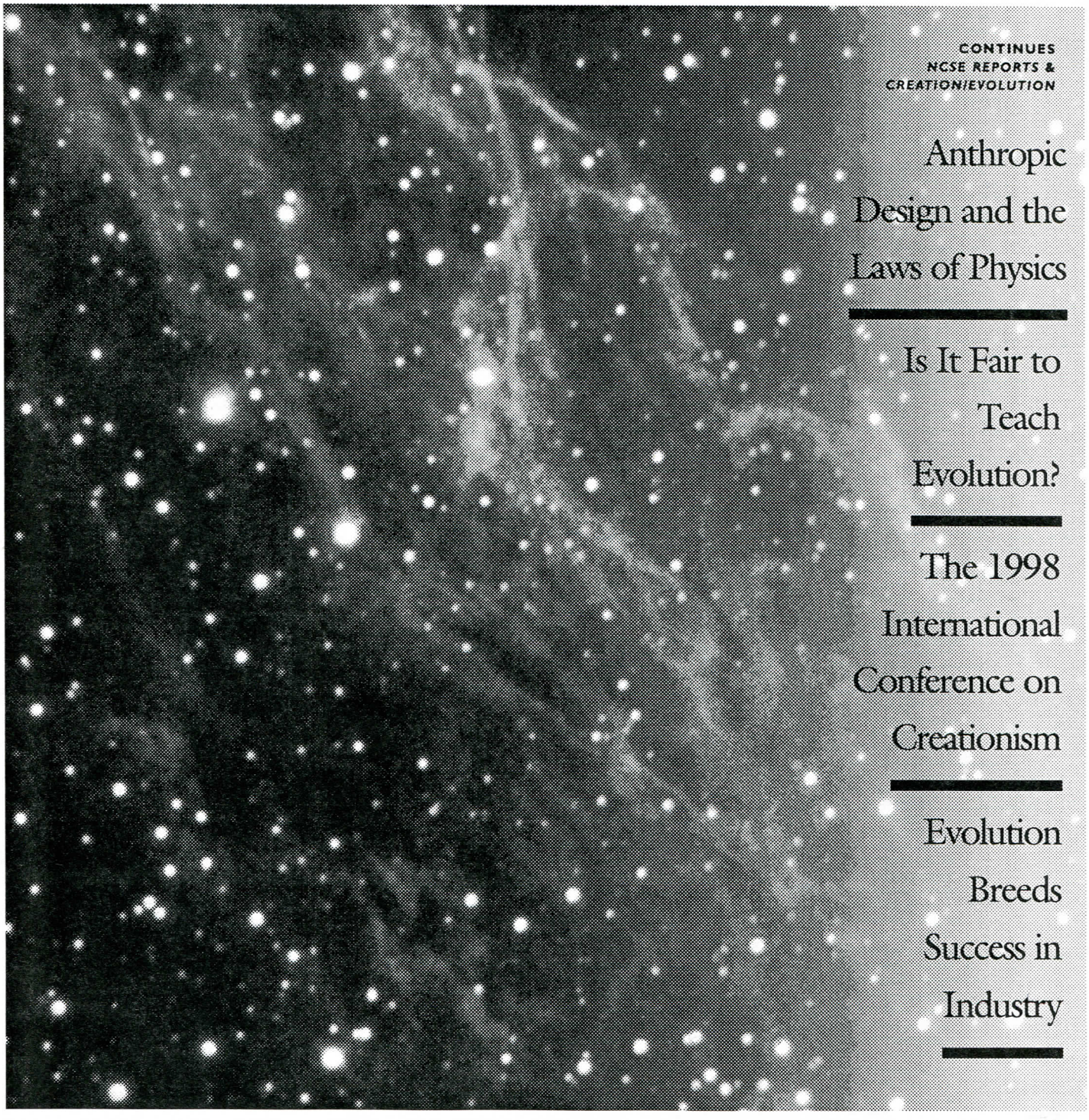
REPORTS OF THE NATIONAL CENTER FOR SCIENCE EDUCATION

Volume 18, Number 3

MAY/JUNE, 1998



CONTINUES
NCSE REPORTS &
CREATION/EVOLUTION

Anthropic Design and the Laws of Physics

Is It Fair to Teach Evolution?

The 1998 International Conference on Creationism

Evolution Breeds Success in Industry

CONTENTS

REPORTS OF THE NATIONAL CENTER FOR SCIENCE EDUCATION
CONTINUES *NCSE REPORTS* & *CREATION/EVOLUTION*

Printed November, 1998

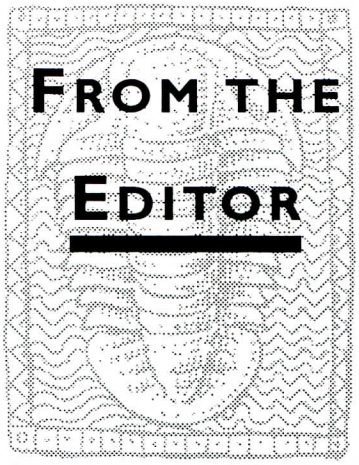
VOLUME 18, NO 3, MAY/JUNE 1998
ISSN 1064-2358

Eugenie C Scott, *Publisher*
National Center for Science Education
PO BOX 9477
BERKELEY CA 94709-0477
510/526-1674
FAX: 510/526-1675
Email: ncse@natcenscied.org

http://www.natcenscied.org

RNCSE is published six times a year.

Address editorial correspondence to the editor. Style guidelines can be found on the inside back cover of this issue. Write the publisher about address changes, missing issues or back issue purchases, reprint rights, etc.



Just when you were getting used to high quality editing, here I am as guest/pinch-hit editor again after turning things over to Anj Petto a couple of years ago! Anj is in the process of moving to Philadelphia to a new job at the College of The Arts, an entirely new institution where he has the task of establishing a faculty and curriculum in the sciences to accompany the arts emphasis of the institution. It sounds like a great opportunity and even great fun, but it also sounds like it might take up at least several hours of his time, so I was invited to return as "guest editor" for the current issue of *RNCSE*.

Anj will be returning as editor, and in fact I'm handling several manuscripts he had already vetted to referees and accepted, and I've already passed some new ones on to him for future uses. Continuity is the watchword — expect no major saltational changes or suddenly missing transitional forms to worry about.

On the Inside...

As suggested by our cover, in this issue we venture into astronomy and cosmology. A somewhat technical article by Victor Stenger on fallacies in the "anthropic coincidences" argument demonstrates why physicists (and others) reject "intelligent design" creationism. Also, Kevin O'Brien demonstrates the weakness of a creationist claim that the fossil history of life on earth is evidence that the sun must be much younger than the accepted age of 4.6 billion years.

NCSE devotes most of its attention to science education, opposing those who want to inject religious views into the science classroom. Because "creation science" is a religious view, NCSE sometimes provides information about the wide range of opinion among theologians, many of whom believe that "creation science" arguments require theological answers. To illustrate one such view, we present in this issue an article by Conrad Hyers. Hyers agrees with many theologians that Genesis is best interpreted symbolically. While some interpretations stress ethical symbolism, Hyers argues from historical biblical scholarship that Genesis is not really about simple "creation" at all but rather is about the rise of Judaic monotheism. Hyers thus rejects "scientific creationism" for theological and historical reasons, complementing NCSE's rejection of it as poor science. I hope his article will be as interesting to everyone else as it was to me!

Long-time readers will recognize the byline of Bob Schadewald, former editor, board member and NCSE president. Bob reports in detail on the 1998 International Creation Conference in Pennsylvania, which he shows to be a far cry from some earlier creationist conferences he has attended. Bob has a unique perspective as both a longtime creationist-watcher/ critic and as a person who has developed and maintained friendly and constructive relationships over the years with many creationists.

You'll also find the usual updates on news of creationism, political developments such as the relatively poor showing by creationist "causes" in the recent US elections, and the continuing and even growing efforts to press those issues upon the public in the US and other countries. We also have a feature on the growing use of "evolutionary algorithms" by industry — how the principle of natural selection is put to use via computer programs to design airplanes, drugs and other industrial products. Not only has evolutionary theory increased its explanatory and predictive power in biology and other academic areas, but it is showing renewed usefulness in commercial applications.

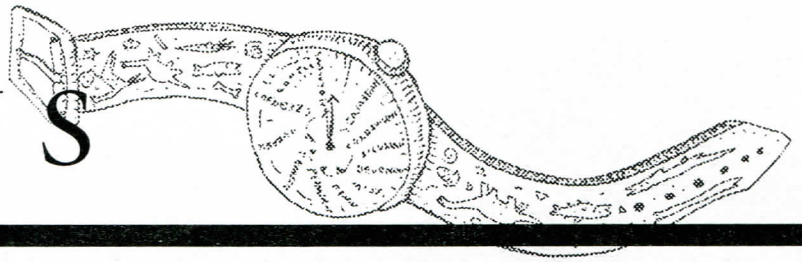
And Don't Forget...

Be sure to check the *RNCSE* centerfold for a special holiday gift from us to you: an additional 5% discount on our already discounted books. You will find some great gifts for yourself or for others at 25% off. But hurry — quantities are limited for these close-outs. Watch the centerfold in the future: there will be more reductions.

I've enjoyed being your editor one more time, and I was happy to give Anj a breather while he settled into a new, demanding job. But you'll see him again in 18.4 — back to the galleys, Anj (with intended double meaning of "galley", of course!)

John R Cole

NEWS



Evolution in the 1998 Elections

Molleen Matsumura
NCSE Network Project Director

The day after the 1998 elections, news began arriving from allied organizations and members around the country, reporting how state and local elections had affected the future of evolution education in their communities. At first glance, the news appeared to be good: many defeated candidates had been endorsed by the "Religious Right" for their support of policies designed to weaken church-state separation. However, a community may elect a creationist for one office and not another; or regional differences in a state may lead to different districts' electing representatives on both sides of the issue. Moreover, support for "creation science" crosses party lines, and some individuals' support for "creation science" proposals results from their acceptance of arguments for local control of curricula or the fairness of "teaching both sides," rather than religious beliefs. Thus it is the details of local results that give the clearest picture. Here's what we've learned so far:

Alabama's incumbent Governor Fob James, still remembered for offering an ape-imitation as an argument against evolution at the 1995 meeting of his state's Board of Education, was defeated in his bid for re-election.

While **California** re-elected State Superintendent of Education Delaine Eastin, who supports evolution education, results of local elections are expected to vary. Already, Bill McComas has reported that James Rogan, a Ventura County Republican who expressly supports "creation science", has been elected to the US Congress.

Just days before the election, we received email from **Florida** asking whether we could verify an allegation that gubernatorial candidate Jeb Bush supports teaching "creation science." We are still exploring this question, and would welcome further information, since Governor-elect Bush was endorsed by the American Family Association, which has opposed evolution education in other states.

Idaho was another state with mixed results. Idaho voters re-elected US Rep. Helen Chenoweth, who has supported a school-prayer amendment and explicitly supports "creation science"; but they rejected Anne Fox's bid for re-election as Superintendent of Public Instruction. Fox, who supported teaching "creation science", lost by a healthy 8% margin.

Writing from **Kentucky**, Thomas Wheeler recalled that earlier in the year, he had read a report in *RNCSE* that, according to the newsletter of "Operation T.E.A.C.H.", State Senator Gex Williams was willing to introduce an anti evolution bill in the state legislature. Williams was just defeated in his bid for a seat in the US Congress.

NCSE members Kim Johnson, Dave Thomas, and Richard Talley report mixed results in **New Mexico**. Roger X Lenard, who has been a strong opponent of evolution while serving on the State Board of Education, lost in his race for a seat in the State House of Representatives. However, P Davis Vickers of Las Lunas, who has been pressing for "creation science" in his school district, was elected to the state House, and Rep Tim Macko, who introduced an anti evolution bill in 1997, was re-elected.With the election of NCSE member Marshall Berman to the Board of Education, the defeat of anti evolution candidates Mary Agnes Gilbert and Darl Miller, and Lenard's vacant seat soon to be filled by a new appointee, New Mexicans are hopeful that the Board will take significant steps to improve science education.

Tennessee shocked the nation with the news of the pre-election murder of Democrat Tommy Burks, a state legislator who was a key supporter of the notorious "Scopes II" anti evolution bill in 1995. Burks' widow was elected to his seat in the state House of Representatives.

Writing from **Texas**, Rob Pennock also reports mixed results. Donna Ballard, known in her state as a "firebrand conservative", had worked hard to limit evolution in the curriculum during her term on the State Board of Education. Having resigned when her family moved, she ran for office in her new district, but was defeated by incumbent Rene Nunez. According to Pennock, "Religious conservatives had targeted five seats on the Board. Had they won all five they would have had a majority." They picked up one new seat, and retained one.

From **Washington**, Pierre Stromberg reported that in pre-election television statements Governor-elect Gary Locke made the evolution-creation controversy a campaign issue, criticizing several Republican opponents for their support of creationism and specifically mentioning the evolution disclaimer bill introduced in

the state senate in January 1998.

Here at the NCSE office, we're eager to hear more local and state election news, and to report it in the next issue of *RNCSE*. Write to us, give us a call, or email the *RNCSE* editor at <editor@natcenscied.org>

Ken Ham Embraced by Marrs

John R Cole
Contributing Editor

Evangelist Texe Marrs has taken up many causes, from hidden UN helicopters poised to take over the US to Satan's plot (called "Project L.U.C.I.D.") to tattoo everyone with Universal Product Codes. He inhabits the shortwave radio world flirting with the militia movement and open anti-semitism. Marrs now has come to the defense of Ken Ham and his embattled plan to build a "Creation Science Museum" in Kentucky (see *RNCSE* 16(4):15).

In a recent newsletter, Marrs devotes the full front page to one article, "Christian Ministry Is Target of Hate Campaign; End of Religious Freedom in USA?" describing Ham and his Answers in Genesis (AIG) organization which, Marrs says, tells "the truth about evolution." AIG, he says, is "Just your typical group of nice, family-type fundamentalist Bible believers." The article features many colorful adverbs and adjectives but few actual details about why the museum project failed to win a zoning change or any mention of the earlier park entrance controversy. Marrs quotes Ham: "This is not just a local Kentucky thing. This is indicative of what is happening across the nation.... We don't have religious freedom in this country anymore. What's happening here should be a warning."

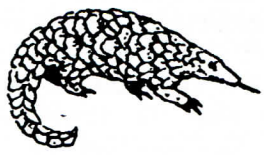
Ham, an Australian evangelist who was briefly considered for an ICR leadership job, is known for taking a more "fire and brimstone", Bible-quoting approach to creation "science" than those who assert that they are nonsectarian. Gary Parker has left his own Florida ministry to join Ham's organization. (Parker, a former ICR biologist, holds a Ball State University doctorate in education.) Ham is no stranger to the type of language Marrs uses (he is quoted as complaining about an "anti-God university professor," a "hysterical" woman at a zoning meeting, "cowardly" officials, "vicious anti-Christian hatred and bigotry," and so on), but one may still question his choice of bedfellows.

Marrs claims Ham's fate is "a prime example of the Clinton-style, 1990s Stalinist America" where Christianity "must not be allowed to function and exist." He then segues into a tale of a "homosexual group" harassing his ministry and ends up with a call to help Ham (and him) fight the "intense persecution" and "vile bigotry." .

On page two of the same issue, in "Amway and the Masonic Lodge" Marrs accuses the DeVos family (founders of Amway) of supporting masonry and similar anti-Christian cults (sic), a charge Richard DeVos, a founder of the Creation Research Society, denies. In another article, Marrs attacks the "Abominations of the Alexandrian Cult" and offers to sell a tape explaining the "hideous and ungodly philosophy of deceit" followed by — among others — Billy Graham, ICR founder Tim LaHaye, Pope John-Paul II, Hal Lindsay, John Ankenberg, Bill Bright, Norman Geisler, Pat Robertson and Jerry Falwell. Perhaps Marrs and Ham are the last Christians left?

References

Flashpoint:A Newsletter Ministry of Texe Marrs 1998, Mar. 98(3):1.



Congratulations to Donald Aguillard!

Donald Aguillard, the Louisiana school teacher who became famous as the victor in the 1987 Supreme Court case *Edwards v. Aguillard* has just earned his doctorate in science education from Louisiana State University. His dissertation included a survey of Louisiana biology teachers and their understanding and teaching of evolution.

Aguillard went through a grueling series of court challenges to a Louisiana law mandating equal time for creationism in public schools whenever evolution was mentioned. Each time he won, and each time the state (in the name of Governor Edwards) appealed. The Southern Appellate Division supported him by a whisker-thin vote of 8-7. The Supreme Court vote was a more definitive 7-2 with the majority opinion written by Justice William Brennan. Justice William Rehnquist, now the Chief Justice, dissented, joined by Justice Scalia.

The Supreme Court decision that became known as *Edwards v Aguillard* declared that because creationism is an inherently religious idea, its advocacy in the public school classroom violated the First Amendment. Laws requiring that creationism be taught were therefore unconstitutional. The decision effectively put to rest efforts to mandate the teaching of creation "science" through "equal time" laws such as that in Louisiana and, earlier, Arkansas. Aguillard's willingness to stand up for his convictions provided the ACLU attorneys the all-important plaintiff so that this law and others like it could be stricken from the books. All teachers (and citizens!) owe thanks to Don Aguillard (an NCSE member, of course!)

