt uses Lake Victoria "as a springboard for explaining basic taxonomy and systematics...and speciation, adaptive radiation, and natural selection." Paperback, 274 pages. *List price $15, member price, $9* (see the review by Danny Yee, *RNCSE* 18[1]:29).

From So Simple a Beginning
by Phillip Whitfield.
This large, beautifully-illustrated book presents the full sweep of 4 billion years of evolution clearly enough for high school students on up. Very good for nonspecialists and teachers. Large format paperback, 218 pages. *List price $19.95, member price $15.95.*

The Diversity of Life
by EO Wilson.
The "dean of biodiversity studies" takes us through the five great extinctions of the last 600 million years. Wilson presents evidence that the sixth, human-made extinction is taking place right now. Written in Wilson's usual beautiful style. Hardback or paperback, 424 pages. *Hardback list price $29.95, member price $24; paperback list price $14.95, member price $12* (limited number of paperback copies available).



For the Technically-Inclined

Evolutionary Biology
by Douglas Futuyma.
The most recent edition of Futuyma's best-selling college-level textbook is an excellent, comprehensive reference for anyone wanting to know more about the science of evolution. Hardback, 827 pages. *List price $64.95, member price $58.50.*

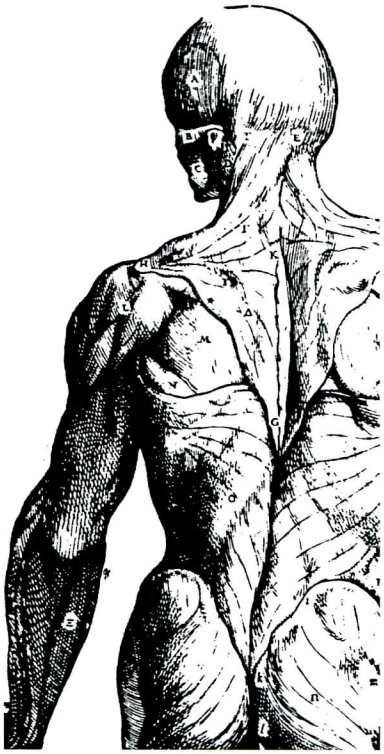
Evolution
by Monroe Strickberger.
This lavishly-illustrated college-level textbook is excellent especially for teachers or anyone who wants an understandable introduction to the wide variety of topics that make up evolution, from biochemical genetics to ecology. Hardback, 670 pages. *List price $58.75, member price $47.*

The Age of the Earth
by G Brent Dalrymple.
Simply the most comprehensive book you can find on how geologists have determined how old the earth is. It includes an interesting historical survey of early ideas, as well as an up-to-date summary of radiometric methods. Hardback, 474 pages. *List price $27.95, member price $22.35.*

The Origins of Order: Self-Organization and Selection in Evolution
by Stuart Kauffman.
Can life self-organize? Kauffman presents a non-Darwinian explanation for the origin of life and early molecular systems. An answer to "design theory"! Paperback, 709 pages. *List price $35, member price $28.*

Evolutionary Ethics
edited by Matthew H Nitecki and Doris V Nitecki.
The historical background to evolutionary ethics and articles for and against sociobiological interpretations of evolutionary ethics. Articles by Richard D Alexander, Laurie R Godfrey, Michael Ruse, Robert J Richards, Elliot Sober, George Williams, and others. Paperback, 368 pages. *List price $19.95, member price $16.*

Major Events in the History of Life
edited by J William Schopf.
This is a must for anyone who teaches evolution. It contains authoritative summaries of origin-of-life research, early life, the appearance of the Metazoa, and the subsequent evolution of plants, vertebrates, and humans. Eugenie Scott says, "I use this book a lot to review the 'big ideas' of the history of life." Large format paperback, 190 pages. *List price $37.50, member price $30.*



GOULD á LA CARTE

Stephen Jay Gould's role in developing the model of punctuated equilibria and his monthly column in *Natural History* have made him a popular writer who needs no introduction. NCSE carries many of his books for our members, including:
An Urchin in the Storm, list price $8.95, member price $7.
Wonderful Life, list price $11.95, member price $9.75.
The Flamingo's Smile, list price $11.95, member price $9.75.
The Panda's Thumb, list price $11.95, member price $9.75.
Bully for Brontosaurus, list price $13.95, member price $11.95.
Ever Since Darwin, list price $10.95, member price $8.75.
Hen's Teeth and Horses' Toes, list price $10.95, member price $8.75.

RESOURCES FOR MEMBERS: BROCHURES AND FLYERS FROM THE NATIONAL CENTER FOR SCIENCE EDUCATION

NCSE has a variety of resources for members and friends who want to help promote and defend evolution education. Many of our members select particular brochures and flyers according to content, then use them in a number of ways. Some distribute copies to students or at workshops for science teachers. Others take them to conferences of civil liberties or public education activists. These resources are also useful for sharing information on legal and educational issues with school administrators or school board members. Our members also use them to inform or remind themselves of key points to cover in public discussions, such as newspaper editorials or panel discussions of educational controversies.

Here is a sampling of current brochures and titles available from NCSE.

PAMPHLETS

Creation or Evolution?
George Bakken.
A brief, but comprehensive rebuttal of such creationist arguments as the meaning of supposed "gaps" in the fossil record.

Would We All Behave Like Animals?
William Thwaites.
A "conversation" dispelling fears that teaching about evolution undermines morality.

Evolution, Creationism, and Science Education: Answers to Ten Common Questions
Molleen Matsumura.
Answers to questions about scientific, legal, and moral issues that occur in ordinary situations such as PTA meetings.

The Record of Human Evolution
Eric Delson.
The story of evolution from the earliest mammals through modern humans.

Origin Myths
Robert Carneiro.
The variety and meaning of creation stories and their relationships to scientific explanations.

"Scientific Creationism", Evolution and Race
Eugenie C Scott.
Explanation of creationist fallacies and the real meaning of human diversity.

The Evolution of Creationism
William Thwaites.
A discussion of the history, changes, and inconsistencies of creationist theories and the acceptance of scientific findings by most religions.

Facts, Faith, and Fairness: Scientific Creationism Clouds Scientific Literacy
Steve Walsh and Thomas A Demere.
Discussion of why creationism is not science and the urgent need to teach evolutionary theory and scientific literacy.

Facing Challenges to Evolution Education
Molleen Matsumura.
Descriptions of strategies commonly used in attempts to force "creation science" into public schools.

FLIERS

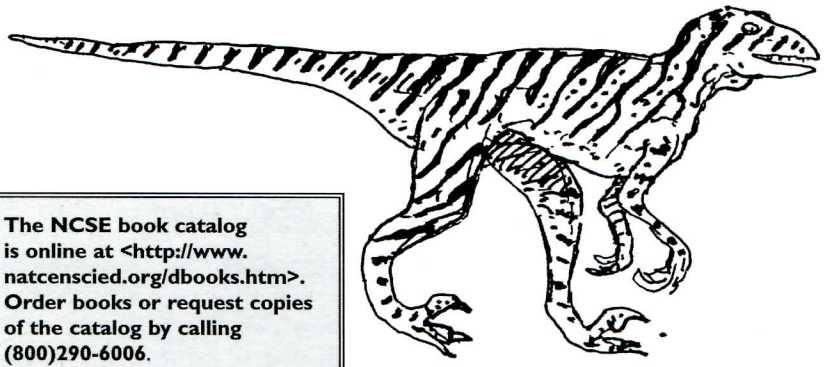
Science and Religion in America (Poll and Survey Data)
Summarizes surveys of public knowledge about science and about evolution.

BACKGROUND: Seven Significant Court Decisions Regarding Evolution/Creation Issues
Summarizes and gives references to seven important court decisions including the landmark *Epperson v Arkansas* and *Edward v Aguillard* Supreme Court decisions.

What's Wrong With "Theory, Not Fact" Policies on Teaching Evolution?
Discussion of legislation and regulations that would require evolution to be taught as "theory, not fact".

25 Ways to Support Evolution Education
Practical, effective suggestions provided by NCSE members.

Single copies of these items are free upon request, accompanied by a stamped, self-addressed envelope. You may also request a complete set of brochures ready for distribution on colored paper or as a set of "masters" on white paper which you can duplicate yourself. For orders of 1-99 copies of a single brochure, please include a fee of 25 cents per copy. For orders of 100 or more the cost is 20 cents each. To preview these materials visit <http://www.natcenscied. org/broclist.htm>.



The NCSE book catalog is online at <http://www.natcenscied.org/dbooks.htm>. Order books or request copies of the catalog by calling (800)290-6006.

NCSE REQUESTS THE PLEASURE OF YOUR OPINION

NCSE is often asked to suggest books on evolution to add to school and classroom libraries. Parents, too, often ask for recommendations of enjoyable books that will supplement what their children read in school. As you can see in this issue's centerfold, there is no shortage of good books, and we've selected some of the best for our readers. Still, we can benefit by tapping our members' wisdom. If you know of a good book, film, or other resource to help children learn about evolution, please send us your short reviews (no more than one page). With your help we can develop an annotated list of the most popular and useful member selections.

In your reviews tell us:

- Your background (for example, scientist, science enthusiast, teacher or parent);
- Author and title of recommended book;
- Topic of book (for example, evolution, human evolution, the age of dinosaurs, how scientists find fossils, biography of Charles Darwin, and so on);
- Age or grade level for which book is appropriate;
- Brief description of the book's strengths and shortcomings and how you have found it useful in teaching your students or children.

When this project is completed, we will be sure to tell our members. Thanks in advance for your help.

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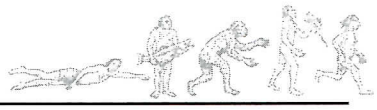

Creationism, A Trip to the Dark Side

Skip Evans

Answers in Genesis, publisher of *Creation* magazine, held a creationism seminar/sermon in Marietta, Georgia on September 15-16, 1997. Several members of the Atlanta chapter of Americans United for the Separation of Church and State attended, and I put together this report from our impressions of that event.

