

REPORTS

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NATIONAL CENTER FOR SCIENCE EDUCATION
DEFENDING THE TEACHING OF EVOLUTION IN THE PUBLIC SCHOOLS



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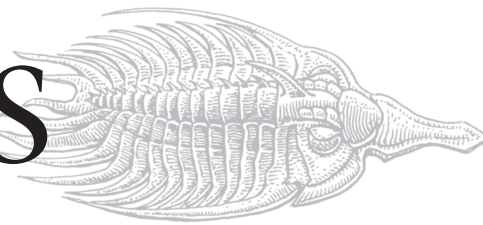
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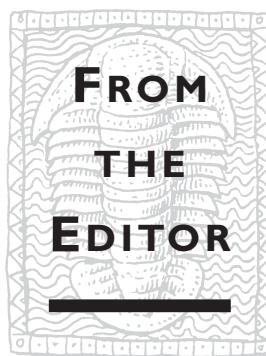
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Cover: Teachers and students learning about human evolution. Photos by AJ Petto.

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For more information on Ray's work explore his website at <www.trollart.com>.



There is perhaps no place where the struggle between evolution and creationism is more evident or more pitched than in the public schools. Even when the stories in this publication focus on legislative or judicial actions and opinions, the target is usually the teaching of evolution in the public school curriculum. That is why we focus this issue on matters pertaining to the public school classroom. Although most state science education standards specify that evolution must be in the curriculum, it is not always the case that students will receive a complete and accurate description of the role of evolutionary theory in support of research and knowledge in the life sciences.

Sometimes it takes an outsider's view to draw our attention to the deficiencies in evolution education throughout the US. A group of South African science educators recently completed a series of professional development workshops in Madison, Wisconsin, including a four-day evolution module guided in part by three NCSE members (see "News from the Membership", p 17). As these teachers begin to implement a new national science curriculum, their questions about resistance to evolution education in the US bring an interesting perspective. They want to know how to do a better job of preparing teachers to present evolution accurately, and in asking us how to do this, they have shone a bright light on our own teacher-education and professional development programs.

Even when teachers are well-prepared to teach evolution, however, there are other challenges in the public-school environment that may impede their success. As we see in this issue, Dina Drits shows that not all students acquire knowledge about evolutionary concepts in the same way — or at the same time! Drits's work is a real-world test of Jerome Bruner's concept of the "spiral curriculum," which argued that *any* scientific concept could be learned successfully at *any* age if presented properly (*The Process of Education*, Cambridge [MA]: Harvard University Press, 1960). Vince Sperrazza also chimes in with some observations and recommendations for middle-level evolution education.

There is more to public education than what teachers do in the classroom, however; and Marni Landry, William Gonzalez, and Jason Wiles tell us about the many interests and influences that teachers and students need to accommodate in trying to teach evolution. Both Landry and Wiles encountered examples of administrative reluctance even to have evolution discussed openly. Gonzalez reports that sometimes the resistance to evolution comes from other teachers and the unwillingness of

administrators to support evolution education actively. (For an overview of the effects of ignoring state science education standards on evolution, readers should return to Randy Moore's "Teaching evolution: Do state science standards matter?" in *RNCSE* 2001 Jan-Apr; 21 [1-2]: 19-21.)

IN THE NEWS

In Dover, Pennsylvania, the first trial involving a legal challenge to "intelligent design" in the science classroom is underway. In the climate of controversy in southeastern Pennsylvania, William Wisdom made a visit to his local school board to encourage its members to continue to provide quality science education.

Tony Ortega reports that the Kansas "kangaroo court" paid to fly in a special "expert" witness — one associated with the Turkish anti-evolutionist and Islamist organization BAV (see "Cloning creationism in Turkey" by Taner Edis, *RNCSE* 1999 Nov/Dec; 19 [6]: 30-5, and "Islamic scientific creationism: A new challenge in Turkey" by Ümit Sayin and Aykut Kence, *RNCSE* 1999 Nov/Dec; 19 [6]: 18-20, 25-9).

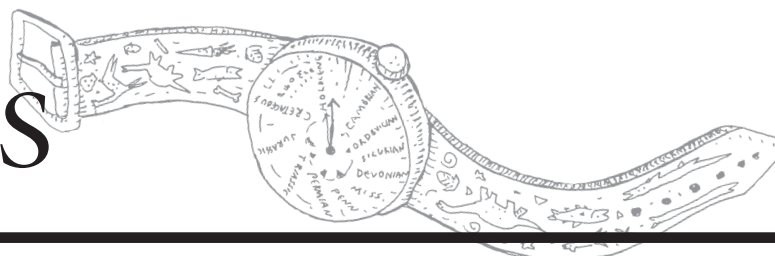
In South Carolina, one state senator keeps trying to establish a legislative committee that would essentially have control over the definition of science for the public schools in the state. Read Robert Dillon's account of how activists worked to head off this attack. And don't forget to read our updates of happenings around the country. Please tell us what is going on where you live.

IN PRINT

Our book reviews section is full of powerful assessments of a variety of interesting publications. Two new books about the current state of the sciences are G Brent Dalrymple's *Ancient Earth*, *Ancient Skies* and Robert Martin's *Missing Links*. Our reviewers tell us that both are intelligent, readable, and up-to-date resources.

We also have two reviews of books about Alfred Russel Wallace. Jane Camerini reviews *A Heretic in Darwin's Court* and Charles Smith reviews *The Elusive Victorian*. Both add some significant depth to a series of recent books on the "co-discoverer" of natural selection.

There is no shortage of "intelligent design" publications, and we review *How Blind is the Watchmaker?* and *The Privileged Planet*. Both books exhibit serious shortcomings, of course. Finally, *Does God Belong in Public Schools?* addresses a number of the larger "culture wars" issues that often surround creationism/evolution flare-ups.



The Senator and the Science Committee

Robert T Dillon Jr
College of Charleston

The origin of the 2005 threat to science education in South Carolina can be traced back five years to the initial adoption of science curriculum standards by our state board of education. Those standards, subsequently awarded a grade of "A" by the Fordham Foundation, included a rigorous treatment of evolutionary science. (See *RNCSE* 2000 Jan-Apr; 20 [1-2]: 14-5 for a review of the controversy surrounding the adoption of a standard science curriculum for South Carolina in 2000.)

One might expect that legislation requiring textbooks and other educational materials to match academic standards would be a logical follow-up to the adoption of statewide curricula. Such legislation was indeed introduced in the South Carolina General Assemblies of 2001-2002 and 2003-2004 without success. Science educators were caught by surprise in April 2003 when Senator Mike Fair (R-Greenville) amended the textbook bill to establish a "South Carolina Science Standards Committee" to examine "alternatives to evolution"; fortunately, that bill died in the House at the end of the 2004 session. So when Fair and two co-sponsors pre-filed S114 for consideration by the 2005-2006 General Assembly "relating to the criteria for the adoption of instructional materials for the public schools," friends of science educa-

tion in South Carolina were alert and ready for action.

The legislative approach taken by Fair is unique, insofar as we are aware. His bill included 4 sections: (1) requiring that textbooks match the state standards, (2) establishing a science committee to examine those standards, (3) providing no funds for the science committee, and (4) repealing the old law. The (rather detailed) section (2) specified a committee membership of 19 to be appointed almost entirely by politicians and charged the committee with determining "whether there is a consensus on the definition of science" and "whether alternatives to evolution as the origin of species should be offered in schools."

Fair's district includes the fortress-like Bob Jones University, a fundamentalist institution that "exists to grow Christ-like character that is scripturally disciplined." And clearly the intent of his legislation was to introduce creationism into the South Carolina public school curriculum. But because S114 did not specifically authorize the science committee to take any action, nor provide any public funding for its deliberations, it is difficult to see how the constitutionality of his legislation could be challenged.

In January 2005, S114 was referred to the Senate Education K-12 Subcommittee, where Fair holds considerable influence. The K-12 Subcommittee is chaired by Robert Hayes (R-Rock Hill), a member of the Presbyterian Church in America — a small fundamentalist organization that has

broken from the mainline Presbyterian Church (USA) over the ordination of women.

CITIZEN ACTION

With the assistance of the NCSE, a statewide group of concerned citizens organized in early 2005 to oppose S114. The group was primarily composed of faculty from the College of Charleston, the University of South Carolina, and Clemson University, with members from public-school education and the community at large, including clergy. We enjoyed excellent communication through an open list-server organized in 2000 by the AIBS, as well as through a more restricted NCSE system.

Early response is a key to successfully countering a creationist threat. So when the Senate K-12 subcommittee first took up S114 on February 9, both Doug Florian (College of Charleston) and I were present to offer comments, supported by a number of allies in the gallery. I argued that the current state science standards are excellent, and that S114 as currently drafted would seem designed to fix a process that "ain't broke." I observed that the term "science" is well-defined, that no committee need be impaneled to examine the meaning of that term, and that there are no "alternatives to evolution" that qualify as science under any conventional definition. Doug followed my comments with a brief review of the legal precedents regarding creationism, should some hypothetical science committee reach ill-conceived recommendations leading in that



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ERRATA In the bibliography to "Polling the creationism/evolution controversy" (*RNCSE* 2004 Sep/Oct: 24 [5]: 18), the date of Witham 1997 was omitted. The reference should have read: Witham L. 1997 Apr 11. Many scientists see God's hand in evolution. *Washington Times* Sect A: 8.

In the introduction to John C Greene's "Impressions of the Claremont Conference & Ernst Mayr" (*RNCSE* 2004 Sep/Oct: 24 [5]: 34-7), the conference dates were given as October 21-24, 2005. The conference was held in 2004.

direction. Also offering comment was a representative from the state Council of Teachers of Mathematics, who simply asked for a clean bill requiring textbooks to match standards, obviously opposing both science committees and creationism without specifically mentioning either.

A debt of gratitude is owed to Senator JW Matthews (D-Bowman), who arrived at the subcommittee meeting prepared with an amendment to strike section (2) from S114. Matthews opined that the evolution/creationism issues raised in section (2) seemed too important and controversial to be confounded with the simple textbook issues addressed in section (1). His motion to strike section (2) was approved by a vote of 5-3, with Hayes joining Fair in the minority.

WHAT GOES 'ROUND ...

But we had not heard the last of Senator Fair or his Science Committee. On February 23, S114 was remanded by the full committee back to the K-12 Subcommittee without objection. Working through contacts, we were able to preview draft language for a new amendment to be proposed by Fair. In his new conception, the Science Committee would "determine whether scientific alternatives to socially or scientifically controversial theories should be offered in schools." This language seemed to us even more slippery than the language deleted on February 9 — avoiding mention of evolution, creation, the origin of species, or indeed any specific "socially controversial theory" at all.

After a series of delays, S114 was taken up by the Senate K-12 Subcommittee on April 13. Present to offer comment on this occasion were Jerry Hilbish (USC Biology), John Saffko (USC Physics), and I. Fair surprised us all with a new amendment to S114, specifying that his science committee would perform six tasks — some of them overtly creationist, many of them described in terms failing the simple test of subject-verb agreement. His task #5 was, for example, "Is there scientific design theory/ies available for discourse

in the public school classrooms of South Carolina?"

I was first to offer comment. I spoke in favor of the simple, clean version of S114 as currently amended, pointing out the logic of textbooks' matching curriculum standards. As I was thanking Senator Matthews and his colleagues for their wisdom in deleting the provision for a science committee in February, I was interrupted by much ado among the senators. Fair stated that he did not realize that his science committee provision had been removed!

I will live and die and never understand how the senator could have been so confused. The language of the amendment he distributed on the morning of April 13 neglected to reinstate his science committee before charging it with the six creationist tasks. So after this (rather important) point was clarified, I finished by observing that a state science committee, as originally proposed by Fair, and obviously still advocated by him, would introduce needless controversy — legal problems, constitutional problems, religious problems — which would complicate the passage of an otherwise simple bill.

Jerry Hilbish came next to the speaker's table, and he offered an excellent overview of the many problems with inserting creationism or "intelligent design" into the public-school curriculum generally. Jerry also spoke highly of the current science curriculum in South Carolina. John Saffko followed with some well-aimed attacks at the specifics of Fair's proposed amendment, focusing on the scientific method.

All three of us were engaged at great length by Fair. He denied that any of his legislation had any religious content or motivation. He listed all the books on his shelves supporting his position, authored by such respected scientists as Gish, Behe, Denton, and Dembski. He called for a tornado to assemble the South Carolina statehouse spontaneously. He evoked pathetic images of his scarred youth, tricked by diagrams of humped-over human ancestors — all faked! We must ensure that both sides of this story are fairly presented, he argued.

Fair concluded by moving that S114 be amended to include the

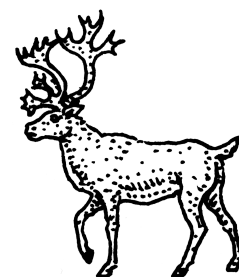
same science standards committee as described in the original version of his legislation, but changed so that its charge included the six tasks specified that morning. Chairman Hayes seconded Fair's proposal. The amendment failed on a vote of 5-3. Then Hayes put the main motion — to report S114 to the Senate favorably without amendment — and that passed unanimously.

This was the best result we could have hoped for, and we were all quite pleased. Afterward I met a lobbyist outside the meeting room who remarked how refreshing it was to hear anything intelligent said at a Senate committee meeting. He commented at length on the influence that can be wielded by three PhD scientists in a meeting such as we had just attended. John, Jerry, and I sat front row center all morning and controlled the show, simply by speaking calmly and looking reasonable.

S114 successfully passed the Senate in clean form on April 26 and went to the House on May 5, where the political climate has been much more favorable in previous sessions. Senator Fair's efforts did, however, slightly affect the review process for our Year 2000 state science curriculum, which (by accident of timing) is on a 5-year cycle. The work of the Science Standards Review Panel, a committee of 28 professional science educators assembled by the State Department of Education, was delayed by the threat of a politically-appointed science committee as envisioned by Fair.

Among the many lessons to be taken from the events of the previous months are the values of information, organization, communication, and early action. We also suggest that it is especially important, even in the face of success, never to declare victory. A new battle may be looming in South Carolina later this year, when our freshly revised science curriculum standards are submitted to the state board of education for approval. We'll keep you posted.

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Your Official Program to the Scopes II Kansas Monkey Trial

A week-long debate over evolution is Kansas's trial of the century!

Tony Ortega

What a triumphant journey awaits Mustafa Akyol. Kansas taxpayers are footing the bill to bring the Istanbul resident to Topeka as one of 23 witnesses scheduled to testify this week [May 5–7, 2005] before a subcommittee of the Kansas State School Board in its unorthodox “trial” over science teaching standards. (Fortunately, Akyol happens to be in Washington, DC, on other business, so Kansans are paying only to bring him across the country, not all the way from Turkey.)

Born in 1972, Akyol has a master's degree in history and writes a column for a newspaper in Istanbul. He also has identified himself as a spokesman for the murky Bilim Arastirma Vakfi, a group with an innocuous-sounding name — it means “Science Research Foundation” — but a nasty reputation.

Said to have started as a religious cult that preyed on wealthy members of Turkish society, the Bilim Arastirma Vakfi has appeared in lurid media tales about sex rings, a blackmail prosecution and speculation about its charismatic leader, a man named Adnan Oktar. But if BAV's notoriety has been burnished by a sensationalist Turkish media, the secretive group has earned its reputation as a prodigious publisher of inexpensive ideological paperbacks. BAV has put out hundreds of titles written by “Harun Yahya” (a pseudonym) on various topics, but most of them are Islamic-based attacks on the theory of evolution.

Turkey is a secular country that aspires to join the European Union and boasts several institutions of higher learning on a par with good

Western universities. But beginning in 1998, BAV spearheaded an effort to attack Turkish academics who taught Darwinian theory. Professors there say they were harassed and threatened, and some of them were slandered in flyers that labeled them “Maoists” for teaching evolution. In 1999, six of the professors won a civil court case against BAV for defamation and were awarded \$4000 each.

But seven years after BAV's offensive began, says Istanbul University forensics professor Ümit Sayin (one of the slandered faculty members), the battle is over.

“There is no fight against the creationists now. They have won the war,” Sayin tells the *Pitch* from his home in Istanbul. “In 1998, I was able to motivate six members of the Turkish Academy of Sciences to speak out against the creationist movement. Today, it's impossible to motivate anyone. They're afraid they'll be attacked by the radical Islamists and the BAV.”

Sayin is well aware of Mustafa Akyol, whom he identifies as one of BAV's many volunteers. (Akyol himself has described his role for the group as that of a spokesman.) The organization's source of funding and internal structure are well-guarded secrets, Sayin says. The Turkish government, he adds, refuses to take an interest, tacitly encouraging the ongoing effort against scientists.

“It's hopeless here,” Sayin says. “I've been fighting with these guys for six years, and it's come to nothing.” As a result of the BAV campaign and other efforts to denounce evolution, he adds, most members of Turkey's parliament today not only discount evolution but consider it a hoax. “Now creationism is in [high school] biology books,” Sayin says. “Evolution is presented [by BAV] as a conspiracy of the Jewish and American impe-

rialists to promote new world order and fascist motives ... and the majority of the people believe it.”

The secret to BAV's success is the huge popularity of the Harun Yahya books, says a professor closer to home, Truman State University physicist Taner Edis, who was born in Turkey. “They're fairly lavishly produced, on good-quality paper with full-color illustrations all over the place,” he says. “They're trying to compete with any sort of science publication you can find in the Western world. And in a place like Turkey, Yahya books look considerably better-published than most scientific publications.”

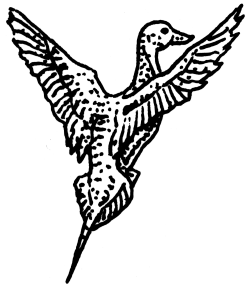
The books are slick, but BAV has had plenty of help. Sayin says that creationism in Turkey got key support in the 1980s and 1990s from American creationist organizations, and Edis points out that BAV's Yahya books resemble the same sorts of works put out by California's Institute for Creation Research — except in Yahya's books, it's Allah doing the creating.

In 2001, *Science* magazine called BAV “one of the world's strongest anti-evolution movements outside of North America,” and Edis tells the *Pitch* that Yahya books are gaining popularity in other parts of the world, including London (which is increasingly becoming a global center for Islamic publishing) and Indonesia.

While its Turkish counterpart thrived, however, American creationism suffered repeated defeats in the 1980s and 1990s, and even some of its most ardent supporters have put their hopes in a newer movement, one that calls itself “intelligent design.”

Sensitive to the charge that they're just the same religiously motivated effort with slicker packaging, the scientists and lawyers who lead the “intelligent design” movement deny that their cause has anything to do with Christianity or with previous attempts to describe biblical accounts in scientific-sounding terms.

Rather than quote Genesis, “intelligent design” proponents cite complex mathematical formulas and biochemical analyses to claim that nature shows the characteristics of a purposeful design that cannot be explained by



Darwinian theory. If such design implies a designer, they say, they make no assumption about who or what that designer is.

To opponents, it's a coy act. Most of ID's leading lights are devout Christians. Earlier this year, the *Pitch* put it directly to one of the movement's local point men, University of Missouri-Kansas City professor of medicine William Harris: Did he believe the "designer" was the Christian God?

Harris admitted that, for him, that was true. But "intelligent design" itself had no opinion on the matter, he said. "I know Muslims who equate that designer with Allah," he told us. Which is why Kansans are paying to bring Mustafa Akyol to Topeka. Harris included Akyol on a list of witnesses whom he wanted brought in to testify on behalf of "intelligent design" in this week's hearings.

Harris says he hasn't heard of BAV. Told of the group's harassment of biologists in Turkey and evolution's defeat there, he replies, "Great! Congratulations! I mean, that is the point, once people start to see science more objectively."

Edis says there's little question why Akyol is on the list of witnesses. "It's perfectly bizarre, in that Akyol really has nothing to contribute in terms of substance to the whole thing," Edis says. "I think it's fairly blatantly obvious the only reason he's coming in is to present the case that this isn't just a Christian thing."

"It's stupid," Sayin adds. "Akyol's not a scientist at all. He's just an activist."

But imagine the pride that Akyol must feel. (We wanted to ask him about it directly, but Akyol didn't answer our e-mail.) After getting a leg up from American creationists, BAV sparked a revolution in its own country and is now so successful that it's been asked to send an emissary to return the favor.

So let's review.

In order to make up its mind over what sort of biological concepts should be taught to Kansas schoolchildren, the state's school board is using taxpayer money to fly in a nonscientist associated with a group that terrorized Turkish professors who dared question that the proliferation of life on earth was a miracle of Allah.

SIX YEARS AGO ...

Was it just six years ago that the state's school board put us through the same thing, minus the Turkish connection?

Back then, board member Steve Abrams of Arkansas City boldly disregarded the science teaching recommendations that a standards committee had made and instead moved to adopt creationist language he'd cribbed from a creationist group in Missouri. Before the world's laughter had even had time to settle down, it seemed, incensed voters tossed out several conservative board members in the next election and the evolution-centered teaching standards were restored.

But when conservatives regained control of the school board last fall, there seemed no question that, once again, Abrams and his allies would be determined to deal evolution a blow. Several things are different this time, though.

In the past six years, the "intelligent design" movement has made gradual gains advancing its agenda, which was spelled out rather nakedly in a document that surfaced in 1999. The "wedge strategy", penned by members of the Discovery Institute, an "intelligent design" think tank in Seattle, detailed a long-term plan that would introduce ID concepts through a concerted media campaign. Beginning with simple ideas that sounded logical — that structures in some species seemed too complex to have been created through random processes — ID would be like the "thin edge of a wedge" that would eventually overwhelm Darwinism and transform society.

Meanwhile, Abrams has learned his lesson from the debacle six years ago. Once again, science standards are on the table in the state, and a committee of 25 scientists and educators has delivered a set of teaching standards that sensibly recommend the teaching of evolution for the school's children. A minority group of eight members of the standards committee, led by UMKC "intelligent design" advocate William Harris, has forwarded a different set of standards critical of evolution.

Guessing which set of standards Abrams and the other five members of the school board's conservative majority will adopt is the easiest game in the state. There's simply no question that the board is eager to adopt Harris's evolution-bashing standards.

So what's the holdup? Abrams seems to be delaying the inevitable because he wants to avoid repeating the controversy of 1999, when he acted too boldly for the taste of Kansas voters. This time, he wants there to be at least the *appearance* that evolution is getting a fair hearing.

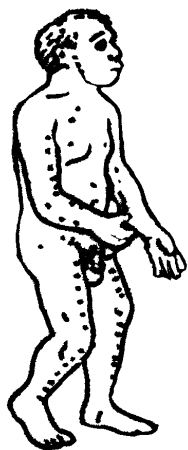
So Abrams has called for exactly that — a hearing. Over three days this week, some of "intelligent design"'s biggest names will be in Topeka speaking to a subcommittee of the board — Abrams and two of his most conservative colleagues, Connie Morris of St Francis and Kathy Martin of Clay Center. Then, next week, Abrams will give evolution its turn. (Scientists are boycotting the event, though — more on that later.)

Naturally, when word of Abrams's plan was first announced, the hearings were immediately compared to the famous 1925 Scopes "monkey" trial in Dayton, Tennessee. And the analogy fits.

John T. Scopes was a substitute science teacher who agreed to take part in an attempt to overturn a Tennessee anti-evolution law. There was little doubt about his guilt — he admitted to teaching evolution in defiance of the law and eventually was fined \$100. But everyone involved had no illusions about what Scopes's prosecution was really about — a chance for pro- and anti-evolution forces to debate the theory in a showdown between two of the country's most high-profile figures, lawyer Clarence Darrow and three-time presidential candidate William Jennings Bryan. As memorialized in the play and movie *Inherit the Wind*, the trial's high point was Bryan's day on the witness stand, when Darrow called him to testify as an expert on the Bible. Although the testimony was ultimately thrown out by Judge John Raulston, Bryan's defenses of some of the more mythical stories from the Bible was high theater.

But we don't expect those kinds of fireworks this week. In





fact, the Kansas hearings may be a crashing bore. "Intelligent design" advocates have dressed up their arguments in scientific-sounding speech, but their objections to evolution have been around since Charles Darwin first published his theory in 1859. "Intelligent design" proponents will claim that evolution is a failed theory that's being abandoned by scientists. (It isn't.) They'll say the news media suppress the huge controversy that is actually raging over evolution in scientific circles. (We aren't, because there isn't one.) They'll claim that evolution requires scientists to give up their religious beliefs and adopt an immoral, materialistic belief system. (It doesn't.) And if we're really lucky, they'll try to explain to nonscientist school-board members how the proteins in the flagella of tiny bacteria inspire their theories.

We figure that Martin's, Morris's, and even Abrams's eyes will begin to glaze over during the first hour of 24 hours of testimony scheduled this week. They will, however, provide the ID folks with exactly the stage and publicity they so crave.

If there were ever any question what a farce the "trial" is, Kathy Martin removed all doubt a couple of weeks ago, when she gave an interview to the *Clay Center Dispatch*.