UPDATES

Arizona, State Standards: Meeting on August 24, the State Board of Education adopted revised science content standards which now include evolution. NCSE congratulates members and friends who made a major contribution in bringing the earlier omission to the Board's attention, participating in the rewriting committee, and organizing support for good science education in Arizona.

Florida, Lee County: In primary elections, Republican voters chose other candidates over incumbent members of the Board of Education who had pressed for the teaching of "creation science" and supported a "Bible as history" course which was later found unconstitutional.

Idaho, Post Falls: After rejecting a proposed policy for "balanced treatment" of evolution and creationism, the school board of this district near Coeur d'Alene considered a new policy statement that was drafted by district staff to meet legal objections and satisfy community concerns (*RNCSE* , 18(2):5). After criticism of this draft proposal by NCSE, Idaho ACLU, and NCSE member Terry Maley, the Board decided on August 10, 1998 not to adopt the statement until it was re-written to reflect more accurately the nature of science and relevant constitutional law. On September 14, the Board of Education unanimously adopted a statement that calls on teachers to "demonstrate an equal level of respect for students, regardless of their beliefs or views," and cites a definition of science given in the McLean v Arkansas decision that struck down an anti evolution law. The statement also says that "The tentative and theoretical nature of the subject matter must be stressed... [and] weaknesses as well as strengths should be acknowledged." A district employee told NCSE that the statement's reference to "scientists [who] do not agree with the mainstream scientific community" acknowledges the range of opinion in the community, but, "Our curriculum hasn't changed."

Idaho, Science Standards: The State Department of Education has drafted Exiting Standards that used National Science Education Standards as well as standards from other states as models, and include explicit coverage of evolution in life and earth sciences. A minority report submitted June 10, 1998 cited common antievolution arguments and called for teaching "the possibility of creation along with the evolution theory." NCSE members and friends attended public hearings in September and October to support inclusion of evolution. NCSE will report the Board's decision in a future issue.

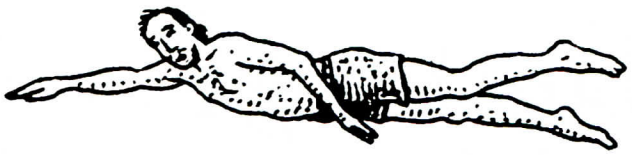
Kentucky, Boone County: Plans by Answers in Genesis (AIG) to build a 95 000 square foot facility housing AIG's headquarters, a "creation science" museum, and a distribution center, have again been rebuffed by the Boone County Fiscal Court. When AIG sought approval to begin construction at another site in 1996, the resulting controversy included both zoning issues and objections by scholars and community members concerned about the site's location near Big Bone Lick State Park, a famous fossil site with its own museum (see *RNCSE* 16(3):10, 16(4):15). County officials stated then that their decision was based entirely on standard zoning concerns. AIG's recent application for rezoning of another site further from Big Bone Lick did not re-awaken the "evolution/creation" controversy, and reportedly was denied because the site lacked necessary infrastructure. AIG's founder Ken Ham says he will appeal the decision.

Michigan, Melvindale: On September 28, nearly a year after some Melvindale parents and clergy asked the school board to have teachers present "creation science" alongside evolution (*RNCSE* 17(4):8), a science-curriculum committee set up to study the issue presented its recommendations to the Board of Education. They reported that both the State Board of Education and two US Supreme Court decisions prohibit teaching "creation science" and recommended that "resources that do not offer a religious view, but offer theories considered contrary to evolution" be placed in district libraries.

New Mexico: Though Board of Education members changed their own appointment deadlines in an effort to add more anti evolutionists to the state textbook commission (see *RNCSE* 18(1):6-7), the science sub-committee has accepted a number of standard textbooks that cover evolution. Both the science sub-committee and the full committee voted down proposals to list some textbooks as "adopted with reservations" and to have the state Department of Education print critiques for teachers and school districts.

Oklahoma, Harrah: In the wake of parental complaints and community controversy surrounding an eighth grade teacher's presenting "creation science," the district's Board of Education voted on September 15 not to add "creation science" to the school's curriculum. The vote was 3-2; NCSE has offered advice to the district administration and will monitor further developments.

Washington, Burlington-Edison: Efforts by concerned parents, NCSE and the ACLU to educate this district's school board have succeeded in changing their support for teaching "intelligent design theory." Board member David Hansen told the Skagit Valley Herald " ... [T] he board has learned more about the legalities of the matter ... [and] it's questionable. And with a previous ruling in the court system, we'd be lucky to win it and don't want to end up wasting taxpayer money." (August 28, 1998, <http://www.skagitvalleyherald.com/daily/98/august/28/a1creationism.html>) The new superintendent, Dr. Rick Jones, announced that biology teacher Roger de Hart would no longer be permitted to teach "intelligent design theory." On the possibility that students will raise the issue, Jones said, "The topic will come up, and of course he, as all teachers would be, is expected to deal objectively with it."



Don't Miss the NCSE "Creation/ Evolution" Grand Canyon Trip

Eugenie C Scott

As a result of the article in *RNCSE* 18.2, many members have made inquiries about our "Creation *and* Evolution" tour of the Grand Canyon, August 7-14, 1999. Mostly to ask whether Eugenie Scott has flipped her lid.

No, I haven't. I, and Dr. Wilfred Elders, University of Riverside geologist and teacher extraordinare, will be leading a "two model" excursion down the Grand Canyon for NCSE members and their families in early August of next year, in what will prove to be a truly unique event. After all, the various creationist groups who lead tours through the Grand Canyon give you only *one* side of the story: that the many layers of the Grand Canyon were laid down during the year that Noah's Ark looked for a landing spot after the Flood waters came. This marvel of nature was cut — whoosh! — in about two weeks when a torrent of water burst forth somewhat north of the present-day canyon and carved it out, leaving the mighty Colorado River as a much-reduced remnant. Betcha didn't know THAT!

Wilf and I, on the other hand, will give you *both* the creationist view and the standard, geological view — who could ask for more! Dr. Elders has made four trips down the Canyon, and, unfortunately for me, since I have to present the creationist side of this tour, has paid particular attention to creationist claims while on his last, November, 1998 excursion. I could be in deep trouble.

So, if you are interested — here are the specifications:

Call or write us to reserve a place in one of the two boats. Send a deposit by February 1, as described below. We have spread the payment schedule out over several months. We will accept deposits as long as there are spaces available, but the 22 seats (on two boats) are likely to fill up quickly, so please let us hear from you early. Here is the schedule:

PAYMENT DUE DATE	AMOUNT
February 1, 1999	$500
May 1, 1999	$500
June 1, 1999	$825
TOTAL	**$1825**

We are also willing to accept full payment at any time, of course! Should you need to cancel, we offer a full refund (less $25 handling fee) for cancellations before June 1. After June 1, the amount of the refund will depend upon whether someone on the waiting list can fill your spot. Every effort will be made to replace participants who withdraw after June 1, including going outside NCSE's membership, if necessary.

So — send in your reservations now! Call us at 1-800-290-6006 or write us at our e-mail address, <ncse@natcen scied. org>. This will be a trip no NCSE member would want to miss!

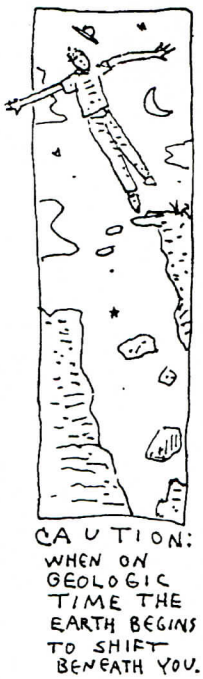
NCSE Receives First Stock Donation

Eugenie C Scott

I received a telephone call a couple of months ago from a retired NCSE member who told me he and his wife were in the midst of estate-planning, and had decided to donate some stocks to NCSE. What a wonderful idea! These stocks had been bought a long time ago, and had appreciated substantially as a result, and if the owners had sold the stock they would have had to pay capital gains tax. By donating the stocks to NCSE, the owners got a welcome tax deduction, and, of course, contributed an asset very much appreciated by NCSE.

If you find yourself in a similar situation, please consider NCSE in your financial planning. NCSE needs to build an endowment fund, and by making such donations (as well as remembering NCSE in your will) you can contribute in a very important way to keeping NCSE a strong and vigorous organization. Also, as with appreciated stock or other property, the large capital gains tax you would otherwise have to pay is eliminated — making your deduction even more valuable to you.

NCSE has a brochure on estate planning that we can send to you, if you would like more information.



NCSE Wish List

NCSE's newsletter production is becoming much smoother, thanks to the donation of a used Macintosh computer (and some memory chips!) by Richard Trott, which allows us to prepare newsletter text with the same software our printer uses. The next step is to upgrade the computer, and donations of used hardware are most welcome. Does anyone out there have a Mac-compatible full page monitor, or a SCSI drive that they could donate? If you do, please call Erik Wheaton at 1 (800) 290-6006. NCSE will gladly pay shipping costs and your donation will be tax-deductible.

ARTICLE

Anthropic Design and the Laws of Physics

Victor J. Stenger

New Relationship or Next Battleground?

In the popular press, on television, and in a number of recently-published books, the "anthropic coincidences" have been getting a lot of publicity. The July 20, 1998, *Newsweek* shouted on its cover: **"Science Finds God"**, and many of the scientists quoted referred to the anthropic coincidences (Begley, 1998). A September, 1998 PBS broadcast, "Faith and Reason" (see URL below) had a segment on the anthropic coincidences, and the latest book by creationist Michael J Denton has a whole section on this argument (*Nature's Destiny*, reviewed in *RNCSE* 18(2) p 10).

So, what, exactly, are the anthropic coincidences, and why should we be concerned about them?

They refer to the notion that the physical laws and constants of the universe seem to be highly "fine-tuned" for the production of life. Theists claim that this shows evidence for the Creator. They believe that our universe seems to be designed in a unique and highly unlikely way for the purpose of bringing life into existence. The fine-tuning argument, and "intelligent design theory," are related ideas that can be used to promote creationism in science classes.

The Lawful Universe

Without the laws of physics as we know them, life on earth as we know it would not have evolved in the short span of six billion years. The nuclear force was needed to bind protons and neutrons in the nuclei of atoms; electromagnetism was needed to keep atoms and molecules together; and gravity was needed to keep the resulting ingredients for life stuck to the surface of the Earth.

These forces must have begun operating within a tiny fraction of a second after the Big Bang — 13 billion years ago according to the current best estimate — to allow for the formation of protons and neutrons out of quarks and their storage in stable hydrogen and deuterium atoms. Free neutrons disintegrate in minutes. To be able to hang around for billions of years, so they could later join with protons in making chemical elements in stars, some neutrons had to be bound inside deuterons and other light nuclei, where the law of energy conservation prevented their disappearance from the universe.

Gravity was needed to gather atoms together into stars and to compress stellar cores, raising the core temperatures to tens of millions of degrees. These high temperatures made nuclear reactions possible. Over billions of years, all the elements of the chemical periodic table, except hydrogen, were synthesized as byproducts.

When the nuclear fuel in the more massive, faster-burning stars was spent, the laws of physics called for them to explode as supernovae, sending into space the elements manufactured in their cores. Then gravity could gather these elements into planets circling the smaller, longer-lived stars. Finally, after about ten billion years, the carbon, oxygen, nitrogen and other chemical elements on a small planet attached to a small, stable star could begin the process of evolution toward the complex structures we call life.

These events are the rationale for the fine-tuning argument, a twist on the old design argument. If the universe had appeared with slight variations in the strengths of the fundamental forces or the masses of elementary particles, then it would be pure hydrogen at one extreme, or pure helium at the other. Neither would have allowed for the eventual production of the heavy elements such as carbon necessary for life. Similarly, if gravity had not been many orders of magnitude weaker than electromagnetism, stars would have collapsed before they could produce the ingredients of life. (For discussions of the anthropic coincidences, see Carter, 1974, Barrow and Tipler, 1986, and Gribbin and Rees, 1989).

Victor J. Stenger is Professor of Physics and Astronomy at the University of Hawaii and author of Not By Design: The Origin of the Universe; *Physics and Psychics: The Search for a World Beyond the Senses;* and *The Unconscious Quantum: Metaphysics in Modern Physics and Cosmology*

The assertion that the material universe resulted from conscious action outside itself can sound convincing even to those who accept biological evolution as established fact. Many who agree that biblical creation is not an appropriate part of the science curriculum, because it is not science, may not object to including material that argues with greater sophistication that the universe itself is the product of intelligent design. Promoters of intelligent design have put forward the *anthropic coincidences* as evidence for a universe that was created with humans in mind. They argue that because there are so many "coincidences" of such "low probability", the universe must have been designed; it could not have just "happened."

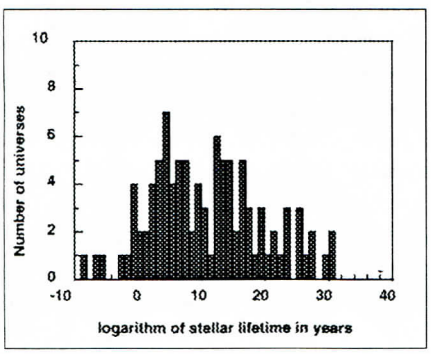
The Argument from Probability

A probability argument often cited by creationists involves a calculation by astronomer Fred Hoyle that the odds against DNA assembling by chance are 10^{40000} (ten followed by 40 000 zeros!) to one (Hoyle and Wickramasinghe, 1981). This may be true, but it is highly misleading. Evolution does not require that DNA assembled purely by chance — only that it assembled by a *combination* of chance and the laws of physics and biology.

In a calculation similar to Hoyle's, mathematician Roger Penrose has estimated that the probability of a universe with our particular set of physical properties is one in $10^{10^{123}}$ (Penrose 1989: 343). Let's just say the probability is zero. But it is important that we do not confuse probabilities of events that have already occurred with probabilities of events *before* they occur.

For example, every human being on Earth is the product of a highly elaborate combination of genes that would be a very unlikely outcome of a random toss. Think of what an unlikely being you are — the result of so many chance encounters between your male and female ancestors. What if your great great great grandmother had not survived that childhood illness? What if your grandfather had been killed by a stray bullet in a war, before he met your grandmother? Despite all those contingencies, you still exist. And if you ask, *after the fact*, what is the probability for your particular set of genes existing, the answer is one hundred percent. Certainty!

Similarly, if we properly compute the probability for the universe's existing with the properties it has, the result is unity [1:1]. The universe exists with one hundred percent probability. The probability that one particular universe chosen from a random set of possible universes would be our particular universe is a different question. And the probability that one of a random set of universes is one that could support some form of life is a third question. It is this last question that is the important one — and we have no reason to expect that this probability is small. It could be 100 percent!



I have made some estimates of the probability that a chance distribution of physical constants can produce a universe with properties that would allow sufficient time for *some* form of life to evolve. In this investigation, I assumed the same laws of physics as exist in our universe, since I know no other. Who knows how many other universes with different laws can still produce life? That only adds to the likelihood of its appearing. According to the laws operating in our universe, the values of four fundamental constants are sufficient to establish the gross physical properties of matter, from the dimensions of atoms to the length of the Earth's day and year and, most important for our purposes, the average lifetime of main sequence stars. Two of these constants are the strengths of the electromagnetic and strong nuclear interactions. The other two are the masses of the electron and proton.

[I]t is important ...not [to] confuse probabilities of events that have already occurred with probabilities of events *before* they occur.

This is not, of course, the whole story. Many more constants are needed to fill in the details of our universe. Varying the constants that go into our familiar equations still gives many universes that do not look a bit like ours. The gross properties of our universe are determined by these four constants, and we can vary them to see how a universe might appear when the values of these constants are altered.

I have written a program called *MonkeyGod*, available on the World Wide Web at the URL given below. The reader is invited to try it. Just click the link and create your own universe! You can choose different values of the four constants and see what happens, or let the computer pick random ones. While these are really only "toy" universes, the exercise demonstrates that there could be many ways to produce a universe old enough to allow time for *some* form of life to evolve.

Figure 1 shows distribution of stellar lifetimes in 100 universes generated with the four constants varied randomly over ten orders of magnitude on either side of their "true" values in our universe. Almost all combinations of physical constants lead to universes, admittedly some strange ones, that would live long enough for some type of complexity to be likely to form. Over half the universes contain stars that persist longer than 1 billion years.

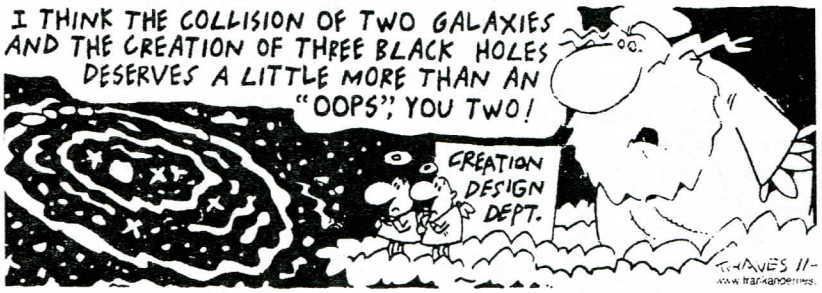
Note that my thesis does not require more than one universe to exist, although some cosmological

theories propose this. Even if ours is the only universe, and that universe happened by chance, we have no basis to conclude that a universe with some form of life was so unlikely as to have required a miracle.