The main chapel of the Roswell Baptist Church was near capacity for Ken Ham, Director of Answers in Genesis. I was surprised that the lecture was extremely short on science and very long on scripture. Maybe it's because I haven't been to one of these shindigs before, but I just assumed that a movement that calls itself "creation science" would have some science to it. Or perhaps because Ham was preaching to the faithful, he knew he wouldn't need much evidence for his claims. Whenever he did present some bit of scientific material to make his point he was always sure to precede it with statements like, "Bear with me, this won't take long." This seemed to indicate that to this audience even pseudoscience was a bit too much like a trip to the dentist. Ham's presentation was much more concerned with imploring his listeners not to give in to the temptation to surrender Genesis to science. He proclaimed, "We must desecularize, de-evolutionize our thinking....If you can't defend Genesis you can't defend Christianity." This statement was followed by a healthy dose of criticism for churches not adhering to his own literalist doctrine.

Ham began by demonstrating how scientists who asserted that *Tyrannosaurus rex* was a carnivore had to be wrong. His evidence? A slide showing the fearsome chompers of *T rex* was whisked off the display and replaced with a verse from Genesis 1:30, "And to every beast of the of the earth, and to every fowl of the air, and to every thing that creepeth upon the earth, wherein there is life, I have given every green herb for meat." Therefore, Ham concluded, all animals at the time of creation were vegetarians, including *T rex*. Meat-eating did not occur until after the Flood and was a result of sin. His presentation was decorated with colorful cartoon slides to emphasize key points. As Adam and Eve held up the forbidden fruit they were watched not only by the serpent but by a friendly brontosaurus as well.

Ham placed creation in opposition to "random, undirected processes" and argued his case using Mount Rushmore as an analogy (this, incidentally, is straight out of a recent issue of *Creation* magazine). First he proposed that Mount Rushmore was not actually created, but occurred by accident. Wind and storm erosion over many years caused, by pure chance, the likeness of the presidents to appear on the rocks. After sufficient chuckles from the audience he then went on to conclude that since it was impossible for Mount Rushmore to have happened by chance, therefore it was also impossible for something as complex as life to have happened by "random, undirected processes". Of course, this has nothing to do with evolution, since evolutionary theory does not say that life occurred by "random, undirected processes", but these small points seem lost on Ham and on his audiences as well.

Perhaps the most disturbing element of Ham's presentation was the absolute disdain he held for the people who had made careers and lives out of the pursuit of scientific truth. His simplistic and insulting remarks smacked of such blatant religious intolerance that when they prompted "amens" from the audience I felt truly afraid. Even NASA was not above his contempt. Ham suggested that the discovery of a meteorite from Mars, perhaps containing evidence of bacterial life on the red planet in the past, was nothing more than a publicity stunt to get NASA in the news and get more money for their programs. Ham shook his head with disgust as the audience voiced their disapproval. I thought of the astronauts and even friends I have known who have worked for our space program and thought, "Is this what they deserve?"

Some of his remarks echoed slogans from the "Religious Right", such as "America is no longer a Christian nation; it is a pagan nation." I did laugh right along with the audience at one of his remarks: "The atheists understand Christianity better than the Christians." However, I have to admit some of his statements were simply lost on me. What possible sense can one make out of a statement like, "Natural selection is the opposite of evolution"?

The rejection of *Creation* magazine by the Athens (GA) Regional Library System was played for all it was worth to promote the magazine and to show that libraries are hostile to Christianity (*See* RNCSE *16 [3]:18*). At the end of the lecture when he solicited the audience

Skip Evans is taking a short hiatus from activism to complete a few unfinished plays and become a real New Yorker, but promises to rejoin the debate very soon.

for subscriptions to the publication he exclaimed, "It's better than *National Geographic*!"

The final part of the lecture was a call to action, a call to arms, against the godless, atheistic, anti-Christian evolutionists who had vowed to destroy Christianity and everything it stood for. To make his point he had another cartoon slide, one of two castle towers with cannons on top of each. The bottom of one tower was labeled EVOLUTION, the other CREATION. Rising up from the word EVOLUTION, pasted on the tower's side were the words ABORTION, PORNOGRAPHY, HOMOSEXUALITY and LAWLESSNESS. Rising up from CREATION were FAMILY, MARRIAGE, GOD and TRUTH.

The next slide showed the two towers again. The "creation" tower was pristine and undamaged, but the "evolution" tower was blasted at the base. According to Ham, this is the way things should be. At the conclusion Ham explained that the cartoons used in the presentation were from the Answers in Genesis publication "A is for Adam", a children's book.

Ham referred constantly to the public school system and went on to catalog all the social ills that derive from including evolution in curriculum. His constant criticism of public schools appeared to be little more than a thinly-veiled call for creationist intrusions into science classrooms.

This lecture was the first of three to be presented over the course of two nights. There was to be another lecture 30 minutes after this one, and then a third the following night. I had intended to go to all three to learn all I could. But I had seen enough. Quite frankly, I just couldn't take any more.

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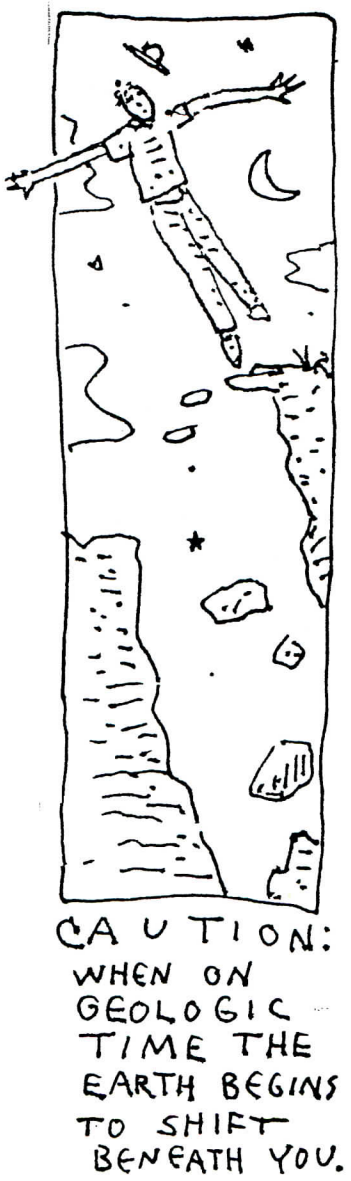
RNCSE readers will recall Ron Ebert's article on the constancy of the speed of light. Now we see that Malcolm Bowden has reviewed the issue for *Creation Ex Nihilo Technical Journal*. His April 1998 article, "Reports of the Death of the Speed of Light Decay are Premature", can be found at <http://www.ldolphin.org/constc.shtml>.

[*Thanks to Jim Foley for locating this one.*]



ROOTS OF MORALITY

One argument we often hear against evolution is that we would drift into immorality if we turned our backs on the religious traditions that serve as the foundations of our laws, ethics, and moral values. In the September 28, 1998 issue of *The New Republic* Charles Larmore reviews *The Invention of Autonomy: A history of Modern Moral Philosophy* by JB Schneewind. He argues that Christian theology beginning with the writings of Paul recognized that moral good and the "discernment of moral truth" do not rely on divine revelation through the Holy Scripture. Larmore tells us that Schneewind's "historian's sensibilities, with a fine eye for unintended consequences" builds a case of moral philosophers' struggle with the idea that each human has the ability to "grasp and heed the principles of right conduct" independent of any sanctions imposed from the outside. According to Larmore, even though many of the philosophers whose work Schneewind explores were practicing Christians, he credits them with building the foundations of a secular morality of "self-governance" or autonomy. In his review, Larmore compares the need to develop criteria for judging the validity of moral standards in the same way that we do scientific ones. These cannot be, he argues, merely normative or socially constructed validity, but must be based in principles that depend on "a validity that we acknowledge, not a validity that we create."

Larmore C. Objectively good. Book review of *The Invention of Autonomy: A History of Modern Moral Philosophy* by JB Schneewind. *The New Republic* 1998 Sept 28; 42-5.

Contributed by Andrew Petto with thanks to Nancy Davenport.

The Origins of Order: Self-Organization and Selection in Evolution
by Stuart Kauffman.
Can life self-organize? Kauffman presents a non-Darwinian explanation for the origin of life and early molecular systems. An answer to "design theory"! Paperback, 709 pages. *List price $35, member price $28.*

Evolutionary Ethics
edited by Matthew H Nitecki and Doris V Nitecki.
The historical background to evolutionary ethics and articles for and against sociobiological interpretations of evolutionary ethics. Articles by Richard D Alexander, Laurie R Godfrey, Michael Ruse, Robert J Richards, Elliot Sober, George Williams, and others. Paperback, 368 pages. *List price $19.95, member price $16.*

Major Events in the History of Life
edited by J William Schopf.
This is a must for anyone who teaches evolution. It contains authoritative summaries of origin-of-life research, early life, the appearance of the Metazoa, and the subsequent evolution of plants, vertebrates, and humans. Eugenie Scott says, "I use this book a lot to review the 'big ideas' of the history of life." Large format paperback, 190 pages. *List price $37.50, member price $30.*

GOULD á LA CARTE

Stephen Jay Gould's role in developing the model of punctuated equilibria and his monthly column in *Natural History* have made him a popular writer who needs no introduction. NCSE carries many of his books for our members, including:
An Urchin in the Storm, list price $8.95, member price $7.
Wonderful Life, list price $11.95, member price $9.75.
The Flamingo's Smile, list price $11.95, member price $9.75.
The Panda's Thumb, list price $11.95, member price $9.75.
Bully for Brontosaurus, list price $13.95, member price $11.95.
Ever Since Darwin, list price $10.95, member price $8.75.
Hen's Teeth and Horses' Toes, list price $10.95, member price $8.75.

RESOURCES FOR MEMBERS: BROCHURES AND FLYERS FROM THE NATIONAL CENTER FOR SCIENCE EDUCATION

NCSE has a variety of resources for members and friends who want to help promote and defend evolution education. Many of our members select particular brochures and flyers according to content, then use them in a number of ways. Some distribute copies to students or at workshops for science teachers. Others take them to conferences of civil liberties or public education activists. These resources are also useful for sharing information on legal and educational issues with school administrators or school board members. Our members also use them to inform or remind themselves of key points to cover in public discussions, such as newspaper editorials or panel discussions of educational controversies.

Here is a sampling of current brochures and titles available from NCSE.