"We are not going to give up until the standards say what we want them to say," Martin told the paper. "Evolution has been proven false. ID is science-based and strong in facts."

Just to show off her stellar science credentials, Martin explained, "Man has changed and evolved, but we are not going to change back into monkeys." Her other statements regarding evolution, which included making outdated distinctions between "microevolution" and "macroevolution," came right out of the creationist playbook.

But Martin went way off-message when the *Dispatch* reporter asked whether ID was just Christian creationism in disguise. Her answer could only have given ID proponents fits: "Of course this is a Christian agenda. We are a Christian nation. Our country is made up of Christian conservatives. We don't often speak up, but

we need to stand up and let our voices be heard."

Moreover, the former school-teacher argued, "Why shouldn't theology be taught in the classroom? Morality ought to be taught in every class. Prayer ought to be allowed. Whenever a child wanted to pray in class, I prayed with them. All children believe in God. Even little children whose parents don't take them to church believe in God."

Her comments have kicked up quite a little firestorm, Martin admitted when the *Pitch* called her last week. Claiming she was quoted out of context by the *Dispatch*, Martin says she's tempted to stop giving interviews altogether.

She says she didn't mean that "intelligent design" was a Christian agenda; the rise of religion in American politics was the Christian campaign she was referring to. "We were talking about the whole issue of people getting out of the pews and taking part in politics," she says. "Perhaps that's why I was elected."

But she did repeat her claim that evolution has been disproved. When the *Pitch* asked if she thought that most biologists would agree with that statement, she answered, "Yes, I think they do. They just don't want to admit that it's happening."

SCIENTISTS: COUNT US OUT

Scientists tend to be pretty intelligent folks, so the world's biologists have seen right through Abrams's ploy. Kansas Citizens for Science, an organization of scientists, public-school biology teachers, and others opposed to the Abrams maneuvers, called a boycott of the hearings and asked that scientists turn down invitations to participate.

Despite getting personalized invitations, then, scientists have told the Kansas board to go stuff itself.

"As I am sure you are aware, the state of Kansas has made itself the laughingstock of the scientific world over this issue," wrote Oxford University professor and well-known author Richard Dawkins to the state board after he got his invitation. "The very idea of 'representatives from both views'

presupposes that there are two views to represent.... For real scientists to share a platform with the biological equivalent of flat-earthers would be to give them the credibility, respectability, and above all publicity that they crave. I am sorry, but count me out."

No other scientists have taken the bait, either. But that doesn't mean the anti-evolutionists won't face opposition.

Pedro Irigonegaray, a civil rights lawyer with a high profile in Topeka, says his involvement in the new monkey trial began when he received a call from the Board of Education.

After scientists turned down requests to take part, the board wondered if Irigonegaray would step in to represent evolution's side in the debate.

"I love the study of science," Irigonegaray tells the *Pitch*. "And it seemed strange to me that it would even be an issue, but, having been asked, I couldn't imagine saying no."

Irigonegaray says his first step was to find out what the Kansas scientific community thought — was there really a controversy about evolution? He got an emphatic no from the scientists he contacted.

"My interest focused then on why are we going through this?" he says. "What's the purpose here, and who's paying for this?"

Irigonegaray says he was stunned to learn that the board had set aside \$40 000 to pay for the anticipated travel expenses of witnesses — \$20 000 for each side. "At a time when our children's education is at stake because we don't even have a budget, our board was going to spend \$40 000 to conduct a debate without a purpose," he says. "So I objected."

The board reacted by lowering the amount of travel funds to \$5000 for each side, but Irigonegaray says he won't spend any of the money allotted to his side. "I won't take a penny that I think is stealing from Kansas children."

Irigonegaray, in fact, will call no witnesses at all. "We're not calling scientists to debate evolution. That's not going to happen. To debate whether evolution is true is to debate whether the earth is round or flat. There's no argument.

It ["intelligent design"] is a minority view of a religious group asserting that all other Christians are wrong."

"Pedro will keep it to legal, not scientific issues," says Steve Case, an assistant research professor at the University of Kansas who served on the standards committee and helped write the majority-backed, pro-evolution guidelines. He says he's glad that Irigonegaray has taken on the role of opposing the anti-evolutionists and will question the legality of the procedure. "It's an 'intelligent design' forum on the state dime, and it probably violates the establishment clause of the Constitution. It's evangelism, and it's a clear preference for one Christian view over another Christian view," he says.

But if Irigonegaray hopes to inject some legal reality into the farcical procedures, he'll run into ID's own local legal attack dog, John Calvert.

Calvert and Harris are the principals behind the Kansas-based Intelligent Design Network, which works to convince school boards around the country that evolution is on the run. Calvert was involved in the adoption of anti-evolution changes that were written into Ohio's school standards three years ago. And he and Harris have kept up a full-court press on the Kansas board.

"I think you're going to hear about the scientific controversy," Calvert tells the *Pitch*, describing what he expects to happen in the hearings. "There is a scientific controversy about evolution. The problem is, if evolution was treated like any other science — objectively — there wouldn't be a problem."

Talking with Calvert and his partner Harris, you hear that word — *objectivity* — a lot. It's no wonder they use it frequently — who could be against scientists being objective? But ID adherents speak less frequently about what it is that they want scientists to be so open to: explanations for the proliferation of life that are outside the normal realm of science. That is, a supernatural designer that has put its stamp on the natural world.

Clever use of language is a hallmark of ID, which has had a slick, legalistic gloss from the start. Many credit Phillip Johnson, a lawyer and

former [UC] Berkeley law professor, with sparking the movement in 1991 with his book *Darwin on Trial*. Evolutionists have complained that Johnson used well-worn legal tricks by distorting the writings of scientists through selective quotations to create an impression that evolution itself was losing favor with the scientific community. Not true at all, biologists say — the distortions in Johnson's book have been exposed since its publication.

Johnson had played on the fact that evolution has, well, *evolved* since Darwin's *On the Origin of Species* was published nearly 150 years ago, and scientists do have disagreements over its details. It's the nature of science, after all, that any theory can be rocked by the newest discoveries — and can be completely overthrown if new evidence demands it. But despite the claims of ID proponents, evolution's central tenets are more strongly supported by the world's scientific community today than at any time in the past.

Those tenets are often confused and conflated by creationists and the mainstream press, but they remain the cornerstone of many different scientific fields. The first states that life-forms change over time. It was Darwin's insight that one of the processes producing that change — natural selection — relies on variations arising in organisms that are selected for their survival benefit through pressures applied by local environments over succeeding generations. Second, the fossil record and anatomical studies suggest that all species on earth share common ancestors and can ultimately be traced back to a single common ancestral organism.

Over billions of years, that process of variation and selection has produced an astonishing array of life. But such spans of time are alien to the human mind, which measures time in seconds, hours and (a relatively few) years. From the start, Darwin's theories were met with the understandable skepticism that random variations over time could really produce something as complex as a human eye, to take a classic example — and one that Darwin himself addressed.

Nine years ago, the new darling of evolution's skeptics became the flagellum, the hair-like thing that helps bacteria move. Michael Behe, a biochemist and devout Catholic at Lehigh University in Pennsylvania, argued in his book *Darwin's Black Box* that certain biological structures, such as the flagellum, were simply too complex — "irreducibly complex" in Behe's lingo — to arise from Darwinian forces.

Take away any of its components, Behe argued, and the flagellum would be useless. How could it have evolved gradually if it had no use until it was fully assembled?

Behe, although he agreed that Darwinian theory could account for most of the history of life and development of new species, claimed that evolution couldn't explain the flagellum and that, therefore, the flagellum was evidence that some intelligence had designed it.

But it didn't take long for biologists to find plausible explanations for how the flagellum could have evolved. In fact, they've identified two very different paths, either of which could have resulted in the complex structure. Just because Behe himself couldn't imagine how the flagellum arose naturally, scientists point out, is no reason to believe that supernatural intervention is responsible for the flagellum's complexity.

IT'S ALL ABOUT "NATURALISM"

In the standards that Harris and Calvert want the Kansas board to adopt, there's no mention of flagella or proteins, but there is a lot of discussion about *naturalism* and how it has led scientists astray. In fact, ID proponents, as part of their "wedge strategy", want to turn naturalism into a dirty word. Scientists, they say, are required by evolution to give up their religious beliefs by siding with a philosophy that denigrates anything having to do with religion or morals. Evolution's disregard for anything but naturalistic explanations has led to a corrupting materialism that has pervaded modern culture, they argue.

"The cultural consequences of this triumph of materialism were devastating," reads the Discovery

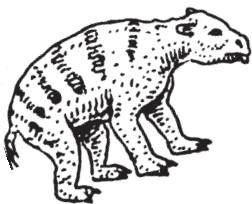


Address to the Haverford Township School Board on the Science Curriculum

William A Wisdom

At my request, the School Board of Haverford Township (a few miles west of Philadelphia) granted me the standard three minutes to address the board at its meeting on May 19, 2005. For years I had been distressed by the efforts of fundamentalist Christians to dilute or remove instruction in the theory of evolution from the public schools. But, like so many people, I figured: "It can't happen here." Then the events of Dover, Pennsylvania, made me realize that the barbarians are at our gates — that the attack on science could happen anywhere. So, with the aid and encouragement of Glenn Branch, deputy director of the National Center for Science Education, I decided to make a pre-emptive strike. My remarks follow.

William A Wisdom is Professor Emeritus of Philosophy at Temple University in Philadelphia.



Dr Van Winkle [Superintendent], Mr Gray [School Board President], and members of the board: I want to thank you for allowing me to address you this evening. I'm Dr William A Wisdom, and I live in the Coopertown corner of the township. In fact, I was raised in Haverford Township and went through my entire primary and secondary education in the public schools of the township. I graduated as valedictorian from Haverford High School in 1952. I was President of the National Honor Society, a member of the Scott's Hi-Q Team, and was elected "Most Likely to Succeed" by my classmates. Along the way I earned merit awards in physics, geometry, algebra, English, Latin, and history.

Thereafter I earned a BA in Classics at Wesleyan University in Connecticut, and an MA and PhD in Philosophy from New York University and Bryn Mawr College, respectively. I taught in the philosophy departments of Bryn Mawr College, Penn State's main campus, and — from 1964 until my retirement in 1997 — at Temple University, where I taught and wrote at both the undergraduate and graduate levels in formal logic (authoring a textbook in the field), the philosophy of science, science and pseudoscience, the philosophy of religion, and various periods and figures in the history of philosophy. I give you this summary of my education and experience to show you that I know what I'm talking about.

Institute's "wedge" document, ID's strategic program. "Materialists denied the existence of objective moral standards, claiming that environment dictates our behavior and beliefs. Such moral relativism was uncritically adopted by much of the social sciences, and it still undergirds much of modern economics, political science, psychology and sociology."

Because scientists look for natural explanations of nature, in other words, mankind is on a greased road to hell. The same attitude is found in Harris and Calvert's discussion of the anti-evolution standards that they want the Kansas board to adopt.

"Naturalism is the fundamental tenet of nontheistic religions and belief systems like secular humanism, atheism, agnosticism and scientism," they write.

But what Harris and Calvert are talking about is *philosophical naturalism*, not the more practical kind of naturalism at the heart of

science, which says only this: To understand nature, a scientist considers natural — not supernatural — causes.

KU biology doctoral student Josh Rosenau, who has closely watched the Kansas School Board's process, offers an example of what scientific naturalism means: "This winter, my downstairs neighbor's pipes froze. I wasn't aware of this. I just knew that my water wouldn't run," he tells the *Pitch*. "I could have concocted wild fantasies about supernatural forces seeking to punish me with dirty dishes and unbrushed teeth. But I didn't, and no one would. I assumed there was some natural process at work. I started by calling my landlord. He came, checked the pipes and thawed them. If that didn't work, I would have called the city and asked them to look into it. They would have checked that other pipes hadn't burst or frozen. They wouldn't have started offering

sacrifices to the gods of plumbing."

Science works the same way. And whether you're trying to understand why your pipes are clogged or how the giraffe developed its long neck, looking for natural causes in no way requires you to give up your religious beliefs. Evolution — and science in general — is neutral to personal beliefs.

That's the message of Brown University's Kenneth Miller, who, in *Finding Darwin's God*, counters the "intelligent design" movement's charge that to use science is to accept atheism. Miller is a Christian who says his understanding of evolution only deepens his faith. The two are not contradictory, he writes — and to insert religion into science does a favor to neither.

When the *Pitch* asked Calvert how he could explain the fact that a scientist like Miller had no problem accepting evolution while also being a Christian, the lawyer said that Miller just "wants to keep his job."

I have read House Bill 1007, with which I hope you are familiar. At this moment, I understand, it is in the Education Committee of the House — which committee is in recess until July, when it may take up the bill again. Its fate is largely in the hands of the chairperson of that committee. If this bill passes in the House, and subsequently in the Senate, a new section entitled “Teaching Theories on the Origin of Man and the Earth” would be added to the Public School Code of 1949. Wherever evolution is taught, the bill would encourage school boards to include instruction in the so-called “theory of intelligent design”. This alleged “theory” is not defined in the bill, but the history of the effort of antiscientific movements to remove or dilute the teaching of evolution is as old as the theory of evolution itself. It began in earnest with the public debates of Thomas Huxley

against Bishop Samuel Wilberforce in England, continued in this country in 1925 with the debates of Clarence Darrow against William Jennings Bryan in the Tennessee “monkey trial” of John Scopes, and is still going on today.

The debates are going on today, not because the evidence on each side is about equally balanced (no evidence does, or could, support “intelligent design”), but rather because science, on the side of evolution, is opposed by antagonists of various stripes for a number of different reasons. The issue is no longer about whether or not God exists: many scientists believe and many do not. The issue is rather about the nature of responsible reasoning about our world. It is important to understand that scientists do not use the word “theory” to mean a hunch or a guess or even a hypothesis. A scientific theory is a comprehensive sys-

tem of belief that explains a relatively large body of facts, from which facts and explanatory power the theory draws its support. This power of the theory of evolution to explain facts in biology, geology, paleontology, and other fields is the evidence required by scientists; and such evidence is wholly absent from the so-called “theory of intelligent design”.

I don’t know what, if any pressure, has already been put on you or your faculty to distort the science curriculum. But I urge you to resist any such pressure, and maintain the high academic standards of which we are justly proud. I have brought with me copies both of my remarks to you, and of supplementary material that may be of interest, which I would like to distribute to the members of the school board. Thank you.

As I finished my remarks, applause broke out from most of

A VAST EVOLUTIONARY CONSPIRACY

Which is the classic ID comeback — the scientific community, you see, is participating in a massive conspiracy to keep the big man upstairs down.

Over the next few days, “intelligent design” will get a boost like never before, thanks to the Kansas School Board. Harris’s list of witnesses includes some of the movement’s big guns: Behe, the champion of the flagellum; Charles Thaxton, a chemist who co-authored one of the first books in the genre, *The Mystery of Life’s Origin*; and Jonathan Wells, a fellow of the Discovery Institute who penned the anti-evolution book *Icons of Evolution*. Harris has also called in the movement’s martyrs: Roger DeHart, a high school teacher who refused to stop teaching “intelligent design” in his classes and was reassigned, and Nancy Bryson, a college professor who was removed from a leadership

position after she gave an “intelligent design” lecture at the Mississippi University for Women. (*The Chronicle of Higher Education* reported that the school later re-instated her, saying that she had been taken out of the position for other reasons, but the timing did look unfortunate.) Such witnesses will no doubt be a hit with the three-member board subcommittee, which will likely soak up arguments that a vast conspiracy of evolutionists threatens academic freedom and prevents an “objective” teaching of origins science.

But Case, the KU professor who helped write the pro-evolution standards, says he’s personally looking forward to some of the more colorful witnesses on Harris’s list.

“Most of these people will go off on religious rants,” Case says, which will make it obvious that ID’s claim to be religiously neutral is a calculated dodge. “Except for Behe and the Discovery Institute

people, the rest will go off on religious topics. We’re glad they’re coming.”

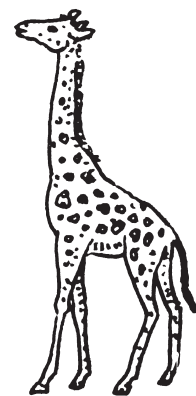
Ultimately, it doesn’t really matter whether the witnesses betray their real religious program. With folks like Kathy Martin in control, there’s little doubt which way the board will vote once the dust settles.

When Mustafa Akyol flies home to Turkey, where evolution is already thoroughly defeated, he can feel comforted in the knowledge that he’s done his little part to see to it that, back here in the United States, a thin wedge has been put in place that could, with the right push, send us on the same path.

AUTHOR’S ADDRESS

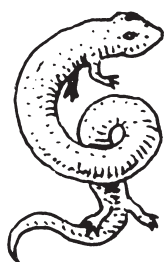
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UPDATES

Alabama: May 3, 2005, was the final day for proposed legislation to pass in either the House or the Senate and still have a chance of passing in the other chamber of the Alabama legislature. Among the dozens of bills that died thereafter were HB 352, SB 240 (see *RNCSE* 2004 Nov/Dec; 24 [6]: 15–20), and HB 716, which was introduced by Representative Scott Beason on April 5, 2005, late in the legislative session. Virtually identical, these bills purported to protect the right of teachers “to present scientific critiques of prevailing scientific theories” and the right of students to “hold positions regarding scientific views.” In language reminiscent of the Santorum language removed from the No Child Left Behind Act, they specified that “[t]he rights and privileges contained in this act apply when topics are taught that may generate controversy, such as biological or chemical origins.” Two similar bills died at the end of the 2004 legislative session. In a post on the Panda’s Thumb web log (<<http://www.pandasthumb.org/pt-archives/001006.html>>), Bob Collins of Alabama Citizens for Science wrote, “We were better organized this year, and it worked!! Thanks to everyone who called, wrote, faxed, talked to their legislators and/or testified. We made a difference!!!!” The next challenge ahead in Alabama, Collins adds, is the state textbook adoption process: “This summer and fall, the Alabama State Board of Education will pick science textbooks for our schoolchildren. They will also



decide whether to continue use of the embarrassing ‘Evolution Disclaimer’ pasted in the front of every elementary, middle- and high-school textbook that mentions anything that happened over 6000 years ago.”

Alaska: On June 10, 2005, the Alaska State Board of Education and Early Development strengthened the treatment of evolution in the state science standards, at what was literally the last minute. While the standards were under revision during the last two years, the question of whether to include the “e-word” — evolution — repeatedly arose, with officials at the state’s Department of Education and Early Development apparently resistant to including it, despite the objections of the educators who helped to draft the standards. Omission of the e-word is not uncommon: Lawrence S Lerner’s study of evolution in state science standards, *Good Science, Bad Science: Teaching Evolution in the States* (2000), identified ten states that omitted “evolution” from their science standards; currently four — Florida, Kentucky, Mississippi, and Oklahoma — still do so. In 2004, a proposal to omit the word from the Georgia science standards, then under revision, was withdrawn amid criticism and ridicule.

In Alaska, wrangling over the place of evolution in the state science standards occurred mainly behind the scenes until June 9, when the topic dominated a public comment period in Anchorage. The comments were generally in favor of improving the treatment of evo-

lution: Bruce Shellenbaum, a former vice president of the Anchorage Council of Parent-Teacher Associations, urged the board to “[p]ut evolution in bold type at the top of the page in natural sciences where it belongs ... Don’t water it down to please political masters or allies. It’s too important for that.” On the same day, a powerful editorial in the *Anchorage Daily News* argued, “Evolution is the state of the art, the unifying principle in the life sciences as well as a profound influence on other fields. ... There should be no pussyfooting or compromise.” The newspaper also published a report on the public comment period, extensively quoting the comments in favor of strengthening the treatment of evolution and explaining the relevance of the standards to standardized testing.

At the June 10 meeting, board meeting Shirley Holloway praised the people who offered comments at the June 9 meeting as “respectful, professional and very helpful,” and her fellow board member Esther Cox proposed the adoption of the Anchorage School District’s suggested revision of the standard on evolution, which would require students to understand “how science explains changes in life forms over time, including genetics, heredity, the process of natural selection and biological evolution.” Her proposal was adopted by a vote of 9–0, and the revised standards were then adopted by a vote of 9–0 as well. Describing the decision as a “good call,” the *Anchorage Daily News* remarked in a June 11 editorial, “The board deserves Alaskans’ thanks; this was a step forward for education.” Taking note of controversies in the lower 48 states, the editorial also

the 50 or 60 members of the audience. Then several of the members of the school board, including both the Superintendent of the School District and the President of the Board, spoke to the issue. They were unanimous in thanking and praising me for my remarks, while adding — and soundly explaining — their own determination never to allow creationism to be taught in any form in a science class.

One of them did say wisely that creationism or any other religious issue might well be explained in a course in comparative religion, but not in a science class. Another influential member of the board said that if the state law required them to teach creationism along with evolution, he would simply say “No!”

All in all, I think that the experience was a valuable one for all of

us involved, and I would recommend that more people undertake to address the school boards in their own districts.

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observed that “to teach the ‘evolution vs intelligent design’ controversy in science classes would give too much weight to ideas that haven’t earned their scientific keep.”

Arkansas, Eureka Springs: The opening of the Museum of Earth History — a young-earth creationist institution in northwest Arkansas that bills itself as “a world-class museum that presents the biblical account of early history” (<<http://www.moeh.org/>>) — attracted a degree of bemused media attention (in, for example, *Time* 2005 May 9 and *The Observer* 2005 May 22). But the state Department of Parks and Tourism took it upon itself to promote the museum in a special advertising supplement in a number of Arkansas newspapers, according to the *Arkansas Times* (2005 May 12). The department’s director Richard Davies defended the advertisement, which promoted a variety of tourist attractions in Kansas: “From the tourism perspective, we’ve about come to the conclusion that our job is to promote things that people might want to travel to — whether they’re public, private or non-profit — as long as they’re not obscene or tasteless ... Whether we agree with it or not, whether we think it’s tacky or beautiful is not important. It’s not our place to make those decisions.”

Florida: When the legislative session of the Florida legislature ended on May 6, 2005, House Bill 837 and Senate Bill 2126 — identical versions of the so-called Academic Bill of Rights promoted by conservative activist David Horowitz — died. The sponsor of HB 837, Dennis Baxley, was earlier quoted as suggesting that a student could sue under the proposed law if a professor were to say, “Evolution is a fact. I don’t want to hear about ‘Intelligent Design’ ... and if you don’t like it, there’s the door.” He was also reported to have claimed that as a Florida State University student “he was subjected to a ‘tirade’ on evolution[’s] being right and creationism[’s] being wrong” (see *RNCSE* 2004 Nov/Dec; 24 [6]: 15–20). According to a later story in the *Tallahassee Democrat* (2005 Apr 22), however, Baxley denied both

that HB 837 was intended to force the teaching of creationism and that the bill would have enabled students to sue. Even before the legislature adjourned, it was clear that the bill was unlikely to pass, but Baxley was reportedly pleased that it at least sparked a discussion about classroom bias.

Indiana, Bluffton: According to a report in *The News-Banner* of Bluffton, Indiana (2005 May 24), on May 23, 2005, the Bluffton-Harrison school board considered whether “to continue requiring the district’s science educators to discuss ‘appropriate theories’ — such as ‘intelligent design’ and evolution — and give a ‘fair and balanced’ presentation when teaching about the origin of the universe and life.” The requirement was apparently a precondition of the board’s approval of the district’s science textbooks, as a similar requirement was six years previously. The sole dissenter on the board, Andrew Carnall, urged the board to approve the textbooks without imposing such a requirement, noting that “we are dictating to our science department to teach something that is not included in the state standards”; high school chemistry teacher Susan Ballinger, who earned a master’s degree in biology, remarked that “‘intelligent design’ had never been discussed in any of the science classes she has taken.” But the board voted 4–1 to continue the requirement; teachers and principals will decide what “appropriate” theories and “fair and balanced” presentations are. NCSE is investigating.

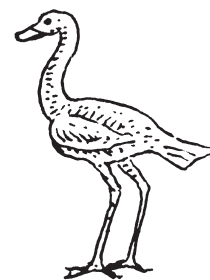
Indiana, East Porter County: On April 25, 2005, the board of the East Porter County School Corporation voted 6–1 to adopt science textbooks recommended by a district committee. Several board members had previously raised questions about the proposed biology texts because they contained material about evolution, but not about creationism or other “alternative” theories. Consequently, a decision on the textbooks was delayed to allow board members time to inspect the proposed texts (see *RNCSE* 2004 Nov/Dec; 24 [6]: 15–20). According to a report in the *Merrillville Post-Tribune* (2005 Apr 15):

Board member Tim Bucher said he wished the books were more balanced and mentioned there were other theories besides evolution. “I believe it’s a theory of evolution, not a fact of evolution.” Bucher, who described himself as a fundamentalist Christian who believes the Bible literally, said he hasn’t seen the recommended texts from Prentice Hall and Holt yet. “I’m trying to be a realist along with my Christian faith. At least let the kids know about it,” he said of creationism.