Simplicity and Physical Law

But if the argument from probability fails, what about the laws of physics themselves? We have admitted that they were required for life to evolve, that the process was not completely random. Can we take the mere *existence* of natural laws as evidence for intelligent design?

Let me begin by addressing two common sense notions: (1) you cannot get something from nothing, and (2) the ordered state of the universe requires the pre-existence of an active intelligence to do the ordering (see Stenger 1990 for technical details, Stenger 1988, 1995 for popular discussions). In physical terms, the creation of the universe appears to have violated both the first and second laws of thermodynamics.



The first law of thermodynamics is equivalent to the principle of conservation of energy: the total energy of a closed system is constant; any change in that total energy must be compensated by a corresponding inflow or outflow from the system to its environment. You can't get something from nothing. Einstein showed that mass and energy are equivalent, by $E = mc^2$. So, if the universe started from "nothing," energy conservation would seem to have been violated by the creation of matter. Some energy from outside is apparently required, hence the argument that "intelligence" is required.

However, our best estimate today is that the total energy of the universe is zero (within a small *zero point energy* that is the minimum energy of any quantum system), with the positive energy of matter balanced by the negative potential energy of gravity. Since the total energy is zero, no energy was needed to produce the universe and the first law, energy conservation, was not violated. No "intelligence" is required.

The second law of thermodynamics requires that the *entropy*, or disorder, of the universe must increase or at least stay constant with time. This would seem to imply that the universe started out in a greater state of order than it has today, and so must have been *designed*. The creationist argument requires high initial order followed by disorder — with the present state being less ordered (or "perfect") than the initial state.

But the second law argument holds only for a universe of constant volume. The maximum entropy of any object is that of a black hole of the same volume. In an *expanding* universe, the maximum allowable entropy of the universe is continually increasing, allowing more and more opportunity for order to form as time goes by. If we extrapolate the Big Bang back to the earliest meaningfully definable time, the so called *Planck time* (10^{-43} second), we find that the universe started out in a condition of maximum entropy — total chaos. The universe had no order at the earliest definable instant. Rather than going from perfect order to disorder, the universe went from chaos to localized order.

Spontaneous Complexity

So, where did the complex order of the universe come from, if it did not exist at the "beginning"? Where did the laws of physics come from, if not from some great lawgiver? We are beginning to understand how the laws of physics could have come about *naturally*, as the universe spontaneously exploded in the Big Bang.

To understand this, we first have to recognize the bias that is built into the whole concept of physical "laws". When Newton developed mechanics and gravity, the Judeo-Christian notion of God-given law was already deeply engraved in his thinking by his culture. Even today, science frequently is interpreted by the public, media, and scientists alike as the process of learning about the "mind of God."

However, the laws of physics — at least in their formal expressions — are no less human inventions than the laws by which we govern ourselves. They represent our imperfect attempts at economical and useful descriptions of the observations we make with our senses and instruments. This is not to say, as we sometimes hear from the "quantum mystic" community (Stenger 1995), that we subjectively determine how the universe behaves, or that it has no orderly behavior. Few scientists deny the existence of an objective, ordered reality that is independent of human life and experience. We simply have to recognize that the concept of "natural law" carries with it certain metaphysical baggage that is tied to our traditional, pre-scientific modes of thought. It is going a step beyond logic to conclude that the existence in the universe of order, which we traditionally label as the "laws of nature," implies a cosmic lawgiver.

We are gradually recognizing that several of the laws of physics, those that seem to be the most universal and profound, are in fact little more than statements about the simplicity of nature that can almost go unsaid. The "laws" of energy, momentum, and angular momentum conservation are mathematical representations of the homogeneity of

space and time. Conservation of energy follows from the absence of a unique moment in time. (Admittedly, the first moment of the universe was unique, but the implied violation of conservation of energy is exactly what gives us the zero point energy mentioned earlier). Conservation of momentum follows from the *Copernican principle* that there is no preferred position in space. Other conservation laws, such as charge and nucleon number, also arise from analogous assumptions of simplicity.

A homogeneous universe, one with a high level of symmetry, is just the kind we would expect to occur by accident. In such a universe, many conservation laws will automatically exist. Generally speaking, then, conservation laws require no explanation. On the other hand, an observed violation of a conservation law demands an explanation, for then we have a deviation from simplicity and homogeneity.

A different argument, still based on simplicity, shows that the second law of thermodynamics is not some underlying principle of the universe. Rather, it is an arbitrary convention we humans use in defining the direction of time. Nothing in mechanics or microscopic physics forbids the violation of the second law. No mechanical principle prevents the air emptying from a room when you open the door, killing everyone inside. Physics does not forbid humans from growing younger or the dead from rising! All that would have to happen for these "miraculous" events to occur is that the molecules involved be accidentally moving in the right direction at the right instant. Of course these miracles are not observed to happen, but only because they are so highly unlikely. "Unlikely" does not mean "impossible."

The second "law" simply expresses what all of human experience has found — that air does not empty from a room, people do not grow younger, and the dead do not rise. But these events are not impossible, just highly improbable. When people falsely state that these unlikely events cannot happen because the second law "forbids" them from doing so they are, like Newton, influenced by our culture. The second law of thermodynamics, along with the arrow of time and the notions of causality and determinism, arise as statistical statements about the likelihood of events that emerge as principles we invent to describe the world of everyday experiences.

However, we do not live in a universe of complete simplicity, with every point in space and time exactly the same as every other. Complexity of the kind we associate with life represents a deviation from simplicity — a breaking of symmetry.

Consider the left-right symmetry of a sphere or cube. You cannot tell such an object from its mirror image. You and I, on the other hand, are not left-right symmetric. Not being identical to our mirror images, we possess what might be called "broken mirror-symmetry" (the symmetry is broken, not the mirror). Just compare a photograph of yourself with what you see in a mirror. While the mirror image is still "you," in detail it looks like a different person, with hair parted on the other side and smile twisted the wrong way.

Highly symmetric structures are very simple. They have a low level of organization and become more complex when some of their symmetry is broken. Consider, for example, what happens when a water droplet freezes into an ice crystal, or a snowflake is formed from unstructured water vapor. A snowflake always has six arms, but that symmetry is less than the complete rotational symmetry of the vapor out of which it formed. Furthermore, a new structure is added by the arrangements of ice crystals along the arms. However, the details of those arrangements are random — "no two snowflakes are alike." The complex organization of the arms of a snowflake thus appears as a kind of disorder superimposed on order.

...spontaneous symmetry *breaking*... is now viewed by physicists as the source of complexity in the universe.

This process, in which randomness is superimposed on an underlying, tautological order, is called *spontaneous symmetry breaking*, and is now viewed by physicists as the source of complexity in the universe. As the universe exploded from its original state of complete disorder, it expanded, cooled, and passed though a series of phase transitions analogous to the freezing of water vapor into a snowflake. Each new phase was more complex than the previous one, but not in any predetermined way. Just as the evolution of life would be different, as Stephen Jay Gould has said, if you rewind the tape and play it over again, so too with the evolution of complexity in the universe including many of what we call "laws" of physics.

Much of the structure of the universe is the result of chance. But the evolution of complexity itself, making possible the evolution of some form of life, was not so unlikely as to demand, to our best knowledge, the outside intervention of a creator.

Implications for Education

In critically examining evidence for or against intelligent design of the universe, it must be understood that we are following a standard practice of science — seeking a natural explanation for observations about the universe. Some of these observations may have been previously attributed to the action of a supernatural deity, or may for other reasons have religious implications. But this is no reason to hang back from attempting a scientific, natural explanation. The discussion should be pursued in a nondogmatic, open fashion, as required by a scientific investigation.

Educators should be aware that modern physics and cosmology provide no basis for treating the bib-

lical creator as a *scientific* hypothesis. They can point out the logical flaw in the "anthropic" probability argument — that it fails to consider *all* the possible ways that some form of life may have developed in some form of universe. Teachers can thereby question the claim that science *requires* a miracle to produce the universe and has thereby "proved" the need for a creator. Teachers must resist those who would attempt to force their personal beliefs into the classroom through the back door of "intelligent design." Above all, we must not leave the field open to those who assert that science supports their religious beliefs, and then demonstrate no commitment to reason and scientific process.

Educators should be aware that modern physics and cosmology provide no basis for treating the biblical creator as a *scientific* hypothesis.

If anthropic design arguments are proposed for consideration in science classrooms, then good science methodology demands that we make clear that these hypotheses are not required by existing scientific knowledge. "Design" or the "anthropic principle" do not deserve a place in the classroom just because they are possible. So are unicorns. Within the framework of Occam's razor, intelligent design is an added hypothesis and the advocate's burden is to demonstrate why it is necessary to make this hypothesis. Furthermore, I have argued that no evidence or rational argument for intelligent design can be found in either the data or the theories of modern physics and cosmology. Design arguments are both unsupported and unnecessary. They have not earned a place in the science classroom.

A Note on References

Many good books by scientists can be used as resources. For example, Stephen Hawking's *Brief History of Time* was a remarkable best-seller. More recent books on cosmological origins include Smolin (1997), Ferris (1997) and Guth (1997). I especially recommend a look at Smolin's book, since it offers a possible Darwinian explanation for the anthropic coincidences. I have not attempted to bring this into the current discussion because Smolin's idea is so original that it would require a full article of its own. But just think of how much fun it would be to move the evolution-creation debate from biology to cosmology. We're talking here about worm holes in warped space-time pinching off to form new universes. Think you can get your kids interested in that?

Acknowledgments

The author is grateful to Taner Edis and John Forester for their comments on an early draft of this essay.

References

Barrow JD, Tipler FJ. *The Anthropic Cosmological Principle*. Oxford: Oxford University Press, 1986.

Begley S. "Science Finds God" *Newsweek* 1994; July 20: 46.

Carter B. "Large Number Coincidences and the Anthropic Principle in Cosmology," in MS Longair, ed., *Confrontation of Cosmological Theory with Astronomical Data* Dordrecht: Reidel, 1974: 291-298.

Denton M. *Nature's Destiny: How the Laws of Biology Reveal Purpose in the Universe*. NY: The Free Press, 1998.

Ferris T. *The Whole Shebang: A State-Of-The-Universe Report*. New York: Simon & Schuster, 1997.

Guth A. *The Inflationary Universe*. New York: Addison-Wesley, 1997.

Gribbin J, Rees M. *Cosmic Coincidences: Dark Matter, Mankind, and Anthropic Cosmology*. New York: Bantam Books, 1989.

Hawking S. *A Brief History of Time: From the Big Bang to Black Holes*. New York: Bantam, 1988.

Hoyle F, Wickramasinghe C. *Evolution from Space*. JM Dent, 1981.

Penrose R. The Emperor's New Mind: Concerning Computers, Minds, and the Laws of Physics. Oxford: Oxford University Press, 1989.

Stenger, VJ. Not By Design: The Origin of the Universe. Buffalo NY: Prometheus, 1988.

Stenger, VJ. The Universe: The Ultimate Free Lunch. European Journal of Physics , 1990; 11:236.

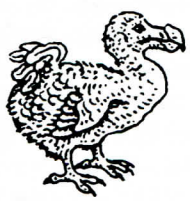
Stenger, VJ. *The Unconscious Quantum: Metaphysics in Modern Physics and Cosmology*. Amherst, NY: Prometheus Books, 1995.

Smolin, L. *The Life of the Cosmos*. Oxford: Oxford University Press, 1997.

web site address: for *Monkey God*: <http://www.phys.hawaii.edu/vjs/www/monkey.html>

for "Faith and Reason" PBS program: <http://www.pbs.org/faithandreason>

An expanded version of this article can be found on Dr. Stenger's "Cosmology and Cosmythology" web page <http://www.phys. hawaii.edu/vjs/www/cosmo.html>



Surely, God could have caused birds to fly with their bones made of solid gold, with their veins full of quicksilver, with their flesh heavier than lead, and with wings exceeding small. He did not, and that ought to show something. It is only in order to shield your ignorance that you put the Lord at every turn to the refuge of a miracle.

—Galileo Galilei

Dialogue on the Great World Systems (ca. 1630)

Contributed by NCSE President Kevin Padian

Yet Another Young Sun Apologetic

Kevin L O'Brien

Dr. Danny Faulkner, Associate Professor of Astronomy and Physics at the University of South Carolina at Lancaster, has published a new creationist claim that the sun is young, entitled "The Young Faint Sun Paradox and the Age of the Solar System" (Faulkner 1998). In it he makes the following extraordinary claim: "While the early faint Sun paradox does not tell us that the Solar System is only thousands of years old, it does seem to rule out the age being billions of years." Just what is he talking about?

The faint, young sun paradox is in fact very simple. "Theories of stellar evolution indicate that as stars mature on the main sequence, they grow steadily hotter and brighter; calculations suggest that at about the time of the formation of Earth, the Sun was roughly two-thirds the brightness that it is now. However, there is no geological evidence on Earth (or on Mars) for the Sun being fainter in the past. At present there is no clear resolution for this paradox" (Francis 1996). For astrophysicists this is an interesting, but not particularly vexing, problem.

For Dr. Faulkner, however, it is a devastating blow to the generally accepted age of the solar system. He claims that if the sun was really 4.6 billion years old, then according to the paradox its luminosity should have increased by 40%. This would have increased the surface temperature of the Earth to the point where life would be impossible, assuming the Earth had started out as warm as it is now. Conversely, the early earth could have been colder than it is now, but he claims it would have been far too cold for life to have begun. He also claims that current geological evidence demonstrates that the global climate has not changed significantly during the last four billion years.

Next he states that the evolution of the atmosphere would have had to keep pace with that of the Sun. As he states it, however, "[t]he precise tuning of this alleged co-evolution is nothing short of miraculous. The mechanism driving this would have to be a complex system of negative feedbacks working very gradually," which could under the slightest influence disrupt the whole system and cause the global climate to catastrophically heat up or chill down. So he offers evolutionists a choice of three explanations for how the Earth maintained a constant temperature despite the increase in luminosity. The first is that "through undirected change the atmosphere has evolved to counteract heating", in much the same way that an animal would evolve to fit a changing environment. The problem with that, he claims, is that "[s]hort of some guiding intelligence or design [like DNA], a similar process for the atmosphere seems incredibly improbable. Any sort of symbioses [sic] or true feedback with the Sun is entirely out of the question."

A second alternative explanation would be to assume "that some sort of life force has directed the atmosphere's evolution", such as John Lovelock's Gaia hypothesis. His third explanation is a young-earth one: "Perhaps the Earth/Sun system is not billions of years old and so there has not been a 40% increase in solar luminosity. If Earth were recently created and designed to have the kind of atmosphere that it has now and the Sun has not changed appreciably in luminosity, then the young faint Sun paradox has been resolved."

The faint young Sun paradox is not as easy to deal with as some astronomical puzzles, but the situation is not as bleak as Dr. Faulkner describes. For one thing, considering that there have been ice ages going all the way back to the end of the Archean eon 2.5 billion years ago, we can say that whatever mechanism was at work trying to keep the global temperature stable, it was not as efficient or precise as Dr. Faulkner implies it should have been. For another, even if the early earth had been much colder than it is today, life could have gotten its start in hot springs or even below ground, where heat produced by radioactive decay and water obtained from the warm crust could have provided an ideal haven for abiogenesis and later evolution.

The most likely explanation, however, is that the atmosphere was able to maintain a tolerably warm surface temperature most of the time. It is known that for the first few billion years the atmosphere had contained large amounts of greenhouse gases

like ammonia, methane and carbon dioxide. An old idea was to assume that ammonia left over from the previous reducing phase of the primeval atmosphere was responsible for the warming, but it photolyzes too readily to have made a significant contribution if there was no source for continual replacement. Recently, however, a mechanism for continual replacement has been proposed (Brandes and others 1998). Since it was generally believed that the atmosphere had always contained large amounts of carbon dioxide, it was assumed that there would have been enough to retain sufficient heat to keep the temperature stable. Recently, however, this has been called into question. Paleosol data from between 2.2 and 2.8 billion years ago indicate that ancient soil contained too little siderite (an iron carbonate compound obtained from the oxidation of native iron by carbon dioxide) to account for sufficient atmospheric carbon dioxide (Kasting 1997, p 1213). This led a few to speculate that in fact the earth might have been covered by ice for about the first billion years after the surface cooled, but the presence of sedimentary rock and fossils after 3.5 billion years ago indicates that surface water must have existed by that time.

Recently, Carl Sagan and Christopher Chyba proposed a new mechanism to try to get around this problem (Kasting 1997, p 1214; Sagan and Chyba 1997). They suggest that a smog of organic particles created by the photochemical polymerization of methane and nitrogen might have protected any ammonia present. Ammonia is such a strong greenhouse gas that in fact only a very tiny concentration is needed to do the trick. Like any new idea, however, it is not without its problems (Kasting 1997, p 1214). If the ratio of methane to carbon dioxide had been less than one, the methane would have oxidized rather than polymerized. Also, methanogenic bacteria would not have been able to produce enough to get around the carbon dioxide ratio problem, or to build a thick enough smog layer.