PAMPHLETS

Creation or Evolution?
George Bakken.
A brief, but comprehensive rebuttal of such creationist arguments as the meaning of supposed "gaps" in the fossil record.

Would We All Behave Like Animals?
William Thwaites.
A "conversation" dispelling fears that teaching about evolution undermines morality.

Evolution, Creationism, and Science Education: Answers to Ten Common Questions
Molleen Matsumura.
Answers to questions about scientific, legal, and moral issues that occur in ordinary situations such as PTA meetings.

The Record of Human Evolution
Eric Delson.
The story of evolution from the earliest mammals through modern humans.

Origin Myths
Robert Carneiro.
The variety and meaning of creation stories and their relationships to scientific explanations.

"Scientific Creationism", Evolution and Race
Eugenie C Scott.
Explanation of creationist fallacies and the real meaning of human diversity.

The Evolution of Creationism
William Thwaites.
A discussion of the history, changes, and inconsistencies of creationist theories and the acceptance of scientific findings by most religions.

Facts, Faith, and Fairness: Scientific Creationism Clouds Scientific Literacy
Steve Walsh and Thomas A Demere.
Discussion of why creationism is not science and the urgent need to teach evolutionary theory and scientific literacy.

Facing Challenges to Evolution Education
Molleen Matsumura.
Descriptions of strategies commonly used in attempts to force "creation science" into public schools.

Do Scientists Really Reject God?

New Poll Contradicts Earlier Ones

Eugenie C Scott
NCSE Executive Director

In a recent issue of *RNCSE*, Larry Witham reported on research he and historian Edward Larson carried out to investigate the religious beliefs of scientists. They had surveyed a sample of 1000 individuals listed in *American Men and Women of Science, (AM&WS)*, using questions originally asked by the Gallup organization in a series of polls of American religious views. The report, entitled "Many scientists see God's hand in evolution", concluded that although scientists were quite different from other Americans in their views of "extreme" positions—such as young earth creationism and atheism—they were very similar to other Americans in the "middle" or "theistic evolution" position.

The title of the recent Larson and Witham article in *Nature*, "Leading scientists still reject God" is premature without reliable data upon which to base it.

In the table below, the full wording of Gallup's question 1 is, "Humans were created pretty much in their present form about 10 000 years ago." The difference between scientists and other Americans is striking. Scientists also respond quite differently to the third question, "Man evolved over millions of years from less developed forms. God had no part in this process." But scientists' responses to Gallup's "theistic evolution" question—"Man evolved over millions of years from less developed forms of life, but God guided the process, including the creation of Man"—directly mirrors that of the general public. The "middle ground" is apparently equally attractive to scientists as it is to the general public.

Gallup Evolution Questions

Question	Scientists	Public
1. Special Creation, 10 000 years	5%	46%
2. Evolution, God Guided	40%	40%
3. Evolution, God had no part	55%	9%

Larson and Witham also asked the *AM&WS* sample a second set of questions, repeating a survey performed in 1914 by sociologist James H Leuba. Leuba had found that, in contrast to the high levels of religious belief in the general American public, scientists exhibited low levels of belief in God. He predicted that over time, more and more scientists would give up their belief in God, as scientific knowledge replaced what he considered to be superstition. Larson and Witham found to the contrary that disbelief among scientists remained stable: 58% in 1914 and 60% in 1976 (Larson and Witham 1997).

Leuba had taken a subsample of more prominent or "greater" scientists in the *AM&WS* sample and reported that they exhibited a higher rate of disbelief (70%) compared to less prominent *AM&WS* scientists. Recently, Larson and Witham asked Leuba's questions of members of the National Academy of Sciences, since *AM&WS* no longer lists "greater" scientists. They claimed to find that NAS scientists had higher levels of disbelief and agnosticism, reporting "near universal rejection of the transcendent by NAS natural scientists" (Larson and Witham 1998).

Are you confused? How can scientists be so like other Americans in one survey and so different in another? We can find part of the explanation in the considerable differences between the questions asked by Gallup and those asked by Leuba.

The wording of questions in any survey can influence the results. Gallup's questions are quite straightforward, well-designed to reveal people's attitudes towards evolution. For reasons that will become important later in this article, a question that requests an opinion on only one issue is superior to one which queries attitudes about two or more.

First, let's look at Leuba's questions, which are, to be charitable, ambiguous. The "personal belief" question attempts to ascertain belief not just in some sort of God, but a very specific kind of personal God.

> 1.I believe in a God in intellectual and effective communication with humankind, i.e., a God to whom one might pray in expectation of receiving an answer. By "answer", I mean more than the subjective psychological effects of prayer.

1. I believe in a [personal]God...

AM&WS	NAS
1914	1998
27.7	7.0

Indeed, the percentage of "yes" answers in 1998 is strikingly lower than that in 1914. Does this mean that fewer scientists believe in God? Not necessarily. Consider how specific this question is. To answer "yes" to this question, one would have to believe that God is not only in *communication* with humankind, which many religious people do believe, but that God is in both *intellectual* and *effective* communication. What is the meaning of "intellectual" communication? "Effective" communication? Someone who believed that God communicated with humankind but not "intellectually" (whatever that means) would have to answer "no." Is "effective" used in the modern sense of the word meaning "something that works well", or in the more archaic (1914) use of the term meaning "to bring about"? Do scientists reading this question today interpret it in the same way as those in 1914?

The clause about answering prayers is also problematic. There are schools of theology that hold that God is personal in the sense of watching over and caring for humankind, but nonetheless, does not answer prayers. We do not know whether members of the general public would respond similarly or differently than scientists do to this definition of God: we do know that there is a wide variety of definitions of God.

Not only have there been changes in theology since 1914, which may be reflected in different Americans' definitions of God, but there have been improvements in survey research techniques. Experienced pollsters simply do not ask paragraph-long questions anymore because they *know* that they elicit contingent (and therefore difficult to interpret) answers!

Most educated, late 20th century Americans are "test wise" and know that the more components to a question, the more likely it is that the question is "wrong". I doubt that this was the case in 1914, when citizens were exposed to far fewer surveys than they are today. I surmise that modern survey-wise scientists would be more likely to answer "no" to a multi-component question like Leuba's number 1 than "yes".

What about Leuba's second question?

2. I do not believe in a God as defined above.

AM&WS	NAS
1914	1998
52.7	72.2

How might this question be interpreted? There is more than one way—which means it's not a good question. You might answer "true" if you did not believe in God at all, which is how Leuba, and apparently Witham and Larson, interpret the question; they describe these answers as demonstrating "personal disbelief." *But you might answer "true" if you believed in a different kind of God than Leuba defined!* A "yes" on question 2 would include both non-believers and those who believe in a less personal God than that of question 1.

Leuba's third question also allows for multiple interpretations.

3. I have no definite belief regarding this question.

AM&WS	NAS
1914	1998
20.9	20.8

Well, there has been no change in the number of "yes" answers over time, but what does the question mean? To me, a "yes" means "I don't think much about religion in general" rather than meaning, as Leuba, Larson and Witham conclude, "I have 'doubt or agnosticism'." Nonbelievers might very likely answer this question "false", because they *do* have definitè views on this question! Most of the atheists and agnostics that I know have quite *definite* views about belief in God! Just as with the other Leuba questions, a "yes" answer reflects more than one possible opinion. Positive answers to this question include those who do not believe, as well as those who are not especially interested in the topic.

What one might conclude from the 1998 Larson and Witham study of NAS scientists is that belief in *Leuba's definition* of a personal God has decreased over time among scientists. The main problem, however, is that Leuba's questions are not well designed for investigating the religious views of scientists (or anyone else).

The Gallup questions, which deal with views of God's role in evolution, rather than general belief or disbelief in God, are far less ambiguous. When these questions were used (Larson and Witham 1997), the answers showed that a large proportion (40%) of prominent scientists believe in a God that is sufficiently personal or interactive with humankind that human evolution is guided or planned.

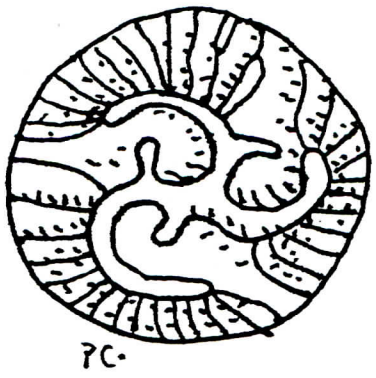
The title of the recent Larson and Witham article in *Nature*, "Leading scientists still reject God" is premature without reliable data upon which to base it.

References

Larson EJ, Witham L. Scientists are still keeping the faith [Commentary]. *Nature* 1997 Apr 3; 386:435-6.

Larson EJ, Witham L. Leading scientists still reject God. *Nature* 1998 Jul; 394: 313.

Witham L. Many scientists see God's hand in evolution. *RNCSE* 17(6):33.



Introduction to "Science and the Spiritual Quest" Conference

Robert Russell
Center for Theology and the Natural Sciences
Berkeley CA

Good morning, and welcome to the "Science and the Spiritual Quest" (SSQ) Conference, drawing together 27 internationally distinguished scientists who are invited to share with us their spiritual journey. I am Bob Russell, Professor of Theology and Science in Residence at the Graduate Theological Union, Berkeley, and Founder and Director of the Center for Theology and the Natural Sciences. I want to start this conference, though, by inviting you to use your imagination:

Imagine the Milky Way as a galaxy so vast that all the stars you can see on a clear night are only a tiny fraction of the hundreds of billions of stars making it up;

Imagine a photograph of deep space dense not with stars but with entire galaxies each as vast as our own Milky Way [and] floating endlessly in the depths of space;

Imagine the evolution of life on earth stretching back billions of years, yet with all species from blue-green algae to hummingbirds linked by a common genetic code;

Imagine the brain of a child with more neural connections than the number of stars in the Milky Way;

Imagine an atom so tiny that a hundred trillion can fit on the dot of an "i";

Imagine elementary particles endlessly arising into a half-existence and then colliding and decaying back into the underlying quantum field in a foaming process happening billions of times each second at every point of space throughout the entire universe;

Imagine the entire universe in its distant past smaller than an atom, a nucleus, even an elementary particle.