According to *The Times* of Munster, Indiana (2005 Apr 26), “Bucher said he would approve the text for lack of a better option. None of the other books include theories other than ... evolution. Bucher vowed to continue to do his own research to find a way to include other theories.”

Michigan: A poor choice of words quickly embroiled the new state Superintendent of Public Instruction, Michael Flanagan, in the creationism/evolution controversy. According to the *Lansing State Journal* (2005 Jun 16), while on a radio show, Flanagan was asked about the teaching of “intelligent design” in Michigan’s public schools, and answered, “We’ve got to at least teach the scientific theory, and I’m also comfortable with teachers exposing kids to a couple of different options.” The *State Journal* reports that in a subsequent interview, “he repeatedly and emphatically stated he is not in favor of teaching ‘intelligent design’ in Michigan science classes”: “What I meant was exposing kids in some other context ... such as a current events class. That’s what was in my mind.” A spokesperson for Governor Jennifer Granholm was also quoted as saying, “We believe in teaching scientific theory in science classes. ... We would see evolution as scientific theory.”

Minnesota: The author of a children’s book about evolution is *persona non grata* in a handful of Minnesota schools, the *Minneapolis Star-Tribune* (2005 May 16) reports. Lisa Westberg Peters, the author of *Our Family*



Tree: An Evolution Story (San Diego: Harcourt, 2003; reviewed by Lisa M Blank in *RNCSE* 2003 Sep-Dec; 23 [5-6]: 54), frequently speaks at elementary schools about her work as a children's author. But in at least three schools, authorities have asked her not to discuss *Our Family Tree* (see p 38). "This is a signal that school administrators may not be backing up good science teachers, that good science teachers may not be teaching evolution, teaching it correctly, or allowing religious beliefs to be substituted in the classroom for fear of controversy," NCSE's Susan Spath told the *Star-Tribune*, "This is a sign that should concern any parent who cares about good education." Writing of *Our Family Tree*, Ernst Mayr exclaimed, "How lucky our children are to have this beautiful and moving guide from which to learn!" The book is one of the featured books in this issue's centerfold (see p 28-9).

Missouri: When the legislative session of the Missouri House of Representatives ended on May 13, 2005, House Bill 35 died in the Education Committee. HB 35 provided that:

All biology textbooks sold to the public schools of the state of Missouri shall have one or more chapters containing a critical analysis of origins. The chapters shall convey the distinction between data and testable theories of science and philosophical claims that are made in the name of science. Where topics are taught that may generate controversy, such as biological evolution, the curriculum should help students to understand the full range of scientific views that exist, why such topics may generate controversy, and how scientific discoveries can profoundly affect society.

The second and third sentences, of course, are modeled after the so-called Santorum language, present only in the Joint Explanatory Statement of the Committee of Conference for the No Child Left Behind Act and not in the act itself. The sponsor of the bill, Cynthia Davis (R-O'Fallon), was a cospon-

sor of both of the previous legislative session's "intelligent design" bills in the Missouri House of Representatives, HB 911 and HB 1722. On May 4, 2004, the House Education Committee allotted 90 minutes of hearings to HB 35, although it was so late then in the legislative session that there was no realistic possibility that the bill would proceed further. During the hearings, according to the *St Louis Post-Dispatch* (2004 May 4), "All but one person who testified in favor of the bill were members of two families, both of which home school their children." Testifying against it were Bob Boldt, Jan Weaver of the University of Missouri, Columbia, and Becky Lutherland, representing the Science Teachers of Missouri. Undaunted, Cynthia Davis told the *Post-Dispatch* that "she hopes that by getting a hearing, she at least introduces a concept that might catch on in next year's session."

New Jersey, Chester Borough: A small group of local Republicans floated the idea of "equal time" for creationism in the science curricula of the West Morris School District, according to the *Newark Star-Ledger* (2005 May 15). Scott Hoffman, pastor of the First Congregational Church of Chester, told the newspaper, "I think what should be taught in schools is the best science available, and my feeling is at this juncture evolution is not it anymore," adding, "It's a theory that has come and gone as an origins of life theory." The director of curriculum for the district stated that the district follows the state standards, which include no mention of creationism, and a spokesperson for the New Jersey School Boards Association said that the idea of teaching creationism or similar ideas has not been broached anywhere in the state. A spokesperson for the New Jersey Education Association explained, "Evolution is well-established and well-supported ... that's why it is taught." A subsequent letter in the *Star-Ledger* (2005 May 22) expressed dismay over the proposal, quoted the National Association of Biology Teachers position statement on evolution, and noted that "The executive board of the Biology Teachers Association of New

Jersey supports the teaching of evolution in schools as outlined in the New Jersey Core Content Curriculum Standards."

New York: Assembly Bill 8036, introduced on May 3, 2005, and referred to the Committee on Education, would have required that "all pupils in grades kindergarten through twelve in all public schools in the state ... receive instruction in both theories of intelligent design and evolution." It also charged New York's commissioner of education to assist in developing curricula and local boards of education to provide "appropriate training and curriculum materials ... to ensure that all aspects of the theories, along with any supportive data, are fully examined through such course of study." A08036, if it had been enacted, would have taken effect immediately. Richard Firenze, who teaches biology at Broome Community College, remarked, "This bill is completely absurd. Those of us in New York who are concerned about our children's science education should sit up and take notice: it's not just in places like Georgia and Kansas that creationists are trying to sabotage biology education." The bill's sole sponsor, Daniel L Hooker (R), represents Assembly District 127, encompassing parts of Greene, Otsego, Delaware, Schoharie, Ulster, Columbia, and Chenango counties.

Introduced late in the legislative session, poorly and vaguely drafted, and with only one sponsor, the bill was never thought to have a chance of succeeding; its sponsor was widely reported as explaining that his intention was more to spark discussion than to pass the bill. Hooker was also candid about his motivations: referring to A08036 and a bill he introduced that would permit the posting of the Ten Commandments on public buildings and grounds, he told the *Albany Times-Union* (2005 May 31), "It's obvious that these are religious-based." The bill died in committee on June 23, 2005, when the legislature adjourned.

Oklahoma, Tulsa: On June 7, 2005, the Park and Recreation Board of Tulsa, Oklahoma, voted 3-1 to approve adding a display depicting the biblical account of



creation at the Tulsa Zoo. According to an Associated Press news report, the decision came after “more than 2 hours of public comment from a standing-room-only crowd.”

Supporters of the proposed delay argued that the zoo already displays religious items, including a statue of the elephant-headed Hindu deity Ganesha (which appears outside the elephant enclosure at the zoo) and a globe carrying a Native American maxim, “The earth is our mother. The sky is our father.”

Tulsa resident Dan Hicks applauded the board’s decision, saying, “I see this as a big victory ... It’s a matter of fairness. To not include the creationist view would be discrimination.” In 1995, Hicks successfully lobbied the zoo to post a disclaimer reading in part, “There are many views on the origins of biological species and their behaviors.”

The idea of adding the creationist display was opposed during the meeting by a number of zoo employees as well as by representatives of Oklahomans for Excellence in Science Education, the Tulsa Interfaith Alliance, Tulsa Metropolitan Ministers, and the Tulsa Geology Society, on the grounds that “religion shouldn’t be part of the taxpayer-funded scientific institution.” The Reverend Marlin Lavanhar objected to the proposed display as divisive, saying, “The fundamentalist perspective is being placed, putting one Christian view above others.” And a zoo curator expressed qualms to the Associated Press about the zoo’s delving into theological debate: “I’m afraid we are going in the wrong direction,” she said.

The exact nature of the proposed creationism display was unclear; a zoo curator estimated that it would take about six months to research and prepare the display, including a disclaimer explaining that it represents only one view. Attorneys for the city urged the zoo to include it as part of a presentation of different cultures’ views of creation.

Writing in the *Tulsa World* (2005 Jun 26), the president and the executive director of the Oklahoma Museum Association decried the board’s interference

with the zoo’s displays, warning, “The question that museums across the state and across the nation are facing today because of this decision is: ‘Where does it stop?’” And a newly formed coalition, Friends of Religion and Science, organized to oppose the display, obtaining over 2000 signatures on a web petition.

Subsequently, at its July 7, 2005, meeting the Park Board voted 3–1 to reverse its June 7 decision. Although the decision to add a creationist display was reversed, Tulsa mayor Bill LaFortune broached the idea of removing the existing supposedly religious items from the zoo; no action was taken on his suggestion at the meeting.

Pennsylvania: On June 20, 2005, four hours of hearings were held on House Bill 1007, which would allow school boards to include “intelligent design” in any curriculum containing evolution and allow teachers to use, subject to the approval of the board, “supporting evidence deemed necessary for instruction on the theory of intelligent design.” (See *RNCSE* 2004 Sep/Oct; 24 [5]: 4–10 for background.) Among those speaking on behalf of the bill before the basic education subcommittee were the Kansas-based “intelligent design” advocate John Calvert and the biochemist Michael Behe, who teaches biochemistry at Lehigh University in Bethlehem, Pennsylvania. According to the Associated Press (2005 Jun 20), Behe contended that “intelligent design” lacked any religious underpinnings, and declined to speculate about when the “intelligent design” occurred. Speaking against the bill were representatives of the American Civil Liberties Union and Americans United for Separation of Church and State, as well as NCSE member Randy Bennett, a biologist at Juniata College. The bill’s prospects are unclear: while subcommittee member Daylin Leach (D–Montgomery) groused, “I’m baffled and exasperated that we are spending time with this” (quoted in the *Philadelphia Inquirer* 2005 Jun 21), a number of his colleagues have expressed sympathy with the bill. HB 1007 has not left the basic education subcommittee for the full education committee as of press date.

Pennsylvania, East Whiteland:

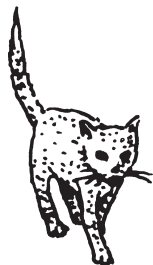
A request to have a child excused from the evolution unit of a high-school biology class escalated into a challenge to the biology textbook itself, according to *The Daily Local News* (West Chester, Pennsylvania: 22 Jun 2005). Katherine Pettiss, the president of the Great Valley School Board, told the newspaper that “In this case the parent[s] just objected to the mention of evolution because it is contrary to their religious beliefs ... so they wanted the textbook removed because it talked about evolution.” The complaint was reviewed by a panel composed of the high-school principal, the school librarian, two teachers, an administrator, two parents, and two students, which concluded that the textbook is “appropriate in meeting standards as described by the curriculum as well as in the state standards. So the committee recommends that we retain the textbook.” Such controversies are in the news in Pennsylvania, largely due to *Kitzmiller v Dover*, the lawsuit over the teaching of “intelligent design” (see *RNCSE* 2004 Sep/Oct; 24 [5]: 4–10). Pettiss said that in discussing “intelligent design” with the Pennsylvania School Boards Association, “[a]ll the discussions we’ve had is that evolution is science-based and ‘intelligent design’ is religious-based and therefore the Supreme Court has told us not to do that. So that’s where we’re coming from.”

South Carolina: On June 1, 2005, a bill modeled on the so-called Santorum language stripped from the federal No Child Left Behind Act of 2001 was introduced in the South Carolina Senate and referred to the senate’s Committee on Education. If enacted, S 909 would require that:

In the promulgation of policies and regulations regarding kindergarten through twelfth grade education, the State Board of Education shall implement policies and a curriculum that accomplish the General Assembly’s desire to provide a quality science education that shall prepare students to distinguish the data and testable theories of science from reli-



gious or philosophical claims that are made in the name of science. Where topics are taught that may generate controversy, such as biological evolution, the curriculum should help students to understand the full range of scientific views that exist, why such topics may generate controversy, and how scientific discoveries can profoundly affect society.



Such bills have been common in state legislatures over the past few years, although none was enacted.

The lead sponsor of S 909 is Michael L. Fair (R-Greenville County), described in *The State* (2005 Jun 17) as the “dominant voice advocating for SC schools to teach more than Charles Darwin’s theories of evolution.” In 2003, Fair attempted to amend a textbook bill to require a textbook disclaimer reading, “The cause or causes of life are not scientifically verifiable. Therefore, empirical science cannot provide data about the beginning of life.” Subsequently, he repeatedly but unsuccessfully attempted to pass legislation to establish a committee to “study standards regarding the teaching of the origin of species; determine whether there is a consensus on the definition of science; [and] determine whether alternatives to evolution as the origin of species should be offered in schools” (see p 4); the *Greenville News* reported (2003 May 1) that “his intention is to show that intelligent design is a viable scientific alternative that should be taught in the public schools.”

S 909 was introduced the day before the South Carolina legislature adjourned; the bill will therefore be at the top of the agenda when it reconvenes in January 2006. *The State* reports, “Fair says he plans to mount a major push during the next legislative session to win colleagues’ support for his latest idea to modify standards for teaching science, particularly in high schools. Public school students, he said, should be told a ‘full range of scientific views ... exist’ when it comes to explaining how fauna, flora and man came to inhabit the earth,” and quotes him

as acknowledging that his critics “will say all this is a thinly veiled attempt to mandate that creationism must be taught,” a charge he rejects. The newspaper’s report noted that South Carolina’s science standards include evolution but not “alternative theories” and also quoted the Reverend Baxter Wynn of Greenville’s First Baptist Church as writing, “It is not necessary to choose between Christianity and evolution — they are not mutually exclusive.”

Texas: House Bill 220, introduced in the Texas House of Representatives on December 14, 2004, by Representative Charlie Howard (R-Sugar Land), would, if enacted, amend the state’s education code to require that textbooks approved by the state be free from factual errors, “including errors of commission or omission related to viewpoint discrimination or special interest advocacy on major issues, as determined by the State Board of Education,” and satisfy general textbook content standards to be defined by the board. HB 220 would thus restore the Texas Board of Education’s ability to micromanage the content of textbooks, which was stripped from it by the legislature in 1995. Kathy Miller, the president of the watchdog Texas Freedom Network, commented, “If this bill passes, we will see a diluting of history and science, a narrowing of perspectives and a removal of factual information if it doesn’t fit with the personal political and religious beliefs of the majority of state board members.” Steven Schafersman, the president of Texas Citizens for Science, added that the bill “would return Texas to its Dark Ages of the 1970s and 1980s, when the Texas State Board of Education routinely forced publishers to change textbook content or rejected the books for adoption and use in Texas public schools based on ‘viewpoint discrimination or special interest advocacy’ as determined by individual powerful board members.” Howard, the bill’s sponsor, told the *Fort Worth Star-Telegram* (2004 Apr 22) that HB 220 would enable the board to ensure that creationism was taught alongside evolution and to remove evolution segments from science textbooks. “Some of our books

right now only teach evolution, [but] if you’re going to teach one, you ought to teach both,” he said. “Evolution is a theory. ... It is a theory, it’s not a fact. There is no fact for evolution, none. ... Why are we teaching a theory, when we have [another] position — creation — that the majority of the people in this country believe?” Similar bills presently in the Texas legislature include HB 973 and HB 2534, according to the *Star-Telegram*, although neither of those bills seems to have been publicly linked to issues involving evolution education.

Virginia, Bristol: After 15 years of using his homemade textbook entitled *Creationism Battles Evolution*, a teacher at John S. Battle High School in Bristol has been told to desist. The book, produced and distributed by veteran teacher Larry Booher, “includes 9 chapters with names such as ‘In the beginning’ and ‘Evidence for a young earth’ and is primarily a compilation of material from other sources,” according to *The Roanoke Times* (2005 Jun 9). Use of the book in Booher’s elective Biology II class was optional, although he granted extra credit to students who used it. He told the *Times* that “It’s not like I’ve tried to make it a secret ... If administrators knew, fine. If they didn’t, I didn’t make an issue of it.” NCSE executive director Eugenie C. Scott commented, “The students at that school are getting short-changed.” Washington County Public Schools Superintendent Alan Lee directed Booher to stop using the book and is reportedly taking steps to ensure that no similar transgressions are occurring. A subsequent editorial in the *Bristol Herald Courier* (2005 Jun 12) opined, “Believing in the biblical account of creation — whether a literal interpretation or the theory of ‘intelligent design’ — is a tenet of faith for many in the region. It’s properly taught at home, in a church or synagogue or in a private school, but not in the public school system. A line was crossed at John Battle. School officials need to take pains to make sure it is not crossed again.”

NCSE NEWS

News from the Membership

Glenn Branch, NCSE Deputy Director

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

Charles F Austerberry's op-ed "Evolving sequel to Bryan's last campaign" appeared in the March 7, 2005, issue of the *Lincoln Journal Star*. "Recent calls for 'intelligent design' theory and evolution disclaimer stickers in biology textbooks are fueled by the same fears that led to John Scopes'[s] prosecution in 1925 for teaching evolution in Dayton," he wrote. "While spurious attacks on religion need to be answered, as a Christian biologist it saddens me to see fellow believers still defending religion with spurious attacks on science." Reviewing the career of Scopes's famous prosecutor William Jennings Bryan, Austerberry finds much to admire and emulate, although not, of course, his rejection of evolution. He concludes with a call for evolution to be taught in a religiously neutral way. Austerberry teaches biology at Creighton University in Omaha, Nebraska, and is cofounder of the Nebraska Religious Coalition for Science Education.

NCSE was in the forefront at a special program for science teachers from South Africa held at the University of Wisconsin-Madison campus. **David Baum**, **Karen Mesmer**, and **Andrew J Petto** teamed up to present an intensive four-day introduction to understanding and teaching evolution. The South African participants are educational leaders from the Western Cape educational district and are responsible for teacher professional development and the implementation of the new science curriculum.

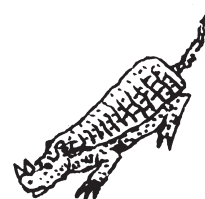
Tim Beazley wrote to the *San Diego Union-Tribune* (2005 May 15) to explain, "Evolution is a scientific theory. It makes testable predictions which have been con-

firmed by positive empirical evidence, as reported in many thousands of peer-reviewed articles in professional science journals. ['Intelligent design'], on the other hand, is a theological theory that does not make any rigorous, testable predictions whatsoever," adding, "The ID argument essentially is, 'We don't know, therefore we do know,' which is obviously nonsensical, the same sort 'reasoning' which 'proved' that the sun was pulled across the sky by Apollo's chariot..." A creationist's letter appeared in the same issue of the newspaper, alleging (among other things) that there are no transitional forms in the fossil record. **J David Archibald** of San Diego State University responded (2005 May 22), "As a paleontologist I can easily demonstrate ... 'transitional species' for many groups of plants and animals," citing the fossil records for the dinosaurian ancestry of birds and for the terrestrial ancestry of whales. He also complimented Beazley's letter for its eloquent explanation of the scientific status of evolution. [*Thanks to Jeff Horowitz for the news.*]

Gary L Bennett's science fiction novel *The Star Sailors* (New York: St Martin's Press, 1980) was reissued (New York: Authors Choice Press, 2005). On its original publication, the reviewer for *Library Journal* wrote, "like Ursula K Le Guin's best work, [it] excels on every level. ... Powerful, absorbing reading; highly recommended." Bennett adds, "The novel deals with the scientific method, evolution, and the danger of blind, dogmatic beliefs." Bennett also contributed "We can still learn lessons from Einstein's watershed year" to *Skeptical Inquirer* (2005 Sep/Oct; 29 [5]: 34-5), in which he explains why 2005 — the centennial of the year in which Einstein published five major papers — was declared the World Year of Physics. Accompanying the article is a side-

bar on the Twin Paradox of special relativity (35, 37, 38) and a box "On problems with near-light-speed travel" (38) by **David E Thomas**.

The May 2005 issue of *The American Biology Teacher* (67 [5]) features no fewer than three articles by NCSE members. First, in his guest editorial "Which scientific method should we teach & when?" (262-4), **J José Bonner** contends, "some kinds of experiments can follow the classic Scientific Method quite well — but others cannot, and can be forced into this paradigm only at great peril. The problem is that textbooks typically present one Scientific Method, and imply that it is universal." Instead, he recommends, science ought to be presented as a way of asking questions, with the classic Scientific Method introduced later in the contexts in which it is appropriate. Second, in "Iconoclasts of evolution: Haeckel, Behe, Wells, & the ontogeny of a fraud" (275-82), Kurt M Pickett, John W Wenzel, and **Steven W Rissing** review the history of embryological support for evolution in order to rebut false and misleading claims perpetuated by proponents of "intelligent design." "While neither the phylogenetic stage nor the hourglass model form any basis of Darwin's description of the theory of natural selection," they summarize, "these are fundamental beliefs of Behe, Wells, and their students in their ongoing Intelligent Design Creationism attack on Darwinian biology." Third, in "Beware of nuts & bolts: putting evolution into the teaching of biological classification" (283-9), **Martin K Nickels** and **Craig E Nelson** address "[p]erhaps the most common — but ultimately self-defeating — approach in teaching about biological classification," which uses manufactured items (such as nuts and bolts) to illustrate the principles of taxonomy.



During a visit to Texas in June 2005, NCSE's **Wesley R Elsberry** kept busy, delivering talks on "Bottlenose dolphin biosonar: Sound production, bioenergetics, and individual variation" to audiences at Baylor University on June 14 and Texas Woman's University at Denton on June 16. On June 18, he also spoke to the North Texas Skeptics on "The logic and tactics of 'intelligent design'", exploring "the socio-political phenomenon of the 'intelligent design' movement and the mode of argumentation used within it. The essential sterility of the 'intelligent design' field provides a fascinating conundrum: with so little to offer, how is it that 'intelligent design' advocates have taken the high-profile position in arguments over evolution and science education?"

Barbara Forrest and **Paul R Gross's** *Creationism's Trojan Horse: The Wedge of Intelligent Design* (New York: Oxford University Press, 2004) received a rave review from Barry Palevitz, writing in *BioScience* (2005 Mar; 55 [3]: 280-2). "Using everything from anecdotal accounts of ID lectures to exhaustive literature searches and direct quotes of ID proponents," Palevitz writes, "Forrest and Gross trace the history of the wedge strategy, mark its progress, and hold the feet of Behe, Dembski, and their ilk to the fire. They reveal the misrepresentations, out-of-context quotes, and outright falsehoods in ID critiques of evolution, showing that, despite their new look, neocreationists are up to the same old tricks."

Starting with the old joke "How many legs does a dog have if you call the tail a leg? Four: calling a tail a leg doesn't make it a leg," **Gregory Fuchs** argued, in a letter to the editor, that "Calling creationism creation 'science' does not make it science," adding, "It has been interesting to watch creationist tactics 'evolve' from the early 'oversimplify and attack' approach as evolution scientists rebutted their arguments." His letter appeared in the June 3, 2005, issue of the *Lafayette (Indiana) Journal and Courier*.

Responding to a commentary arguing that "intelligent design needn't be religion" and a creationist letter in the *Cincinnati*



Enquirer (2005 Feb 20), **Daniel K Gladish** noted, "If there were any empirical evidence to support 'intelligent design', it would already be a part of scientific evolution theory, but there isn't. ... Tens of thousands of studies by thousands of scientists over 240 years (Darwin was not the first) show that evolution occurs." Gladish is a botanist at Miami University in Hamilton, Ohio; his letter appeared on February 24.

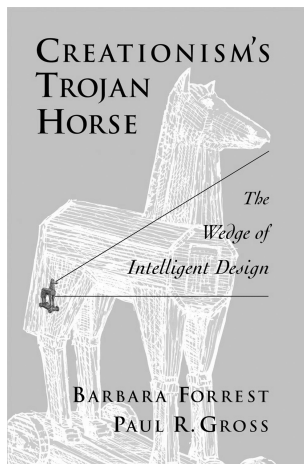
Ursula Goodenough contributed "Reductionism and holism, chance and selection, mechanism and mind" to *Zygon* (2005 Jun; 40 [2]: 369-80). "Despite its rich and deepening panoply of empirical support," she writes in the abstract to her essay, "evolutionary theory continues to generate widespread concern. Some of this concern can be attributed to misunderstandings of the original concept, some to unfamiliarity with its current trajectories, and some to strongly held fears that it strips the human of cherished attributes. In this essay I seek to deconstruct such misunder-

standings, lift up current concepts of what evolution entails, and address some of the existential issues it generates." Goodenough is Professor of Biology at Washington University, St Louis. A number of articles in the same issue of *Zygon* are likely to be of interest as well.

Responding to an op-ed by "intelligent design" advocates John Angus Campbell and Stephen C Meyer in the *Memphis Commercial Appeal* (2005 Apr 19) calling for "teaching the controversy", **David O Hill** wrote to challenge their motives. Noting Meyer's affiliation with Palm Beach Atlantic University, which requires its faculty to subscribe to a statement of faith including "the divine inspiration of the Bible, both the Old and New Testaments; that man was directly created by God" (<<http://www.pba.edu/CD/guiding.htm>>), he remarked, "This suggests their real motive may have little to do with preparing America's next generation of scientists. ... However cloaked, Campbell and Meyer are pushing their personal religious beliefs, and part of their strategy is that if you shout 'evolution is only a theory' often enough, some are bound to believe it." His letter appeared on April 22.