Some researchers have suggested that methane by itself would have been enough, without ammonia and without smog (Kasting 1997, p 1214). A concentration of only 100 parts per million would have been sufficient to compensate for the reduction in carbon dioxide called for by the siderite data. Methanogenic bacteria could easily have produced this amount, as long as the atmosphere was virtually devoid of free oxygen. And methane can also absorb visible red and near-infrared light, thus increasing the amount of heat retained by the atmosphere.

In conclusion, it would seem that Dr. Faulkner is exaggerating the problem. His entire effort has less to do with supporting creationism than it does with refuting evolution. Not only is there good evidence that the "miraculous" fine-tuning Faulkner claims was needed did not exist, there are also possible mechanisms to resolve the paradox.

References

Brandes JA, Boctor NZ and others. Abiotic nitrogen reduction on the early Earth. *Nature* 1998 Sep 24; 395(6700):365-367.

Faulkner D. The Young Faint Sun Paradox and the Age of the Solar System (Impact No. 300).*Acts & Facts* 1998 June; 276(5316):i-iv. <http://www.icr.org/pubs/imp/imp-300.htm>.

Francis EM. The Laws List. 1996; Available from <http://www.alcyone.com/max/physics/laws/index.html> Accessed 1998 Jul 17.

Kasting JF. Warming Early Earth and Mars. *Science* 1997 May 23; 276(5316):1213-1215.

Sagan C and Chyba C. The Early Faint Sun Paradox: Organic Shielding of Ultraviolet-Labile Greenhouse Gases. *Science* 1997 May 23; 276(5316):1217-1221.

Author's Address:

Kevin L. O'Brien
915 East Drake #178
Fort Collins, CO 80525
Email: Cuchulaine@worldnet.att.net

SEVEN PERCENT OF SCIENTISTS BELIEVE IN GOD

(Mr. TRAFICANT asked and was given permission to address the House for 1 minute and to revise and extend his remarks.)

Mr. TRAFICANT. *Mr. Speaker, a new report says only 7 percent of scientists believe in God. That is right. And the reason they gave was that the scientists are 'super smart.' Unbelievable. Most of these absent-minded professors cannot find the toilet.*

Mr. Speaker, I have one question for these wise guys to constipate over. How can some thing come from no thing?

And while they digest that, Mr. Speaker, let us tell it like it is. Put these super-cerebral master debaters in some foxhole with bombs bursting all around them, and I guarantee they will not be praying to Frankenstein.

Beam me up here. My colleagues, all the education in the world is worthless without God and a little bit of common sense. And I yield back whatever we have left.

Rep James A Traficant, Jr. D-OH, August 3, 1998
Reported in 1998
Congressional Record : H6885
<http://rs9.loc.gov/
cgi-bin/query/D?r105:2:./ temp/~r105btmHof:>

What Genesis Is *Really* About

Conrad Hyers
Saint Olaf College
Northfield, MN

. . . When one looks at the myths of surrounding cultures, in fact, one senses that the current debate over creationism would have seemed very strange, if not unintelligible, to the writers and readers of Genesis. Scientific and historical issues in their modern form were not issues at all. Science and natural history as we know them simply did not exist, even though they owe a debt to the positive value given to space, time, matter, and history by the biblical affirmation of history.

What did exist — what very much existed — and what pressed on Jewish faith from all sides, and even from within, were the *religious* problems of idolatry and syncretism. The critical question in the creation account of Genesis 1 was polytheism versus monotheism. *That* was the burning issue of the day, not some issue which certain Americans 2,500 years later in the midst of the scientific age might imagine that it was. And one of the reasons for its being such a burning issue was that the Jewish monotheism was such a unique and hard-won faith. The temptations of idolatry and syncretism were everywhere. Every nation surrounding Israel, both great and small, was polytheistic; and many Jews themselves held — as they always had — similar inclinations. Hence the frequent prophetic diatribes against altars in high places, the Canaanite cult of Baal, and "whoring after other gods."

Read through the eyes of the people who wrote it, Genesis 1 would seem very different from the way most people today would tend to read it — including evolutionists who may dismiss it as a pre-scientific account of origins, and creationists who may try to defend it as the true science and literal history of origins. For most peoples in the ancient world the various regions of nature were divine. Sun, moon, and stars were *gods*. There were sky gods and earth gods and water gods. There were gods of light and darkness, rivers and vegetation, animals and fertility. Though for us, nature has been "demythologized" and "naturalized" — in large part because of this very passage of scripture — for ancient Jewish faith a divinized nature posed a fundamental religious problem.

In addition, pharaohs, kings, and heroes were often seen as sons of gods, or at least as special mediators between the divine and human spheres. The greatness and vaunted power and glory of the successive waves of empires that impinged on or conquered Israel (Egypt, Assyria, Babylon, Persia) posed an analogous problem of idolatry in the human sphere.

In the light of this historical context it becomes clearer what Genesis 1 is undertaking and accomplishing: a radical and sweeping affirmation of monotheism vis-à-vis polytheism, syncretism and idolatry. Each day of creation takes on two principal categories of divinity in the pantheons of the day, and declares that these are not gods at all, but creatures — creations of the one true God who is the only one, without a second or third. Each day dismisses an additional cluster of deities, arranged in a cosmological and symmetrical order.

On the first day the gods of light and darkness are dismissed. On the second day, the gods of sky and sea. On the third day, earth gods and gods of vegetation. On the fourth day sun, moon, and star gods. The fifth and sixth days take away any associations with divinity from the animal kingdom. And finally human existence, too, is emptied of any intrinsic divinity — while at the same time *all* human beings, from the greatest to the least, and not just pharaohs, kings and heroes, are granted a divine likeness and mediation.

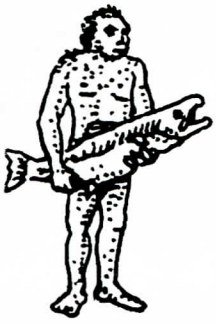
On each day of creation another set of idols is smashed. These, O Israel, are no gods at all — even the great gods and rulers of conquering superpowers. They are the creations of that transcendent One who is not to be confused with any piece of the furniture of the universe of creaturely habitation. The creation is good, it is very good, but it is not divine.

We are then given a further clue concerning the polemical design of the passage when the final verse (2:4a) concludes: "These are the generations of the heavens and the earth when they were created." Why the word "generations," especially if what is being offered is a chronology of days of creation? Now to polytheist and monotheist alike the word "generation" at this point would immediately call

continued on page 33

BARGAIN BOOKS FOR THE HOLIDAYS!

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>.



NCSE has decided to close out its books in stock, and what better time to begin than the holidays?

OUR HOLIDAY GIFT TO MEMBERS IS AN INCREASED DISCOUNT OF 25% UNTIL ALL BOOKS IN STOCK ARE SOLD.

You can share the gift with friends and loved ones! In this issue we feature gift books — primarily children's books and "coffee table" books — some educational and all enjoyable. Please hurry with your order — our 25% discount offer is limited to supplies on hand.

"COFFEE-TABLE" BOOKS

What Is Life?
by Lynn Margulis and Dorion Sagan
With eighty illustrations ranging from the smallest known organism to the biosphere itself, this exploration of the meaning of "life" has been praised by E O Wilson as a "new and spirited explanation ...likely to influence future introductions to biology." Introduction by Niles Eldredge. Cloth, large format, 199 pages. *List price $40.00, sale price $30.00*

Planet Ocean: Dancing to the Fossil Record
by Brad Matsen and Ray Troll
Dozens of imaginative, full color paintings and block prints are accompanied by a text explaining the history of life on our ocean-covered planet, what we know and how we know it. Paper, 127 pages. *List price $19.95, sale price $15.00*

Illuminations: A Bestiary
by Rosamond Wolff Purcell and Stephen Jay Gould
Museum exhibits of stuffed animals, skeletons, and fossils appear in 69 full color photos with accompanying text in which noted scientist and author Stephen Jay Gould "speaks of layers of data lost, and meaning added" in our attempts to understand the natural world. Paper. *List price $19.95, sale price $15.00*

The Human Odyssey: Four Million Years of Human Evolution
by Ian Tattersall
The Human Odyssey grew out of the American Museum of Natural History's "Hall of Human Biology and Evolution" and the many illustrations include photos of fossils and reconstructions in that exhibit. Combines scientific accuracy with vivid photography. Cloth, large format, 190 pages.*List price $27.50, sale price $20.75*

Imprints of Time: The Art of Geology
by Bradford B Van Diver
This rare gem is a collection of 147 photographs of geological formations large and small, illustrating the forces that shape our landscape and the mineralogical delights they produce. Each section includes a brief, explanatory introduction on: Canyonlands; Badlands; Dunescapes; Playas; Ice; The Art of Pele [volcanoes]; Microcosms [crystals photographed under polarizing microscope]; or Other Places, Other Times. Paper (high quality photographic). *List price $19.95, sale price $15.00.*

CHILDREN'S BOOKS

Maybe Yes, Maybe No
by Dan Barker
Did a poltergeist knock over the peanut butter jar? Maybe yes, maybe no.... In a series of short, illustrated vignettes showing ordinary children explaining puzzling events, Barker explains basic principles of critical thinking. For grades 4-6. Paper, 80 pages. *List price $13.95, sale price $10.50*

The Usborne Young Scientist: Evolution
by Barbara Cork and Lynne Bresler
This could be your very last chance to obtain this out-of-print book — a comprehensive, well illustrated introduction to basic evolutionary concepts and their history. Paper, 32 pages with glossary, index, suggested activities and further readings. *List price $6.95, sale price $5.20*

Tree of Life
by Ellen Jackson
Simple illustrations communicate the long history and great diversity of life for children aged 4-9. Paper, 40 pages. *List price $14.95, sale price $11.20.*

The Evolution Book
by Sara Stein
Recipes and mysteries, pictures, projects, and fascinating facts, all set against the background of the history of life. The principles of evolution are clearly explained, and used to answer many questions of how the world got the way it is — from the reason puppies lick your face to why it is that African algae are found in Boston's subways. While the reading is at the fourth to seventh grade level, this book is appropriate for all ages, since parents will enjoy using it to answer small children's questions, and sharing the activities designed for exploring and understanding nature. Paper, 387 pages, illustrated. *List price $12.95, sale price $9.70*

The Science Book
by Sara Stein
Sara Stein says, "This has been the hardest book to write that I have ever

written...because... every time I thought I had an answer, I found another question.... [N]ow I realize that's the way writing a science book ought to be." The fun is infectious in a book that your child will enjoy for a long time, reading in short spurts and returning to sip and savor discoveries about "Outsides" (pets, pests, people), "Insides" (what we find under the skin and under the microscope), and "Invisibles" (senses, behavior). Just right for grades 5-7, and the young at heart. Paper, illustrated, 285 pages. *List price $9.95, sale price $7.50*

Raptors, Fossils, Fins, & Fangs
by Ray Troll and Brad Matsen
With vividly colored illustrations by Ray Troll, (you've seen his work in *Reports of NCSE*), and text by Brad Matsen, this book describes the history of animal life from the Cambrian to the present, using representative species from trilobites to you and me. Perfect for ages 5-9 and the ones who love them (with timelines on every page for curious grown-ups). Cloth, 31 pages. *List price $14.95, sale price $11.20*

From So Simple a Beginning: The Book of Evolution
by Philip Whitfield
With more than 400 stunning illustrations including color photographs and diagrams that genuinely clarify the text, this book tells the story of life and lucidly explains evolutionary principles — no misconceptions allowed. Fascinating insets illustrate concepts like mutation and adaptation with phenomena ranging from the sickle-cell gene to the rattlesnake's heat sensors. Foreword by Roger Lewin. Ages 12- grandparent. Paper, 220 pages. *List $19.95; sale price, $15.00*

Humor

Creation/Evolution Satiricon: Creationism Bashed
by Robert S Dietz and John C Holden
Offered as "a serious satire on the creation/evolution controversy", the *Satiricon* contains mini-essays, cartoons, aphorisms and definitions in the spirit of H L Mencken's remark that, "One good horselaugh is worth a thousand syllogisms." Topics include: Historical and Modern Background, Creationism and Fundamentalism, Creationism and the Physical Sciences, Evolution and Creationism, and The Philosophy of Science. *List price $9.95, sale price $7.50*

The Evolutionary Tales
by Ronald L Ecker
In this delightful rhyming parody of *The Canterbury Tales* ten scientists on their way to a "Back to Genesis" seminar describe how their respective specialties contribute to the overwhelming evidence supporting evolution. With comprehensive notes, bibliography, and index, this entertaining book doubles as a handy creation/evolution reference. Paper. *List price $14.95, sale price $11.20*

The Best of The Journal of Irreproducible Results
Edited by George H Scherr
Bring down the Ivy Tower in a fit of laughter! Over 90 selections from the journal that parodies academic research journals, with topics like "Golf and the Poo Muscle" and "Prenatal Psychoanalysis." Paper, 194 pages. *List price $10.95, sale price $8.20*

In a Class of Their Own

Visitors from the Red Planet
by Dr Crypton
77 intriguing and humorous solve-them-yourself mysteries from the man who asks on the back cover "Is Dr Crypton *really* the smartest man in the world or is his reputation merely the fruit of a relentless public relations campaign?" Fortunately he provides answers to the first 77! Paper, 154 pages. *List price $7.95, sale price $6.00*

A Reparation: Universal Gravitation A Universal Fake
by C S Deford
Never mind the title! This historical oddity is an extended essay offering "scientific" and religious reasons that the earth must be flat! Paper, 62 pages. *List price $4.95, sale price $3.70*

The Dechronization of Sam Magruder
by George Gaylord Simpson
In this short novel, the great paleontologist realistically describes the dilemma of a time-traveler marooned in the Jurassic era. More than an adventure story, the novel is, in the words of Stephen Jay Gould, "a profound work about the sense and meaning of human life." Introduction by Arthur C Clarke. Cloth, 132 pages with an afterword by Stephen Jay Gould and a memoir by Joan Simpson Burns. *List price $17.95, sale price $13.50*

ORDER FORM NCSE PO Box 9477, Berkeley, CA 94709-0477

Name

Address

City State Zip

Home Phone Work Phone

METHOD OF PAYMENT

☐ Check (U.S. Dollars) Made payable to NCSE

Charge to ☐ VISA ☐ Mastercard Name as it appears on card

Credit Card Number Exp Date Signature

QUANTITY	DESCRIPTION			PRICE
			SUBTOTAL	
SHIPPING				
Books		each	$2.00	
Cassettes, transcripts, diskettes		1-3	$1.25	
		4-5	$1.75	
		6+	$2.00	
CA residents add 8.25% tax				
Foreign Orders: We will invoice shipping costs			SUBTOTAL	
			TOTAL	

Creation/Evolution
Back Issues Still Available

Have you ever wondered why some "creation scientists" insist that the dust layer on the moon is evidence for a young earth, and why they're wrong? What does forensic science tell us about the likelihood of mass drownings in the Noachian flood? Are special creation and UFOlogy equally popular among college students? All this and much, much more was covered in *Creation/Evolution*, the journal that was merged with NCSE's newsletter to create the bi-monthly *Reports of NCSE*.

Complete sets are still available, and you may also order individual issues. For each issue, 1-9 copies are $6.00 each, and 10 or more copies are $5.00 each; a complete set of 39 issues is $150.00. Just use the order form in the centerfold of this issue.

Here are some tantalizing (we hope!) highlights; there's a lot more where they came from! You can also order a complete, cross-referenced index of the first 25 issues (compiled by NCSE member Kenneth Saladin). A complete listing of contents of each issue of *Creation/Evolution*, compiled by NCSE member Thomas Moore, is available at <www.natcenscied. org/cecont.htm>

***Warning**: Some early numbers are in limited supply.*

Issue 1*: The Fatal Flaws of Flood Geology

Issue 2: Evidence Supporting a Great Age for the Universe

Issue 3: The Bombardier Beetle Myth Exploded

Issue 4: Do Gaps in the Fossil Record Disprove Descent with Modification?

Issue 5: Defining "Kinds" — Do Creationists Apply a Double Standard?

Issue 6: Misquoted Scientists Respond

Issue 7: Answers to Standard Creationist Arguments

Issue 8: Are There Human Fossils in the "Wrong Place" for Evolution?

Issue 9: Old-Time Religion and the New Physics

Issue 10: Whales: Can Evolution Account for Them?

Issue 11: Special Issue: The Impossible Voyage of Noah's Ark
From shipworms to seed-storage, a through analysis explaining why Noah's ark and its passengers could not have survived a global flood.

Issue 12: Genesis Knows Nothing of Scientific Creationism

Issue 13: Design in Nature: A Debate

Issue 14: Creationists, Population Growth, Bunnies, and the Great Pyramid

Issue 15: Special Issue: The Paluxy River Footprint Mystery — Solved
An entire issue reporting research on what REALLY left "human" footprints next to dinosaur footprints at this famous fossil site.