What we are seeking to imagine lies beyond our direct perceptions and our ordinary, everyday world, but it is nevertheless real. These discoveries are the result of centuries of pioneering scientific research. They are the gifts of the natural sciences, gifts which are our common human heritage. Without science we could never have known any of this. Knowing it all has forever changed our understanding of the universe and of ourselves. This knowledge affects us at our deepest level, leading us to rejoice in the splendor of the universe and the joy of living.

Yet it also stirs within us those ancient and always present, ever pressing questions: who are we, where did we come from, why are we here, how are we to live our lives, what will be our future? These questions are basic to what many call the spiritual quest—our thirst for the infinite, for the transcendent, for meaning and purpose. I believe the questions science raises deserve an answer at least as profound as the discoveries themselves. The answers we give, whether sublime or superficial, will mark our lives and those of future generations. We are truly at a cusp in history of extraordinary ramifications.

For some scientists, the universe as such is the answer. It alone is our source, and science offers us sufficient meaning and purpose. For other scientists, many of whom are gathered here today, science is part of the answer, but a truly adequate account requires language about the God whom Jews, Christians and Moslems praise as the Creator of the universe and the ultimate source of meaning and purpose in our lives and world. The primary purpose of SSQ is to explore this second option.

First I want to give you a brief overview of the broader context in which it is located. SSQ is part of a rapidly growing intellectual movement commonly referred to as "science and religion". We are nearly 40 years into this exciting new period of open dialogue and creative, mutual interaction. I want to note some key factors which have made this possible.

In philosophy of science, we have moved from the modern period starting with the 17th century Enlightenment and culminating in the first half of this century. Here science was portrayed as an entirely objective, rational and impersonal process—one which eventually could explain all of human knowledge and experience in terms of physics. Nature was given a mechanistic interpreta-

Robert Russell delivered these remarks at the opening of the Science and the Spiritual Quest conference on Sunday, June 7, 1998. We reprint them with permission.

tion characterized by determinism and reductionism. Since the 1960's we have been moving into what many call a post-modern understanding of science, which emphasizes the historical, inter-subjective and holistic character of scientific knowledge and which sees nature in terms of unpredictability and emergence. Scientists form a community of consensus, persons with shared assumptions whose knowledge is couched in revisable models of nature which point to reality but are never able to grasp it unequivocally and in its entirety.

Likewise in the philosophy of religion we once viewed religious language as merely expressive and religious experience as strictly subjective, totally divorced from scientific knowledge. Instead, scholars now acknowledge the cognitive content of religion and its broader explanatory power. In theology, too, we are moving away from a period of isolation between religions and between secular learning and sacred teaching. Instead we are living with the possibility of a fresh, invigorating intellectual climate infused with the spirit of ecumenical and inter-religious dialog, a climate which encourages a new and vigorous interaction both with the humanities and the natural sciences. Many scholars now see theological doctrines, like scientific theories, not as rigid, closed dogmas but as hypotheses about the world which, while firmly believed to be true, are radically subject to testing by the appropriate data. For at least some of these theologians, the "data" should now include the theories and discoveries of the natural sciences. They also see science as infused with concepts and assumptions whose roots, though often unacknowledged, lie in philosophy and, more indirectly, in Western monotheism, and which invite a critical discussion between theologians, philosophers and scientists.

But what is most relevant to our conference is the effect that the stunning discoveries of the 20th century sciences are having on this dialogue. Think of the discoveries I listed already. Add to them the extraordinary explanatory theories of the natural sciences: physics, with the challenge of relativity to our fundamental notions of space, time, matter and energy; quantum mechanics, with its challenge to our notions of causality and separability and locality; cosmology, with the discovery of what might be the birth of our universe 15 billion years ago and the possible "freeze or fry" scenarios for its far future; evolutionary and molecular biology, with the ethical, legal, social, and medical issues surrounding genetics and the challenge to purpose, design, directionality or trends in nature; and think how the computer, the internet, virtual reality, artificial intelligence, robotics, and all the rest are raising the key questions about self, reason, embodiment and community. In fact, more often than not, it is the scientists who are moving out from their labs and knocking on our doors, saying, "Can we talk?"

In light of these factors and others, a wealth of responses has developed over the past 40 years, so that today the "generic" term, "science and religion", points to an immensely rich interdisciplinary field. It began in the 1960s through the genius of a handful of pioneering scholars with joint training in the sciences, theology and philosophy and by a few philosophers and theologians who have taken the discoveries and methodology of science seriously. There now exist centers and societies in the United States, England, Europe and Australia which support research, conferences, courses, public fora, and scholarly and publicly-oriented journals.

The Center for Theology and the Natural Sciences here in Berkeley is one such center, committed to sponsoring research, teaching and public service both at the Graduate Theological Union and through a series of national and international programs, including SSQ. This past decade in particular has also brought a rapidly growing series of outstanding lectures, books, and journal essays which are "essential requirements" for anyone seriously interested in this interdisciplinary field. One may debate the issues, but one can no longer debate the fact that "science and religion" is a field whose research and courses deserve to be part of ongoing academic life.

Today we are fortunate to see the first fruits of what promises to be an invaluable new approach to the field. Unlike most of the interdisciplinary research characteristic of "science and religion", SSQ focuses specifically on scientists at the cutting edge of their research fields who are willing to share their experience of science as a spiritual journey. Most of them come from and participate in the traditions of Judaism, Christianity, and Islam. Most of them have had little time in an extraordinary research career to devote to extensive studies in religion and philosophy. For the past two and one half years, though, they have been willing to work closely together towards a common goal, asking how the discoveries, the theories, and the practices of science both inform and are informed by their spiritual journey as scientists. Today I invite them to share the insights that journey has yielded about the presence of transcendence in their lives, about the common ground they find in the experience and practice of science and religion, about the moral and spiritual dimension of science, and, for those who find this language appropriate, about God whose creative presence is known through the Book of Nature as well as Scripture and who calls us to participate in the healing, repairing and redemptive transformation of the world.

In fact, more often than not, it is the scientists who are moving out from their labs and knocking on our doors, saying, "Can we talk?"

Science Education, Scientists, and Faith

Mike Salovesh
Northern Illinois University

Anthropologist Mike Salovesh received a letter about the potential exposure of a high-school student only to evolution in classes in public schools and university. He has allowed us to reprint his reflections on the place of evolution in the social and life sciences and on the relationship between science and religion.

The concerned parent wrote:

> I have some concerns about...evolution.... Is it taught as theory or fact? Can students discuss differing viewpoints? [Our child] is a very grounded young man but I worry that this may not be the right choice for his first class.

Of course, there's no way I can guess what a particular instructor will or won't do in a classroom. I can make some general points, though.

Anthropology sits at some important intellectual crossroads. Some parts of anthropology can only be done within the confines of a scientific approach. One of those parts deals with the history of our human biological nature.

When we're doing science, there are generally accepted rules of evidence that we have to follow. The central rule is that knowledge can't properly be regarded as scientific unless it can be tested against the real world. Scientific theories are attempts to explain what happens in the real world. A "theory", in this sense, says that under specific circumstances, if you do X and look at the world to see what happens next you can expect to see Y. To test the theory, we go out and do X. If we don't then see Y, we know there's something wrong with the theory. We also know that we're either going to have to modify the theory or throw it out entirely.

You ask whether an anthropology course would teach evolution as theory or as fact. Well, let me say what an anthropologist means by "evolution" in the first place. One of the simplest definitions I know says that "evolution is a change in the distribution of hereditary biological traits in a population through generations of time." Science starts by accepting the observable fact that the distribution of hereditary traits in any biological population changes through time.

If evolution is defined that way, then evolution is a fact. I've seen it myself, back when I was an army medic. Some of the diseases we were treating were changing right in front of us as different strains of the organisms that caused those diseases developed immunity to drugs we used to cure them. There's a whole spectrum of illnesses that we used to be able to cure with penicillin, for example, that can't be today. That's known as "penicillin resistance". In fact, there have been recent mutations that have led some disease-causing bacteria to produce substances that actually destroy penicillin.

"Theories of evolution" are definitely not facts. They are attempts to *explain* the observable facts. Charles Darwin, who is usually credited with inventing "the" theory of evolution, did not really do that. What he did was put forth *one* theory of evolution, in several parts. Some parts of Darwin's theory are as solidly based as anything we know in science; some of them were discarded nearly a century ago because they just did not stand up to the facts of the observable universe.

Darwin's principle of natural selection was one, but only one, part of the general theory he proposed in an attempt to explain the fact of evolution. It has been subject to scientific testing repeatedly for nearly 140 years. It has never been shown to be wrong by observation of the real world. The basic idea of the principle of natural selection is that organisms that have the largest number of offspring have greater influence over the biological nature of generations that come after them than do related organisms that have fewer offspring. By extension, if those organisms leaving the greater number of offspring possess any biological traits which contribute to increased survival and reproduction of those offspring, then successive generations of this organism should show greater proportions of individuals with this trait than among their ancestors.

That's exactly what we see in real populations. It's what we see in one-celled organisms; it's what we see in whales, the biggest animals on earth; it's what we see in every form of animal in between. It's what we see in every form of plant life on this planet. And, incidentally, it's what we see in human beings.

Darwin's theory of evolution didn't stop with the principle of natural selection, however. He offered an explanation of how reproduction passes traits from one generation to another—and his explanation was dead wrong. Considering that Darwin had never heard of genetics, it should be no surprise. The book where he published his theory of evolution, *On The Origin of Species by Means of Natural Selection*, was published more than half a century before the facts of genetics were generally known to science.

Not knowing anything about genetics, Darwin couldn't include genetic mutations in his explanations of the fact of evolution. Statistics, as a branch of mathematics, hadn't been invented when Darwin wrote, either. That's why his theory of evolution didn't make any allowances for the influence of statistical distributions in changing the frequency of biological traits in a population from one generation to the next.

I say all of this to make the point that no *theory* of evolution is, or can be, a fact. Darwin's theory of evolution, to be specific, is certainly not a fact. A reasonable theory of evolution is one that explains growing numbers of apparently unrelated facts, tells us something useful about those facts, and hasn't yet failed the test of observation.

Right now, we are having a very lively time in anthropology because two views of human evolution are in direct conflict. Specialists are lining up on opposing sides and hotly searching for key evidence to knock down each other's views. Since I'm in the business of teaching students to weigh the evidence and decide for themselves, I present both viewpoints in the classroom. I point to the ideas that lead people on each side to their very different views; I cite the evidence that supports them, and I cite what their opponents find wanting in the way that evidence was collected or what it means. And, on days when I do my job very well, discussion gets just as hot in my classroom as it does in scientific journals.