Brigid LM Hogan, Professor and Chair in the Department of Cell Biology at Duke University Medical Center, was elected to the National Academy of Sciences, according to a May 3, 2005, press release from the NAS. Members of the NAS are elected "in recognition of their distinguished and continuing achievements in original research."

Owen D Jones and **Timothy H Goldsmith** collaborated on a major law review article on "Law and behavioral biology" (*Columbia Law Review* 2005 Mar; 105 [2]: 405-502). From the abstract: "Society uses law to encourage people to behave differently than they would in the absence of law. This fundamental purpose makes law highly dependent on sound understandings of the multiple causes of human behavior. The better those understandings, the better law can achieve social goals with legal tools. ... Jones and Goldsmith argue that many long-held under-



standings about where behavior comes from are rapidly obsolescing as a consequence of developments in the various fields constituting behavioral biology. By helping to refine law's understandings of behavior's causes, they argue, behavioral biology can help to improve law's effectiveness and efficiency." Jones is Professor of Law and Professor of Biological Sciences at Vanderbilt University; Goldsmith is Professor Emeritus of Molecular, Cellular, and Developmental Biology at Yale University.

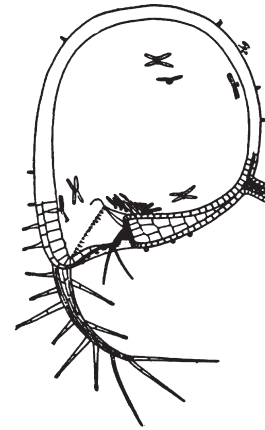
John Klimenok Jr is not amused by the syndicated comic strip *B.C.*, writing, "The creator of the 'comic' strip, Johnny Hart, is an unabashed Christian fundamentalist and creationist who belittles anything and everything that is contrary to his belief system. His May 1 polemic denigrated Charles Darwin, one of the great scientific minds of the 19th century and his theory of evolution. Comic strips like this one that use inflammatory and/or defamatory rhetoric should be regulated to the oped pages where they belong." His letter appeared on May 29, 2005, in two Vermont newspapers: the *Rutland Herald* and the *Barre Montpelier Times Argus*.

Bradley T Lepper edited and contributed to *Ohio Archaeology: An Illustrated Chronicle of Ohio's Ancient American Indian Cultures* (Wilmington [OH]: Orange Frazer Press, 2005). The publisher writes, "Ohio's rich archaeological heritage has captivated generations of scholars and scientists. Yet, archaeologists over the past few decades have made new discoveries that are revolutionizing our understanding of these American Indian cultures and their achievements. ... Written in an engaging and understandable style, this epochal story is beautifully illustrated with over 340 photographs, original artworks, maps, timelines and graphics. *Ohio Archaeology* is a valuable resource for readers, teachers and students who want to learn more about the lifeways and legacies of the first Ohioans." Lepper is Curator of Archaeology of the Ohio Historical Society.

On May 1, 2005, NCSE's **Nick Matzke** spoke on "Evolution of

Utricularia" to the Bay Area Carnivorous Plant Society, arguing that the *Utricularia* evolved from an extinct species of pitcher plant in the *Lentibulariaceae*. Part of Matzke's interest in carnivorous plants and their evolution derives, of course, from their serving as a counterexample to claims about "irreducible complexity" (as independently remarked by **Hubert P Yockey**, writing in *RNCSE* 2001 May-Aug; 21 [3-4]: 18-20).

A portrait of the late **Ernst Mayr** as a young man was on the cover of *Skeptic* (2005: 11 [4]), corresponding to a remembrance and tribute by his student, colleague, and friend Frank J Sulloway (13-4). Also of interest in the same issue of *Skeptic* were three articles on creationism. First, **Robert Camp**'s "Democratizing Darwin" (16-7), which reported on the fifth annual "Darwin, Design, and Democracy" conference held by "intelligent design" promoters; Camp comments, "as much as proponents wish to cast this debate as one between competing scientific theories, their perspective is still little more than a collection of grievances, hopes, and inapplicable probabilistic ideas." Second, **Mark Perakh**'s "The dream world of William Dembski's creationism" (54-65) seeks to "examine the most salient features of Dembski's prolific literary output, most of which turns out to be poorly substantiated, contradictory, and often self-aggrandizing"; the article updates Perakh's treatment of Dembski's work in his *Unintelligent Design* (Amherst [NY]: Prometheus Books, 2004; reviewed by **Jason Rosenhouse** in *RNCSE* 2004 May-Aug; 24 [3-4]: 49-50), and can be found on-line at <http://www.talkreason.org/articles/Skeptic_paper.cfm>. Third, Robert Weitzel's "Creationism's holy grail" reviews the controversy over the publication of a paper by the Discovery Institute's Stephen C Meyer in a legitimate scientific journal (*Proceedings of the Biological Society of Washington*); Weitzel's article relies on a critique of the paper written by **Alan Gishlick**, **Nick Matzke**, and **Wesley R Elsberry** and posted at The Panda's Thumb blog (<http://www.pandasthumb.org/archives/2004/08/meyers_hopeless_monster.html>).



A cross-section diagram of the bladder trap of *Utricularia biloba*, modified from FE Lloyd, *The Carnivorous Plants*, Waltham (MA): *Chronica Botanica*, 1942, plate 276, number 1.

org/archives/2004/08/meyers_hopeless_monster.html>.

With Joseph M Dirnberger and Tom Howick, **Steven McCullagh** contributed "Writing & drawing in the naturalist's journal" to the January 2005 issue of *The Science Teacher* (72 [1]: 38-42). "The naturalist's journal," they write, "is an effective tool for learning about nature and science and can be an effective teaching strategy. ... a vehicle to help students explore the connections between how they perceive and think about natural phenomena and how they value our natural environment." McCullagh teaches biology at Kennesaw State University. In his article "Art and evolution" in the same issue of *The Science Teacher* (22-5), **Mark Terry** discusses how he and his colleagues integrate art and evolution in their biology instruction. "If we have brought all our students closer to the natural world and if we have helped them see how familiarity with that natural world led to the great evolutionary questions, we have accomplished our immediate goal," he concludes. "If we plant in some of our students the urge to see more, draw more, diagram more, analyze more, and pursue these evolutionary questions on their own, then we have truly furthered their education and the science of biology." Terry is chair of the science department at The Northwest School in Seattle.

Mark Perakh's *Unintelligent Design* (Amherst [NY]: Prometheus, 2004) received a generally favorable review from Mark

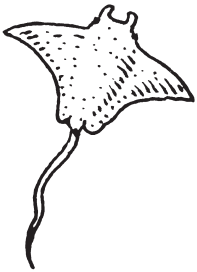
D Decker, writing in *Cell Biology Education* (2005 Summer; 4: 121-2). “*Unintelligent Design* represents a slightly different entry into the increasingly crowded field of anti-ID books,” Decker observes. “Whereas most of these books are written by biologists and/or philosophers, Perakh is a professor emeritus of physics (California State University, Fullerton) and brings a unique perspective to the discussion. Perakh focuses throughout on the illogical nature of the arguments proposed by ID adherents and on the misuse and misapplication of statistical analysis in ID claims.” The book, he adds, “is certainly interesting and serves a useful role in the universe of materials on this topic. Part of the enjoyment (at least for an evolutionary biologist) stems from how willing Perakh is to call most of the claims made by ID advocates and others ‘utter nonsense.’”

“Evolution and evidence” was the theme of the March/April 2005 issue of *Skeptical Inquirer* (29 [2]), so it was no surprise that a number of NCSE members were represented. **David E Thomas**, the president of New Mexicans for

Science and Reason, listed “NMSR’s best and worst of 2004 awards” (11) which included the “Not the e-word!” award to Kathy Cox and the “Amen, Brother Jimmy!” award to Jimmy Carter for their roles in the Georgia debacle over the word “evolution”, the “Right on!” award to the high school students in Darby, Montana (see *RNCSE* 2004 Mar/Apr; 24 [2]: 4-12), the “ID is content free!” award to William A Dembski for a clear statement of “intelligent design”’s vacuity, the “Teach the controversy (unless it bothers creationists)” award to Phillip Johnson for his repeated refusal to take a position on the age of the earth, the “At least he had a beard” award to Barnes and Noble, whose 2004 edition of Darwin’s autobiography featured a picture of Alfred Russel Wallace on its cover, and the “Don’t stop now — it’s getting good” award to the theory of evolution. **Matt Young** and Ian Musgrave, in their “Moonshine: Why the peppered moth remains an icon of evolution” (23-8), argue in detail that Judith Hooper’s allegations of fraud (in her *Of Moths and Men* [New York: WW Norton, 2002]) in

Bernard Kettlewell’s classic experiments on the peppered moth are unwarranted. And **Timothy H Heaton** reviews old-earth creationist Hugh Ross’s *A Matter of Days* (Colorado Springs CO: NavPress, 2004), concluding, “Ross’s shrewd criticisms of the young-earth creationists can easily be turned on his own views, for his peculiar blend of Christianity and science is no more intuitive or harmonious than theirs is” (44-5). Also of interest were Dennis R Trumble’s “One longsome argument”, a general discussion of the creationism/evolution controversy emphasizing the nonrational basis of creationism and the scientific basis of evolution (18-22), **David Morrison**’s “Hyperbole in media reports on asteroids and impacts” (29-33), and Greg Martinez’s “‘Stupid dino tricks’: A reply to Hovind’s web response” (54-5), which answers a reply to his report (in a previous issue) of his visit to Kent Hovind’s Dinosaur Adventure Land.

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



YOUNG-EARTH CREATIONIST ARGUMENTS SCRUTINIZED

Maintaining creationist integrity — There is a big verbal battle between Carl Wieland, Ken Ham, and Jonathan Sarfati of Answers in Genesis and Kent Hovind of Creation Science Evangelism. See <<http://answersingenesis.org/docs2002/1011hovind.asp>>.

Unleashing the storm — Answers in Genesis critiques a new edition of Dennis Peterson’s book *Unlocking the Mysteries of Creation*. See <<http://www.answersingenesis.org/docs2003/0113peterson.asp>>.

How good are those young-earth arguments? — Dave E Matson offers a thorough point-by-point rebuttal of Kent Hovind’s arguments. See <<http://talkorigins.org/faqs/hovind/howgood.html>>.

The GISP2 ice core: Ultimate proof that Noah’s Flood was not global — Paul H Seely, writing in *Perspectives on Science and Christian Faith* (the journal of the American Scientific Affiliation) 2003 Dec; 55 (4): 252-60. See <<http://www.asa3.org/ASA/PSCF/2003/PSCF12-03Seely.pdf>>.

[A version of this note originally appeared in the IBSS Newsletter dated December 28, 2003. The Institute for Biblical Studies and Science publishes weekly updates on science, religion, and creationism/evolution issues. For more information, e-mail Stephen C Meyers at ibss@comcast.net or visit <<http://bibleandscience.org>>.]

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We also extend special thanks for their much-appreciated support to the following people who donated \$100 or more between January and June 2004

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STARTING EARLY:



INTRODUCTION

It should come as no surprise that adults in our country hold serious misconceptions about basic principles of evolutionary theory. These include the belief that the environment itself causes traits to change, that all individuals change slowly over time, and that evolutionary change is due to perceived need or to the demands of use and disuse. Many see evolution as goal-oriented, and many confuse the scientific definitions of terms such as “theory” with colloquial ones, resulting in skepticism about the scientific validity of the theory of evolution (Alters and Nelson 2002). Others, of course, hold creationist beliefs.

These are not uneducated adults who slept through biology class. They are, in fact, college students and graduates, many of them science majors. Even biology master’s students and medical students are subject to misconceptions about evolution, specifically about the process of natural selection (Brumby 1984; Zaim-Idrissi and others 1993). These misconceptions, according to several researchers, persist so strongly because once acquired, it is difficult for new, accurate information to override them (Alters and Nelson 2002; Greene 1990). This is true of creationist ideas as well — once these beliefs become ingrained in people, their attitudes do not change even when they are presented with clear evidence for evolution (Sinclair and Pendarvis 1998).

According to the National Science Education Standards (NRC 1996) and *Benchmarks for Science Literacy* (AAAS 1993), which offer general science

standards guidelines for states to follow, evolution should formally begin to be taught in middle school. This is followed by more advanced and complex evolution education in high school. But teachers do not always teach evolution adequately. Some barely mention evolution, some teach evolution but compromise the information by teaching creationism as well, and some ignore the subject altogether (Moore 2004).

While inadequate middle- and high-school evolution education can contribute to the formation of some misconceptions, should we be looking further back in a student’s education to trace the origin of most of the misconceptions? In other words, could students entering middle school with these misconceptions already formed?

In theory, the life science standards for elementary students, as recommended in the National Science Education Standards (NRC 1996), are intended to provide students with a foundation for future learning about evolution. They should “develop the knowledge base that will be needed when the fundamental concepts of evolution are introduced in the middle and high school years” (Moore 2004). These standards focus on the characteristics and life cycle of organisms. Students in grades K–2 learn that some species once on earth are extinct and that basic similarities exist within groups of plants and animals. In grades 3–5 they compare fossils to one another and to living organisms for similarities and differences, and they learn the basic principles of taxonomy. But even though evolution is usually not formally taught at this age, there are many ways for misconceptions to develop in the elementary classroom.

Teachers might not, for example, explain the difference between the scientific usage of a term such as “theory” and the vernacular usage during science lessons. Teachers themselves might hold misconcep-

Dina Drita recently received her MA in physical anthropology and will begin a doctoral program in 2005. Prior to entering graduate school she edited children’s books.

Preventing Misconceptions about Evolution through Elementary Education

Dina Drits



tions (or creationist beliefs) and pass them on to students. Teachers, for many reasons, might not disabuse students of misconceptions they easily picked up outside of school, from sources such as popular culture (cartoons, movies, and other media), parents, friends, or anti-evolution propaganda. If misconceptions are learned at this young age, students and teachers are already at a disadvantage when formal evolution education begins, and the misconceptions will almost certainly persist if future evolution education is inadequate.

Perhaps, then, one solution to preventing misconceptions from forming is to introduce students to important concepts in evolution *effectively* at the elementary school stage. For my master's project in physical anthropology, I decided to test whether this idea has any practical value. I developed a study that would answer two questions: Whether elementary-aged students are capable of understanding, and interested in learning about, concepts in evolution. If they are, what is an effective teaching method for students of this age?

I chose to test learning through a relatively new teaching method called "Inquiry Zone" learning. It is well known that classroom lessons that result in the best learning are those that encourage play and stimulate physically and mentally active, self-motivated learning. Classroom-inquiry-style learning, currently the most recommended form of science education, promotes physically and mentally active learning. But the Inquiry Zone method goes one step further by enabling children to choose the subjects they want to explore, without a teacher's instruction. It allows students to engage in true self-motivated, self-guided learning.

Crossroads Elementary School, an ethnically diverse, year-round science magnet school in St Paul, Minnesota, developed an Inquiry Zone based on a

model in a Connecticut school. Students visit the area, comprised of 30–35 learning stations, for one hour a week, and work at any station they choose. Each station is subject-based, ranging from biology to music to engineering. As students work with the objects at the stations by disassembling and reassembling them, by testing and experimenting with them, they formulate their own scientific questions, ideas, and conclusions. A teacher/facilitator is available to answer questions and discuss hypotheses.

THE STUDY

I developed three stations for the Inquiry Zone, each on a different concept in evolution. These concepts all concern "change over time" of the earth or of animal species; they all could lead easily to topics that will (or should) be covered to some extent again in middle and high school; and they were most conducive to the Inquiry Zone style of learning. Each station was accompanied by colorful laminated signs with instructions and definitions of new terms, along with other topic-appropriate signs such as timelines.

STATIONS

Station 1. Law of Superposition (older strata, or layers in the ground, lie beneath younger strata) and Stratigraphy

Students created a new layer of "sediment" every week for 5 weeks by pouring cupfuls of differently colored sand, dirt, or pebbles into an empty aquarium. Students wrote their names, the date, and a description of the day on a small piece of paper each week and buried it in that week's sedimentary layer in order to date the layers. At the end of the study, they "excavated" the site by digging out layers and reading the notes buried within.

Station 2. Hominid Behavior, Stone Tools, and Change in Tool Technology

To introduce students to the idea that materials used to make tools (and, for the most part, tool shape) have changed over time, a series of photographs were displayed at the station that depicted changes in tool technology from approximately 2 million years ago to the present. Students worked with replica stone tools that were of different sizes and shapes, to simulate the life of an early human. Students cut, peeled, and cracked objects such as pieces of fur, potatoes, apples, and nuts, and assessed which shape of tool was most effective to use on the different objects. They also molded their own stone-like tools out of self-hardening clay, which they could take home. An illustration of an early human using a stone tool with text describing stone tool use hung next to the photographs.

Students were most excited and engaged by station 2 (hominids and tools) ... Students had animated discussions and asked the most questions at this station ...

Station 3. Natural Selection

Students simulated a predator-prey relationship by pretending to be birds searching for worms in a tub of sand. The “worms” were pieces of yarn in 6 different colors, one of which was a similar color as the sand and therefore camouflaged. On the first day of the study, the tub contained 15 pieces of each color of worm mixed into the sand. Using a stopwatch to time one another, each student had 30 seconds to pick out worms. Students then counted and recorded the number of worms they found and left them outside of the tub. The worms left inside the tub were “alive” and would “reproduce” by doubling in quantity during the week. At the end of each study period, I graphed the day’s results on a large chart at the station. Indeed, by

the final day of the study, all of the worms died out except for the camouflaged ones.

DATA COLLECTION

The subjects of my 6-week study at Crossroads Elementary School were 26 ethnically diverse students in a fourth-grade classroom at the school. I tested the amount of learning that occurred during the study period (through pre- and post-tests), the stations’ effectiveness in attracting students to work at them, and whether a relationship existed between number of station visits and test scores.

OUTCOMES AND CONCLUSIONS

The results showed that the elementary students were capable of learning certain concepts in evolution and that the Inquiry Zone method was effective in teaching these concepts. The pre- and post-test scores showed an increase in the number of correct answers in 83% of the questions. Scores on questions from station 1 (law of superposition) increased by 28%, scores from station 2 (hominids and tools) increased by 26%, but scores decreased in questions from station 3 (natural selection) by 8%.

Stations 1 and 2 were clearly more effective in

teaching students about specific concepts in evolution and in attracting the students to work at them than station 3, which was not effective in either of these respects. Possible explanations for these results could be that the concepts from stations 1 and 2 were more understandable to fourth graders, the stations had a more attractive design, or that the stations provided students with more opportunities for building and creating. The results from station 3 could be attributed to the most obvious, that the concept may be too advanced for fourth graders, or the station design may have been too confusing and unattractive.

Although test results from station 3 suggest that the students were confused rather than educated, I would not altogether dismiss the possibility of trying to teach natural selection to young students. Based on my observations of the students in my study, it seems that if a teacher or facilitator had spent some time explaining natural selection to the students, many would have understood the basic concept. Possibly, this concept could have been taught more effectively as a combination of Inquiry Zone station and teacher-led, in-class exercise. I believe that it is necessary to introduce natural selection as early in students’ lives as possible to provide them with a solid foundation years before they are taught the complexities of it in high school (if it is taught at all). This concept requires special attention because the process seems to be misunderstood consistently by the general public and advanced science students alike.

The results also showed that the students were most excited and engaged by station 2 (hominids and tools). Although girls visited station 1 more times than 2, they spent the most time at station 2, while boys both visited and spent the most time at station 2. Students had animated discussions and asked the most questions about this station, such as, “Did we come from apes?” and “What did early humans use these tools for?” Some of their questions revealed that they had already formed some misconceptions that I described earlier in adults. Students asked fewer questions about station 1, and the only question they asked about station 3 was for clarification on the instructions.

The data showed that the more often students visited a station, the better their post-test scores were for topics presented at that station. In other words, participation directly and positively contributed to learning. Interestingly, learning seemed to occur even when the length of stay at a station was short, as long as students actively participated. Finally, although there was bias by sex for *individual* stations, the stations *as a unit* attracted students at the same rate, regardless of sex and ethnic background.

Although this study is only a pilot containing a relatively small study population, these results offer some interesting preliminary implications for teachers, administrators, and others. First and foremost, not only *can* students learn concepts in evolution by fourth grade, they are very open and eager to do so. These concepts can be successfully taught through Inquiry Zone learning. Moreover, these results suggest that this method seems to be unbiased *as a whole* by sex and ethnic group, which has useful and valuable implications for schools with diverse student populations. Furthermore, when students actively work at a

station, learning seems to occur even when length of stay is short, which is critical for busy, time-restricted school days.

Knowing that their students are probably able to understand basic concepts in evolution, elementary teachers should try to incorporate lessons on evolution in their classrooms. Teachers should also try to make connections between topics that students are already learning in their classrooms, such as taxonomy and fossils, to future learning about evolution. Some interesting inquiry-style projects on evolution can be found on the internet and in several excellent children's books (see sidebar below).

In conclusion, early, effective exposure to concepts in evolution may provide students with a solid base for future learning about this important subject, reducing misconceptions, suspicions, and controversy about evolution for generations to come.

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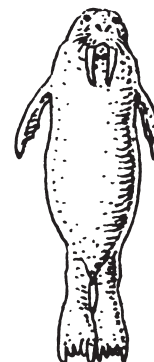
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My Trip Down the Rabbit Hole: Experiences as a Science Teacher in South Texas

William J Gonzalez

I received my Bachelor of Science degree in Botany from the University of Vermont, and my Master in Teaching Biology from Indiana University, Bloomington. I consider myself fortunate to have had as good an education as this country has to offer. While at Indiana University, I was a student in the Evolution, Ecology and Organismal Biology Department. After graduation, I decided to accept a high-school teaching position in South Texas at a magnet school district that claimed to have a strong science emphasis. The district's two flagship schools are its Science Academy and the Medical High School. I thought that teaching — especially in a school district of a low socio-economic area of primarily Hispanic students — was the best application of my own education. My own background is upper middle class; both my parents have college degrees. My father was a Spanish teacher, and my mother a guidance counselor. My paternal grandparents were from Mexico, and my maternal grandparents were from Italy. So both my background and my education seemed to point me to this choice.

I knew that the unambiguous teaching of evolution is the *sine qua non* of biology, serving as a theoretical foundation in the same way as quantum mechanics does for modern physics and chemistry. The purpose of this account is not to restate what the best and brightest scientists have clearly stated:

that evolution is a simple fact, not something to be “believed in,” but something to be understood in order to have a thorough understanding of biology and the natural world. Rather, as somebody who has been in the front lines of science education, I want to point out that what should be a rigorous science background for people living in the most powerful nation in the world is being undermined by religious extremism and creationism: not from outside, but from within the ranks of supposed science educators. The following accounts are all real, and as true and accurate as memory allows.

THREE STRIKES?

The first experience deals with a young biology teacher, a recent graduate of a local university that is part of the University of Texas system. This teacher is enthusiastic, born and raised in south Texas, and a product of the local education system. This teacher's assignment was to teach first-year and advanced-placement biology. From all appearances, this teacher did a good job, incorporating labs along with lecture and discussion — *except* that this teacher uses the book *Of Pandas and People* as a supplement to the assigned text. RNCSE readers know that *Pandas* advocates “intelligent design” and has been used in a not-very-well-veiled attempt by a fundamentalist religious group in Texas to promote a religious and anti-evolution agenda (<<http://www.textbookleague.org/53panda.htm>>). It could be hoped that this teacher uses this book as an exercise to teach critical thinking and to show what science is

not. But that is not the case. This teacher openly admits to being an anti-evolutionist based on his fundamentalist religious beliefs. Strike one!

The next experience recalls a conversation I had with a teacher in reaction to the PBS series, *Evolution*. This series deals with evolution in a thorough and intelligent manner and covers the friction between science and religion in a sensitive and thought-provoking segment, *What about God?* The series includes videos, a website, and educational materials for the classroom (<<http://www.pbs.org/wgbh/evolution/>>). It is so well done that I thought it would be a good idea for all the science teachers to show the series in their classrooms no matter what subject they taught (for example, physical science, chemistry, and so on). After all, the series deals with the scientific method, cosmology, and chemistry, and it is topical. The teacher in question frowned, became very serious, and commented that this program could not be shown in the classroom because “I do not believe in evolution.” This teacher majored in science education, and like the teacher in the previous account, is a product of the local school system. Their teaching assignments included physical science and chemistry. Strike two!

The third account deals with a teacher whose teaching assignments have included physical science, physics, chemistry and biology, but now focus on physics and physical science. This teacher is very involved with the (Catholic) church and was a missionary in South America. I think the charitable work done by this individual, inspired by deep religious convictions, is commendable. But this same teacher has expressed a decidedly anti-evolution and anti-science sentiment. In one incident the teacher hurriedly entered my classroom as both our classes were in session. At the time, he was doing a dissection of the grasshopper. There was a term in the dissection material that he did not

continued on page 31

Why Teach Evolution?