Issue 16: "Nebraska Man"

Issue 17: "Scientific Creationism" and Error

Issue 18: Evolution and Testability

Issue 19: Plagiarized Errors and Molecular Genetics

Issue 20: Fossil Insects: Pests of Creation

Issue 21: Morality, Religious Symbolism, and the Creationist Movement

Issue 22: Gentry's Tiny Mystery — Unsupported by Geology

Issue 23: The Flood: Mesopotamian Archaeological Evidence

Issue 24: Formless and Void: Gap Theory Creationism

Issue 25: Debunking New Myths

Special Issue: Index of Issues 1-25

Issue 26: Protein Sequences and Denton's Error

Issue 27: Past Imperfect: Scientific Creationism and Prehistoric Archeology

Issue 28: Bobbing for Dinosaurs: A Forensic Scientist Looks at the Genesis Flood

Issue 29: A Survey of Pseudoscientific Sentiments of Elected Officials: A Comparison of Federal and State Legislators

Issue 30: Radiocarbon Dating Dinosaur Bones: More Pseudoscience from Creationists

Issue 31: Creationism and Appearance of Age — Is Anybody Really Anywhere?

Issue 32: Orthodoxy and Originality in Creationist Thought

Issue 33: Henry Morris on Racism

Issue 34: Islamic Creationism in Turkey

Issue 35: Debates and the Globetrotters

Issue 36: A Tale of Two Teeth, or, The Best of Teeth, the Worst of Teeth

Issue 37: A Content Analysis of the Institute for Creation Research's Institute on Scientific Creationism

Issue 38: Are Polonium Halos in Coalified Wood Evidence for the Noachian Flood?

Issue 39: **Robert Pennock's Award winning essay**: Naturalism, Creationism and the Meaning of Life: The Case of Phillip Johnson

*Some issues of *Creation/Evolution* were given Roman numerals, others Arabic numerals; here all are listed with Arabic numerals

RECOMMENDED READING

Contributing editor John R Cole recommends these recent books taking popular approaches to biology and evolution:

Andreadis, Althea. *To Seek Out New Life: The Biology of Star Trek* (NY: Crown, 1998).

Mr. Spock — offspring of a Vulcan mating with Jane Wyatt of *Father Knows Best*? Illogical (humans and petunias would be closer genetically). But what about the rest of Star Trek's s/f biology? What makes sense and what does not? A Harvard assistant professor of neurology (and fan) analyzes the biological and evolutionary premises of various aspects of the Star Trek universe.

Harris, Judith Rich *The Nurture Assumption; Why Children Turn Out the Way They Do* (NY: Free Press, 1998).

In this controversial re-examination of an age-old debate, Rich looks at how children's peers and environment interact with biology.

Pyne, SJ. *How the Canyon Became Grand; A Short History* (NY: Viking, 1998).

A historian shows how the Grand Canyon has affected our views of aesthetics, nature and the age of Earth.

Skal, David J *Screams of Reason: Mad Science and Modern Culture* (NY: WW Norton, 1998).

The *New York Times* considers this a sometimes overwrought critique of Hollywood's view of science. (Surely sometimes it *is* "just a movie?") But popular culture both reflects and informs our attitudes, and the only sympathetic movie portrayal of a scientist in recent years I can think of is Jodie Foster in *Contact*.

Widmaier, Eric P. *Why Geese Don't Get Obese (and We Do).* (San Francisco: WH Freeman & Co, 1998).

Comparative physiology and evolution explored with wit and whimsy.

Is It Fair to Teach Evolution?

Molleen Matsumura

Although most Americans belong to religious denominations that accept evolution (Matsumura, 1998), several misconceptions about religion and science continue to hamper efforts to improve evolution education — or to teach evolution at all. Many students and parents who oppose the teaching of evolution argue that it "unfairly" offends religious beliefs or "teaches only one side"; they get a sympathetic hearing from fellow-citizens and school administrators who care very much about being fair.

One good answer to the "fairness argument" is that it is hardly fair to give students an incomplete science education. However, this answer alone will not resolve most conflicts; it may not even get a hearing unless misconceptions about religious concerns are cleared away.

Some common misconceptions are that

- "Religion" is equivalent to "Christianity"
- Christian belief prohibits acceptance of evolution
- Fairness demands teaching all beliefs
- Most Americans support teaching "creation science" or at least "balancing creation and evolution"
- Support for teaching either "creation science" or "both sides of the issue" is based on religious convictions.

The real story is more complicated.

Religious Beliefs Worldwide

Table 1 shows that the distribution of religions in North America (including the US, Canada, and Mexico) is quite different from their worldwide distribution. It is clear that not all religious people are Christians, and in fact the religion of most Americans is shared by much less than half the world's population.

What about teaching all beliefs about the history of life? Carneiro (1980) reports that "A few societies have no myth to account for the origin of the world.... Beliefs about the origin of human beings fall into three main types: (1) they have always existed on earth, (2) they did not always exist but were created in some way, and (3) they previously existed, but in another world, and had somehow to be brought to this one." Parts of some belief systems are compatible with scientific explanations (for example, some religions hold that the earth is ancient); but trying to make science fit with other creation beliefs would mean teaching things that are incompatible with each other and with scientific research. There really is no fair way to teach anything but science in science class!

[F]airness in science education does not require teaching... misconceptions

Do Most Americans Believe In "Creation Science?"

While it is important to make it clear that there are many religious views of the history of life, most creation/evolution controversies in the US hinge on the perception that large numbers of Americans — perhaps most — are Biblical literalists, whose views must be included for the sake of fairness. Examining relevant survey findings could help many science teachers both lessen resistance to teaching about evolution, and teach some lessons about interpreting opinion surveys that are quite appropriate for presentation in a science class. These same findings also give defenders of evolution education a better understanding of the problems they face.

To understand whether individuals are "literal creationists," or "Biblical literalists," we must first define

Table I WORLDWIDE ADHERENTS OF ALL BELIEFS, MID-1995*

BELIEF* *(largest to smallest, worldwide)*	NORTH AMERICA		WORLD	
	RAW NUMBER	% TOTAL	RAW NUMBER	% TOTAL
Christians	249 277 000	85.1	1 927 953 000	33.7
Roman Catholics	(74 243 000)	(25.4)	(968 025 000)	(16.9)
Protestants	(123 257 000)	(42.1)	(395 867 000)	6.9
Orthodox	(6 480 000)	(2.2)	(217 948 000)	3.8
Anglicans	(6 819 000)	(2.3)	70 530 000	1.2
Other Christians	(38 478 000)	(13.1)	275 583 000	4.8
Muslims	5 450 000	1.9	1 099 634 000	19.2
Nonreligious	25 050 000	8.6	841 549 000	14.7
Hindus	1 185 ,000	.1	708 547 000	13.7
Buddhists	920 000	<0.1	323 894 000	5.7
Chinese folk religionists	98 000	<0.1	225 137 000	3.9
Atheists	1 670 000	<0.1	219 925 000	3.8
New-Religionists	956 000	<0.1	121 297 000	2.1
Confucians	26 000	<0.1	5 254 000	<0.1
Ethnic religionists	47 000	<0.1	111 777 000	2.0
Sikhs	490 000	<0.1	19 161 000	0.3
Jews	5 942 000	2.0	14 117 000	0.2
Spiritists	300 000	<0.1	10 190 000	0.2
Jains	4 000	<0.1	4 886 000	0.1
Bah'a'is	356 000	<0.1	6 104 000	0.1
Parsees	1 000	<0.1	189 000	<0.1
Shintoists	1000	<0.1	2 844 000	<0.1
Mandeans	0	0	44 000	<0.1
Other religionists	1 068 000	<0.1	1 923 000	<0.1
TOTAL	**482,005,000**	**100.0**	**5 716 425 000**	**100.0**

**Adapted from "Worldwide Adherents of All Religions by Six Continental Areas" Britannica Online , 1998*

"literalism". If we define it as meaning the belief that human beings were created in their present form about 10 000 years ago, some survey results, like those in Tables 2 and 3, would give us the impression that nearly half of adult Americans are "literalists", and that this percentage has been fairly consistent through the years.

However, when we compare answers to different questions within one survey, we find inconsistencies, whether the emphasis is on scientific knowledge or on religious belief. Table 3 shows how the same respondents answered two different questions in a 1993 Gallup poll.

Why did more people in this sample agree to the idea of special creation than agreed that the Bible must be accepted literally? Could the answer be that people have different ideas about what the Bible has to say? Could it be that there are some people who accept the notion of special creation, without believing that the Bible must be taken literally? These statistics don't tell us, but they do teach the valuable lesson that a single survey answer may not give us a complete picture of what people think. The lesson is confirmed by the findings displayed in Table 4.

While 40% of respondents gave a "young earth" biblical literalist answer to the question about human evolution, only 7% gave a "young earth" answer to the question about continental drift! A teacher can present this information to show how a single question from a survey may not fully reveal respondents' beliefs. Furthermore, additional questions would be needed to explain why some people who understand a major evolutionary concept about the age and history of the earth, misunderstand or reject the concept of evolution. One possibility is that at least some are "old earth" creationists, who accept some evolution but reject human evolution; another is that disagreement that "human beings ... developed from earlier species" reflects not religious conviction but scientific illiteracy.

Once again, answers to additional questions from the same survey are helpful: they show that "scientific illiteracy" could be part of the answer. The questions in Table 4 are only two of twenty that were asked in the same survey. Only one question was answered correctly by more than 90% of Americans (that question concerned the link between smoking and lung cancer, which has been the subject of extensive public education campaigns). In many cases, the majority are uninformed; for example, 71% of adult Americans agree

Table 2 GALLUP POLL RESPONSES, 1982-1997

BELIEF	Percentage agreeing, by year 1982	1991	1993	1997
Special creation of humans (10 000 years ago)	45	46	47	44
Theistic evolution (God guided)	39	40	35	39
Evolution without God's help	9	9	11	10
Don't know/other	7	5	7	9

that "Lasers work by focusing sound waves", not light; 56% think that "Electrons are smaller than atoms"; and, while the number who understand that the earth revolves around the sun has risen to 73%, only 48% know how long it takes to do so (National Science Foundation, 1998).

Clearly, fairness in science education does *not* require teaching the misconceptions of the majority, but instead teaching what scientists have actually learned, and how they learned it. It is unfair to limit teachers' ability to do so by imposing religiously-based restrictions; in the words of the *Epperson v Arkansas* decision striking down a law that prohibited teaching evolution, "There is and can be no doubt that the First Amendment does not permit the State to require that teaching and learning must be tailored to the principles or prohibitions of any religious sect or dogma."

NOTE: The percentage of "True" answers given to questions in Table 4 were the same in 1996 and 1998. The distinction between "Don't Know" and "False" is based on a personal communication with Dr. Jonathan Miller; NCSE has not obtained this information for the 1998 survey.

Table 3 GALLUP SURVEY OF RELIGIOUS BELIEF, 1993

QUESTION	% AGREEING
"God created mankind in its present form about 10 000 years ago"	47%
"The Bible is the actual word of God and is to be taken literally, word for word."	35%

REFERENCES

Bishop, G. What Americans believe about evolution and religion: a cross-national perspective. Paper presented at the Annual Conference of the American Association for Public Opinion Research, St. Louis, Missouri, May 14-17, 1998.
Gallup survey results from 1982-1997 are presented in this report

Britannica Online "Worldwide Adherents of All Religions by Six Continental Areas" <http://www.eb.com:180/cgi-bin/g? DocF =table/ob6reli001t1.html [Accessed June 8, 1998], Copyright 1994-1998 Encyclopaedia Britannica, Inc.
Statistics for other continents, definitions of terms, additional information about some religions (for example, membership in different Islamic sects), and statistical sources on which figures are based may also be found at the above URL.

Carneiro, R. "Origin Myths" (Pamphlet of the American Anthropological Association, 1980). [*Reprinted by NCSE and available at* <http://www.natcenscied.org/origin.htm> *or by sending an SASE to NCSE*]

Epperson v Arkansas, 393 US 97, 21 L Ed 2d 228, 89 S Ct 266.

Matsumura, M. "What do Christians *really* believe about evolution?" *Reports of the National Center for Science Education* 1998, March/April; 18(2): 8

Miller, J. 1997 Personal communication

National Science Board, *Science and Engineering Indicators — 1996* — Washington, DC: US Government Printing Office, 1996 (NSB 96-21).

National Science Board, *Science and Engineering Indicators — 1998.* Arlington, VA: National Science Foundation, 1998 (NSB 98-1).

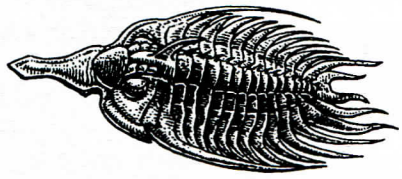


Table 4 ADULT AMERICANS' SCIENTIFIC KNOWLEDGE, 1996*

QUESTION	TRUE	FALSE	DON'T KNOW
"The continents on which we live have been moving for millions of years and will continue to move in the future"	78%	7%	15%
"Human beings, as we know them today, developed from earlier species of animals"	44%	40%	16%

The 1998 International Conference on Creationism

by Robert Schadewald

The 1998 International Conference on Creationism (ICC98) was held at Geneva College in Beaver Falls, Pennsylvania, August 3 through 8, 1998. Organized every four years by the Pittsburgh Creation Science Fellowship, the ICCs are the most ambitious of creation conferences. ICC98 was organized in two tracks, the Technical Symposium and the Educators' Symposium. The former ran the full six days and included 47 papers; the latter ran Thursday through Saturday with an even dozen presentations. Also, a plenary session was held every evening. Total attendance was probably around 400.

Beaver Falls, Pennsylvania, a town of about 10,000, is roughly 30 miles northwest of Pittsburgh. Geneva College is a small school run by the tiny Reformed Presbyterian Church of North America, whose publishing arm originally brought forth Henry Morris's *Genesis Flood*. The campus is very beautiful, with lots of trees, flower beds, and old-fashioned stone buildings. The dorms are not air-conditioned, unfortunately, and everyone sweltered at night. The cafeteria food was a pleasant surprise, especially in comparison with Duquesne in Pittsburgh, site of the three previous ICCs (1986, 1990, and 1994).

I have attended all four ICCs and six other major creation conferences, beginning in 1983. (It is sobering to think that I have spent more than two months of my life at creation conferences.) During that period, attendance by skeptics has varied from about a dozen at ICC86 to yours truly at ICC94. This year, Frank Lovell, a long-time creationist-watcher from Louisville, Kentucky, also attended the entire conference. Astronomer Francis Graham, who defended Copernicanism in a formal debate against geocentrists at the 1985 National Creation Conference, attended ICC98 on Tuesday. Tom McIver drove up from Cleveland on Saturday. The notes that follow are my own impressions of the conference, tempered throughout by conversations with Frank Lovell.

The conference is not easily summarized, other than to say that it was a far cry from the National Creation Conferences that the old Bible-Science Association used to sponsor. For example, I heard only two speakers mention that old creationist chestnut, the thickness of dust on the moon. One said that it is no problem for the conventional view, but it is a bit of a problem for young-Earth creationists, because at the current influx rate there is *far* too much moon dust for a 10,000-year scenario. The other noted that Snelling and Rush thoroughly debunked the moon dust argument in *Creation Ex Nihilo Technical Journal* some years ago.

In other words, this was not your father's creation science.

The opening presentation on Monday morning was entitled "Blotting Out and Breaking Up: Miscellaneous Hebrew Studies in Geocatastrophism" by David Fouts and Kurt Wise, both of Bryan College. Fouts, who teaches Hebrew and Old Testament, did the actual presentation. The authors argued that the Hebrew of the Flood story requires the "blotting out" of life on Earth by waters of the "great deep" exiting through both oceanic and terrestrial fountains or springs. The language does not, however, require obliteration of signs of life on Earth, and the existence of fossils is consistent with (if not required by) the text. The paper tended to provide scriptural validation for global Flood models that depend on terrestrial water sources.

Also on Monday was "Numerical Simulation of Precipitation Induced by Hot Mid-Oceanic Ridges" by meteorologist Larry Vardiman of the Institute for Creation Research (ICR). Vardiman obtained the source code for a weather modeling tool developed by the National Center for Atmospheric Research (NCAR) and modified it to run on a microcomputer. Using this model, he investigated what would have happened to global precipitation just after the Flood if the mid-oceanic ridges, being newly-formed and very hot, heated the waters above them to 30°C, 50°C, or even 70° C. Needless to say, the hotter the ocean surface, the greater the evaporation, and what goes up must come down, lots of it in the polar regions. Could this explain *the* — as in *one* — Ice Age?

On Tuesday morning, T. Fritsche presented a paper entitled "The Impact at the Cretaceous/Tertiary Boundary." Fritsche gave quite a nice summary of the history of the impact hypothesis, the broad range of

evidence supporting it, the challenge of the competing volcanic eruption hypothesis, and the apparent triumph of the impact scenario. Frank and I didn't notice any significant omissions or distortions here. I was anxiously awaiting Fritsche's explanation of how the dust cloud blasted into the atmosphere by the impact managed to penetrate the Flood Mud and form a worldwide layer of clay just below the Tertiary deposits. (Most creationists believe the Flood waters then were carrying essentially all of the Tertiary sediments in suspension.) Alas, Fritsche never mentioned this. Strangely enough, I've never heard any other creationist try to account for it, either.