In this particular debate, I do favor one explanation over the other on the basis of what I know now. On questions like this, though, I try to be a scientist. That means that tomorrow I may learn of evidence that proves that the explanation I favor is wrong. In that sense, I would expect any competent person teaching introductory anthropology to encourage the discussion of differing explanations. I suspect that's not what you were asking about, however.

There are other ideas about the origins of *Homo sapiens* and all other living species. One set of such ideas sometimes calls itself "Creation Science". In its full-blown form, it is based on unyielding acceptance of what the Bible says about creation. It holds that it is impossible for any facts of the real world to contradict the teachings of the Bible.

You already know that I learned something in my Bible studies classes. I didn't leave religion behind me when I left high school. Many anthropologists are deeply religious. I personally look forward to a special time at the annual meetings of the American Anthropological Association, when we Quaker anthropologists hold a meeting for worship in a meeting room the Association has always provided at our request.

My religious beliefs can't be proven true by any scientific test. They are absolute, universal, and not subject to change by any external circumstance. For example, I take the commandment "thou shalt not kill" as part of the bedrock of my faith. There is no way I can prove that my belief about killing is true to the satisfaction of anyone who does not share that article of faith with me. Suppose I were to say that the rule comes from the Bible, and that the Bible is the revealed word of God. There is no way that argument would convince somebody who does not believe in God.

Indeed, I cannot imagine any facts in the real world that would convince me to give up my belief that killing another human being is wrong. That is precisely why I say that my belief about killing is not, and cannot be, a scientific conclusion. It can't be tested against observable fact. I would, therefore, be wrong if I tried to teach my college classes that science proves that my belief is the only possible one that can be held by a reasonable person.

I cannot in conscience introduce so-called "creation science" into a classroom as a viewpoint relevant to the teaching of science. It is NOT science. I believe that nearly all anthropologists whose courses are supposed to consider how humanity developed its biological nature would agree. (I have never met any who would disagree.)

My religion teaches that there is that of God in every human being. It asks that I make moral decisions about my own behavior by considering that Inner Light which comes from the presence of that of God within me. My religion also teaches me to respect the fact that another person may be perfectly sincere in denying a belief that I hold sacred, or in affirming a belief that my Inner Light would lead me to deny. It teaches me to believe that other people's beliefs about what their moral course should be are based on their faith in the guidance of their own Inner Light.

As a Quaker, I could never demand that a student abandon religious convictions. I could never demand that a student deny a religious conviction that, say, Genesis describes the actual facts about how God created the heavens and the earth. Those beliefs are a matter for the student's moral decisions, and I cannot make moral decisions for another person.

A reasonable theory of evolution is one that explains growing numbers of apparently unrelated facts, tells us something useful about those facts, and hasn't yet failed the test of observation.

As a professor teaching science in a university classroom, I can try to make sure that what is taught and discussed there is relevant to a scientific approach to the universe. The standards of judgment I try to uphold are those that are fundamental to science. Other standards don't belong in a science classroom. The moral judgments that I base on my own religious convictions are among the other standards that have no place being taught in a science classroom. Taking time to support or to deny views that are not relevant to scientific judgment while trying to teach science is an inappropriate use of energy and resources; and it risks focusing students' attention away from the proper study of scientific subjects.

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"Science and Religion", "Christian Scholarship", and "Theistic Science": Some Comparisons

Eugenie C Scott
NCSE Executive Director

With support from the Templeton Foundation, the Berkeley-based Center for Theology and the Natural Sciences (CTNS) hosted a four day conference on "Science and the Spiritual Quest" June 7-10, 1998. Scientists and philosophers who identify themselves as Christians, Muslims and Jews discussed challenges and opportunities science presents to monotheistic traditions as well as how "the fundamental principles of religious faith affected the development of theory in the sciences." Future conferences will "include nontheistic faith, such as Buddhism, Confucianism and some parts of Hinduism".

The CTNS conference is one of a growing number of "science and religion" conferences. *RNCSE* reported on an earlier conference on "The Epic of Evolution" sponsored by the American Association for the Advancement of Science's Program of Dialogue Between Science and Religion, held in November of 1997 (*RNCSE* 1997; 17[3]:7-8), and there also have been two "science and religion" conferences sponsored by "intelligent design" proponents (*see article by Larry Witham,* Washington Times *6/10/98*).

The "science and religion" movement is a broad one. Participants include adherents to mainline Catholic, Protestant, and Jewish faith as well as conservative Christians. Attitudes towards evolution vary accordingly, from acceptance (as illustrated by the AAAS conference) to rejection (the "design" conferences). The CTNS conference, judging from abstracts, dealt somewhat with cosmological evolution (the anthropic principle) and scarcely at all with biological evolution. Wider religious and philosophical issues seemed to be the order of the day: transcendence, science and morality, aesthetics, creativity rather than creationism. Participants seemed largely content to let science rather than revelation tell us about the nature of the physical universe. Physicist and ordained minister Robert Russell, Director of CTNS, presented opening remarks that seem to reinforce this distinction (*see article on page 26*).

Several institutions besides CTNS examine the relationship between science and religion, including the Chicago Center for Religion and Science, the Institute for Religion in an Age of Science (Concord NH), and the American Scientific Affiliation (Ipswich MA). The International Society of Ordained Scientists, founded by British biologist and theologian Arthur Peacocke, claims 3000 members. Dialogue between science and religion is clearly a hot topic. *Science* published a long essay presenting the views of both proponents and opponents of an enlarged discussion between science and religion (Easterbrook G. Science and God: A warming trend? *Science* 1997 Aug 15; 277:890). *Newsweek* for July 20 published a cover story titled, "Science finds God", and the same week *US News and World Report* featured an exploration of science and religion titled, "Cosmic Designs".

Christian Scholarship

The "science and religion" movement should be distinguished from a more amorphous trend called "Christian Scholarship" with which it seems to overlap only slightly. Christian Scholarship sentiments are found predominantly at secular, rather than denominational universities and are a reaction of (primarily conservative Christian) religious faculty concerned with the secularization of university life. It promotes the position that just as other ideologies (Marxism, feminism, environmentalism, and so on) can "inform" scholarship at the university level, Christian ideology should also be recognized as a legitimate perspective. A recent book, George M Marsden's *The Outrageous idea of Christian Scholarship* (Oxford 1997) argues this view, and protests that the secularization of American universities has "marginalized" religion as a source of scholarship.

We will present a more complete review of Marsden's book in a future issue, but let me note here that "Christian Scholarship" as a perspective on knowledge is more likely to be successful in the humanities and perhaps history, than in the natural sciences. If one may propose a feminist or Marxist interpretation of the causes of World War II, one may perhaps have a Christian interpretation as well. It is far less

likely that a contribution to scholarship will be made by feminist thermodynamics or Christian meiosis. (For a more complete discussion see: Scott EC. Creationism, ideology and science, in *The flight from science and reason*. Gross PR, Levitt N, Lewis MW, editors. *Annals NY Academy of Sciences* 1996; 775:505-22).

Scientists do not seem to be heavily represented among proponents of Christian Scholarship, judging by the presentations at a conference titled, "Christian Scholarship: Knowledge, Reality and Method" held in Boulder CO, in October 1997. Most abstracts dealt with philosophy, the humanities, and the social sciences. Only a few had to do with natural sciences, although there are indications that the role of natural scientists in Christian Scholarship is increasing. Still, it appears as if the major concern of Christian Scholarship is less with Christianity as a source of specialized insight into the workings of the natural world (that is, there is no "Christian meiosis" yet) than with the consideration of philosophical, theological and ethical issues in science. More information on the Boulder Christian Scholarship conference can be found at <http://www.origins. org/common/conf-scholarship-abstracts.html>.

Theistic Science

Finally, the Christian Scholarship movement can be distinguished from the much smaller "theistic science" movement, though there is slight overlap. "Theistic science" is promoted by some "intelligent design theory" proponents and focuses much more closely on the evolution issue than do the other two movements discussed in this article. As proposed by Whitworth College philosopher Stephen C Meyer, Biola University philosopher JP Moreland, and Notre Dame theologian Alvin Plantinga, "theistic science" goes beyond proposing a dialogue between science and religion to recommending a fundamental alteration of the very way that science is practiced.

Most scientists today require that science be carried out according to the rule of *methodological materialism*: to explain the natural world scientifically, scientists must restrict themselves only to material causes (to matter, energy, and their interaction). There is a practical reason for this restriction: it works. By continuing to seek natural explanations for how the world works, we have been able to find them. If supernatural explanations are allowed, they will discourage—or at least delay—the discovery of natural explanations, and we will understand less about the universe.

There is also a logical reason for methodological materialism: the essence of science is the testing of alternate explanations against the natural world. To "test" means to hold constant or *control* some factors. If omnipotent powers exist, by definition their effects cannot be held constant, or controlled. As a result, without making a judgment on the existence or nonexistence of God, modern scientists carry out their tests of hypotheses as if only natural causes were operating. It's a scientific analog of Pascal's wager: if an omnipotent power such as God exists, then we can't control for its actions, so we're stuck with methodological materialism. If God doesn't exist, then of course methodological materialism is the best way to understand the natural world.

Advocates of theistic science would like to change all this by allowing "God did it" as a scientific, not merely theological, statement. They do stipulate, however, that God's hand not be invoked capriciously. Plantinga and others suggest that most of the time God operates using secondary causes, but room must be left for the occasional miracle. It is not coincidence that these allowances for miraculous interventions seem to focus around the topic of evolution. Moreland points out, for example, that "theologians have little interest in whether a methane molecule has three or four hydrogen atoms" but because God "designed the world for a purpose", He "has directly intervened in the course of its development at various points ([for example], in directly creating the universe, first life, the basic kinds of life, and humans)" (for details, readers should consult Moreland JP, *Creation Research Journal*, 1993 Fall; available on line at <http://campus.leaderu.com/real/ri9404/threat/html>).