Andrew J Petto, Department of Biological Sciences, University of Wisconsin–Milwaukee

Despite a series of federal court decisions supporting biological evolution in the curriculum, the struggle over evolution in the science curriculum continues. Recent conflicts over science education standards in many states have arisen precisely because evolution *was* awarded its proper status as the fundamental theory supporting modern biology.

What is biological evolution?

Biological evolution is a theory of change that accounts for the pattern of similarities and differences among living things on earth throughout the earth's history and in all its habitats and biomes. Evolution is a theory of *emergence* of new varieties of life forms, *not* a “theory of *origins*” that accounts for how life began. Scientists are currently studying several hypotheses about the beginning of life as we know it, but evolution begins *after* life is established on earth.

What about macro-evolution?

Scientists use the terms *macroevolution* and *microevolution* to describe different *perspectives* on life's history. Macroevolution describes the pattern of evolutionary change we observe over time, especially in response to large-scale events that affect the abundance and distribution of species. Macroevolution is what we see in the fossil record as forms of life change from one geological time to another. These organisms share features both with those that appeared earlier in time and those that emerge later. Their transitional features show both continuity and change among groups of organisms. So, in macroevolution, we focus on patterns of evolutionary change that occur *between* species, while in microevolution, we focus on patterns of evolutionary change that occur *within* species and evolving lineages. These two terms represent *perspectives* on the process of evolutionary change, not fundamentally different processes.

Why is evolution mandated in science education standards?

There are two main reasons to mandate biological evolution in science education. First, evolution is the fundamental, unifying theory that supports all the life sciences. It has formed the basis of productive and active research for over 140 years and continues to do so. This is why evolutionary theory is universally accepted among professional biology researchers. The second is that science education standards emphasize learning the *process* of science — especially scientific inquiry. The first step in this process is to develop testable questions that can be answered by scientific investigation. These questions are guided by scientific theories, and their answers continue to show the value of biological evolution as a theory for forming useful, answerable questions in biology.

Isn't evolution only a theory?

A scientific theory is a framework that guides research, not an idle speculation or a “hunch”. These theories are systematic, well-tested explanations that account for a broad range of observations. Biological evolution is a scientific theory that explains the pattern and process of variation and similarity among living things in terms of descent from common ancestors. It is a widely accepted and applied theory because it continues to guide useful research and answer new questions.

Why are no other theories required in the science education standards?

Many scientific theories are required in these standards. For example, students learn atomic theory, the foundational theory for understanding the basics of chemistry and physics — including the periodic table of the elements. Other advanced theories, such as quantum theory, or unsettled ones, such as super-string theory, are less likely to

be required. To be included in standards, theories generally must be (a) recognized by the scientific community as settled because of their consistent performance in supporting research; (b) fundamental to a field of study because they form a unifying framework to help us understand important issues in that field; and (c) able to be successfully learned and understood by students in public schools at various ages because they have the necessary content background and analytical skills. Not every scientific theory meets *all three* criteria, and those that do not will not usually appear in the curriculum.

What about other scientific “theories of origins”?

A main goal of science education standards is to teach students how to form questions for successful scientific inquiry. This question is an example of how misunderstanding the process of science can undermine this goal. There is no competing *scientific* theory for the pattern of diversity of life on earth. The “theories of origins” and “origins science” are religious ideas that are based on an interventionist theology held by *some* Christian denominations.

Isn't evolution controversial?

Biological evolution is a scientifically settled theory. Among scientists, this means that its fundamental principle — the shared ancestry of living organisms — has overcome all scientific challenges. However, the general public is uncomfortable with evolution because of what some people perceive as the moral or cultural *implications* of evolution. Scientific controversies are resolved by careful scientific inquiry, but moral and political dilemmas can never be resolved *only* by scientific inquiry. These dilemmas can also never be resolved by ignorance, so it is especially important for students to have a complete and accurate understanding of the contemporary theory of biological evolution.

What about dissenting scientists?

In the past few years, researchers have supposedly expressed new skepticism about evolution: “We are skeptical of claims for the ability of random mutation and natural selection to account for the complexity of life. Careful examination of the evidence for Darwinian theory should be encouraged” (<<http://www.discovery.org/scripts/viewDB/filesDB-download.php?id=153>>). This statement is misleading; it implies that evolutionary theory is based merely on random mutation and natural selection. In the past 140 years, many sources of biological change have been identified and incorporated into evolutionary theory. This classic “straw-man” argument first describes evolutionary theory incorrectly, then implies that being skeptical of the incorrect definition is the same as being skeptical about evolutionary theory.

What about critical thinking?

Critical thinking is an important component of a good education. Critical thinking about evolution must start with a proper understanding of what evolution is and how contemporary scientists understand it. “Critical thinking” materials recently offered to school boards consist of misinterpretations of scientific research about biological evolution. They confuse an active discussion among scientists over the details of evolutionary change with a disagreement about whether evolution has occurred. This is not critical thinking, but hucksterism.

"When you combine the lack of emphasis on evolution in kindergarten through 12th grade, with the immense popularity of creationism among the public, and the industry discrediting evolution," Randy Moore once said, "it's easy to see why half of the population believes humans were created 10 000 years ago and lived with dinosaurs. It is by far the biggest failure of science education from top to bottom." It is, of course, a failure that NCSE strives to rectify as well as to understand. So for the contentious history of evolution education in the United States, starting with the Scopes trial and continuing to the present day, or for expert advice on how to teach evolution effectively, or for entertaining and educational books for children about evolution, search no further than the following books, now available through the NCSE website: <<http://www.ncseweb.org/bookstore.asp>> — look in the "In the latest RNCSE" section. And remember, every purchase benefits NCSE!



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

SCOPES AND BEYOND

The Scopes Trial: A Photographic History

by Edward Caudill, Edward Larson, and Jesse Fox Mayshark

At last, the opportunity to see the persons and places of the greatest trial of the 20th century! The backdrop and the repercussions of the Scopes trial are ably discussed by Edward Caudill and Jesse Fox Mayshark, respectively, but the heart of the book is its wealth of documentary photographs, annotated by Edward Larson, the author of the definitive history of the Scopes trial, *Summer for the Gods*. (*Library Journal* comments, "The photographs and captions alone are worth the price, showing how the news coverage of the trial transformed a town and shamed a state.") Slim and elegant, *The Scopes Trial: A Photographic History* is simply irresistible.

Summer for the Gods: The Scopes Trial and America's Continuing Debate over Science and Religion

by Edward J Larson

Edward J Larson's Pulitzer-Prize-winning account of the events in Dayton, Tennessee, in the 1920s and their continuing impact on American life provides a historical perspective on the persistent con-

flict between creationism and science. *Summer for the Gods* is endorsed by such diverse readers as Phillip Johnson, Will Provine, and Ronald L Numbers, who says that it "is, quite simply, the best book ever written on the Scopes trial and its place in American history and myth." Larson teaches law and history at the University of Georgia; his latest book is *Evolution: The Remarkable History of a Scientific Idea* (New York: Modern Library, 2004).

***Trial and Error*, third edition** by Edward J Larson

Trial and Error is simply the single most useful resource on the complicated legal history of the creationism/evolution controversy available. "God may have created the universe in six days, but this slender volume evolved over two decades," Larson quips in his preface to its third edition, which he brings up to date with the addition of a chapter on "Mandating evolution: The 1990s and beyond." Writing in *The New Republic*, the historian of science Daniel J Kevles comments, "Larson ... ably illuminates the legal and constitutional issues ... yet he is admirably aware that what transpires in state houses and law courts usually reflects larger social forces."

The Scopes Trial: A Brief History with Documents

by Jeffrey P Moran

Following a detailed 72-page introduction by Moran himself to the Scopes trial and its cultural and historical milieu, *The Scopes Trial* provides original source documents — extensive selections from the eight days of the trial transcript and contemporary coverage of the courtroom as well as cartoons and selections illuminating how the issues of the trial were connected with issues of race, educational freedom, feminism, new religious movements in the 1920s, and local control over education. New York University's Jonathan Zimmerman predicts, "It will become the standard short interpretation of Scopes and anti-evolution." The author is Associate Professor of History at the University of Kansas.

TEACHING ABOUT EVOLUTION

Defending Evolution: A Guide to the Creation/Evolution Controversy

by Brian J Alters and Sandra M Alters

Defending Evolution is an unequivocal must for anyone concerned with evolution education. Ernst Mayr writes, "This book should be in the hands of every educator dealing with the subject

of evolution,” and Eugenie C Scott, executive director of NCSE, agrees, “At last a book for teachers to help them cope with anti-evolutionism. Clearly written and filled with practical advice about the underlying religious and scientific issues prompting student questions, *Defending Evolution* should be on every teacher’s bookshelf.” A board member of NCSE and *RNCSE* associate editor for education, Brian J Alters directs the Evolution Education Research Centre at McGill University.

Teaching Biological Evolution in Higher Education: Methodological, Religious, and Nonreligious Issues
by Brian Alters

From the publisher: “An important new book by the author of the bestselling text *Defending Evolution: A Guide to the Creation/Evolution Controversy*, *Teaching Biological Evolution in Higher Education* examines the controversial issues surrounding this central concept of life science; explores students’ common scientific misconceptions; describes approaches for teaching topics and principles of evolution, and offers strategies for handling the various problems some students have with the idea of evolution due to religious influences. This book is an indispensable resource for all instructors who teach aspects of biological evolution in their college courses.” Alters directs the Evolution Education Research Centre at McGill University.

Teaching About Evolution and the Nature of Science
from the National Academies of Science
Published in 1998 under the auspices of the National Academies of Science, which provides authoritative scientific advice to the federal government, *Teaching About Evolution and the Nature of Science* is addressed to “the teachers, other educators, and policy makers who design, deliver, and oversee classroom instruction in biology. It summarizes the overwhelming observational evidence for evolution and suggests effective ways of teaching the subject. It explains the nature of science and describes how science differs from

other human endeavors. It provides answers to frequently asked questions about evolution and the nature of science and offers guidance on how to analyze and select teaching materials.”

The Nature of Science and the Study of Biological Evolution
from the National Science Teachers Association and the Biological Sciences Curriculum Study

New for 2005, it’s *The Nature of Science and the Study of Biological Evolution*, which — as its title indicates — adroitly interleaves a discussion of the nature of science with a broad perspective on evolution. Consisting of a text for high school students and a CD-ROM for teachers, the material discusses the nature and methods of science, the development of the theory of evolution, seven lines of evidence that converge on evolution, population genetics, natural selection, and primate and human evolution. Both the text and the CD-ROM are imbued with the pedagogical acumen characteristic of the NSTA and the BSCS.

FOR THE CHILDREN

The Sandwalk Adventures
by Jay Hosler

A delightful graphic novel, in which Charles Darwin himself explains the rudiments of deep time, common ancestry, and natural selection to Mara, a winsome befreckled teenager who just happens to live in Darwin’s left eyebrow — she is, after all, a follicle mite. Reviewing *The Sandwalk Adventures* for *BioScience*, NCSE deputy director Glenn Branch praised it for its “engaging art and snappy dialogue” as well as its pedagogical sophistication: “Hosler obviously is aware of the likely misconceptions that his readership will have about evolution.” Also the author/illustrator of the equally delightful *Clan Apis*, a graphic novel about honeybees, Hosler teaches biology at Juniata College.

Darwin and Evolution for Kids
by Kristin Lawson
In *Darwin and Evolution for Kids*, Lawson provides a biography of Darwin combined with a sketch

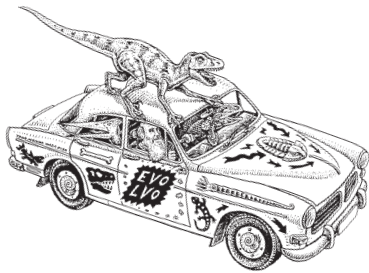
of his ideas and their development, along with “engaging and fun activities where children can: make their own fossils using clay, seashells, and plaster; keep field notes as backyard naturalists; investigate whether acquired traits are passed along to future generations; explore the adaptive strategies plants have developed to distribute seeds; observe how carnivorous plants trap and devour their prey; go on a botanical treasure hunt.” *Darwin and Evolution for Kids* was selected by National Public Radio’s *Science Friday* as one of the best science books of 2003. For ages 9 and up.

Our Family Tree: An Evolution Story
by Lisa Westberg Peters

Charmingly illustrated by Lauren Stringer, *Our Family Tree* is the perfect picture book about evolution for children ages 4–8 (supplemented with explanations, a handful of references, and a timeline for their adult friends). Reviewing *Our Family Tree* in *RNCSE*, Lisa M Blank recommends the book to “[p]arents and teachers struggling for an intellectually honest and yet engaging approach for answering young children’s questions about how life began”. And Ernst Mayr wrote, “If we do not understand evolution, we will never understand our world. How lucky our children are to have this beautiful and moving guide from which to learn!”

Raptors, Fossils, Fins & Fangs: A Prehistoric Creature Feature

by Brad Matsen and Ray Troll
With vividly colored illustrations by Ray Troll (whose delightful illustrations grace every issue of *RNCSE*) and text by Brad Matsen, *Raptors, Fossils, Fins & Fangs* describes the history of animal life from the Cambrian to the present, using representative species from trilobites to you and me. Perfect for children aged 5–9 and the people who love them (with timelines on every page for curious grownups). “Troll and Matsen are the best,” writes Peter Ward of the University of Washington: “This book is for all the kids, grown and otherwise, who still love fossils.”



NCSE on the Road

A CALENDAR OF SPECIAL EVENTS, PRESENTATIONS, AND LECTURES

DATE December 1, 2005
CITY Fairfax VA
PRESENTER Eugenie C Scott
TITLE Why Scientists Reject Intelligent Design
EVENT A lecture sponsored by the Provost, the Dean of the College of Arts and Sciences, and the Krasnow Institute for Advanced Studies at George Mason University
TIME 7:00 PM
LOCATION Dewbury Hall South, George Mason University
CONTACT Ernest Barreto, ebarreto@gmu.edu

DATE April 4, 2006
CITY San Francisco CA
PRESENTER Eugenie C Scott
TITLE The Pillars of Creationism
EVENT A talk for the symposium "Teaching the Science of Evolution Under the Threat of Alternative Views," sponsored by the American Society for Biochemistry and Molecular Biology's Public Affairs Advisory Committee, held at the annual meeting of the Federation of American Societies for Experimental Biology. Other speakers include Kenneth R Miller, Donald C Johanson, and Ted Peters.
TIME TBA
LOCATION Moscone Convention Center
CONTACT Peter Farnham, pfarnham@asbmb.org

NCSE SPEAKERS AVAILABLE

NAME Eugenie C. Scott
TITLE NCSE Executive Director
CONTACT scott@ncseweb.org

NAME Andrew J Petto
TITLE NCSE Board Member
CONTACT editor@ncseweb.org

NAME Glenn Branch
TITLE NCSE Deputy Director
CONTACT branch@ncseweb.org

NAME Wesley R Elsberry
TITLE NCSE Information Project Director
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NAME Nicholas J Matzke
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NAME Susan Spath
TITLE NCSE Public Information Project Director
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NAME Philip T Spieth
TITLE NCSE Director of Operations
CONTACT spieth@ncseweb.org

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know: “serial homology”. I gave him the “short” explanation: specialized structures on the same organism that have been modified through selection to perform different tasks from those performed by the same structures in ancestors. The classic examples are the chelipeds, walking legs, and swimmerets of the crayfish.

When I explained this to him, he looked clearly upset, and said, “you mean [choke] evolution?” This teacher freely expressed his opinion to me: “There is no good evidence for evolution.” In another poignant statement, this teacher expressed the opinion that, “science is just another religion.” We happened to be teaching in the same school when Pope John Paul II came out with his address to the Pontifical Academy of Sciences on Evolution (see <<http://www.cin.org/jp2evolu.html>>), which can be interpreted as reconciliation between the scientific theory of evolution and Roman Catholic doctrine. When I asked this teacher about this he said that, “people misunderstood the Pope’s statement. ... He was not referring to organic evolution.” Although I admit that the obtuse language used in his statement complicates the issue much more than necessary, I think the Pope used the word “evolution” in the same way I, or any well educated person, would use it when referring to biology and science. Strike three!

STANDARDS AND TEACHER EDUCATION

Of course, what is perhaps a greater concern is that Texas, like most states, has standards that all teachers are expected to follow. These standards are meant to assure that teachers are fulfilling their contractual duty and giving students the kind of education they deserve. Under section 112.43, High School Biology, the Texas Essential Knowledge and Skills (TEKS) standards state the following:

(7) Science concepts. The student knows the theory of biological evolution. The student is expected to:

(A) identify evidence of change in species using fossils, DNA sequences, anatomical similarities, physiological similarities, and embryology; and
(B) illustrate the results of natural selection in speciation, diversity, phylogeny, adaptation, behavior, and extinction.

The Texas Education Agency wrote these guidelines, and it should be commended on its unambiguous statement in support of the teaching of evolution. The trouble is in the implementation. Not all administrators require the teachers to write lesson plans, and it is in lesson plans that teachers document the TEKS standards that are covered in their classrooms. And even when they do address the standards in their lessons, there is plenty of room for “spin” in the classroom. For example, one teacher at a school where I taught admitted to me that she was a creationist. I happened to see an essay question from one of her tests: “Explain some of the weaknesses of the theory of evolution, and come up with an alternative theory that explains the diversity of organisms.” It does not take much imagination to figure out the expected answer. I am sure that this teacher wrote on her lesson plans that she was addressing the appropriate TEKS.

Unfortunately, most teachers do not get a good background in evolution. Most have majored in education, with a minor in one of several specialties that are licensed by the state. For the most part, they take introductory classes, with a smattering of upper-level courses. They take very few graduate level courses where they might be exposed to detailed exploration of the real issues in evolutionary biology and learn why biologists are so firm in their support of evolution.

NOT JUST THE LOCAL SCHOOLHOUSE

I also taught introductory biology at the local community college for eight years as an adjunct faculty member and taught biology labs for one year at the local four-year

university. For six of the eight years at the community college, evolution was not even mentioned in the official curriculum. While teaching labs at the university, I took the opportunity to use the planarian as a model to explain the evolution of complex structures, borrowing an example from Stephen Jay Gould (the lab manual used in the course gave evolution only cursory coverage). Anti-evolutionists have used the eye as an example of a structure that could not have evolved. They like to point out that all the structures in the eye have to be working in unison, and in the absence of just one of those structures, the eye no longer functions. Therefore, they argue, the eye could *not* have evolved.

But there is no need for the *whole* eye. Planarians have ocelli that lack a lens and are simple cup-shaped structures that can detect light. Planarians cannot “see” an image, but they can detect gradations of light and dark, which gives them a selective advantage. As I was pointing this out to the class, a young woman in the class interrupted me, visibly upset and argumentative, and criticized me for teaching evolution as if it were fact. She went on for what seemed like ten minutes and I thought to myself, “is this an isolated incident, and if not, is the same thing happening in the lecture component of the class?” I decided to place copies of a statement on the importance of teaching evolution published in *Scientific American* in the mail boxes of the biology faculty at the university. When I told the lab coordinator, about the article, he asked me if I had put my name on the article. I thought that was an odd question, and asked him why. He said there are a lot of very religious people on the faculty. The implication was that I could get in trouble.

WHAT CAN BE DONE?

I have questioned teachers, including the ones I mentioned above. In my own district, I went to the school’s district superintendent to express my concerns over the teaching of evolution and religion in the (public) school in place of contemporary science. In reply I was given a political shrug of the





Is Evolution Arkansas's "Hidden" Curriculum?

Jason Wiles

As I was working on a proposal for a project at the Evolution Education Research Centre at McGill University in Montréal, I received an e-mail from an old friend back in Arkansas, where I was raised, whom I had known since high school. She was concerned about a problem her father was having at work. "Bob" is a geologist and a teacher at a science education institution that services several Arkansas public school districts. My friend did not know the details of Bob's problem, only that it had to do with evolution. This was enough to arouse my interest, so I invited Bob to tell me about what was going on.

He responded with an e-mail describing the scenario. Teachers at his facility are forbidden to use the "e-word" with the kids. They are permitted to use the word "adaptation" but only to refer to a current characteristic of organism, not as a product of evolutionary change via natural selection. They cannot even use the term "natural selec-

tion". Bob fears, and I agree with him, that not being able to use evolutionary terms and ideas to answer his students' questions will lead to reinforcement of their misconceptions.

But Bob's personal issue is more specific, and the prohibition more insidious. In his words, "I am instructed NOT to use hard numbers when telling kids how old rocks are. I am supposed to say that these rocks are VERY VERY OLD ... but I am NOT to say that these Ordovician rocks are thought to be about 300 million years old." As a person with a geology background, Bob found this restriction a bit hard to justify, especially since the new Arkansas educational benchmarks for 5th grade include introduction of the concept of the 4.5-billion-year age of the earth. Bob's facility is supposed to be meeting or exceeding those benchmarks.

The explanation that had been given to Bob by his supervisors was that their science facility is in a delicate position and must avoid

irritating religionists who may have their fingers on the purse strings of various school districts. Apparently his supervisors feared that teachers or parents might be offended if Bob taught their children about the age of rocks and that it would result in another school district pulling out of their program. He closed his explanatory message with these lines:

So my situation here is tenuous. I am under censure for mentioning numbers ... I find that my "fire" for this place is fading if we're going to dissemble about such a basic factor of modern science. I mean ... the Scopes trial was how long ago now??? I thought we had fought this battle ... and still it goes on.

I immediately referred Bob to the people at the NCSE. He wrote to them explaining the situation, and they responded with excellent advice and support. Bob was able

shoulders, and asked, "Well, what do you think we should do, Mr Gonzalez?"

It is an important challenge to us all. State educational agencies set out standards, issue guidelines, and set up achievement exams. But rarely is there any *enforcement* of the standards or any penalty for teachers and schools that intentionally undermine them.

Public officials are most responsive to the political process, as shown when Rod Paige, the former Secretary of Education in the Bush cabinet, remarked that he prefers schools that teach *Christian* values. For many parents — and

unfortunately a number of teachers — Christian values are inherently anti-science. It is clear that having solid support of evolution in state standards is essential, but not enough! We — teachers, parents, concerned citizens — need to pay attention to what is happening in individual classrooms and provide accurate and up-to-date information to break the cycle of anti-evolutionism in the science classroom. As my experiences show, even in the science classroom, a significant number of teachers either avoid evolution entirely or use one of the unconstitutional "two-models" approach.

Perhaps if science teachers received more rigorous training in their chosen fields, including courses in history and philosophy of science; perhaps if future science teachers were required to major in the subject area they will teach, or even take graduate courses in the field; perhaps then our science students will not end up like Alice down the rabbit hole: surrounded by doors to a fascinating world, but all of which are locked!

AUTHOR'S ADDRESS

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to use their suggestions along with some of the position statements found in the NCSE's *Voices for Evolution* in defense of his continued push to teach the science he felt he was obligated to present to his students, but his supervisors remained firm in their policy of steering clear of specifically mentioning evolution or "deep time" chronology.

I was going to be in Arkansas in December anyway, so I decided to investigate Bob's issue in person. He was happy for the support, but even more excited to show me around the facility. Bob is infectious about nature and science education. He is just the kind of person we want to see working with students in this type of setting. He had arranged for me to meet with the directors of the facility, but he wanted to give me a guided tour of the place first.

SELF-CENSORSHIP IN DEFENSE OF SCIENCE?

I would like to describe the grounds of the facility in more detail, but I must honor the request of all parties involved to not be identified. It was, however, a beautiful setting, and the students, 5th graders that day, seemed more engaged in their learning than most I had ever seen. To be sure, the facility does a fantastic job of teaching science, but I was there to find out about what it was *not* teaching. Bob and I toured the grounds for quite some time, including a hike to a new cave he had recently discovered nearby, and when we returned I was shown to my interview with the program director and executive director.

Both of the directors welcomed me warmly and were very forthcoming in their answers to my questions. They were, however, quite firm in their insistence that they and their facility be kept strictly anonymous if I was to write this story up. We talked for over an hour about the site's mission, their classes, and Bob's situation specifically. Both directors agreed that "in a perfect world"

they could, and would, teach evolution and deep time. However, back in the real world, they defended their stance on the prohibition of the "e-word", reasoning that it would take too long to teach the concept of evolution effectively (especially if they had to defuse any objections) and expressing concern for the well-being of their facility. Their program depends upon public support and continued patronage of the region's school districts, which they felt could be threatened by any political blowback from an unwanted evolutionary controversy.

With regard to Bob's geologic time scale issue, the program director likened it to a game of Russian roulette. He admitted that probably very few students would have a real problem with a discussion about time on the order of millions of years, but that it might only take one child's parents to cause major problems. He spun a scenario of a student's returning home with stories beginning with "Millions of years ago ..." that could set a fundamentalist parent on a veritable witch hunt, first gathering support of like-minded parents and then showing up at school-board meetings until the district pulled out of the science program to avoid conflict. He added that this might cause a ripple effect on other districts following suit, leading to the demise of the program.