I also attended a Tuesday presentation by Robert H. Brown of the Seventh-day Adventist (SDA) Geoscience Research Center. Brown's paper, "Meteorites and a Young Earth," was somewhat similar to one he gave at the first ICC in 1986. This time, he focused on the Asuka meteorite, which has been dated by six different radiometric techniques. All give the same date within a few percent. A nuclear physicist by training, Brown carefully explained the logic underlying radiometric dating and argued that the concordant dates have to mean something. At the end of his presentation, he suggested that the Genesis creation story seems to deal primarily with events involving Earth, and creationists should at least consider the possibility that some of the creation already existed. During the question period, John Baumgardner, a geophysicist at Los Alamos National Laboratories, sharply attacked Brown for this bit of alleged heresy. Baumgardner accused Brown of not being a real young-Earth creationist and of deceiving the conference organizers to get on the program. The elderly Brown handled the ugly situation with poise and dignity. I half expected someone to stand up and tell Baumgardner to sit down, but no one did. The charge of deceit was especially unfair; Brown has spoken at every ICC, and the organizers knew his views from the beginning.

On Tuesday evening, philosopher of science Paul Nelson gave a presentation on "Understanding the Logic of Design." Nelson is one of the few who are firmly established in both the young-Earth creationist and Intelligent Design camps. According to Nelson, the logic of Design comes down to this: Science as conventionally practiced deals with natural causes and excludes intelligent causes. In the real world, however, we appeal to intelligent causation all the time. Detectives, for example, do not demand natural causes in murder cases. They look for intelligent causes. It is absurd for science to demand natural causation and exclude intelligent causation. And so on, through many examples.

When Nelson finished, the first question came from Paul Ackerman, a psychologist at Wichita State University. Ackerman argued that the problem with Nelson's approach "is the distinction between natural causes and intelligent causes. Any psychologist would say that intelligent human behavior is a natural cause." He went on to suggest that the proper distinction would be supernatural creation or supernatural design versus evolution. I was intrigued to hear a creationist make exactly the same objections I would have made.

Nelson's response was revealing. "I'm going to have to resist that move," he said, "because I do not think that the best way to make the analytical cut is between natural and supernatural. If you let them make the distinction between natural and supernatural, you will never be able to crack methodological naturalism."

Indeed! The claim that "natural" and "intelligent" somehow are opposites is fundamental to Intelligent Design. By promoting a false dichotomy, by equivocating with the words "natural" and "intelligent," Intelligent Design advocates hope to smuggle miracles into scientific explanations without facing up to the questions David Hume raised more than two centuries ago.

Phillip W Dennis is an industrial research physicist with publications in quantum field theory and invariant methods in special and general relativity. On Wednesday morning, Dennis gave the first half of his presentation on "Probability and Quantum Mechanics: A Christian Theistic Interpretation." A hard-shell Calvinist, Dennis believes that absolutely nothing is truly random. As he put it, "There is not one contingent electron floating around in the universe." Everything is foreordained. (Later, I gratefully learned that it was foreordained that Dennis would loan me change for the Coke machine when I was dying of thirst.)

If you let them make the distinction between natural and supernatural, you will never be able to crack methodological naturalism.

In his two-part presentation, Dennis argued two points. First, he argued that probability can and should be put in a Christian framework. Every event in the universe has meaning and purpose. "Probability is attributable to a correlation between the limited knowledge of man and the external objective state of affairs — again arranged according to the eternal decree of God." Secondly, Dennis argued against the Copenhagen interpretation of quantum mechanics and reviewed numerous alternatives proposed by others. Without claiming to have solved the problem, he suggested an approach for a Christian realist interpretation of quantum mechanics.

On Wednesday afternoon, Dean H Kenyon, a biophysicist at San Francisco State University,

presented a paper entitled "Hierarchical Information Content, Linguistic Properties and Protein-binding Oligomers in Coding and Noncoding DNA Sequences." Kenyon noted that up to 97% of the DNA in mammalian genomes doesn't code for anything. Some of it has a regulatory function, but most of it is introns with no known function. He argued that the "texture" of noncoding DNA differs significantly from that of coding DNA. The introns have many more repeats and quasi-periodic sequences, as he demonstrated with striking slides. What could this mean? Kenyon characterized his work as an exploration, a search for ways to test hypotheses about whether genetic systems show Intelligent Design.

[Wise] said point blank that if it weren't for his religious beliefs — if he had only the scientific evidence — he would accept evolution himself.

Kenyon was followed by Andrew Snelling, a geologist with the Australian branch of Answers in Genesis, and John Woodmorappe, speaking on "The Cooling of Thick Igneous Bodies on a Young Earth." Earth's crust contains many large blobs of granitic rock that rose from the interior in a molten state and then cooled and solidified. Some of these plutons are several kilometers in diameter. According to the conventional view, some of them took hundreds of thousands or even millions of years to cool, mostly by conduction. This view is incompatible with a young Earth as defined by the authors (6000 to 7000 years old rather than 4.55 billion). The authors argued that a high water content can reduce the melting point of a magma, and magma can absorb up to 24% water by weight at a depth of 100 km. Escaping water can carry away a lot of heat. Moreover, water percolating through cracks and pores in the surrounding country rock and the plutons themselves could carry away more heat by convective cooling. By maximizing favorable variables and invoking every known and conceivable mechanism, the authors claimed to answer "yet another objection to the young-Earth creationist position." Don't hold your breath waiting for this one to survive conventional peer review!

Danny Faulkner, an astronomer at the University of South Carolina (Lancaster), is perhaps the world's only young-Earth creationist astronomer with a secular academic appointment in astronomy. On Wednesday morning, Faulkner reviewed the states of conventional and creationist astronomy. I don't recall any strong assertion about the former that a conventional astronomer would dispute. He also said that, although creationists have partial and/or hypothetical alternatives to some of the conventional ideas, the fact is that no creationist astronomy model exists. (For more on Faulkner's astronomy, see "Yet Another Young Sun Apologetic", p. 13)

On Friday morning, Kurt Wise gave a presentation on creationist systematics entitled, "Is Life Singularly Nested or Not?" Wise is noted for telling his students and others trying to construct creation models to "think weird." By this, he means to think outside the box — preferably, *way* outside the box. And he takes his own advice. In this presentation, Wise noted that both evolutionists and creationists take some sort of hierarchy of life, some sort of nesting scheme, for granted. But what if it ain't so? Many familiar concepts and objects can be grouped into multiple, equally valid categories. Consider table utensils. Obviously, one can group forks into one category, spoons into another, and knives into another. But it is equally valid to categorize table utensils as silver, stainless steel, plastic, and so on. Can life forms also be rigorously classified in multiple ways? Wise argued that examples of problematica, chimeromorphs, horizontal gene transfer, cladistic observations of unresolved multichotomies, and numerous other lines of evidence suggest multiple nesting. He argued that creationists ought to consider a multiply nested scheme for classifying living things above the level of the "baramin" (created kind).

On Friday afternoon, Steven A Austin of ICR and Andrew A Snelling of Answers in Genesis gave a presentation entitled "Discordant Potassium-Argon Model and Isochron 'Ages' for Cardenas Basalt (Middle Proterozoic) and Associated Diabase of Eastern Grand Canyon, Arizona." It is well-known that rubidium-strontium and potassium-argon (K-Ar) radiometric dates for the Cardenas basalt disagree. The usual explanation for the discordance is argon loss. Based on published dates and analyses of their own samples, the authors concluded that conventional explanations for the discordance fail. They reviewed three alternatives, each having major problems of its own. Nevertheless, the authors concluded, "All three explanations offered as alternatives to the argon loss models invalidate using the K-Ar system as conventional geochronology would assume."

Saturday afternoon, speaking on "A College Creation Curriculum" at an Educators' Symposium (nontechnical) session, Wise presented an impressive review of global plate tectonics, hitting most of the highlights and pointing out the consilience between several independent lines of evidence. He told the audience that evolution is a powerful theory, and that anyone who claims otherwise simply doesn't understand evolution. He said point blank that if it weren't for his religious beliefs — if he had only the scientific evidence — he would accept evolution himself.

Saturday evening, Wise gave the closing presentation for the conference, and among other

things, he reviewed the state of the creation model in various fields. Astronomy? No creation model exists. Biology? Same. Paleontology (his own field)? Same. He thinks a couple of other fields, such as the development of a Flood model, are making slow progress.

Despite this seemingly gloomy summary, Wise sent people away fired up. His message was that creationists have an enormous amount of work to do, and it is time for them to get cracking. He appealed to everyone present to pitch in and do whatever they could. One prominent creationist told me later that he thought the Wise windup was the best presentation of the conference.

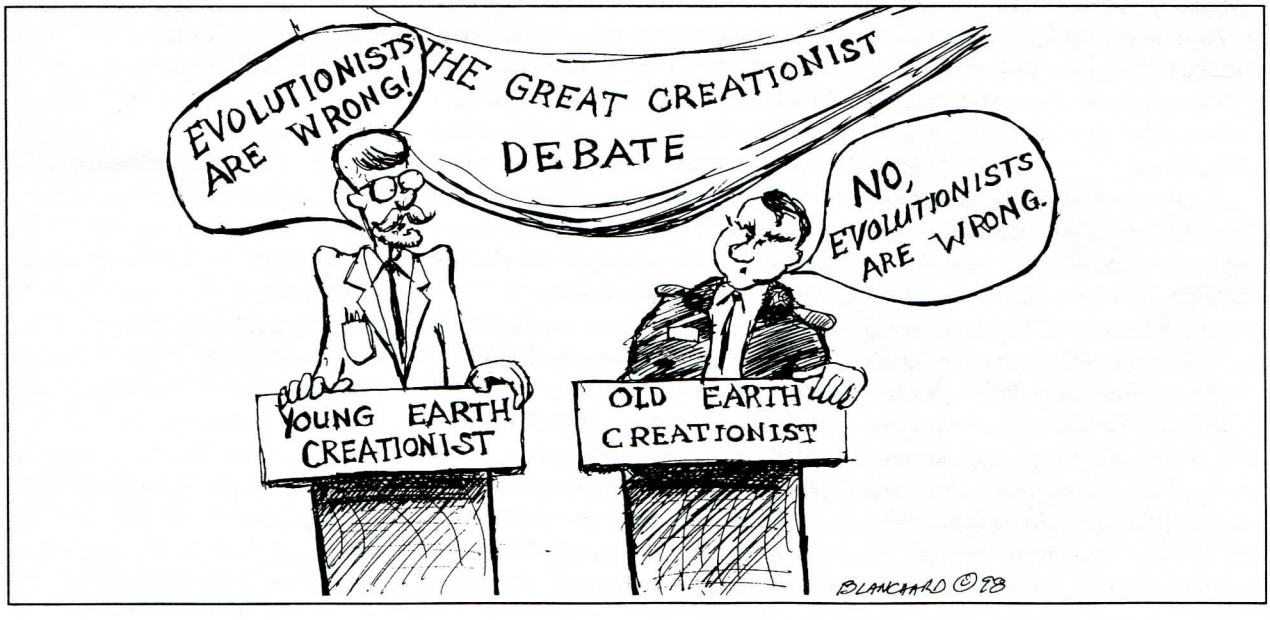
It is hard to overstate the influence of Kurt Wise in shaping modern creationism as it is practiced at its higher levels. I first met Kurt at NCC85 in Cleveland (the conference that ended with a formal debate over the relative merits of heliocentricity and geocentricity). Kurt then was still a graduate student at Harvard studying paleontology under Stephen J Gould. He immediately impressed me with his candor in dealing with the evidence, but it didn't really sink home until the following year, when I heard him give a presentation at ICC86 entitled "How Geologists Date Things." The talk was absolutely straight Geology 101, except for a few debunking asides. ("You know how creationists often claim that geologists use circular reasoning, that the rocks date the fossils, and fossils date the rocks? Well, that's wrong." And he explained why.) That was 12 years ago. Since then, Kurt has labored tirelessly, in public and private, by example and persuasion, to convince his creationist colleagues to face the facts and find new ways to interpret them.

Credit also is due to the Pittsburgh Creation Science Fellowship (CSF), organizer and sponsor of the ICCs. Bob Walsh and Henry Jackson III of CSF were at NCC85 in Cleveland to promote the conference they were planning for the next year. They told me then that they intended to set a higher standard. ICC86 was indeed a significant improvement, but it still was largely evolution-bashing. Besides the technical and educational tracks, ICC86 featured a "basic creationism" track whose menu included dishes such as Walter Brown's Hydroplate Model (some creationists privately referred to it as the "wacky track"). The second ICC, held in 1990, was marginally better, but evolution-bashing and "wacky track" nonsense still were abundant. Following ICC90, CSF established a refereeing system that essentially eliminated outright shoddiness. Meanwhile, Wise and other Young Turks, especially philosophers Paul Nelson and John Mark Reynolds, had convinced the powers that be at CSF that evolution-bashing never has advanced and never will advance a real "creation model." As a result, ICC94 was dramatically better.

At ICC98, the transformation sought by the Young Turks was virtually complete. A speaker or two may have aimed the occasional cheap shot at conventional science, but nothing remotely resembling a Gishian performance was on the program. Period. For better or worse, most presentations tried either to advance a model in some way or at least to honestly review the evidence that needs explaining. This requirement was stated in the call for papers and enforced in the refereeing process, and I didn't see a significant breakdown. Anyone whose only exposure to creationism is a Gish Gallop would not have recognized a single presentation at ICC98.

One result of the higher level of ICC presentations seems to be a higher-level audience. The deep-denial school of creation science — the "absolutely no evidence for evolution," dust-on-the-moon, salt-in-the-sea, evolution-is-Nazism

continued on page 33



Helping Schools to Teach Evolution: What Scientists Need to Know

Donald Kennedy

In the August 7, 1998 issue of The Chronicle of Higher Education, *Donald Kennedy, President Emeritus of Stanford University, explained why the National Academy of Science had produced a handbook for K-12 teachers on "Teaching About Evolution and the Nature of Science" (see forthcoming article in RNCSE 18[4]). After discussing the importance of evolution education and the pressures that prevent the teaching of evolution, Kennedy went on to describe the lessons he learned from media and public reaction.*

I am now more worried about the chilling effect of creationism on teachers than I am about explicit bans...

...The publication was front-page news and the subject of editorials in several daily newspapers. I was asked to discuss the booklet on radio talk shows, in television interviews, and even in a debate on *The News Hour with Jim Lehrer.*

I am now more worried about the chilling effect of creationism on teachers than I am about explicit bans by states or local school boards on teaching evolution. When I participated in a talk show on Wisconsin Public Radio, a high-school teacher called in to say that, although he wasn't proud of his actions, he had decided to duck the whole issue by leaving evolution out of his course. He had a family, he told me, and they had to get along in a small community. Other callers spoke of trying to combine good teaching with a respect for the situations that many of their students were facing outside the classroom. I am full of admiration for most teachers and impressed, at the same time, with the seriousness of the problems they have to overcome.

The News Hour with Jim Lehrer presented the issue as a debate: two biologists *versus* two creationists.One creationist was a very thoughtful young teacher from a Christian high school, who professed admiration for the booklet and said that he had no problem with crediting small biological changes to evolution, but that he thought that evolutionists hadn't given satisfactory accounts of big biological changes.The other creationist, a dean at a fundamentalist Christian university, insisted on a literal biblical interpretation of creation and said that evolutionists were "brainwashing" their students while supported by tax dollars.I found particularly telling his charge that many evolutionary biologists are atheists; the claim that scientists (and thus science) are inherently antireligious is a perennial feature of the creationist case.

Perhaps the most useful lesson of these and other discussions is how important it is for scientists to treat religious conviction with respect — in particular, not to suggest, even indirectly, that science and religion are unalterably opposed. Most major religions have found ways to reconcile evolution and theology; a papal decree accepting evolution has made this absolutely clear for Catholics, for example. Indeed, the conflict between science and religion has surfaced only in one or two countries besides the United States. More important, most scientists have been able to combine their personal religious convictions and their work in science without difficulty. Obviously, some scientists have no formal religious commitments and do not worship. But others do, including colleagues of mine who engage the subject of evolution in their work — and they find no difficulty whatever in reconciling their beliefs with their science.

Scientists at colleges and universities have an important stake in the resolution of the conflict between creationism and evolution. Alabama — the state that gave us EO Wilson, perhaps the most important evolutionary biologist of his generation — recently refused to distribute the NAS's booklet to teachers in its schools. In many other states, students also are entering college with little knowledge of evolution, and thus an incomplete understanding of the natural world. Unless those of us in higher education begin to take an active role in shaping what elementary and secondary students learn about science — and in assisting local teachers who must walk a tightrope in even introducing the topic — a determined minority will continue to deprive our future students of one of the foundations of scientific literacy.

Quantifying the Importance of Evolution

Molleen Matsumura, NCSE Network Project Director

Recently a concerned parent asked NCSE for advice because her child's science teacher planned to skip the textbook chapter on evolution in order to avoid conflict with a creationist student who was very vocal about his views. Besides offering the teacher support for teaching evolution, this parent wanted to provide the teacher with solid information about how to teach evolution well, and the reasons it is important to teach evolution.