Echoing this approach, Meyer separates science into two kinds: "historical" and "operational" ("empirical"). Operational science is the familiar everyday science exploring the processes and mechanisms of how the universe works, and miracles are not expected to be discovered. Both theists and nonbelievers would conduct operational science in the same fashion. Historical science, on the other hand, deals with nonrepeating events such as speciation events in the fossil record, the explosion of the Pinatubo volcano, the appearance of a supernova and so forth. Of course historical sciences can be studied scientifically: there may have been only one observed eruption of Pinatubo, but there certainly can be a science of volcanic eruption that can be used to *explain* Pinatubo. Similarly, only once in history did a population give rise to genus *Equus*, but we can still derive theories from this and similar events to explain macroevolution.

"[T]heistic science" goes beyond proposing a dialogue between science and religion to recommending a fundamental alteration of the very way that science is practiced.

More for theological than scientific reasons, God's direct hand is allowed in historical science, though strongly discouraged in operational science. This is so, it seems to me, because it is primarily historical sciences (like evolution) that have serious consequences for certain conservative Christian theologies.

When do "theistic science" proponents invoke a miracle? When they can't figure out a materialistic explanation. As

Plantinga states,

> "Why couldn't a scientist think as follows? God has created the world, and of course He created everything in it directly or indirectly. After a great deal of study, we can't see how he created some phenomenon P (life, for example) indirectly; thus probably he has created it directly" (Plantinga 1997).

It is telling that 3 of the topics most frequently cited as requiring divine intervention...are ones for which there is not consensus on a fully natural explanation.

Plantinga's position is given in more detail in "Methodological Naturalism? Part 2", *Origins and Design*, 1997; 18(2):34 (footnote 63).

It is telling that three of the topics most frequently cited as requiring direct divine intervention (and cited by Moreland, above) are ones for which there is not yet consensus on a fully naturalistic explanation: the Big Bang, the origin of life, and the Cambrian explosion. The fourth topic is the origin of humans, upon which there actually is quite a *good* consensus, though the degree of agreement is not well-known to the general public.

It is fair to state that "theistic science" is a form of special creationism, or even "creation science" that cleverly ignores issues divisive to anti-evolutionists—such as the age of the earth—and focuses on unifying issues—such as the importance of God's hand in the universe. "Theistic science" has not been uniformly embraced even within the ranks of conservative Christians. (For critical reviews, see Howard Van Till, "Special creationism in design clothing: A Response to *The Creation Hypothesis*", *Perspectives on Science and Christian Faith* 1995 Jun; 42:123-31; and DF Siemens Jr, "On Moreland: Spurious freedom, mangled science, muddled philosophy", *Perspectives on Science and Christian Faith* 1995; 49: 196-9).

Science, Religion, and Evolution

NCSE is concerned with evolution education and the public understanding of the nature of science. How will these three intersections of science and religion affect our issues? My evaluation is that the "science and religion" movement, consisting primarily of theists who already accept evolution and who have a healthy respect for science, is not a challenge and may be beneficial to the public understanding of science and evolution. Many members of the general public have not heard a counterargument to the anti-evolutionist position that one "must choose between evolution and religion." Greater public prominence of religious scientists who accept evolution should help put that falsehood to rest and may promote a climate in which more teachers can teach evolution without fear of reprisal.

The "Christian Scholarship" movement in its current form is also not a major threat to evolution. Currently, this movement is as much about "free speech" for religious academics as anything else, and, as mentioned previously, it does not seem to be targeting science. Little has been said by proponents of the "Christian Scholarship" movement for or against evolution. If the "Christian Scholarship" movement expands, we can anticipate an increase in religious expression on campuses, paralleling the expansion of secular ideologies (Marxism, feminism, and so on) currently occupying the interest of the postmodern academy.

However, the "theistic science" movement is a challenge both to science and to the acceptance of evolution in our society. "Theistic science" seems to focus especially on evolution; few other topics seem relevant (see Moreland JP, editor. *The Creation Hypothesis*, InterVarsity Press, 1997). By proposing that we consider not just natural but supernatural causes, "theistic science" advocates employ a "let's use all of the evidence we have" argument, which ultimately is a more sophisticated version of the very popular anti-evolutionist "equal time" or "fairness" argument. Perhaps the most dangerous effect of the "theistic science" movement, if it gets off the ground, will be its effect on the public understanding of the nature of science. "Theistic science" proposes that we abandon methodological materialism in science, in favor of the "occasional" supernatural intervention. This is, in Plantinga's own words, a "science stopper", because once one stops looking for a natural explanation of a phenomenon, one is assured of never finding it. The fact that 30 or more years of research have not produced a complete understanding of how the first replicating molecule may naturally have originated does not mean that we will never devise a plausible explanation—unless we stop trying.

NCSE members may wish to read more about one or more of these approaches to integrating religion and science, depending on their particular interests. There is much discussion of each on the Internet.

Abstracts of some conference papers from the "Mere Creationism" and "Naturalism, Theism, and the Scientific Enterprise" can be found at <http://www.origins.org/mc>.

More information on the Christian Scholarship Conference can be found at <(http://www.origins.org/common/conf-scholarship-abstracts.html>.

Creation Research Journal, 1993 Fall; available on line at <http://campus.leaderu.com/real/ri9404/threat/html>.

BOOKREVIEW

The Science of God

by Gerald L Schroeder. The Free Press, 1997.

Reviewed by Frank Sonleitner, Department of Zoology, University of Oklahoma, Norman OK 73019.

This book is essentially an elaboration and update of Schroeder's earlier book *Genesis and the Big Bang* published in 1990. Schroeder is an Israeli physicist who has also extensively studied biblical interpretation. He uses the arguments of the anthropic principle (*see p 12*) as evidence for God; but he also insists that the Bible and science agree. Genesis is not to be taken literally nor dismissed as poetry but must be interpreted correctly following the lead of talmudic scholars such as Nahmanides and Maimonides. Although his interpretation twists, stretches, and sometimes directly contradicts the literal meaning of Genesis, it confirms all the findings of modern cosmology and geology.

Using a universal time clock based on the stretching of the wavelengths of light as the universe expands, he concludes that the universe is 15.75 billion years old. The six days of Genesis consist of a nonlinear day-age description of the history; day 1 covers the first 8 billion years, and day 6 only the last 1/4 billion.

Schroeder accepts the standard geologic and paleontologic history of the earth but he balks at evolution (although he admits some sort of genetic continuity as suggested by the evidence of comparative anatomy, biochemistry and embryonic recapitulation). He rejects all transitional forms among higher categories such as classes and phyla, but later admits that there might be transitional forms *within* classes. (He does discuss the recently discovered intermediate forms of whales.)

Schroeder rejects evolution because he considers its mechanism to rest solely on pure chance. There is no discussion of natural selection; it doesn't appear in the index although the term is used in passing while discussing Dawkins. His "proof" that it is impossible for convergent evolution to produce similar eyes in taxa which did not inherit these structures from a common ancestor uses a mathematical calculation based on two assumptions—(1) evolution is pure chance; and (2) the taxa have no genes in common except those "inherited" from the protozoa. Yet in other places he seems to be aware of the recent evidence that the phyla have many genes in common; he discusses the *Hox* genes that determine body plans and the *Pax* genes that are involved in eye formation!

Schroeder admits that there were "pre-Adamites" (Cro-Magnon and Neanderthals) living for 40 000 years prior to Adam, but questions the existence of earlier hominid species because of the fragmentary nature of their fossils. Again he uses a mathematical model to show that the evolution of humans from an ape ancestor is impossible. This model also assumes that (1) evolution would occur by pure chance and (2) one million mutations would be necessary to produce the ape-human transition!

It takes more than the Big Bang and the fine tuning of universal constants to demonstrate that the creator is the kind, loving, personal God worshiped by Christians. And there Schroeder's arguments fall apart.

For example, he argues that quantum mechanics provides the basis of free will and that the determinacy of our genes does not prevent our exercising free will. Yet later he says that randomness in nature (including random mutations) is necessary for free will!

And natural disasters are necessary. We must suffer earthquakes and volcanic eruptions that result from plate tectonics made possible by the earth's molten core because the latter is necessary to generate a magnetic field to protect us from the high energy radiation produced by the life-giving sun.

But then he says that the biblical Creator could have made stars that didn't produce those lethal rays but "they would not be natural" and would offer absolute testimony of the Creator's existence! And still later he contradicts this principle (that the universe is organized "naturally" to hide the existence of the Creator) by saying that the earth is at an "unnatural" distance from the sun and hints that this may be miraculous! (According to Schroeder some exponential law determines the distance of the planets, and the earth's distance does not fit the pattern.)

Evolutionists will justifiably criticize Schroeder for his simplistic and inconsistent treatment of evolution while the real creationists will reject him for his theology which includes rejection of the literal reading of Genesis, acceptance of the Big Bang, an old age for the earth, existence of pre-Adamites, a local flood, and ignoring Christ, Christianity and the New Testament.

BOOKREVIEW

Redeeming Culture: American Religion in an Age of Science

by James Gilbert. University of Chicago Press, 1997. viii + 407 p. $28.95 cloth.

Reviewed by Edward B Davis, Messiah College, Grantham PA.

When Bryn Mawr psychologist James Leuba surveyed religious beliefs among American scientists more than eighty years ago, he found that about 42% affirmed their belief in a personal God who answers prayer, while the same percentage denied this; another 17% defined themselves as agnostics. Leuba predicted that unbelief would increase in all corners of American society as education became more widely available. Yet when his survey was repeated recently by Edward Larson and Larry Witham, the results were very nearly the same; although scientists are still markedly less religious than other Americans, no significant erosion of religious belief among scientists is evident. Furthermore, as other studies have shown, religion in America today seems surprisingly robust, even after a century of scientific advances—a phenomenon that has many historians and social scientists searching for explanations.

"[R]eligion and science probably cannot be reconciled, if only because we do not really desire any such closure."

James Gilbert is one such historian. Above all, what he tries to explain in *Redeeming Culture* is the persistence of religious belief in modern America in spite of scientific progress. The answer that emerges from the twelve case studies in the book is that Americans have found an almost astonishing variety of creative, apparently satisfying, ways to integrate their religious beliefs with ideas coming from the sciences. This has been possible, he tells us, because "neither science nor religion has had a stable and permanent definition in American culture. They continually shift in meaning and in their relation to each other."