Essentially, they are not allowing Bob to teach a certain set of scientific data in order to protect their ability to provide students the good science curriculum they do teach. The directors are not alone in their opinion that discussions of deep time and the "e-word" could be detrimental to the program's existence. They have polled teachers in the districts they serve and have heard from them more than enough times that teaching evolution would be "political suicide".

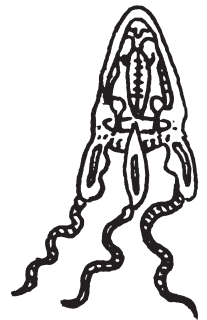
Bob's last communication indicated that he had signed up with NCSE and was leaning towards the "grin and bear it" option, which, given his position and the position of the institution, may be the best option. I was a bit disheartened by the situation, but still impressed with all the good that is going on

at Bob's facility. I was also curious about the climate regarding evolution in other educational facilities in the state, so I decided to ask some questions where I could.

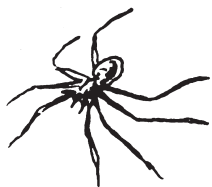
The first place I happened to find, purely by accident, was a privately run science museum for kids. As with Bob's facility, the museum requested not to be referred to by name. I was only there for a short time, but I'm not quite sure what to make of what happened there. I looked around the museum and found a few biological exhibits, but nothing dealing with evolution. I introduced myself to one of the museum's employees as a science educator (I am indeed a science educator) and asked her if they had any exhibits on evolution. She said that they used to at one time, but that several parents — some of whom homeschooled their children; some of whom are associated with Christian schools — had been offended by the exhibit and complained. They had said either that they would not be back until it was removed or that they would not be using that part of the museum if they returned. "It was right over there," she said, pointing to an area that was being used at that time for a kind of holiday display.

Because I had happened upon the place by accident, I had not made room in my schedule for a longer exploratory visit. I did call the museum at a later date to find out more about the removal of the evolution exhibit. After calling several times and leaving a few messages, I finally reached someone who explained that the exhibit had not been removed due to complaints, although people had in fact objected to the display. Rather, it had been taken down to make room for their merger with another science education institution. I am not speculating here, only reporting information that I was given, but when I asked when the newly partnered institution planned on moving in, I was told that the grant for the new space had not yet been written. It could be quite some time.

Later that evening, I had a visit with the coordinator of gifted and talented (GT) education at one of Arkansas's larger public school dis-



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tricts. As before, she has requested that she and her school system be kept anonymous, so I will call her "Susan". Susan told me about a situation she had been trying to decide how to deal with. She had overheard a teacher explaining the "balanced treatment" given to creationism in her classroom. This was not just any classroom, but an Advanced Placement Biology classroom. This was important to Susan, not only because of the subject and level of the class, but also because it fell under her supervision as part of the GT program. Was she obliged to do something about this? She knew quite well that the "balanced treatment" being taught had been found by a federal court to violate the Constitution's Establishment Clause — perhaps there is no greater irony than that two of the most significant cases decided by federal courts *against* teaching creationism were *Epperson v Arkansas* and *McLean v Arkansas Board of Education*. She is quite knowledgeable, and her husband is a lawyer who has written about the *Edwards v Aguillard* evolution case. She also knew that this was unsound pedagogy, but dealing with the issue is not easy in Arkansas.

Susan sincerely wanted to do something about it, but in the end, she had decided to let it go. Her reasoning was that this particular teacher is probably in her final year of service. To Susan, making an issue out of this just was not worth the strife it would have caused in the school and in the community when it would soon be taken care via retirement.

As the discussion progressed that evening, I learned that omission was the method of dealing with evolution in another of Arkansas's largest, most quickly growing, and wealthiest school districts — an omission that is apparently strongly suggested by the administration. I decided to check on this, but made little progress, receiving the cold shoulder from the administration and the science department at that school. However, I spoke with a person who works for a private science education facility that does contract work for this district: "Helen" — she, like the other people I had

visited, requested that she and her employers not be identified. I asked Helen about her experiences with the district's teachers. Her story was that in preparation for teaching the students from that district, she had asked some of the teachers how they approached the state benchmarks for those items dealing with evolution. She said, "Oh, I later got in trouble for even asking," but went on to describe their answers. Most teachers said that they did not know enough about evolution to teach it themselves, but one of them, after looking around to make sure they were safely out of anyone's earshot, explained that the teachers are told by school administrators that it would be "good for their careers" not to mention such topics in their classes.

INADEQUATE SCIENCE EDUCATION

How often does this kind of thing happen? How many teachers are deleting the most fundamental principle of the biological sciences from their classes due to school and community pressure or due to lack of knowledge? How many are disregarding Supreme Court decisions and state curriculum guidelines? These are good questions, and I have been given relevant data from a person currently working in Arkansas. I was introduced to this person, who has clearly expressed his wishes to be kept anonymous (are you noticing a pattern here?), through the NCSE. I will call this science educator "Randy". When I began looking into Arkansas's evolution education situation, the NCSE sent me Randy's contact information.

Randy runs professional development science education workshops for public school teachers. He's been doing it for a while now, and he has been taking information on the teachers in his workshops via a survey. He had a bit of data that he was not sure what to do with while maintaining his anonymity, but he shared it with me. He later posted the same results on an e-mail list-serve for people interested in evolution education in Arkansas, but this is the way it was reported to me.

According to his survey, about 20% are trying to teach evolution

and think they are doing a good job; 10% are teaching creationism, even though during the workshop he discusses the legally shaky ground on which they stand. Another 20% attempt to teach *something* but feel they just do not understand evolution. The remaining 50% avoid it because of community pressure. On the list-serve Randy reported that the latter 50% do not cover evolution because they felt intimidated, saw no need to teach it, or might lose their jobs.

Apparently, by their own description of their classroom practices, 80% of these teachers are not adequately teaching evolutionary science. Remember that these are just the teachers who are in a professional development workshop in science education! What is more disturbing is what Randy went on to say about the aftermath of these workshops. "After one of my workshops at an [state] education cooperative, it was asked that I not come back because I spent too much time on evolution. One of the teachers sent a letter to the governor stating that I was mandating that teachers had to teach evolution, and that I have to be an atheist, and would he do something."

Of course the dichotomy of "you're either an anti-evolutionist or you're an atheist" is a false one. Many scientists who understand and accept evolution are also quite religious, and many people of faith also understand and accept evolution. But here is a public school teacher appealing to the governor to "do something" about this guy teaching us to teach evolution. Given that evolutionary science is prescribed in the state curriculum guidelines, and given that two of the most important legal cases regarding evolution education originated in Arkansas and *Edwards v Aguillard* originated in Louisiana directly to the south (all of these cases resulted in support of evolution education and restriction of creationist teachings in public schools), how exactly would we expect the governor to respond? I am not sure how or even whether Governor Mike Huckabee responded to this letter, but I have seen him respond to

concerned Arkansas high-school students regarding evolution in the schools on television.

The Arkansas Educational Television Network produces a program called “Arkansans Ask” on which the state’s citizens confront the governor about various issues affecting the region. I’ve seen two episodes on which students have expressed their frustration about the lack of evolution education in their public schools. These students obviously care about their science education, and for two years running Huckabee has responded to them by advocating that creationism be taught in their schools. Here is an excerpt from one of these broadcasts, from July 2004:

Student: Many schools in Arkansas are failing to teach students about evolution according to the educational standards of our state. Since it is against these standards to teach creationism, how would you go about helping our state educate students more sufficiently for this?

Huckabee: Are you saying some students are not getting exposure to the various theories of creation?

Student (stunned): No, of evol ... well, of evolution specifically. It’s a biological study that should be educated [taught], but is generally not.

Moderator: Schools are *dodging Darwinism*? Is that what you ... ?

Student: Yes.

Huckabee: I’m not familiar that they’re dodging it. Maybe they are. But I think schools also ought to be fair to all views. Because, frankly, Darwinism is not an established scientific fact. It is a *theory* of evolution, that’s why it’s called *the theory* of evolution. And I think that what I’d be concerned with is that it should be taught as *one* of the views that’s held by people. But it’s not the only view that’s held. And any time you teach one thing as that it’s the only thing,

then I think that has a real problem to it.

Governor Huckabee’s answer has several problems and is laced with some very important misconceptions about science. Perhaps the most insidious problem with his response is that it plays on one of the most basic of American values: Huckabee appeals to our sense of democracy and free expression. But several court decisions have concluded that fairness and free expression are not violated when public school teachers are required to teach the approved curriculum. These decisions recognized that teaching creationism is little more than thinly veiled religious advocacy and violates the Establishment Clause.

Furthermore, Huckabee claimed not to be aware of the omission of evolution from Arkansan classrooms. From my limited visit, it is clear that this omission is widespread and no secret; but it is even harder to understand the governor’s apparent ignorance about the situation in July 2004, when another student called in with similar concerns almost exactly one year earlier on the July 2003 broadcast of “Arkansans Ask”:

Student: Goal 2.04 of the Biology Benchmark Goals published by the Arkansas Department of Education in May of 2002 indicates that students should examine the development of the theory of biological evolution. Yet many students in Arkansas that I have met ... have not been exposed to this idea. What do you believe is the appropriate role of the state in mandating the curriculum of a given course?

Huckabee: I think that the state ought to give students exposure to all points of view. And I would hope that that would be *all* points of view and not only evolution. I think that they also should be given exposure to the theories not only of evolution but to the basis of those who believe in creationism ...

The governor goes on for a bit and finishes his sentiment, but the

moderator keeps the conversation going:

Moderator (to student): You’ve encountered a number of students who have not received evolutionary biology?

Student: Yes, I’ve found that quite a few people’s high schools simply prefer to ignore the topic. I think that they’re a bit afraid of the controversy.

Huckabee: I think it’s something kids ought to be exposed to. I do not necessarily buy into the traditional Darwinian theory, personally. But that does not mean that I’m afraid that somebody might find out what it is ...

SISYPHEAN CHALLENGES

How are teachers like “Bob”, administrators like “Susan”, and teacher trainers like “Randy” supposed to ensure proper science education regarding evolution in accordance with state standards and within the bounds of case law and the Constitution if politicians like Huckabee consistently support and advocate the teaching of non-science and pseudoscience that flies in the face of sound pedagogy and the First Amendment’s Establishment Clause?

It is quite telling that none of the people I spoke with were willing to be identified or to allow me to reveal their respective institutions. In the case of “Bob” and his facility’s directors, they were concerned about criticism from both sides of the issue. They did not want to lose students by offending fundamentalists or lose credibility in the eyes of the scientific community for omitting evolution. “Susan” has been trying to avoid a rift in her district, so identifying her school is out of the question. “Randy” believes that much of the good that he does is at least partly because of his “behind-the-scenes” activity and that he “may do the cause more good by not standing out.”

Some people might assume that the evolution education problems of Arkansas and its governor end at its border. In fact they do not, but I think that we seldom realize the wider influence our local politicians might have. For instance, the





Evolution and Middle-Level Education: Observations and Recommendations

Vince Sperrazza

The 12-year-old's hand goes up at the first mention of the word "evolution": "Is it true we came from monkeys?" It's the first day of school, and I mentioned evolution in a list of topics for the year ahead in my 7th-grade life science classes.

That is the nature of middle school students. Impulsive, inquisitive, focused on their peers, yet they can still be excited about learning. As their brains try to catch up with their fast-growing bodies, they are "hormones with feet," as one adolescent psychologist characterized them many years ago.

Teaching middle school students any subject can be a challenge. Veteran middle school teachers say the average attention span of a 12- or 13-year-old is about 10 minutes. Many teachers agree that it's a good strategy to "change the activity" at least three times in a 40-minute class period.

This is my 31st year teaching 7th-grade science in a small rural public school district about an hour's drive from Syracuse, New York. Science instruction lends itself to fast-paced, inquiry-based lessons, with lots of opportunity

for lab work and informal small group activities.

Back to the question, "Is it true ... ?" I usually respond by first asking "Do you want the long answer or the short answer?" Seventh-graders generally want the short answer. So I answer that we are most closely related to chimpanzees and that the best evidence (stressing evidence) indicates a common ancestor of both humans and modern African apes. Informing the students that we'll study evolution in more depth later in the year usually ends the discussion, as we need to continue with routine opening-day tasks.

Working through the life science curriculum, evolution surfaces throughout. In our discussion of plants, we might talk about the giant horsetails of the Carboniferous forests. With animals, we might talk about amphibians as the first terrestrial vertebrates. In the context of the whole school year, many middle-level teachers (and texts) prefer to study evolution after the genetics unit. This leaves the students with at least a modicum of understanding when describing the inheritance of the best suited traits.

I find it helpful to present evolution by starting out with a good story. *Openers for Biology Classes* prints a classic that puts earth history into a 24-hour clock, while some teachers prefer to start with the story of Charles Darwin and the *Beagle*. Then as the unit progresses and the students become engaged, the teacher can follow the scope and sequence of the curriculum as described in the textbook and in the *New York State Intermediate Level Science Curriculum Guide*.

It is important to present a complex topic like evolution in a manner that is easy to understand for 12-year-olds, but not oversimplified. Beginning teachers might do well to simplify the unit into a few key points.

Earth history, brief overview
Charles Darwin, explorations and writing — *Variation, inheritance and selection; natural selection leading to speciation; evidence for evolution* — *fossil record, homologous structures, and more*

Human evolution, including "Lucy" to modern humans

Educational Commission of the States is an important and powerful organization that shapes educational policy in all 50 states. Forty state governors have served as the chair of the ECS, and the current chair is — you guessed it — Governor Huckabee of Arkansas.

Because anti-evolutionists have been quite successful in placing members of their ranks and sympathizers in local legislatures and school boards, it is imperative that

we point out the danger that these people pose to adequate science education. Although each school, each museum, or each science center may seem to be an isolated case, answering to — and, perhaps trying to keep peace with — its local constituency, the larger view shows that evolution is being squeezed out of education systematically and broadly. Anti-evolutionists have been successful by keeping the struggle focused on the

local level and obscuring the larger agenda, but the educational fallout is widespread ignorance of the tools and methods of the sciences for generations to come. The scientific literacy of our future leaders may very well depend on it.

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In addition, it is helpful to have a good fossil or cast collection, as well as a good collection of instructional graphics on evolution. I find it important to explain the branching model of evolutionary descent in contrast to the popular cliché of the ladder diagram. In addition, a good middle-level science text should have age-appropriate activities on evolution. As far as budgeting class time, in my experience, more than a week is needed to do the job.

Middle-level science texts vary widely in their approach to evolution. In evaluating recently published texts, I looked at the contents and index first, then the chapters and ancillary materials. Some texts use the word “evolution” directly in their chapter titles, while some seem to fear the controversial “e-word.” This will show up in the index too. I found that some texts purposefully omit any reference to human evolution, while others do a good job presenting human evolution in a way that the students can understand.

Inevitably, the creation question arises in class. Some recommendations for a beginning teacher include discussing:

“Theory” as used in science is much more than a “just a guess.”

Creationism, in any guise, is religion, not science.

Students are entitled to their religious beliefs, but religion is not science.

The *New York State Curriculum Guide* does not include creationism.

Teaching religion does not belong in any public school.

Of course, 12-year-olds most often repeat their parents’ opinions. However, to the 7th-grade brain, peers count most, teachers are down the list, and parents inhabit the very bottom. Often, I find students understanding evolution, while their parents simply refuse. Yet a teacher needs to be aware there may be vocal student opposition to evolution. A few years

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ago, one student rather vehemently wanted me to teach creationism as an alternative to evolution. Her classmates were quick to respond. “Didn’t you listen?” they said. “Religion doesn’t belong in science class.”

Engaging 7th graders in a unit on evolution can be challenging. However, in over 30 years of teach-

ing, I have found students to be quite interested in both understanding the evolution of life on earth and the scientific evidence that explains it.

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SELECTED RESOURCES FOR MIDDLE-LEVEL TEACHERS AND STUDENTS

Books

Allen K and others. 2005. *Holt Life Science*. New York: Holt, Rinehart & Winston.

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INTERNET RESOURCES

Becoming Human — from the Institute of Human Origins, a “journey through the story of human evolution,” a Webby “Best Science Site,” includes a learning center: <<http://www.becominghuman.org/>>.

Middle Level Science On-Line — the author’s website: <<http://www.angelfire.com/ab/vsperr>>.

National Center for Science Education — <<http://www.ncseweb.org/>>.

New York State Intermediate Level Science Curriculum Guide — from the New York State Education Department: <<http://www.emsc.nysed.gov/ciai/mst/scirg.html>>.

The Panda’s Thumb — a place to discuss evolutionary theory, critique the claims of the anti-evolution movement, and defend the integrity of both science and science education: <<http://www.pandasthumb.org/>>.

Science Odyssey — “You try it”: human evolution activities for students: <<http://www.pbs.org/wgbh/aso/tryit/evolution/>>.

Talk.Origins Archive — dedicated to the scientific study of human origins: <<http://www.talkorigins.org/>>.

Understanding Evolution — the best “one stop shopping for evolution education”: <<http://evolution.berkeley.edu/>>

University of California Museum of Paleontology — all about fossils, geologic time periods, and more: <<http://www.ucmp.berkeley.edu>>.



Nothing Wrong with Discussing Evolution in School

Lisa Westberg Peters

Under the newly approved science standards, Minnesota's youngest students will be expected to understand that biological populations change over time. Students will need to know that many organisms, such as dinosaurs, used to live on earth but are now extinct. This understanding of basic science can't come soon enough.

A suburban Twin Cities elementary school invited me to speak to its students recently about my work. I have written several children's books, including a science book about our intimate connection to earth and life's history. This book recently won the Minnesota Book Award for children's nonfiction. The school agreed to prepare for my visit by reading and discussing my books with the students.

The day before my presentation, the school sent me an e-mail. The faculty and the principal had discussed whether it was a good idea to share a book about evolution in their school and they decided that without much more in-depth discussion, it was not. They hadn't shared my evolution book with the students, and they preferred that I not share it either. Later, on the phone, I learned that parents with certain religious beliefs would object to the presentation of this book. The school was asking me to censor myself, but the idea didn't much appeal to me. I

knew I would do a disservice to myself and other writers by agreeing to this surprise, last-minute request.

What if parents had come to this same school arguing that the earth was the center of the universe? Teachers, well familiar with the scientific evidence, would have continued teaching their students the facts: the earth is not the center of the universe and here's the evidence for that position. Even Pope John Paul II, who must be as devout as any Christian, accepts the idea that life has evolved. Millions of Christians, Jews, and Muslims have a concept of God that is large enough to include the process of evolution. But I was asked not to discuss this fascinating subject in a Minnesota school. Many other elementary schools avoid it, too. Some teachers tell me they wouldn't dare teach evolution. A southern Minnesota educator warned me in hushed tones that her town was pretty religious. I hear the word "touchy" all the time.

This widespread timidity comes, in large part, from ignorance. Elementary teachers reflect the general population: They don't know much about evolution. If they did, they would have captive audiences. They could tell their students that we share 98% of our genes with our closest relatives, chimpanzees. They could ask: Is it the remaining 2% that makes us wear platform shoes and dye our hair purple? What child would not be intrigued by that discussion?

While we wait for the new science standards to force teachers to bone up, here is a brief biology lesson: Elementary teachers have

backbones, inherited from the earliest fish in ancient seas. Teachers should use their backbones to stand tall and teach basic science. Tell the kids who object that they don't have to accept it, but they do have to understand it to graduate. Teach students about the wide range of creation stories, too, but do it during social studies.

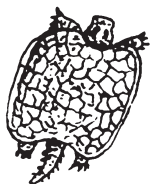
Teachers have lungs, also inherited from early fish. They should use their lungs, take a deep breath and repeat: Evolution is not just one explanation for the diversity of life; it's *the* scientific explanation. Evolution is not a belief system that you take on faith; you examine the evidence for it and accept it or not. Teachers have legs and feet, inherited from early amphibians. Teachers should use their legs and feet to politely escort anyone who protests the teaching of basic science to the front door. And finally, elementary teachers have large brains, inherited from the earliest hominins. They should use those great brains to read more and learn more about evolution. When a parent comes in arguing that life hasn't changed over time, these informed teachers can continue teaching the facts: life has indeed evolved, and here's the ample evidence for that position.

Knowledge is power and elementary teachers need more of both.

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Teachers' Comments on Evolution Education

Our locus of control is in the classroom, and that is where we will have the greatest impact. My students don't realize coming into my class that I consider teaching them about evolution to be my most important objective, and I don't want to blow my cover. On the final exam, I survey them and ask what are the biggest things they learned or what stands out most in their minds. Close to two-thirds of the students make some mention of evolution; it's right up there with the pig dissection that we finish two days before the final.

I think our efforts are best focused

on the members of our own profession who a) have a substandard understanding of evolution and therefore do a poor job of teaching it; b) allow their own religious views to interfere with their responsibility to teach evolution properly; and/or c) are too scared of riling people to do it justice. Evolution is not something that we can expect a 15-year-old to understand if we skim over it in five days or confuse them with "intelligent design" or creationist pseudoscience. The way I see it, I start teaching evolution in late November with cellular genetics. I don't actually use the word until late January or early February when we actually get into that part of the course. After a good 4-5 weeks of work explicitly teaching evolution, it continues to be a recurring theme for the rest of the year. If we [teachers] don't do a

good enough job of providing all of the evidence that has made evolution the scientific theory (in the true sense of the word "theory") it is, then we have no one but ourselves to blame when kids grow into adults who think it is controversial.

I teach evolution, and I am very clear on what that means.

I back it up with specific examples and evidence from real examples and not just hypothetical ones. There are multiple examples of observed natural selection and speciation to draw from. I am also ready to answer their potential questions about so-called "problems" with evolution (holes in the fossil record, and so on) sensitively and scientifically. I weave it throughout my curriculum so it gets the central importance it deserves.

But I have had pressure from parents, students and even colleagues to teach non-evolution, usually dressed in the form of "intelligent design". I stand firm and do not let them intimidate me. The most tense time I ever had was with a very assertive parent during a conference. He had been bringing up the topic of "intelligent design" at school board meetings. He said he felt that students should get both sides of the debate, and that they deserved to know about special creation so they could make an informed decision. I told him, "I agree. I will teach the science. Your religious leaders can teach the theology. Then they will have both." I guess he couldn't

argue with my logic, because he dropped it. I have not had a problem since.

There is sometimes a need, though, to be extra cognizant and sensitive of where students are coming from. I have had some "talks" with certain students who have come to see me during office hours. They are often dealing with their own spiritual doubts, so I have told them that they need to know the scientific theory of evolution thoroughly so they can make an informed decision, as well as learn the content of my class, and that usually defuses the issue. I want them to understand evolution and the wealth of evidence that supports it, not feel intimidated and forced into it.

The conflict will be there, unfortunately, so my advice to fellow teachers is to arm yourself with all the science you can and stand firm.

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The Taboo Standard

Marni Landry

High school biology teachers cope with controversy every time they teach the theory of evolution in the public school classroom. Fear and ambiguity force these instructors to avoid teaching ideas that are the pillars of scientific knowledge. The battle between teaching evolution and creationism looms over every science teacher's head; the inconsistency in science standards among states and the inability of many administrators to uphold them inhibits teachers' ability to deliver instruction on evolutionary theory in an effective manner. When teachers are unsure about what to teach and how to teach it, students suffer.

As a master's degree candidate, I had proposed a study to survey one district's life science teachers concerning their attitudes and experiences associated with teaching the theory of evolution. My original proposal and my edited versions were turned down by school district administrators with the explanation that the topic of evolution was "too controversial". The irony of this position is palpable: If the topic is too controversial to discuss, why is it required by our state standards?

The cultural controversy associated with teaching evolutionary theory seems completely unavoidable. Because 43 states require at least two years of science for high school graduation (Blank and Langesen 1997) and 93.4% of all high school seniors earn biology credits (National Science Board 1998), it is evident that nearly

every high school student will take biology, and learn that evolutionary theory is the unifying foundation of biology. The general public, however, is deeply divided whether it wants evolution taught in public school science classes. Recent polls show that 83% of respondents thought evolution was appropriate for the classroom; an almost equal 79% felt the same about creationism. Furthermore, many believed the apparently contrasting views to be compatible; 68% thought it was possible to believe in evolution and some form of divine origin (Glanz 2000).

In most cases, the standards are quite clear, but are in conflict with the *instructors'* religious beliefs. With 86.2% of all Americans identifying themselves as Christians, it is impossible to believe that none of the thousands of US biology teachers are. A 1999 survey showed that roughly one-third of teachers felt that equal time should be given to creationism in their science classes (Scott 1999).