As many readers of *RNCSE* know, leading scientific and educational organizations have all developed science curriculum guidelines that strongly emphasize the importance of evolution as a unifying principle. For example, the *National Science Education Standards* released by the National Academy of Science in 1996 list five "Unifying Concepts and Processes" underlying all scientific disciplines:

> Systems, order, and organization
> Evidence, models, and explanation
> Change, constancy, and measurement
> *Evolution and equilibrium*
> (italics added)
> Form and Function
> (National Academy of Science, 1996)

Standards developed by the National Science Teachers Association and the American Academy for the Advancement of Science emphasize evolution just as strongly, and all these documents have helped tremendously with efforts to assure that evolution is included in state science guidelines.

Still, for a classroom teacher who is being pressed not to teach evolution, it may be necessary to give a very concrete, practical answer to the question, "What harm is done if my child doesn't study evolution?" And the answer is, "S/he can't possibly score well on the College Board biology exams," (also known as "subject SAT tests".)

In describing each of the tests in biology, College Board literature not only states the importance of evolution, but *quantifies* it. It says of the Biology Subject Test, "***Skills Needed***... Ability to recall and understand the major concepts of biology and to apply the principles learned to solve specific problems in biology," and reports that 10% of the questions cover "Classical Genetics" and 11% cover "Evolution and Diversity." For the Biology E/M (Evolutionary/Molecular) Subject Test, which was first offered in 1997, each student takes a number of core questions, then elects to take either the "evolutionary" or molecular" portion of the test. The College Board states that, "[The] Purpose [is] To assess the student's understanding of core topics in general biology. Special emphasis is placed on either ecology or molecular biology, with recognition that ***evolution is inherent in both***" (emphasis added) . The specialized questions comprise 25% of the test, and core questions devoted to biology comprise another 11%.

The Advanced Placement test, which is based on "college curriculum surveys of introductory biology courses for biology majors," devotes 25% of questions to "Heredity and Evolution." The Board says of one other biology test, "The Subject Examination in General Biology covers material usually taught in a one-year biology course at the college level."The proportion of the test devoted to "Population Biology" makes up 33% of a student's score, and includes questions on "Principles of evolution: History of evolutionary concepts, Lamarckian and Darwinian theories; Adaptive radiation; Major features of plant and animal evolution; Concepts of homology and analogy; Convergence, extinction, balanced polymorphism, genetic drift ; Classification of living organisms; Evolutionary history of humans." Related concepts — about Mendelian and modern genetics, for example — are included in other portions of the test. (All the foregoing quotations are excerpted from test descriptions at the College Board Online web site at <www.collegeboard.org>).

Even students who don't intend to major in science in college must respect the needs of classmates who will take qualifying exams in which roughly 20%-36% of the questions require an understanding of evolution. But that is not the only concern — the emphasis on evolution in these examinations also reflects the fact that an understanding of evolution is a crucial element of scientific literacy. The "harm" in excluding evolution is the denial of an education that includes a fundamental scientific concept — and that can't be quantified. What price ignorance?

References

National Academy of Sciences. *National Science Education Standards* 1996. Washington, DC, National Academy Press. (Also available on the World Wide Web at <http://www.nap.edu/readingroom/books/intronses>)

College Board Online, <http://www.collegeboard.org> (Note: Information about various examinations was found by using the search engine on the top page. Because one of the resulting URLs is 267 characters long, we suggest you find these tests by using the search engine on the top page. Simply click on the "store" check box so that this portion of the site will *not* be searched, type the word "biology" in the search box, and click the search button. Then use the appropriate links from the results generated by the search engine. Site last accessed November 5, 1998.)

Evolution Breeds Success in Industry

David E Thomas, Peralta, NM

The July 27, 1998 issue of *US News & World Report* has an article by CW Pettit entitled "Touched by nature: Putting evolution to work on the assembly line." The article discusses several very successful applications of "genetic algorithms," including new turbine and wing designs (Boeing), trusses for space platforms (Matra Marconi Space), production scheduling (Deere & Co), development of new antibiotics (Maxygen Inc), and others.

Genetic (or "evolutionary") algorithms are now being used for problems that are so difficult that no simple solution is obvious. Take the problem of designing an airplane that can carry 600 passengers, and yet have a wingspan no wider than current jumbo jets. Sounds difficult — and it is! But Boeing engineers were able to find an unexpected, yet elegant solution by applying Darwin's theory to groups of numbers on a computer. Here's how it works: You start out with a whole herd of potential solutions; for the airplane wing problem, the initial herd would contain short wings, long wings, wide wings, curved wings, and so on. Then, you test each configuration for the features you want to maximize, such as lift, and resistance to vibration. The wings that get the best grades are more likely to pass their "genes" (for specific wing features) on to their "children." The "baby" wing designs can inherit features from two parental wings (sex), and occasional mutations are thrown into the mix. These can occasionally produce useful innovations, which are inherited by future generations. After many generations, the results can be astounding.

Creationist critics say that genetic algorithms do not demonstrate evolution in action, because one has to supply information about the desired goal at each and every step. But they miss the most important part of the process. Yes, elements are tested for performance, but such a test involves simply a comparison of different candidates, not a specification of an actual design. It's a simple matter to test whether the long, narrow wing works better than a short, wide wing. The details of specific designs emerge — not from a drawing board — but from the process of natural selection itself. And Life's test is simple to apply, also. If an organism survives long enough to have offspring, it "passes" — otherwise, it fails.

I've employed my own genetic algorithms to solve difficult problems at my job (acoustic nondestructive testing). I have found quick (a few minutes), effective solutions for pattern recognition problems that would have taken literally decades to find by brute force (evaluating all the possibilities). Might I have missed even better solutions? Perhaps — but the solutions I could produce in minutes could be easily checked for performance, and they often met or exceeded our expectations.

The Pettit article concludes on an interesting note. A researcher, asked if he minded putting a nuclear power plant into the hands of an evolved robot, wasn't really bothered. "After all, today we turn such plants over to people. Nobody really knows how *they* work, either."

Reprinted with permission from *Reports of New Mexicans for Science and Reason* May, 1998: 43-45

NEW AGE CREATIONISM

Glenn R Morton sent a reminder that there's more than one kind of creationism. Don't forget the "New Age" variety! A perfect example is Richard Petersen's *New Insights to Antiquity* (Engwald & Co, 1998).

According to Glenn, "Petersen adds his own novel twists to the Velikovskian view" that comets have played a major role in human history, influencing everything from the Noachian flood to the Great Chicago Fire and the fate of the Seven Cities of Cibola located in the American Southwest. Petersen offers loess (deposits of glacial powder that have been transported by the wind) as evidence for his "most amazing claim — that comets come into the solar system from a fourth spatial dimension." Arizona's Petrified Forest logs, too, lie exactly where they fell during their transportation from extra-dimensional space. (Glenn notes that the "4th Dimension" in physics is Time, not some other place!)

Petersen offers something for everyone, explaining that young-earther Robert Gentry's ideas about polonium haloes are further evidence that various geologic features "can only be explained by their sudden appearance from a 4th dimension." Glenn concludes, Petersen's "...highly imaginative but preposterous and easily falsified hypothesis...will probably have little influence even among the most hardened young-earth creationists while appealing to some New Age antievolutionists."

"Creation Science": A Successful Export?

Molleen Matsumura
NCSE Network Project Director

In June, 1998 Answers in Genesis (AIG), the Kentucky-based international "creation ministry", announced the opening of an affiliated office near Tokyo. According to the announcement, AIG founder Ken Ham "and another board member, Mr. Carl Kerby have witnessed the darkness of a country that has a very small Christian population. Churches are crying out for answers in their evolutionary-dominated country... Mr. Nao Hanada, who is Japanese but has been living in America the past four years, is deeply committed to creation evangelism and is opening the AIG office .... AIG/US is his main contributor..." (Anonymous-a, 1998).

Whether the transplant will succeed remains to be seen. As the AIG article points out, Japan "has a very small Christian population," and NCSE anticipates little support for doctrinal demands so much at odds with the traditional religions of a country that has easily accepted evolutionary science.

However, efforts by the Institute for Creation Research (ICR) to introduce "creation science" are faring well in Turkey, where Islamic orthodoxy offers "fertile territory" (Edis, 1994). In 1994, two years after ICR had sponsored a "Creation Conference" in Turkey, anti-evolution literature that was originally produced for government use was available to the public in inexpensive pamphlet form. In July, 1998 the Turkish Science and Research Foundation invited ICR speakers to additional conferences (Anonymous-b, 1998). ICR President John Morris views Christian/ Islamic cooperation on this issue as "'cutting edge" evangelism:

> ...[T]hey acknowledge Jesus Christ as "the word of God," a prophet of the highest order...risen into heaven, and returning as King.... [T]hey also need to recognize his deity and to understand that His death paid the penalty for their sins. (Morris, 1998)

Whether or not the ICR's work will lead to acceptance of Christianity in Turkey, its efforts to promote creationism continue to be influential. NCSE recently received correspondence from a Turkish scientist who reported that, while evolution continues to be the basis of the science curriculum, the 1997 publication of a book entitled *Evrim Aldatamacasy* (*The Evolution Deceit*) has attracted great interest (Oktem, 1998). Shortly afterward a Turkish newspaper reported that the Turkish Academy of Science had issued an announcement which "drew attention to a recent organized campaign against modern science and education", specifically "...attacks on scientific theories concerning the origins and development of the universe and life, [which] were carried out with the cooperation of both Turkish and foreign religious groups" (Anonymous-c, 1998).

These examples of outreach to non-English-speaking countries represent a new challenge. NCSE encourages members with personal and professional relationships in other countries to watch for other examples, so we may serve as a resource for the international scientific community.

NCSE thanks Taner Edis and Jere Lipps for information used in this article.An English version of Evrim Aldatamacasy *is available at* <http://www.webcom.com/vural/Eng/evol/evol.html> *NCSE member Taner Edis has offered to provide rebuttals. If you would like to help, write to NCSE and we will forward your correspondence.*

References

Anonymous-a. Japan for Genesis! *Answers in Genesis Newsletter* June, 1998 <http://www.answersingenesis.org/WebMan/Article.asp?ID=1337&Count=true> accessed September 14, 1998.

Anonymous-b. ICR assists in Turkish creation movement, *Acts & Facts* 27:9, p1 September 1998.

Anonymous-c. They declared war on science. *Cumhuriyet* September 22, 1998.

Edis, Taner. Islamic creationism in Turkey, *Creation/Evolution* XXXIV, 1994; Summer:1-12.

Morris, John D. Creationist evangelism in Turkey, *Acts & Facts*, 1998; September, 27:9.

Oktem, Serdar. Personal communication, September 8, 1998.

BOOKREVIEW

The Spice Islands Voyage: The Quest for Alfred Wallace, the man who shared Darwin's discovery of evolution

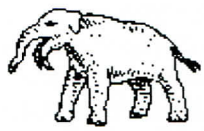
by: Tim Severn, 1998. NY: Carroll & Graf. 267 p, illustrations.

Reviewed by John R Cole, Contributing Editor, <fcattus@aol.com>

Severn retraces Wallace's journeys by land and sea in the East Indies, starting with a biography of the man, then taking a look at the places he saw, together with speculations on how he was influenced by the area. Wallace independently developed a theory of evolution, prompting Darwin to finally publish *On the Origin of Species*. Darwin's "Voyage of the Beagle" is a familiar story, but Wallace's voyages are much less well known today (as is Wallace himself).

Severn enriches biography with travel writing, history and observations on endangered wildlife and habitats in Southeast Asia. In a sense, the book is a historical re-enactment which allows the author to comment on the quality of environmental preservation a century and a half ago in the context of today's conditions and issues.

The author's argument that it was Wallace who got first to the theory of evolution, and Darwin who followed, has long been popular with anti evolutionists who simply like anything they can find that seems to make Darwin look bad. In fact, Darwin had long been nursing his theory and was spurred into action when he learned that Wallace was about to "scoop" him. Creationists would do well to emulate Wallace in deferring to Darwin the credit for elaborating evolutionary theory.



Crucible of Creation: The Burgess Shale and the rise of animals

by: Simon Conway Morris, 1998. Oxford: Oxford University Press. 242 p.

Reviewed by Peter Bowler, Department of Philosophy, Queen's University of Belfast.

Stephen Jay Gould's *Wonderful Life* (1989) brought the beautifully preserved fossils of the mid-Cambrian Burgess Shale to the attention of the reading public. But Gould used the fossils to promote a highly contentious interpretation that stressed the contingency of the evolutionary process. He argued that the "Cambrian explosion," the comparatively rapid appearance of a multitude of animal phyla at the start of the Palaeozoic era, had generated a vast array of different types, many of which have subsequently been lost through extinction. According to Gould, if we could somehow "rewind the tape" of evolution and let it play again, chance would favor a different selection of that original multitude, and the world would be a very different place from the one we see around us. There is nothing "preordained" about the appearance of humanity or the human level of awareness.

Simon Conway Morris has produced another account of the Burgess Shale creatures, explaining to a wide audience the significance of new discoveries and new interpretations that have emerged since Gould wrote. As a piece of popular science writing the book is very well done, and many will read it for the latest information about the bizarre world of the earliest animals. But make no mistake: Despite the plethora of illustrations and a fictionalized account of what it would be like to explore these ancient seas, this is no coffee-table excursion through the details of an ancient ecosystem. It is a full-scale assault on Gould's interpretation of the Cambrian explosion and on the materialist philosophy of life embodied in that interpretation. Conway Morris wants to convince us that we (or thinking beings very like us) are the unique yet intended goal of evolution. The word "creation" in his title is not to be taken lightly.

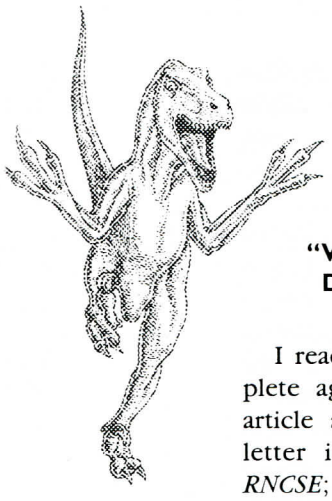
Like *Wonderful Life*, Conway Morris's book takes us through the story of Charles Doolittle Walcott's discovery of the Burgess Shale and his efforts to describe the animals revealed by the high level of preservation in this very special (but now by no means unique) location in the Canadian Rockies. Walcott was Gould's anti-hero, the paleontologist who shoehorned a whole range of bizarre Cambrian types into a few known categories, mostly arthropods. I have often wondered if Gould's attitude was influenced by the fact (which I found out from his book) that Walcott had masterminded the plan to blacklist Franz Boas's anti-racist anthropology within the American scientific community. Be that as it may, Gould's real complaint was that Walcott was blind to the obvious strangeness of the Burgess Shale creatures because he was committed to the orthodox view

that the cone of evolutionary diversity must expand through time. Conway Morris to some extent rehabilitates Walcott's reputation by showing that the diversity of Cambrian forms was by no means as extensive as Gould claims. To establish this point he gives us a fascinating tour through the research that has transformed our understanding of the Burgess Shale creatures, revealing that the strangeness is often only skin deep, concealing underlying features that confirm their position within, or between, known phyla. More discoveries from similar sites in Greenland and China have also thrown light on the Cambrian fauna. The climax of the book is an imaginary tour of the Cambrian seas via submersible and time machine, with detailed descriptions of the structures and habits of the various species as now understood (including some fascinating color plates).

The concluding chapters survey the theoretical significance of the new interpretations. Conway Morris is keen to explain how and why the Cambrian explosion took place, constructing a theory that combines genetic triggers for structural innovations with an ecological pressure generated by the origin of predators. His real concern, though, is to refute the claim that the explosion requires the postulation of evolutionary forces that are no longer in operation. The main plank of the argument is the denial of Gould's alleged diversity of form. Using cladistic analysis, Conway Morris argues that the Burgess Shale creatures can all be fitted into known phyla, or show intermediate states that actually throw light on the process by which the known phyla diverged from one another. He notes that Harry Whittington and Derek Briggs, the Cambridge paleontologists who made the first modern studies of the Burgess Shale species, were influenced by Sidnie Manton's thesis that the arthropods are polyphyletic. According to Manton, there was no "arthropod Eve," no single ancestor from which all modern arthropods are descended. The chelicerates (spiders and scorpions),crustaceans (crabs and prawns), uniramians (insects and myriapods) and the extinct trilobites had each independently evolved the characteristic arthropod structure. On such a model it would not be surprising that some other, equally independent, arthropod types might have appeared in the Cambrian and then become extinct. Modern studies have now shown that all the Burgess Shale arthropods can be accommodated within a scheme that explains their origin in monophyletic terms — from a single common ancestor in which the basic arthropod structure was developed. Meanwhile, *Wiwaxia* (from the Burgess shale) and the halkieriids (from Greenland) show how the mollusks and brachiopods evolved from the annelid worms. Major transformations are involved, of course, but nothing that requires the postulation of evolutionary forces outside the range of what can be studied in more recent times.