Gilbert begins with a chapter on William Jennings Bryan that takes Bryan, a member of the American Association for the Advancement of Science (AAAS), on his own terms as a certain type of scientist—as a representative of an older, less abstract way of understanding scientific knowledge. Bryan held a a commonsense Baconianism that eschewed speculative hypotheses (such as evolution) and saw both science and religion as ways of glorifying God. Bryan's "greatest mistake" was to assume that this view of science was still operative among professional scientists in the 1920s. Because it was still part of the popular conception of science, however, his actions leading up to the Scopes trial "revealed a fault line between popular and professional science."

The rest of the book deals mainly with movements along this fault line during and since the Second World War, which Gilbert sees as a crucial event because the atomic bomb greatly increased the public visibility of science and forced scientists to negotiate their political image. Both the bomb and the abuses of science in Germany and the Soviet Union, Gilbert argues, presented the American public with the image of science as a highly secular and immoral enterprise. This caused problems as scientists represented science to a religious society as a secular, rational discourse and sought government funding for theoretical research by elite scientists, many of whom were not religious.

The interplay of science, politics, and religion continues as Gilbert turns his attention to three groups that interpreted science differently from the scientific establishment. First he shows how Rabbi Louis Finkelstein (of the Jewish Theological Seminary in New York City) assembled an eclectic group, unified by their rejection of John Dewey's pragmatic vision of a secular democracy underwritten by science (especially the social sciences), into the Conference on Science, Philosophy, and Religion in Their Relation to the Democratic Way of Life. In this he was joined by philosopher Mortimer Adler, a fellow Jew though a leading neo-Thomist, and astronomer Harlow Shapley, whom Gilbert describes as "a seeker, a joiner of conversations and organizations devoted to exploring the potential fusion of religion and science." Their opponents, such as philosopher Sidney Hook, refused to concede that religion was a separate realm from science, contending instead that only a religion derived from science had intellectual respectability.

Next Gilbert tells the fascinating story of how technically superb films and demonstrations about the unity of science and religion within a traditional Baconian framework, produced by the Moody Institute of Science (an arm of the Moody Bible Institute of Chicago), became widely used by the

armed forces as part of officially sanctioned moral education for soldiers during the Cold War.

Rounding out this triumvirate is Gilbert's account of the early years of the American Scientific Affiliation, an organization devoted to reconciling science with traditional theology begun in 1941 by several evangelical scientists. Some ASA members had ties to the MIS, although from the start they had an ambivalent relationship with that more clearly evangelistic group. They also had a more open attitude toward evolution, fueled by a growing professionalism which led Henry Morris and other creationists to exit the ASA in the early 1960s. (If he had gone on to write about more recent ASA history, he would have seen an organization that now includes several distinguished scientists and has become an important player in the contemporary religion/science scene.)

The next few chapters illustrate other ways in which science has been popularized in America, beginning with the ideas of Immanuel Velikovsky. These were widely seen as supporting the historicity of certain Old Testament events, such as the miracles of the Exodus and the long day of Joshua. Here Gilbert focuses on the bitter public dispute between Horace Kallen, a student of William James and a follower of Dewey who nevertheless supported Velikovsky's efforts to get a serious scientific hearing, and Harlow Shapley, who declared public opinion to be irrelevant to scientific truth.

Similar tensions are evident in Gilbert's account of four television programs on science from the late 1950s, directed by Hollywood legend Frank Capra and sponsored by Bell Laboratories. A devout Roman Catholic who saw "the deep-seated American controversy between amateurism and scientific expertise ... as the source of animosity between science and religion," Capra argued with a board of scientists for control over the content of his films. In the end, Capra won, as his vision of science as "just another facet of man's quest for God" [Capra's words] came across clearly in several films. This is especially evident in "Our Mr Sun"—ironically, based on the book *Our Sun* by astronomer Donald Menzel who sought "to steer public attitudes toward a favorable view of scientific research and away from religion and mystery."

Menzel was also involved in the postwar controversy over UFOs, which he interpreted as neither extraterrestrial nor supernatural in origin, going against public opinion on both counts. An alternative vision was provided by Werner von Braun, who helped Walt Disney produce three television programs (shown in 1957) that delivered his message that God approved of human space travel.

In the final section of the book, Gilbert considers three relatively recent examples of the interaction between religion and science, beginning with social science, which Gilbert calls "a genetic carrier of both science and religion." He compares the Society for the Scientific Study of Religion (founded in 1949) with the Religious Research Association (founded in 1951).

These two organizations have substantially overlapping membership but quite different agendas—the former oriented toward academic sociology and the latter toward serving various churches. An influential member of both, Ralph Wendell Burhoe, joined Shapley in 1954 in founding the Institute on Religion in an Age of Science (IRAS; publisher of the journal *Zygon*).

As Gilbert sees it, IRAS sought to create a new religion based on modern cosmology and evolution. They were important for fostering conversations between theologians and some scientists, but their vision "lacked the immediacy and spiritualism of contemporary American religious culture," thus their influence has been limited. This contrasts with the "profound statement" made by the Seattle World's Fair (1962) which placed the Spacearium, featuring a film prepared against the advice of Menzel, directly opposite a pavilion sponsored by the Christian Witness, a coalition of Protestant groups with a common evangelistic purpose.

Gilbert sees this last episode in his book as no more than exactly that, telling us that "the interaction between science and religion has not ceased." Furthermore, "religion and science probably cannot be reconciled, if only because we do not really desire any such closure." The astonishing range of interpretations of religion and science by practitioners from both communities make it difficult to disagree with his final statement, "that one of the most creative impulses of American culture is the continuing presence of religion at the heart of scientific civilization."

References

Larson EJ, Witham L. Scientists are still keeping the faith. *Nature* 1997; 386: 435-6.

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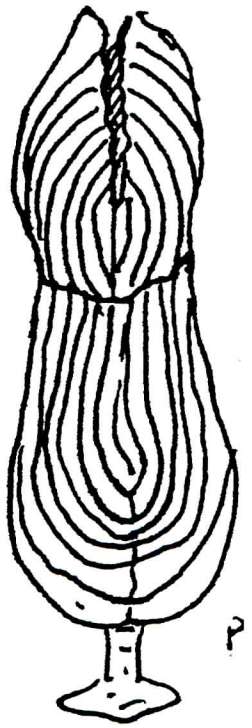

RESOURCES

Anderson CL, Canning EU, Okamura B. A triploblastic origin for Myxozoa? *Nature* 1998 Mar 26; 392: 346-7. Myxozoa are normally classified as protoctista, but they may actually be metazoans that have undergone parasitic degeneracy. In their life cycle they parasitize teleost fishes and oligochaete worms.

Anonymous. Humpbacked dinosaurs. *Discover* 1998 Apr; 19(4): 12.

Anonymous. There were giants on the earth in those days. *Discover* 1998 Apr; 19(4): 14-8. Discovery of a fossil giant armadillo.

Anonymous. Pioneer biped. *Discover* 1998 Apr; 19(4): 29. Earliest bipedal reptile.

Anonymous. An upstanding ape. *Discover* 1998 Feb; 19(2): 14. The fossil ape *Oreopithecus* was probably bipedal.

Barnett A. The second coming. *New Scientist* 1998 Feb 14; 157(2121): 19 .

See also: Koga Y, Kyuragi T, Nishihara M, Sone N. Did archaeal and bacterial cells arise independently from noncellular precursors? Did life evolve on Earth more than once? A hypothesis stating that the advent of membrane phospholipid with enantiomeric glycerophosphate backbones caused the separation of the two lines of descent. *Journal of Molecular Evolution* 1998 Jan 3; 46(1): 54-63.

Blackman S. Safety in number. *New Scientist* 1998 Mar 14; 157(2125): 15. Did multicellularity help an animal avoid being eaten?

Brookes M. Day of the mutators. *New Scientist* 1998 Feb 14; 157(2121): 38-42. Role of mutation in bacterial evolution.

Chown M. Let there be light. *New Scientist* 1998 Feb 7; 157(2120): 26-30. The Big Bang and the origins of stars and galaxies.

Cowen R. Fossils from Mars: Point, counterpoint. *Science News* 1998 Jan 3; 153(1): 11.

Doolittle RF. Microbial genomes opened up. *Nature* 1998 Mar 26; 392: 339-42.

See also: Deckert G, Warren PV, Gaasterland T. The complete genome of the hyperthermophilic bacterium *Aquifex aeolicus*. *Nature* 1998 26 Mar; 392: 353-8.

Doolittle WF. A paradigm gets shifty. *Nature* 1998 Mar 5; 392: 15-6.

See also: Martin W, Muller M. The hydrogen hypothesis for the first eukaryote. *Nature* 1998 Mar 5; 392: 37-41. Vogel G. Did the first complex cell eat hydrogen? *Science* 1998 Mar 13; 279: 1633-4.

The online book "store", Amazon.com, invites readers to post their reviews of books and other materials sold through this service. Jeffery Jay Lowder noticed that there were 6 reviews of Denton's *Evolution: A Theory in Crisis* and that 5 were written by creationists. If you are online and can connect to Amazon.com, consider posting a review of a book on evolution that you have read. You can reach this service at <http://www.amazon.com/>.

Duboule D, Wilkins AS. The evolution of bricolage. *Trends in Genetics* 1998 Feb; 14(2): 54-9. Most of our genes are shared with other organisms; diversity depends on the differential use of the same component genes. Evolutionary 'bricolage' (tinkering) with the developmental system is very conservative.

Flammer L. Evolution as fact and theory questioned. *The American Biology Teacher* 1998 Mar; 60(3): 3. Comment on McComas W. The discovery and nature of evolution by natural selection: Misconceptions and lessons from the history of science. *The American Biology Teacher* 1997 Oct; with reply by McComas.

Gibbons A. Ancient island tools suggest *Homo erectus* was a seafarer. *Science* 1998 Mar 13; 279: 1635-7.

See also: Morwood MJ, O'Sullivan PB, Aziz F, Raza A. Fission-track ages of stone tools and fossils on the east Indonesian island of Flores. *Nature* 1998 Mar 12; 392: 173-6; Bower B. Human ancestor may have taken to sea. *Science News* 1998 Mar 14; 153(11): 164; Thwaites T. Ancient mariners. *New Scientist* 1998 Mar 14; 157(2125): 6.