The district where I proposed my study is the largest in the state, in one of the fastest growing cities in the United States (Arizona Department of Economic Security 2000). This district is racially diverse, with a relative student body ethnic composition of: Hispanic 63.0%, Anglo 20.2%, African American 11.3%, Native American 3.4%, and Asian 2.1% (Phoenix Union High School District 2000). Since 86.2% of all American respondents identify themselves as Christians, and the majority of responding Hispanics identify themselves as Catholics (Adherents.com 2001), it is safe to assume that most of students in this district are Roman Catholic. Although statistically a majority of the district's population must be Christian, it is important to realize that not everyone is — and not

everyone is the same *kind* of Christian. If we decide to include creationism in order to appeal to some Christian denominations, it would certainly create new controversy among others.

WHAT TEACHERS DID SAY

Although my original proposal was turned down, I did complete a pilot study of high school science teachers in preparation for my thesis research to understand the backdrop against which evolutionary theory had to be taught. In this study, 17% of teachers felt that creationism should have equal representation in the classroom; 17% were not sure what their district standards say about evolution; and 17% said that evolution goes against their religious beliefs.

Fifty percent of respondents reported having had a confrontation with a student or parent about evolution. In these situations, some teachers did not know what their educational obligation was concerning evolution. They were either unclear on the specific state standards concerning evolution, or found the standards so ambiguous as to lend themselves to broad interpretation (see Lerner 2000).

Other responses show that 49.5% of my sample did not feel that their administration would back them in a confrontation over evolution. However, even more troubling is the very fact that I was not even allowed to *administer* the final survey. What better proof could there be that there is a problem with teaching evolution in the schools that the fact that it was considered too controversial even to *ask* about it in a survey of teachers who were required by state standards to teach it?

Teachers must feel supported when teaching state-mandated standards. They must have the

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backing of their administrators and the community. But when administrators are reluctant even to allow a discussion of what is being taught, how it is being taught, and why, it is clear that we are a long way from this ideal.

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TABLE I. THE OFFENDING QUESTIONNAIRE

| | AGREE COMPLETELY | AGREE SLIGHTLY | DISAGREE SLIGHTLY | DISAGREE COMPLETELY |
|---|---------------------|-------------------|----------------------|------------------------|
| I have helped to write the district or state science standards. | 33% | | | 67% |
| I would like to contribute in the writing of the district or state science standards. | 67% | | 16.5% | 16.5% |
| I know specifically what the district standards are concerning the theory of evolution. | 50% | 33% | 17% | |
| I have avoided details about the origin of life in order to avoid conflict in my classroom. | 17% | | 17% | 67% |
| The theory of evolution goes against my religious beliefs. | | 16.5% | 16.5% | 67% |
| If I were to get into a confrontation with a student or parent concerning the theory of evolution, I feel that [the] administration would support my actions. | 16.5% | 33.% | 33.% | 16.5% |
| I feel that creationism (creation science) should be taught parallel to evolution in the classroom. | | 16.5% | 16.5% | 67% |
| I am concerned over the fact that many states have removed evolution from their science standards | 50% | 33% | | 17% |
| Students must understand the theory of evolution in order to understand the study of biology | 50% | 33% | | 17% |
| I have experienced conflict with a student, parent, or administrator concerning my teaching of evolution. | 17% | 33% | | 50% |

RESULT OF PILOT SURVEY

Range of grades taught: 9-12

Years teaching: mean 12.5 years, median 8 years.

Range of instructor's level of education:

Bachelor's + 15 hrs — Master's + 40 hrs

Mean class size: 30 students.

Comments and suggestions:

Explain the difference to students between evolution, natural selection, and common ancestry.

Present physical evidence that is undeniably evolutionary.

Explain that it is the teacher's job to ensure students understand the scientific position on evolution, and let students make up their own mind. It seems that some teachers use evolution as their religion, and do more harm than good to their students.

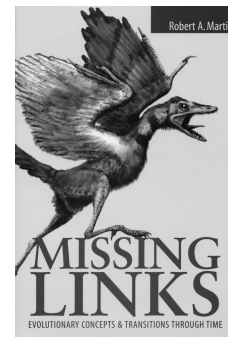
BOOKREVIEWS

MISSING LINKS: EVOLUTIONARY CONCEPTS & TRANSITIONS THROUGH TIME

by Robert A Martin

Sudbury (MA): Jones and Bartlett Publishers, 2004. 303 pages

Reviewed by Kenneth D Angielczyk, California Academy of Sciences



Among the most consistently misunderstood parts of evolutionary theory is the concept of a “missing link.” Typically people think of missing links as organisms that bridge a gap between two disparate groups, such as between fish and amphibians, or between reptiles and mammals. Sometimes a living organism is portrayed as transitional between two other types of living organisms. For example, a chimpanzee might be used as a link between living monkeys and humans. Although these modes of thought often appear in the popular media, they are based on a ladder-like picture of evolution that scientists have long recognized as inaccurate. Moreover, the persistence of “ladder-thinking” makes it difficult for many people to grasp the true nature of evolutionary transitions, and the ways biologists and paleontologists go about reconstructing the history of life. Robert Martin’s *Missing Links: Evolutionary Concepts & Transitions Through Time* attempts to correct many of these misconceptions by presenting a general introduction to evolutionary theory, as well as numerous examples of how scientists have used data from the fossil record and the living world to understand evolutionary transitions.

Missing Links is more than just a narrative recounting of different

evolutionary transitions or descriptions of putative transitional forms. Following a short definition of “missing link,” the first three chapters provide an introduction to different biological and geological concepts that are relevant to evolutionary theory, including the scientific method, plate tectonics, the dating of rocks and fossils, the mechanism of natural selection, speciation and extinction, and the preservation of fossils. Martin then proceeds with nine chapters describing different case studies. The examples he discusses are drawn heavily from the vertebrate fossil record, and many will be familiar to anyone with an interest in vertebrate paleontology (for example, the evolution of whales from terrestrial ungulates or the dinosaur-bird transition). Beside presenting data and interpretations, many chapters include anecdotes about the people involved in the discoveries, which help to put a human face on the science.

The book closes with an epilog addressing some of Darwin’s concerns about missing links and the fossil record. A glossary of definitions for many of the terms used in the book is provided, and all chapters include short lists of references for further reading. Overall, *Missing Links* offers an easy-to-read introduction to the science of paleontology for readers whose previous experience with the field is based mainly on popular books and television. Moreover, Martin’s examples span many scales of evolutionary transition, from subtle changes in tooth morphology in voles to the origin of birds, mam-

mals, and tetrapods, and it is hard not to be impressed by the scope of the history preserved in the fossil record when reading the book.

Nevertheless, I found *Missing Links* to suffer from two problems that affect its suitability for the intended audience. The first stems from the difficulty of simplifying complex concepts and data in a way that is lucid and well-organized, but also accurate. This often leads to juxtapositions of explanations with obscure details and personal stories. For instance, it seems clear that one of Martin’s goals is to show how scientists develop and test different evolutionary hypotheses. An example he uses is found in the chapter on bird origins. There we learn that Jacques Gauthier, Kevin Padian, and Luis Chiappe have conducted phylogenetic analyses that suggest that birds are a subgroup of carnivorous dinosaurs. Martin provides a list of characters that support this hypothesis, but some of these features are likely to be unfamiliar to anyone without a scientific background. Moreover, although the work of Gauthier, Padian, and Chiappe is “impressive and very convincing to many enthusiasts,” Alan Feduccia believes the observed similarities are the result of convergent evolution. Unfortunately, we are not told why Feduccia believes this, how his hypothesis can be tested, or why most workers do not accept it. It is not difficult for a reader familiar with the primary literature and the personalities involved to be able to follow the argument, but I fear that the lay audience to whom the book

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is directed may not fully grasp why the controversy exists or how application of the scientific method can lead to its resolution.

The second problem is more specific, and of importance to more advanced readers. Although the book's focus is on missing links, Martin's explanation of this concept is problematic. The definition he uses is simple; missing links are organisms that connect different lineages. However, this definition is incomplete for two reasons. First, it does not emphasize that the organisms in question are common ancestors, and that at some level any two individuals are related because of their descent from a common ancestor. Second, although we might never find the common ancestor of two lineages in the fossil record (or recognize it as such if we do find it), we can use the distribution of different features among organisms to identify which share recent or distant common ancestors, and to make inferences about what those common ancestors were like.

For example, the famous extinct "mammal-like reptiles" are not missing links between the lineages that include reptiles and mammals because neither group evolved into the other. Instead, the link between these two groups is the common ancestor they share. As the earliest members of the mammal lineage, the "mammal-like reptiles" help us to understand what features were inherited from this common ancestor, as well as how those characters changed during the subsequent history of the group. Ultimately, this criticism boils down to a need for more direct inclusion of phylogenetic information in the different case studies.

Phylogeny (or the genealogical ordering of organisms) is the key to understanding how different lineages are connected, and how features change in each of those lineages. Several schematic phylogenies appear in *Missing Links*, but they often receive only passing mention and are not always consistent with current hypotheses. I think readers would come away with a much stronger understanding of why traditional portrayals of missing links often are inaccurate

if the concept were explicitly reviewed in the context of phylogeny, and the phylogenetic relationships of organisms were used consistently as a framework for structuring each of the examples.

Despite these flaws, I think *Missing Links* has the potential to be a useful resource. In particular the book seems very well suited as a text for an introductory class on evolutionary theory and the fossil record. The information it provides is enough to get students thinking about the different case studies and concepts, which can then be developed further and synthesized with the help of an instructor. Indeed, any attentive reader will come away from the book with questions and wanting to learn more about evolution. The different examples also are an ideal foundation for discussions of how scientists develop and test hypotheses, and how knowledge progresses as a result of this process. Increasing the public's knowledge of how science works and making evolution accessible to everyone are critical goals for educators and scientists, and *Missing Links* is a step in the right direction.

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THE HERETIC IN DARWIN'S COURT: THE LIFE OF ALFRED RUSSEL WALLACE

by Ross A Slotten
New York: Columbia University Press, 2004. 602 pages

Reviewed by Jane R Camerini

... A man's following is not so much the sum of all the people who favour his various ideas as it is the residue left after subtracting all those whom he has affronted by one or another. Subtract the gentlemen and those vested interests who were shocked by Wallace's socialism, the

scientists who scoffed at spiritualism, the medical men who defended vaccination, and the conservative religious folk who were shocked by evolution — and who is left to sing Wallace's praises? — Hardin (1959)

When Garrett Hardin wrote this, Alfred Russel Wallace was indeed the black sheep of evolutionary theory's lineage. But fortunately, Wallace's life and work, especially his role as co-discoverer of the theory of evolution by natural selection, have recently become the focus of revitalized interest. Who is left to sing Wallace's praises? A surprising number of new books on Wallace, including biographies (Wilson 2000, Raby 2001, Shermer 2002), an intellectual history (Fichman 2004), and reproductions of his writings (Berry 2002, Camerini 2002, Smith 2004), suggest that the "neglect" of Wallace is being redressed. Slotten's biography of Wallace does much more than sing praises; he offers a balanced and thorough account of Wallace's long and varied career.

This is a solid, well-researched, and highly readable book, justifying the nearly 500-page narrative (plus notes, bibliography, and index). The book has much to offer to educators, historians, and scientists. Slotten carefully seasons the narrative with contextual details, at times adding a richness to events for which limited documents remain, at other times offering original insights and interpretations. For example, he provides ample historical and biological information about the preparations Wallace and his naturalist friend Henry Walter Bates made for their collecting trip to the Amazon, including a description of state-of-the-art preservation techniques, contemporary practices in the trade in natural history specimens, and a brief comparison with Darwin's experiences with hunting and taxidermy. Slotten's thor-



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ough reading of archival letters led him to describe Wallace's falling out with Bates in far more detail than other biographers. The chapters on Wallace's eight-year journey to the East Indian Archipelago are excellent, showing an appreciation for the vicissitudes of fieldwork as well as articulating the intellectual and scientific progress of the journey. Slotten's measured account of the epochal publication of the 1858 paper is aptly contextualized as one event among many during Wallace's adventures in the Eastern Archipelago.

One of the major strengths of the book is that it fleshes out Wallace's views on spiritualism and on human evolution in relation to his scientific colleagues and the larger intellectual community. The fact that Wallace became something of an outsider is well-known, but the details that Slotten articulates lend substance and texture to the facts. Wallace made many social contacts in pursuing non-scientific interests, especially socialism and spiritualism, and Slotten shows the consequences of the loss of respect by some of his contemporaries. In an even-handed and respectful way, Slotten takes the reader through the decades of Wallace's forays into unpopular causes and scientific controversies, including his contested relationship with William Benjamin Carpenter and the lengthy disagreement with George Romanes.

In describing a book Wallace published in 1878, *Tropical Nature and Other Essays*, Slotten asserts that it anticipates a concern with the environment that would not fully emerge until the 20th century. He goes on to call it the spiritual forerunner of Rachel Carson's *Silent Spring*. *Tropical Nature* is replete with appreciation and description of the biology, climate, and evolutionary history of tropical regions, to the extent these were known, but conservationist or environmentalist messages are somewhat dispersed and indirect. Wallace himself did not emphasize this strand of his thinking, although his warnings are there if one seeks to discern them. It might have been helpful if Slotten's reading of this rarely dis-

cussed book, particularly the conservationist spirit he sees, were more clearly spelled out.

Slotten neither idealizes nor judges his subject. The book gives readers a sympathetic, informed understanding — a feeling for — one of the most interesting men of his time, who made highly significant, at times pivotal, contributions to evolutionary thought. In the final chapter, we read of the accolades bestowed upon Wallace and of the mysticism, a sort of evolutionary theism, of his final years. The ideas that separated Wallace from more strictly scientific naturalists remain at the heart of present-day conflicts between advocates of organic evolution and those who find compelling evidence for an intelligence that guides the mysteries of the origins of life. This is a worthwhile, well-written book that will reward its readers with an enhanced understanding of the history of evolutionary thought and of one of its least well understood protagonists.

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AN ELUSIVE VICTORIAN: THE EVOLUTION OF ALFRED RUSSEL WALLACE

by Martin Fichman
Chicago: University of Chicago Press, 2004. 382 pages

Reviewed by Charles H Smith,
Western Kentucky University

The recent re-examination of the life and work of naturalist and social critic Alfred Russel Wallace (1823-1913) has led to the production of more than a dozen monographic studies over the past eight years or so, and the trend continues with this new analysis by historian of science Martin Fichman. There are good reasons for all this attention: apart from his fame as the "other man" in the story of the realization of the theory of natural selection, Wallace's reputation as perhaps the pre-eminent field biologist/tropical-regions naturalist in history has made him an ideal candidate for re-appraisal in view of the ever-accelerating biodiversity studies movement. Even beyond this, however, Wallace's career presents a number of further potential sources of interest for today's workers: (1) his ideas on natural selection and the speciation process include points that are still debated; (2) his recognition as the father of the study of zoogeography, another field that has been rejuvenated by the growing interest in biodiversity; (3) his social activism as one of his time's most committed and vocal humanists, a true champion of the "little guy" who continually battled unfair and immoral practices and laws; (4) his deductive studies on the physical

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environment of Mars and other celestial bodies that made him one of the first important exobiologists; and (5) his cosmological beliefs that led to his becoming one of the originators of the anthropic principle. Nor does the list really end there: for example, he was also one of the first to use statistical analysis in an epidemiological context in his anti-vaccination-related studies of smallpox and was an early proponent of the paper-dollar-based economic philosophy later adopted by some Chicago School economists.

It would be too much to ask that the world-view of such a well-spring of creativity should turn out to be a straightforward one. Wallace's motives, in fact, are anything but transparent to the casual, or even intent, student of his work. Of course it is easy enough to admire casually a man who was both physically and intellectually courageous to the degree Wallace was — even a passing look at his life and activities, including, just to begin with, his utterly solitary twelve years in the tropical forests, support for the theory of evolution at a time when such was hardly the norm, and full-blown and vocal adoption of spiritualism, cannot help but leave a strong impression — yet beyond such obvious connections there is a good deal more that might be engaging the interest. For many years, unfortunately, the core elements of Wallacian thought have been left to molder in the shadows while the more sensational elements of his life have either been relayed with simple awe, or, alternatively, ridiculed. This is partly the fault of Darwin (if only for being in the way), partly the fault of Wallace (for not being even more demonstrative, or perhaps better organized in his efforts), and partly *our* fault for our prejudgments. Old biases often die slowly ...

Martin Fichman's excellent study of Wallace goes a good deal further than others have to address our chronic misperceptions of the man. Fichman has used his many years of experience as a Victorian Era social historian and historian of science to create a view of Wallace that both adroitly links him to his time, and looks toward a more

advanced interpretation of his thoughts. The approach is loosely biographical, but is also contextualist to the extent that he frequently disengages from a mere chronology of the events of Wallace's life to consider particular kinds of associations (for example, there is an interesting discussion of the intellectual and social parallels between Wallace and two central American philosophers, William James and CS Peirce). It is therefore as much an intellectual history as it is a biography per se. Fichman has also served his readers well from the standpoint of carefully researching his subject, as referrals to many new archival and other sources demonstrate. Finally, his writing style, while perhaps not lively enough to invite a mass readership, is nevertheless light and accessible. I did see a few minor factual errors that Fichman perhaps should have noticed and corrected (for example, his statement that Wallace's wife was 18 at the time of their marriage — actually, it had been known for a couple of years before the book came out that she was really 20), but these are of no great consequence to the main thrust of the book.

Overall, this is the best study yet both of Wallace the man, and Wallace the intellectual. Even so, one cannot help but feel that Fichman has perhaps put the cart before the horse here. By producing the sociohistorical portrait he has he implicitly embraces the notion that the "the social environment produces the man" approach to history will yield the most instructive results in this instance. I have my doubts. Hardly any scientist in history has been so forthright in saying exactly what he believed — implications be damned — as Wallace was; probably not surprisingly, his reputation has suffered accordingly. Still, his successes were many and his actual failures (that is to say, matters on which he has been *demonstrated* to be incorrect outright) few. One could argue that an ultimately satisfactory sociohistorical study of the man remains years away from being possible for the simple reason that workers still cannot agree on a prior matter: exactly *what* he believed, and when, and how his

ideas fit together. For example, many continue to think that Wallace underwent a "change of mind" in the mid-1860s regarding the applicability of natural selection to the evolution of humankind's higher elements of consciousness, perhaps because of his adoption of spiritualism, or perhaps because he had lost faith in natural selection's ability to illuminate social processes. Fichman does touch on this matter, but only to the extent of expressing some doubts as to the "change of mind" theory's validity: he alludes to an alternate "no change of mind" interpretation of the events, but stops short of a full-hearted attempt to trace out its possible implications.

The reader may expect that we have not heard the last of efforts to get to the bottom of Wallace's world-view: the story is only just beginning to get interesting.

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ANCIENT EARTH, ANCIENT SKIES: THE AGE OF THE EARTH AND ITS COSMIC SURROUNDINGS

by G Brent Dalrymple
Stanford: Stanford University Press,
2004. 247 pages

**Reviewed by Timothy Heaton,
University of South Dakota**

The age of the earth has become a touchstone issue in the creation/evolution debate. Yet it is a simpler issue to address scientifically than the complexities of evolution, and one the general public can easily understand. Nevertheless the propaganda rages. The Institute for Creation Research (ICR) is about to release the findings of its RATE (Radioisotopes and the Age of The Earth) project, offering rea-

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sons to doubt the evidence for an old earth. On the other hand, old-earth creationist Hugh Ross just released his book *A Matter of Days* (Colorado Springs: NavPress, 2004), which argues strongly for an old universe (while denying evolution). So the public is being bombarded with conflicting information that makes the dating methods seem complicated and suspicious. Making science accessible and understandable is an important step in the education process. Fortunately one of the leading authorities on radiometric dating, Brent Dalrymple, has made an important contribution to this effort.

Inspired by the 1982 Arkansas trial, Dalrymple wrote his book *The Age of the Earth* (Stanford: Stanford University Press, 1991). In 474 pages he introduced the various methods of radiometric dating in great detail, including mathematical formulas. But he realized that this work was still too long and complicated for the casual reader. Since publication of that book, several refinements have been made to the ages of celestial objects based on techniques other than radiometric dating. In hopes of making radiometric dating more understandable and showing its harmony with other, unrelated methods of estimating ages, Dalrymple has written the 247-page book *Ancient Earth, Ancient Skies*.

Dalrymple does an excellent job of making his subject matter understandable. He begins with a thorough discussion of how science works, and what assumptions are needed to make it work, as well as its limits. "Science can determine the age of the Shroud of Turin ($AD\ 1325 \pm 65$ years) but has nothing to offer on its religious significance" (p 3). He discusses the difficulty of comprehending deep time, but he also explains how science can approach such far-reaching issues and give confident estimates on ages using relatively simple techniques. He discusses a host of early attempts to date the earth using Scripture, sea-level decline, saltiness of the oceans, rates of sediment accumulation, and heat loss from the earth. These examples give the reader a thorough concept of what finding an accurate

geologic clock is all about. Dalrymple uses this discussion to illustrate how radiometric dating circumvents the pitfalls of earlier, discredited methods.

Perhaps the most impressive feature of the book is how it leads the reader so quickly and smoothly from the basic logic of radiometric dating to cutting-edge methods and findings. Even many geologists have much to learn here. Dalrymple takes the reader through simple accumulation clocks, multiple decay series, isochrons, and the complexities of lead isotopes. He also discusses precision and sources of error. He freely admits that decay rates can be altered in certain cases, but he explains how these situations do not apply to the rocks being dated. Furthermore he takes the reader through techniques used to obtain dates from disturbed systems with methods like incremental heating (for argon) and discordia lines (for lead), illustrating how these methods are self-checking and reliable. This is done with easy-to-understand illustrations and clear, simple explanations.

Dalrymple never loses sight of his primary topic, which is the age of the earth and the universe. After introducing the dating tools, he discusses at length earth's oldest rocks, including their locations, tectonic history, and mineralogy. He makes their investigation an adventure story. He then moves on to the moon and meteorites, discussing their diverse mineralogy and history in interesting detail. The book ends with a look at the astronomical methods used to date the Big Bang, galaxies, and stars. This includes methods that dovetail with radiometric dating, such as lead isotope ratios, plus other independent methods such as starlight travel times, the temperature of background radiation, stellar evolution in globular clusters, and vibrations within the sun. He shows how the ages obtained from

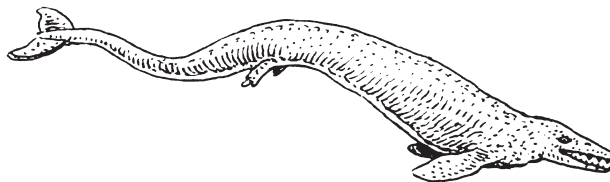
all these methods are consistent with their obvious relative sequence (Big Bang first, then galaxies, then the earth), giving confidence to the conclusions.

Is anything missing from the book? Although this book was inspired in part by the claims of young-earth creationists, Dalrymple does not address these claims at all. He merely explains the methods and conclusions of mainstream science on the age of the earth and universe. It would be useful to have someone of Dalrymple's expertise address all the diverse methods thrown about by the creationists, but this book does not do that. Fortunately, but ironically, this gap is filled by old-earth creationist Hugh Ross in *A Matter of Days*. In addition to covering much of the same material as Dalrymple, Ross addresses many common creationist objections to an old earth. He also critiques the faulty geologic clocks that some creationists use in their vain attempts to show that the earth is young (his distaste for evolution notwithstanding). On the subject of ages, at least, it is nice to see an expert geochronologist and an evangelical creationist (with a PhD in astronomy) so fully agree!

Ancient Earth, Ancient Skies is a much-needed contribution to scientific education. It takes a pivotal and complex topic and makes it very easy to understand by non-scientists. Even high school students should have no trouble following its logic and methods. What's more, he makes the search for earth's age fun and interesting with his fast-paced style and superb integration of methodology and findings. This book deserves a place in every school and public library.

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THE PRIVILEGED PLANET: HOW OUR PLACE IN THE COSMOS IS DESIGNED FOR DISCOVERY

by Guillermo Gonzalez and
Jay W Richards
Washington (DC): Regnery
Publishing, 2004. 444 pages

**Reviewed by William H
Jefferys, University of Texas
at Austin**

THE SAME OLD SHELL GAME

The Privileged Planet is based upon the odd notion that the more *unsuitable* our universe is for producing intelligent life, the more likely it is that our universe was “designed” to produce intelligent life by a “designer” of indeterminate nature; put another way, supposedly the less likely it is that there could be a planet in our universe that supports intelligent life, then the more likely it is that the universe was “designed” to produce a particular intelligent life form — us — that can and will investigate the nature of the universe.

We know from experience that this is not how human beings, the only intelligent designers of which we have any experience, work. We know that a human designer of a factory does not design a factory so that it will only occasionally, if ever, produce a car, or a computer, or whatever the target object is; rather the factory is designed to produce the largest possible amount of product consistent with the constraints: cost, energy, physical reality ... whatever.