Conway Morris thus claims that Gould's scenario for the origin of animals is disproved: There was no vast radiation and no winnowing out of many early phyla by extinction. But the disagreement between the two paleontologists is more fundamental than this, because Conway Morris thinks that Gould's whole rerunning-the-tape idea is misleading if it is meant to imply that the outcome could be significantly different from what we observe. He certainly does not want to imply that evolution is directed by mysterious goal-directed forces. But he appeals to the widespread existence of convergence to argue that at least in its broad outlines, the outcome of evolution is predetermined. Convergence occurs when two lines of evolution independently develop the same or very similar structures, as when ichthyosaurs (reptiles) and whales (mammals) independently evolved a fish-like body plan. This occurs because certain structures are simply the best for certain adaptive purposes — any vertebrate wanting to swim in the water is going to evolve in the same direction. Conway Morris believes combined limitations of the developmental pathways triggered by genetics and the demands of the environment mean that the possible outcomes of the evolutionary process are very limited. We can conceive of all sorts of alien creatures, but they could never exist in the real world — and what can exist is pretty much confined to what we actually see. So rerunning the tape would produce more or less the same results, although the details might be different. There would be something like whales swimming in the modern seas, although they might have evolved from different mammalian ancestors.

Curiously, Conway Morris has himself demolished the most effective case for the power of convergence — Manton's theory of the independent origin of the arthropod body plan by several different phyla. In fact, the possibility of a polyphyletic origin for the arthropods goes back to Walcott's time and may have influenced his original interpretations of the Burgess Shale creatures. But it has now been disproved and with it the best example of the power of convergence to predetermine the outcome of evolution. Instead, Conway Morris offers us the parallels between the marsupials and the placental mammals, his best example being the independent evolution of a marsupial very much like the saber-toothed tiger. The main problem with this argument (and it is not a new one) is the kangaroo. If convergence is so powerful, how was it possible for the kangaroos to proliferate into a major component of the Australian fauna whereas nothing like them ever became dominant among the placentals of the rest of the world? Gould's interpreta-



Letters to the Editor

"Willful Disregard" Tactic?

I read with interest and complete agreement Karen Bartelt's article and Emile Zuckerkandl's letter in the January/February *RNCSE*; and the earnestness — wholly commendable — of the two communications led me somehow to wonder if we realists don't pay insufficient attention to what may be a widespread phenomenon among creationists: willful disregard. Was it Scarlett O'Hara who said, "I'll think about that tomorrow"? Willful disregarders say, in effect, "I'll not think about that at all."

I believe there are two motivations for willful disregard. One, of course, is dishonesty: some people have a position of power of some kind that they wish to protect. Perhaps books to be published, an organization to control or the lecture circuit to address. The motivation of others, however, could be entirely innocent: their psychic need to believe in divine intervention is so compelling that they must, on occasion, engage in disregard. In doing this, such persons will attend to an argument; will understand it; will realize that it is compelling; and then, either during the last moment of such realization or shortly after that attention process shuts down, make the decision — consciously or not — to disregard the argument. It is necessary that they do so in order for them to preserve their belief system. How to deal with such honest people in that kind of situation ought, I'd think, to be more widely addressed.

Ken Herrick
Oakland, CA

---

tion of the Cambrian explosion may have been demolished, but this reviewer, at least, remains unconvinced by Conway Morris's argument that the outcome of evolution is predetermined. If placental kangaroos had taken charge outside Australia, who knows what the world would look like now.

There is thus far more at stake here than the nature of the Cambrian explosion. Conway Morris is quite clear about how far he wants to extend the power of convergence: It guarantees the emergence of high intelligence (in mollusks like the octopus and in vertebrates) and of human spiritual faculties (in the Neandertals as well as our own ancestors). In the end, he wants us to believe that something very like human nature was bound to emerge sooner or later from the evolutionary process. This contrasts with Gould's position, which follows a materialist tradition pioneered by the founder of modern Darwinian paleontology, George Gaylord Simpson, who insisted that humans were a most unlikely product of so haphazard a process. Gould's Marxist leanings are well known, and we can see why he would favor a viewpoint that leaves the human race to figure out its own moral values with no hints provided by any transcendental source. Conway Morris's opposition to this is driven by a more traditional perception of the human situation. He tells us that our intelligence is a gift, that we shall be called into account and that the evils perpetrated by humanity make sense only if they can be redeemed. For him, we are not only the intended outcome of evolution — we may also be the unique embodiments of spiritual faculties in the universe. His last chapter is a brief but clear-cut rejection of the popular assumption that there are many life-bearing planets throughout the galaxy. Evolution is predetermined, but it has only happened once.

To a historian of science such as myself, the books by Gould and Conway Morris seem themselves like a rerunning of the tape of history, but in this case there is a loop that was first played in the late-19th century and is now repeating itself almost exactly. For all the new discoveries and the modern apparatus of cladistic analysis, the alternative visions of the nature of history are as clear today as they were to the biologists who tried to defend their belief in a purposeful universe against the assault of Darwin's *Origin of Species*. Gould himself once wrote about the "eternal metaphors" of paleontology, and on that point, Conway Morris has merely confirmed his claim that the rival visions of nature are still in play.

Peter Bowler writes and teaches at Queen's University of Belfast, where he is professor of history and philosophy of science. He is the author of 11 books, including Life's Splendid Drama: Evolutionary Biology and the Reconstruction of Life's Ancestry, 1860-1940, *just released in paperback (University of Chicago).*

Reprinted with permission from American Scientist. *Sept-Oct 1998, 86(5).*

Hyens *from page 15*

one thing to mind. If we should ask how these various divinities were related to one another in the pantheons of the day, the most common answer would be that they were related as members of a family tree. We would be given a genealogy, as in Hesiod's *Theogony*, where the great tangle of Greek gods and goddesses were sorted out by generations. Ouranos begat Kronos; Kronos begat Zeus; Zeus begat Prometheus.

The Egyptians, Assyrians, and Babylonians all had their "generations of the gods." Thus the priestly account, which had begun with the majestic words, "In the beginning God created the heavens and the earth," now concludes — over against all the impressive and colorful pantheons with their divine pedigrees —"*These* are the generations of the heavens and the Earth when they were *created*." It was a final pun on the concept of the divine family tree.

The fundamental question at stake, then, could not have been the scientific question of how things achieved their present form and by what processes, nor even the historical question about time periods and chronological order. The issue was idolatry, not science; syncretism, not natural history; theology, not chronology; affirmations of faith in one transcendent God, not creationist or evolutionist theories of origin. Attempting to be loyal to the Bible by turning the creation accounts into a kind of science or history is like trying to be loyal to the teachings of Jesus by arguing that the parables are actual historical events, and only reliable and trustworthy when taken literally as such.

If one really wishes to appreciate more fully the *religious* meaning of creation in Genesis 1, one should read not the creationist or anticreationist diatribes but Isaiah 40. For the theology of Genesis 1 is essentially the same as the theology of Deutero-Isaiah. They are also both from the same time period, and therefore part of the same interpretative context. It was a time that had been marked, first, by the conquest of most of Palestine — save Jerusalem — by the Assyrians under Sennacherib (ca. 701 BC). And a century later the Babylonians under Nebuchadnezzar had in turn conquered the Middle East, Palestine, and even Jerusalem.

The last vestige of Jewish autonomy and Promised Land had been overrun...

Given the awesome might and splendor and triumphs of Assyria and then Babylon, was it not obvious that the shepherd-god of Israel was just a local spirit, a petty tribal god who was hardly a match for the likes of Marduk, god of Babylon? Where *was* this god...? Yet despite the littleness and powerlessness of a conquered people...a prophet dared to stand forth and declare what Genesis 1 in its own way also declares:

> ...It is he who sits above the circle of the earth,
> and its inhabitants are like grasshoppers;
> who stretches out the heavens like a curtain,
> ...and makes the rulers of the earth as nothing.(Isaiah 40:21-23)

Had there been a controversy in the Babylonian public schools of the day — and had there been Babylonian public schools — these would have been the issues in debate.

Excerpted and reprinted with permission of the author from "Biblical literalism:constricting the cosmic dance", in Roland Mushat Frye (ed) Is God a creationist? The religious case against creation-science. *NY: Charles Scribner's Sons, 1983: 100-104. Prof. Hyers explores this matter in detail in his book,* The Meaning of Creation: Genesis and Modern Science, *John Knox Press, 1984.*

ACKNOWLEDGMENT

NCSE thanks James Moore for bringing this essay to the editor's attention.

Schadewald *from page 25*

geomagnetico-thermoapologetic ICR parrots — were mostly silent, though not entirely absent. Consequently, the level of hostility toward Frank and me was minimal, and our interactions with the creationists invariably were cordial or better. Frank and I always ate together in the cafeteria, and we had company more often than not. Some of our mealtime companions were friends from previous creation conferences, and others were new acquaintances. Questions were many, and we tried to give straight answers to all. In return, we got straight answers to questions of our own. We both felt that these exchanges were the best part of the conference.

On one point we found complete agreement: precious little of the ICC-style creationism has filtered down to the grassroots level. Duane Gish, Gary Parker, Kent Hovind, Walter Brown, Donald Chittick, and others still spout the same old stuff in seminars and debates, and it is endlessly regurgitated at Sunday schools, Bible clubs, and on the Internet. The new-generation creationists are painfully aware that most of the popular creationist literature is dreck. Although they cannot (and should not) prevent anyone from publishing anything, a move is afoot to establish some sort of clearinghouse that will award a seal of Clean Creation Science (or whatever) to books that meet the new standards. Moreover, they intend to commission someone to write an up-to-date replacement for Henry Morris's *The Genesis Flood*, which they hope then will go mercifully out of print, along with the equally valuable works it spawned. Even with a serious effort by dedicated people, it will take decades to purge the nonsense, and it may not be purgable at all.

INTERNET LOCATIONS VISITED IN THIS ISSUE

Topic: "Toy universe" program
Owner: Victor Stenger
Location: http://www.phys.hawaii.edu/vjs/www/monkey.html
Last visit: November, 1998

Topic: Expanded version of "anthropic coincidences" article
Owner: Victor Stenger
Location: http://www.phys.hawaii.edu/vjs/www/cosmo.html
Last visit: November 1998

Topic: "Faith and Reason" PBS program by Margaret Wertheimer
Owner: Public Broadcasting Service
Location: http://www.pbs.org/faithandreason
Last visit: November 1998

Topic: Complete contents of *Creation/Evolution* issues 1-39
Owner: NCSE
Location: www.natcenscied.org/cecont.htm
Last visit: November 1998

Topic: ICR *Impact* No. 300: "The Young Faint Sun Paradox and the Age of the Solar System"
Owner: Institute for Creation Research
Location: http://www.icr.org/pubs/imp/imp-300.htm
Last visit: November, 1998

Topic: "The Laws List" (physical laws)
Owner: EM Francis
Location: http://www.alcyone.com/max/physics/laws/index.html
Last visit: November 1998

Topic: "Worldwide Adherents of All Religions by Six Continental Areas"
Owner: Britannica Online
Location: http://www.eb.com:180/cgi-bin/g?DocF=table/ob6reli001t1.html
Last visit: June 1998

Topic: "Origin Myths"
Owner: NCSE
Location: http://www.natcenscied.org/origin.htm
Last visit: November 1998

Topic: NCSE online book catalog
Owner: NCSE
Location: http://www.natcenscied.org/dbooks.htm
Last visit: November 1998

Topic: SAT examinations
Owner: College Board Online
Location: http://www.collegeboard.org (use search engine to locate specific tests)
Last visit: November 1998

Topic: National Science Education Standards
Owner: National Academy of Science
Location: http://www.nap.edu/readingroom/books/intronses
Last visit: November 1998

Topic: Evrim Aldatamacasy (The Evolution Deceit — English version)
Owner: Harun Yahya
Location: http://www.webcom.com/vural/Eng/evol/evol.html
Last visit: November 1998

Topic: "Japan for Genesis!"
Owner: Answers in Genesis
Location: http://www.answersingenesis.org/WebMan/Article.asp?ID=1337&Count=true
Last visit: November 1998

Topic: Congressional Record: Rep.Traficant's remarks on scientists' beliefs
Owner: Thomas Legislative Information on the Internet
Location: http://rs9.loc.gov/cgi-bin/query/D?r105:2:./temp/~r105btmHof::
Last visit: November 1998

INSTRUCTIONS FOR CONTRIBUTORS

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

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

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

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

STYLE AND FORMAT

1. Manuscripts must be typed double-spaced, including inset quotations and references. Margins must be adequate for editorial notation.

2. Manuscripts should not exceed 20 double-spaced typewritten pages and must be accompanied by a brief biographical statement identifying the author and giving an address where interested readers may contact the author(s).

3. A printed original and two copies should be supplied by the author. Names of the author(s) should appear only on the cover page, if blind review is desired. All submissions will be sent to referees for evaluation. Manuscripts submitted on computer diskette will greatly expedite the editing and publication process. Acceptable diskette formats include (standard or high density 3.5-inch) WordPerfect 5.1, MS-Word, or ASCII formats in DOS/Windows versions and MS-Word 6.0, Claris Works 5.0, or plain text for the Macintosh. Manuscripts and other notes submitted by electronic mail should be in plain text format. Please contact the editorial office for information about other word processing and diskette formats that might be acceptable.

4. Citations within text referring to reference section should be limited to author, date and (when appropriate) page, for example (Smith 1982, p 21). Multiple references within text appear in chronological order, for example (Thomas, Peters, and others 1925; Smith 1943, 1947; Smith and Jones 1983a, 1983b, 1984). Citations of electronic resources should include author(s) and date accessed. When appropriate to include internet locations, these should be enclosed in angle brackets, for example <http://www. natcenscied.org>.

5. Reference sections are alphabetical and should conform to the citation-sequence format in *Scientific Style and Format: The CBE Manual for Authors, Editors, and Publishers*, illustrated in the following example for books and periodicals.

Chan L. Exciting potential of scholarly electronic journals. *Canadian Association of University Teachers Bulletin* 1996; 43(7):9. <http://www. caut. ca/bull/ejournal.html> Accessed April 17, 1997.

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

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

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

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

6. Material formatted as footnotes or endnotes should be incorporated into the text or deleted.

7. Text abbreviations based on non-English terms should be translated into the appropriate English equivalent. For example, *e.g.* should be rendered as *for example*.

8. All measurements reported in scholarly and scientific articles are to be expressed in SI or "metric" units.

9. Figures, plates, or diagrams should be submitted in camera-ready form or provided in that form upon acceptance. Submission of these materials and of quotations by writers presumes that authors have obtained permission to use these potentially copyrighted materials. Photographs should be glossy prints and should be accompanied by "permissions" when appropriate.

10. Authors should retain copies of all manuscripts, photographs, and figures submitted; NCSE assumes no responsibility for materials submitted.

11. All submissions are subject to editorial correction of grammar, spelling, punctuation, and consistency as per *Scientific Style and Format: The CBE Manual for Authors, Editors, and Publishers*.

12. Manuscripts cannot be returned unless accompanied by stamped, return-addressed envelopes.

NATIONAL CENTER FOR SCIENCE EDUCATION
PO Box 9477
Berkeley CA 94709-0477

Address Service Requested

Non-Profit Org.
U.S. Postage
PAID
Permit 1197
Berkeley, CA

18(3)

NCSE is a nonprofit, tax exempt corporation affiliated with the American Association for the Advancement of Science

Membership in the National Center for Science Education brings you

- One year's subscription to *Reports of the National Center for Science Education* (6 issues)
- 15-20% discount on selected books
- Participation in NCSE's diverse efforts to promote and defend the integrity of science education

MEMBERSHIP / SUBSCRIPTION / DONATION

Name

Address City State Zip

Home Phone Work Phone

Occupation

☐ Check here if you object to our sharing your name with other nonprofit organizations

NCSE MEMBERSHIP **ONE YEAR** US:$30 Foreign: $37 Foreign Air: $39 **LIFETIME** $600	$
TAX DEDUCTIBLE CONTRIBUTION TO NCSE	$
BACK ISSUES *NCSE REPORTS / C/E Newsletter* (Vol 1-16, $3 per issue; $18 per volume; all 16 vols., $225) *C/E Journal* (1-9 copies, $6 each; 10 or more, $5 each; full set, nos. 1-39, $150)	$
SHIPPING $1 for 1 issue; add $.75 for each additional issue; maximum of $10 — even for all 39 back issues.	$
TOTAL ☐ Check (US dollars) Charge to: ☐ VISA ☐ Master Card	$

Credit Card Number Exp. Date

Name as it appears on card

Signature

SUBSCRIBER INFORMATION

Subscriptions are fully tax deductible. NCSE is tax exempt under Federal IRS Code 501(c)(3) and the corresponding provisions of the California law. Amounts paid to NCSE are tax-deductible to the extent permitted by law.

MISSING ISSUES

If your issue fails to arrive or is badly damaged in transit, send us the date of issue and we will rush you a replacement.

MOVING TO A NEW ADDRESS?

Let us know your new address as early as possible and we will update our records of your subscription accordingly. Please allow 4 weeks for an address change.

Please mail all correspondence about your subscription to:

NCSE
PO BOX 9477
BERKELEY CA 94709-0477
(510) 526-1674
(800) 290-6006

Printed on recycled paper.