Gibbons A. missing link ties birds, dinosaurs. *Science* 1998 Mar 20; 279: 1851-2.

See also: Forster CA, Sampson SD, Chiappe LM, Krause DW. The Theropod ancestry of birds: New evidence from the Late Cretaceous of Madagascar. *Science* 1998 Mar 20; 279: 1915-9; Chiappe LM, Norell MA, Clark JM. The skull of a relative of the stem-group bird *Mononykus*. *Nature* 1998 Mar 19; 392: 276-8. An *Archaeopteryx*-like bird with a *Velociraptor*-like claw on second toe.

Gibbs WW. Endangered. *Scientific American* 1998 Apr; 278(4): 19-21. Other explanations for the Martian fossil.

Gould SJ. The lying stones of Wurzburg and Marrakech. *Natural History* 1998 Apr; 107(3): 16-21, 82-90. Eighteenth-century fossil collector Johann Beringer fooled by fake fossils.

Hanken J, Richardson MK. Haeckel's Embryos. *Science* 1998 Feb 27; 279: 1288. These authors contend there is no identical phylotopic stage in all vertebrate embryos.

Hecht J. On the level. *New Scientist* 1998 Jan 31; 157(2119): 13.

See also: Mound JE, Mitrovicia JX. True polar wander as a mechanism for second-order sea-level variations. *Science* 1998 Jan 23; 279: 534-7.

Holden C. Ocean sighting confirmed. *Science* 1998 Mar 13; 279: 1639.

See also: Cowen R. Craft eyes new evidence of a slushy Europa. *Science News* 1998 Mar 7; 153(10): 149; Hecht J. Galileo gets slushy with Europa. *New Scientist* 1998 Mar 7; 157(2124): 5; Seife C. To the iceworld. *New Scientist* 1998 Feb 14; 157(2121): 20; Anonymous. A world of ice. *Discover* 1998 Mar; 19(3): 22. New images from the Galileo spacecraft give further evidence for an ocean on Europa.

Jablow V. A tale of two rocks. *Smithsonian* 1998 Apr; 29(1): 32-5. Reviews the evidence that the Chicxulub structure is the K-T impact crater.

Jensen M. Modern climate has roots in early Devonian. *Science News* 1998 Feb 14; 153(7): 103. Tall plants with deep roots 390 million years old.

Jensen M. Worms' hot ends set thermal record. *Science News* 1998 Feb 21; 153(8): 126.

Joyce GF, Orgel LE. The origins of life—A status report. *The American Biology Teacher* 1998 Jan; 60(1): 10-2.

Kerr RA. Black Sea deluge may have helped spread farming. *Science* 1998 Feb 20; 279: 1132. About 7500 years ago, the Mediterranean overflowed into the Black Sea, flooding the surrounding area.

Knight J. Clear as mud. *New Scientist* 1998 Feb 28; 157(2123): 15.

See also: Kitagawa H, van der Plicht J. Atmospheric radiocarbon calibration to 45 000 years BP: Late glacial fluctuations and cosmogenic isotope production. *Science* 1998 Feb 20; 279: 1187-90. Calibrated from fossils in laminated sediments of Lake Suigetsu, Japan, these measurements confirm chronologies from German pine, other varved sediments, and carbon-dating of corals.

Levitin C. Russian church and scientists lay revolutionary quarrels to rest. *Nature* 1998 Mar 26; 392: 318.

Lewin R. Survival strategy. *New Scientist* 1998 Mar 1; 157(2124): 23.

See also: Jablonski D. Geographic variation in the molluscan recovery from the end-Cretaceous extinction. *Science* 1998 Feb 27; 279: 1327-30. Recovery patterns of fossil molluscs differ among localities in North America, Europe, Africa and Asia.

MacKenzie D. Walk this way. *New Scientist* 1998 Mar 7; 157(2124): 24. A set of 117 000-year-old human footprints are found in South Africa.

Marshall CR. Mass extinction probed. *Nature* 1998 Mar 5; 392: 17-20.

See also: Smith AB, Jeffrey CH. Selectivity of extinction among sea urchins at the end of the Cretaceous period. *Nature* 1998 Mar 5; 392: 69-71.

McDonald KA. New evidence challenges traditional model of how the new world was settled. *The Chronicle of Higher Education* 1998 Mar 13; XLIV(27): A22-3. Findings hint at the arrival of humans 30 000 years earlier than many researchers had thought.

McKie R. The people eaters. *New Scientist* 1998 Mar 14; 157(2125): 42-6. New evidence for cannibalism in human history.

Menon S. King claw. *Discover* 1998 Apr; 19(4): 30. Discovery of *Megaraptor* in Argentina.

Monastersky R. Fossil soil has the dirt on early microbes. *Science News* 1998 Mar 7; 153(10): 151. Two-billion-year-old soil with chemical clues to microbes found in South African manganese mine.

Monastersky R. Dinosaur denizens of the dark. *Science News* 1998 Mar 14; 153(11): 172.

See also: Anonymous. Dinosaur bridge. *New Scientist* 1998 Feb 14; 157(2121): 21. A duck-bill dinosaur is found in Antarctica.

Motluk A. Know your bug. *New Scientist* 1998 Feb 14; 157(2121): 5. A non-profit organization is going to sequence the genomes of pathogens and make them public on the internet. Some of these have been sequenced more than once because the drug companies that do the work keep their results secret.

Nielsen C. Sequences lead to tree of worms. *Nature* 1998 Mar 5; 392: 25-6.

See also: Blaxter ML. De Ley P, Garey JR. A molecular evolutionary framework for the phylum Nematoda. *Nature* 1998 5 Mar; 392: 71-6.

Pagel M. A man for all seasons. *New Scientist* 1998 Feb 7; 157(2120): 44-5. Book review of Caudill E. *Darwinian Myths: the Legends and Misuses of a Theory*. The misuses of Darwinism by eugenicists, racists, social Darwinists, and so on.

Pain S. The intraterrestrials. *New Scientist* 1998 Mar 7; 157(2124): 28-32. A review of deep subterranean life.

Palmer D. Cuvier the catastrophist. *New Scientist* 1998 Jan 31; 157(2119) 44. Book review of Rudwick M. *Georges Cuvier, Fossil Bones, and Geological Catastrophes.* University of Chicago Press.

Sasso CD, Signore M. Exceptional soft-tissue preservation in a theropod dinosaur from Italy. *Nature* 1998 Mar 26; 392: 383-7.

Seife C. Designer enzymes enjoy life in the hot seat. *New Scientist* 1998 Mar 7; 157(2124): 10.

See also: Van den Burg B, Vriend G, Veltman OR, Venema G, Eijsink VGH. Engineering an enzyme to resist boiling. *Proceedings of the National Academy of Sciences* 1998 Mar 3; 95(5): 2056-60. Mutations in the lab produce a modified enzyme from a hyperthermal bacterium that works best at very high temperature.

Svitil KA. Hot times on Titan. *Discover* 1998 Mar; 19(3): 29.

Travis J. Protein gives the heads-up to frog embryos. *Science News* 1998 Jan 24; 153(4): 55. A protein necessary for the growth of a head.

VanDecar J. Crater row. *Nature* 1998 Mar 12; 392: 131.

See also: Spray JG, Kelley SP, Rowley DB. Evidence for a late Triassic multiple impact event on earth. *Nature* 1998 Mar 12; 392: 171-3.

Vogel G. For island lizards, history repeats itself. *Science* 1998 Mar 27; 279: 2043.

See also: Losos JB, Jackman TR, Larson A, de Queiroz K, Rodriguez-Schettino L. Contingency and determinism in replicated adaptive radiations of island lizards. *Science* 1998 Mar 27; 279: 2115-8. Similar ecological variants evolved independently on various islands.

Wang J. Scientists flock to explore China's "site of the century". *Science* 1998 Mar 13; 279: 1626-7. This is the fossil site yielding the exquisitely preserved early Cretaceous birds.

Watson A. The universe shows its age. *Science* 1998 Feb 13; 279: 981-3. New measurements indicate the oldest stars are no longer thought to be older than the universe as a whole.

Wiley JP Jr. A space invader is here. *Smithsonian* 1998 Apr; 29(1): 20-2. A small irregular galaxy is moving through the milky way galaxy.

Zimmer C. The equation of a whale. *Discover* 1998 Apr; 19(4): 78-84. The discovery of the original *Basilosaurus*.

Letter to the Readers

I am looking for a copy of a short film that shows in the National Museum of Natural History in DC called "Enter Life". It's an old film that is out of print, according to the Smithsonian folks. It's sort of corny, but it inspired me to be interested in biochemistry, and I'd like to show it to future students. I would appreciate any help in locating a print.

Thanks,

Ken Mills
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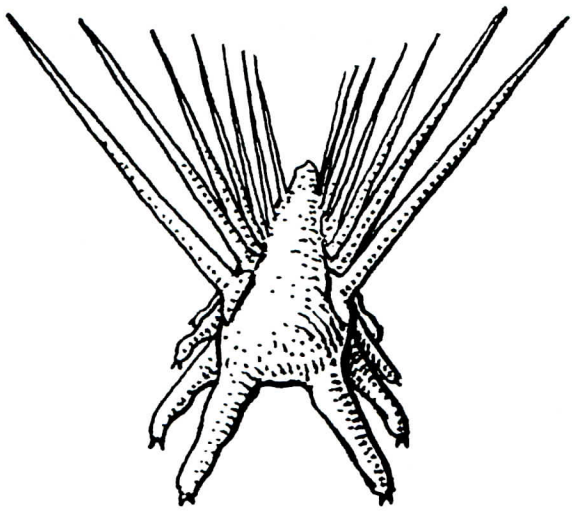

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Location: http://www.nlrc.org/public/docs/joint1.htm
Last visit: June 1998

Topic: *Voices for Evolution*
Owner: NCSE
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Topic: Survey of 12 largest US Christian Denominations
Owner: Religion News Service
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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> Accessed 1997 Mar 28.

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.

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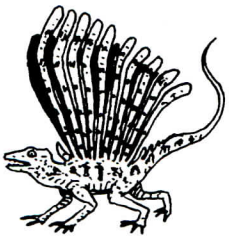

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