The fundamental error made by Gonzalez and Richards, as with most creationists (including “intelligent design” [ID] creationists), is that they imagine that they can prove the existence of their “intelligent designer” by merely alleging *evidence against* a particular strawman naturalistic scenario, and, without clearly specifying an alternative model, simply *assert* that the only other explanation

possible is that everything was created by a “designer”. Under this strategy, no details are specified about what we would expect to see if the “designer” existed, or why we would expect to see that and not something else. It is, as we shall see, not a scientific theory. It is instead nothing but the usual fallacious Argument from False Dichotomy.

Of course, we know why ID creationists do not want to talk about the nature of the “designer”. If they were to do so, they would undermine their claim that ID creationism has nothing to do with religion. They do admit the nature of their designer in private, among friends, but not before school boards or state boards of education. Since the real point of ID is to slip religion surreptitiously into the public school classroom, they cannot reveal the true nature of their “designer” in any arguments intended for public consumption (as this book is). In line with this political strategy, the authors of this book are similarly cagey about the nature of the designer (p 330).

But they are between a rock and a hard place. Gonzalez and Richards do not realize that unless they can show that what we actually see is *more* probable — given that an “intelligent designer did it” — then they have no case. This is because a basic rule of inference is that one has to compare the likelihood of observing evidence E under *all* relevant hypotheses H_1, H_2, \dots, H_n . Then the hypothesis that has the greatest likelihood is the one best supported by the evidence. Obviously, if you do not say what your hypothesis is — in this case by specifically describing the nature of the “intelligent designer” and the consequences for the real world if that entity exists, so that actual calculations can be made — then it is impossible to compute the likelihood of observing E under your hypothesis, and your hypothesis never even gets to the starting gate.

One wonders what Gonzalez and Richards would say if the evidence were otherwise. They talk about the fantastically small probability that our universe would give rise to intelligent, inquisitive life, but what if it were the opposite?

What if we had observed that the universe was actually quite conducive to the existence of intelligent, inquisitive life? Would Gonzalez and Richards then conclude that the probability of observing such a universe, given that it was designed by an “intelligent designer”, was small? I hardly think so. In such a case they would surely be pointing to the fecundity of the universe as evidence for the existence of their “intelligent designer”. In other words, the assertion of a “designer” is a no-lose position. *Whatever* evidence one observed would by this fallacious reasoning support their “designer.”

But there’s the rub. They cannot have it both ways. An elementary rule of inference is that if evidence E supports hypothesis H, then observing that E is false would undermine H. In other words, if observing that the universe is fecund were to support the hypothesis that the universe is “designed”, then observing that it is *not* fecund would necessarily support the hypothesis that it was *not* “designed” and would *undermine* the design argument.

Unfortunately, it means that the ancient argument from design (of which this book is just a modern example) is scientifically useless. There is no conceivable evidence that could, even in principle, refute the notion that everything happens as a result of an unconstrained, very powerful “designer”. This is because such an entity can be invoked to explain any evidence whatsoever. Real scientific hypotheses have to be *vulnerable to evidence*. It must be possible to imagine evidence that would undermine them (see Pennock 1999, ch 6, for an extensive discussion). This is not the case for a mysterious “intelligent designer” of nature so unspecified that one cannot even make predictions about what one would expect to observe if it existed.

Consider, for example, the fine-tuning argument: The fact that “the constants are right” for our own existence is supposed to support the existence of an intelligent designer. Philosopher of science Elliott Sober (2003) has refuted this argument and, independently, Michael Ikeda and I have made

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similar points with some variations (Ikeda and Jefferys 1997). Sober points out that the usual design argument is that the probability that the “constants are right,” given that design is true, is greater than the probability that “the constants are right,” given a naturalistic universe. Notwithstanding the fact that we do not know whether this inequality is true or not in the ID creationist view — because the ID community stubbornly refuses to specify the nature of the “designer” so that we can actually do the required calculations — there is a deeper problem.

Sober and Ikeda and I pointed out that the relationship fails to take into account our own existence. In other words, we are here (we know this, and could not be making any arguments if it were not so), so any discussion *must* take this fact into account. Thus, the correct comparison is between (A) the probability that “the constants are right” *given* design *and* our own existence, and (B) the probability that “the constants are right” *given* a naturalistic universe *and* our own existence. Since in a naturalistic universe our own existence implies that the constants *must* be right, this means that (B) is equal to 1. What about (A)? Clearly, since probabilities are always less than or equal to 1, (A) cannot be larger than 1, so the ratio of (B) to (A) must be at least 1. This means that observing that “the constants are right” cannot undermine the naturalistic hypothesis.

Sober says that (A) is also 1, but here he missed an important point. Since the nature of the designer is unspecified, and might be an omnipotent deity, for example, it would be possible for the designer to produce universes where the constants are *not* right, but in which we could still exist.

An example would be a universe where the constants are *not* right for producing carbon in stellar interiors. In their book, Gonzalez and Richards mention Fred Hoyle’s remarkable 1954 prediction of special resonances in carbon and oxygen nuclei (p 198 and following). These resonances were predicted because without them, carbon and oxygen could not be synthesized in stars, and

since they also could not be synthesized by the Big Bang, our own existence implies that the resonances must exist, at least if the universe is naturalistic. This in turn leads to rather narrow predicted ranges for certain physical constants (“the constants are right”). Indeed, the resonances were found to exist, one of the earliest and possibly best examples of a prediction of a physical fact from the so-called *weak anthropic principle*, that sentient beings ought to observe that the universe they inhabit is consistent with their own existence.

But, if the universe had been designed by a sufficiently powerful designer, the constants would not *have* to be right in order for us to exist. For example, the designer could create a universe where the constants are *not* right for the production of carbon and oxygen in the interiors of stars, preferring instead (for whatever reason: whim, or the desire to accomplish other goals such as letting us know that he exists by means of a subtle scientific clue) just to manufacture the required carbon atoms and sprinkle them where needed throughout the universe.

If we consider the possible existence of such a designer — and remember, the ID creationists’ intentional refusal to specify the nature of their designer leaves this possibility open — then it is no longer the case (as Sober asserts) that (A) is equal to 1. Indeed, it is less than 1 and could be quite small, which means that our observing that “the constants are right” actually provides powerful evidence *in favor* of the naturalistic hypothesis. It would actually be our observing that “the constants are *wrong*” that would undermine, and in fact refute the naturalistic hypothesis. The ID creationists have the inequality backwards.

In another section, Gonzalez and Richards also attempt to refute the so-called “Many Worlds Hypothesis” (MWH), which postulates the existence of a very large or even actually infinite collection of universes called the *multiverse* (p 268 and following). I should first point out that they are simply wrong to think that the motivation for the MWH is to get around the

fine-tuning problem. In fact, it is a consequence of the leading theory of cosmology — the theory of chaotic inflation — which is the theory best supported by the evidence (including that from the recent Wilson Microwave Anisotropy Probe, or WMAP). Chaotic inflation was invented to explain certain observed facts about our universe, for example its flatness and homogeneity. One *consequence* of inflation is that the universe is actually infinite in extent both in space and time, containing infinitely many regions that have each inflated into expanding universes much like ours, but perhaps with physical constants different from ours. Indeed, this multiverse is so vast that it would contain infinitely many universes exactly like ours, as well as infinitely many others that differ from ours in only subtle ways, for example ones in which I am an ID creationist and the authors are attempting to refute my pro-ID arguments, or ones where I have a long green tail, or ones in which a particular gene in my genotype has a C substituted for an A (see Seife 2004 for more on this).

Gonzalez and Richards’s “refutation” of the MWH is unconvincing. It consists of a bland dismissal that an actual infinite set can exist (p 268 — where did they learn their mathematics?) together with a claim that “we have no evidence to think that other universes exist,” a claim that happens to be false, for several reasons. One reason is that it is a prediction of the best-supported theory in cosmology — one that is strongly supported by evidence. And the second is that under that model, our own existence evidentially supports the MWH (since under that hypothesis a selection effect is involved: we can only exist in one of the very small proportion of worlds in which “the constants are right,” so our own existence implies the existence of these other worlds).

As Mark Perakh (2004) has pointed out in another context, there is nothing particularly unparsimonious about the multiverse hypothesis. For one thing, it is based on the observational fact that our own universe definitely exists, and since it does exist, it is



reasonable to presume that naturalistic processes would produce other universes, just as different versions of our own. If physics can produce one universe, there is nothing in principle to prevent it from producing infinitely many. Indeed, it would be expected. By contrast, the hypothesis of an intelligent designer of universes is completely speculative; there is, as Perakh points out, not a single observational fact that points to the existence of such an entity other than ancient, conflicting legends.

In their discussion of the MWH, Gonzalez and Richards also repeat a fallacious argument (p 270) that has been made by John Leslie, concerning a hypothetical officer who survives a Nazi firing squad and concludes that this must be due to design (the firing squad intended to miss) rather than chance (the firing squad members all missed by accident). We are supposed to reason by analogy that since the officer concludes that design rather than chance was the reason for this particular low-probability event, we should infer the same as regards the universe. Notwithstanding the obvious differences between naturalistic universes that have no known intentions, alleged “designers” whose intentions cannot be clearly specified without undermining the political aspirations of ID creationists, and firing squads that have well-understood intentions, this argument is plain silly and has been decisively refuted in Sober’s paper (2003). Analogies can be treacherous things.

Finally, I turn to Gonzalez and Richards’s notion that our earth is uniquely designed for its inhabitants to do scientific exploration, and that the universe is similarly designed for *us* to do that scientific exploration. They point to a number of phenomena that have aided *our* scientific enterprise, such as the transparency of the earth’s atmosphere, the fact that we have a moon that is just far enough from the earth to produce spectacular solar eclipses, and so on. Of all the arguments in the book, I find this the weakest. It puts the cart before the horse. Suppose it were not so; if we exist-

ed on another world very different from the earth, then we would surely be doing something. We would be doing whatever was possible for us to do under the circumstances in which we found ourselves. If we accepted the Whiggish reasoning of the authors, we would be just as justified in concluding that our planet — and our universe, if we could see it in this alternative reality — was designed so that we would do whatever we happened to be doing at the time or find interesting at the time (as diverse human cultures have always done). The authors could learn much by studying a little anthropology and a little history.

To summarize, the little that is new in this book is not interesting, and what is old is just old-hat creationism in a new, modern-looking astronomical costume. It is the same old shell game. It is too bad that Guillermo Gonzalez (whom I know from his tenure as a post-doctoral fellow in the University of Texas’s Astronomy Department) has allowed himself to be sucked in as an advocate for this ancient argument. The Argument from Design is at least 200 years old and has not improved with age. It has not resulted in any new *knowledge* in all of those years. Modern astronomy is constantly producing new knowledge and understanding of the universe. Gonzalez is a promising young astrophysicist, and I hope that he does not throw away his career on such nonsense.

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HOW BLIND IS THE WATCHMAKER?: NATURE’S DESIGN & THE LIMITS OF NATURALISTIC SCIENCE

by Neil Broom

Downers Grove (IL): InterVarsity Press, 2001. 224 pages

**Reviewed by C Kevin Geedey
and Stephen B Hager,
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One might consider Neil Broom’s *How Blind is the Watchmaker?* as a plea to liberate science from the confining power of scientific naturalism. Broom’s intention is clear. On page 135 he writes:

It seems to me that the main point of the creation narrative is to put nature (including humankind) fairly and squarely in its place as created, and thus as a consequence never to be accorded the status of divinity. No part of nature is to be the object of human worship. No part of nature, including the heavenly bodies, is to shape human destiny. God alone is the source and sustainer of all created things.

In this book Broom attempts to disperse the details of this guiding light through the prism of “intelligent design” creationism.

His attack is squarely aimed at what he calls (variously) the materialistic, naturalistic, or reductionist approach to evolution that is taken by “Darwinians”. Broom laments that this interpretation entails that life has been produced by “a mechanistic, chance-driven process that, by its very definition, destroys any



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ultimate basis for meaning and purpose within the universe" (p 25). In addition, Broom asserts that modern evolutionary theory fails as a scientific explanation of nature's diversity.

Although neatly packaged, the various constituent parts of the book are somewhat haphazardly interwoven. The result is a patchwork pattern that seems unconnected except by two main threads that are supposed to show for the reader the logical pathway to true knowledge: the "concept of hierarchical structures" and a "prolife principle". He separates the former into descriptions of the cosmos by modern science that are "unquestionably marvelous mechanical contrivances" (lower-level knowledge; p 46) and metaphysical or religious explanations of the purposefulness of such mechanisms (higher-level knowledge). The prolife principle, according to Broom, suggests that all of life strives with intentionality to survive. In combination, Broom hopes that these themes will cause the reader to "... shun the temptation to embark on that journey through the desert of naturalism, choosing rather to follow the route signposted so clearly by the findings of science, the path that leads to the sources of all life — God" (p 193).

Broom does not appear to have a problem with the unadorned fact of evolution *per se*. He seems happy to accept the general principle of descent with modification (p 134, footnote), but is far less pleased with the Darwinian interpretation of descent. Although Broom's book contains versions of nearly every critique of Darwinism in the "intelligent design" arsenal, his central argument about the inadequacy of Darwinism seems to be that it fails to capture the "non-material or transcendent dimension of purpose and meaning" (p 41). Living things differ from non-living things in that living things (and their component parts) are functional and purposeful (much like the parts of a machine). Ice cannot resist melting if the ambient temperature around it is warmer than its melting point. This behavior of ice is explicable, according to Broom, only by refer-

ence to physical laws. He argues that living systems, on the other hand, are task-oriented. Living things "take measures against the future in a manner denied to an object, which cannot take measures at all" (p 69). Mere chance associations of atoms cannot "take measures", so living things cannot be mere associations of atoms.

At this point evolutionists ought to object that they already have an explanation for how organisms come to show such complex traits (adaptations). In a Darwinian universe, natural selection substitutes for Broom's "transcendent dimension". No guiding hand is needed. Variation and differential survival and reproduction are all that is required. Broom will have none of this, of course.

To bolster his argument, Broom considers Richard Dawkins's discussion in *Climbing Mount Improbable* of Nilsson and Pelger's research on the evolution of the eye (Dawkins 1996). Nilsson and Pelger start with the assumption of a flat plane of photosensitive cells and simulate (using a mathematical model) how small anatomical changes, each beneficial in terms of spatial resolution or visual acuity, can eventually add up to an eye similar to a fish's. Dawkins uses this example in the context of reviewing just how *easy* it is to evolve eyes and that the huge diversity of adaptive solutions to the various problems associated with sight (compound vs simple, lenses vs mirrors, details of the retina, and so on) to suggest that some aspects of vision have evolved independently and rapidly (Dawkins 1996: 194).

Broom misses this point entirely. To Broom, only the distant goal of a vertebrate eye — a striving towards this as an end — can explain Nilsson and Pelger's series of transitions. Broom asks, "Why should 'winning' be so important to an organism? ... Why not simply 'go with the flow' and be carried along by the brute forces of an impersonal and wholly material universe?" (p 169). To Broom, selection will not work without a purposeful life-promoting drive or vitalistic force.

It is difficult to take Broom's vitalism seriously. Vague talk about

"meaning" aside, Broom's attack on selection is a clear miss. If a small anatomical change allows an organism to have better visual acuity, then its probability of survival and reproduction will be enhanced. If there is additional variation for visual acuity in the population in this context of its selective advantage, then evolutionary change will continue. It is not necessary to invoke an "ultimate goal" for particular outcomes or vitalistic drives.

Broom (rightly) points out that biologists (including Darwin) talk about adaptation (design, purpose, function) in a way that seems to imply an overall drive or a designer. Teleological, *apparently* purpose-laden talk abounds in evolutionary literature. However, this talk is shorthand for more technical discourse. Ruse (2003) points out that this sort of purpose-laden talk in evolutionary biology is metaphorical. Broom seems to have missed the utility of such language entirely. Selection is an algorithmic process that can result in functional, complex adaptations without invoking non-material "final causes" or "transcendence". (See Dennett [1995] for a particularly good discussion of this point.)

Overall, Broom's rhetoric for vitalism entangles the discussion throughout the book. His arguments lack clarity, his characterization of science is unfair and, at times, wrong, and many of his examples are taken out of context. All of this is obvious to the reader seasoned with a background in science and knowledge of the "intelligent design" agenda.

The book also suffers from numerous factual errors related to biology. Some are relatively minor, but the more egregious suggest that bacteria have nuclei (p 94), life is not characterized by reproducing, using energy, behaving, and evolving, but rather by functioning with order and purpose (chapter 3), and that neo-Darwinists despise Lamarck (p 128). Broom may not object to evolution, but his explanation for how it works is deceptive and thus incorrect. He seems to believe that evolution is inherently progressive (for example, p 127). Furthermore, he claims that scientists literally (not metaphori-



cally) consider time as an instrument of organismal change (p 73) and that natural selection “guides” random variations (p 160).

These shortcomings are symptomatic of a broader failure of *How Blind is the Watchmaker?* to achieve its ultimate goal. Broom vaguely articulates what he wants the reader to do, but lays no foundation for how to achieve it. Instead, it would have been enormously helpful if he would have offered a meaningful and mature examination of humanity and its desire to understand the universe. The general tone of the book is cynical and abrasive, mostly in reference to evolution as well as to science in general. Unfortunately, Broom’s divisive dialog fails to convince the reader that life is a product of moral, intentional, and compassionate design. Indeed, the only signpost one will acknowledge after reading *How Blind is the Watchmaker?* is “Dead End”.

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DOES GOD BELONG IN PUBLIC SCHOOLS?

by Kent Greenawalt
Princeton: Princeton University Press, 2004. 261 pages

Reviewed by John Pieret

Kent Greenawalt is a former law clerk to Supreme Court Justice John M Harlan, a former Deputy US Solicitor General, and Professor of Law at Columbia University’s School of Law. He is an expert in the field of constitutional law and jurisprudence, with an emphasis on issues of church and state.

Professor Greenawalt’s book is

a good primer in the often arcane jurisprudence surrounding the Establishment Clause of the United States Constitution and its application to issues of religion in public education. About a quarter of the text is devoted to the questions that arise out of the teaching of natural science, specifically focusing on the area of evolutionary theory, “creation science” and “intelligent design” (“ID”). It should be noted that much of this material can be found in Greenawalt’s paper “Evolution, creationism, and intelligent design” delivered at the Colloquium on Constitutional and Legal Theory in March 2003 (available on-line in PDF format at <<http://www.utexas.edu/law/faculty/conlawtheory/Greenawalt.pdf>>).

One good reason for reading this book is that recent positions taken by advocates of ID, including the Discovery Institute, appear aimed at meeting some of the criteria for passing constitutional muster that Greenawalt posits. But any teacher or administrator in the public school system will find the book a most useful resource for navigating such thorny issues as what sort of holiday celebrations can take place in public schools, sex education, student religious clubs, prayers at school events, and the like. Naturally enough, this review will focus on the part of the book dealing with the teaching of science.

The book is written in an open style, without much in the way of legal jargon, but is heavily footnoted (67 pages’ worth) for those who want to delve deeper. It should be noted that books of this sort have been influential on US courts in the past, especially in areas fraught with more public passion than solid case law, as is the case with the relationship of ID to science and religion.

Greenawalt starts with a brief history of public schools in the US, noting that, up until quite recently, it was common practice to require

students to participate in religious devotions that amounted to a kind of nonsectarian Protestantism. Greenawalt then summarizes the major Supreme Court decisions during the last half of the 20th century that, at least officially, ended such practices.

Next, Greenawalt lays out the various theoretical purposes for having a tax-supported educational system in order to set the stage for differentiating valid secular purposes from impermissible religious ones. He identifies the major aims of public education as: vocational training; enhancement of the capacity to make life choices; enrichment of lives through knowledge of literature, science, history and sports; training to participate in civic life and the instillation of socially desirable morals and ideals, such as honesty and respect for others.

Greenawalt quickly points out that there is no simple one-to-one relationship between any one of these purposes and any particular area of study. Great literature, for example, not only enriches the aesthetic sense but also can illuminate political life, instruct in social morals and even contribute to career choices. These necessarily overlapping domains result in what Greenawalt calls “spillover effects,” where an area of study undertaken for otherwise acceptable purposes can impact a particular set of religious beliefs. Spillover effects are the source of much of the conflict that occurs in the realm of religion and public education.

An early question to address is: What are religious propositions? Greenawalt suggests that claims about the existence, nature, and actions of God, life after death, and the ultimate significance of physical reality and human life are inherently religious. Agnostic and atheist claims that address these areas, whether or not these beliefs are themselves “religions,” are constitutionally impermissible, if taught as true, because they consist of answers to those same religious questions. Similarly, practices such as church attendance, prayer, and sacraments cannot be held up as desirable or mandatory, but neither can they be held up as undesirable



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or forbidden. Gray areas arise because religions typically include ideas about how people should live their lives. For example, many religions teach personal honesty, generosity towards others and parental love. Greenawalt would identify these as secondary religious propositions that flow from, but are not themselves dependent on, the primary religious perspectives. For example, a belief that the nature of God includes a desire that we care for each other does not debar schools from teaching that children need love from their parents, as that can be presented on a basis other than the nature of God. On the other hand, teaching that parents should love their children because the Bible tells them to would involve primary religious claims and is not allowed.

When Greenawalt turns to science education, he makes this initial point:

Although I have no expertise in evaluating the plausibility of scientific claims, my appraisals are nevertheless worth stating, both because almost anyone trying to figure out what is true overall must engage a field in which he is not expert and because many educational officials and virtually all judges who must discern if educational decisions are constitutional will lack special scientific competence. (p 101)

No matter how much we might wish otherwise, because of our constitutional framework and the patchwork system of US education that emphasizes the political role of state and local school boards, critical decisions about what constitutes valid educational goals are necessarily in the hands of people with little or no expertise in either education or the particular subjects to be taught. (Science education would be well served if all school board members, administrators and judges had anywhere near Greenawalt's grasp of the issues involved in the evolution/creationism dispute. If his notes are any guide, he has read widely in the literature of both sides. Besides referencing such well-known philosophers of science as Hume, Popper,

Lakatos, and Kuhn, he discusses the works of philosophers particularly interested in the evolution/creationism debate, including Philip Kitcher's *Abusing Science*, Larry Laudan's "Science at the bar: Causes for concern" and Robert Pennock's *Tower of Babel* and *Intelligent Design Creationism and its Critics*. Among scientists, he is familiar with Kenneth Miller's *Finding Darwin's God* and numerous works by Stephen Jay Gould, Richard Dawkins, Niles Eldredge, and others. Nor does he neglect the creation science and ID side, citing works by Henry Morris, Jonathan Wells, Phillip Johnson, Alvin Plantinga, William Dembski, and Michael Behe.) Greenawalt admits that "it may seem that I give more credence to critics of dominant evolutionary theory than would the overwhelming majority of practicing scientists" (p 89), but goes on to point out that the primary issue in the law is not the scientific validity of the critique but whether including it in public education transgresses constitutional boundaries.

One point Greenawalt forcefully makes is that natural selection, and evolutionary theory in general, are important not only in the study of the development of species but also across the board in the biological sciences. Therefore, according to the standards within the discipline, evolutionary theory would undoubtedly be taught except for religious opposition. Any decision not to teach evolution or to teach that it is "only a theory" (as long as that implies that it is less well confirmed than most scientific explanations) would be an implicit endorsement of religious views and violate the Establishment Clause.

After discussing the philosophy of science in some detail, he concludes that both creation science and ID are really about the limitations of science. He further concludes that claims that scientific theories may fail as explanations *could* be an appropriate subject in science courses. In short, he is of the opinion that at least some issues in the philosophy of science are appropriate to public school science courses. Greenawalt also points out that negative arguments

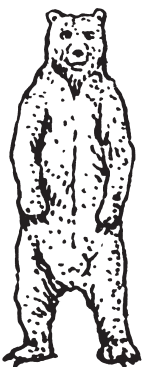
do have a legitimate role in scientific discourse, but he acknowledges that the leap ID makes from arguments that selection fails to explain apparent design to the claim that such features are necessarily the result of an intelligent creator, is unwarranted.

As an "ideal" statement of what might be discussed about the limits of science, Greenawalt offers the following:

Modern science seeks to discover natural explanations for physical events. We cannot be certain that natural explanations will always suffice, but physics, chemistry, and biology have made amazing advances by assuming that they will. If we had powerful evidence that science could not conceivably explain some phenomena, this evidence of limits could be one small part of science courses; some people believe such evidence exists about evolutionary processes, but the uncertainties there are matched by those in other areas of science. In any event, it is too soon to conclude that any difficulties with evolutionary theory, even if they exist, cannot be rectified by scientific explanation. (p 114)

Coming to the nitty-gritty, Greenawalt has no great difficulty identifying "creation science" as a religious program. "[W]hat makes the theory religious is that religious premises explain why the practitioners reach the conclusions they do" and no attempt to edit out scriptural references and to substitute "abrupt appearance" for "divine creation" can disguise that (p 116).

ID is, however, less easy to locate within constitutional law. Greenawalt notes that just because a scientific explanation of phenomena happens to bear on the likely truth of a religious tenet does not make the explanation religious in nature and, hence, impermissible in public education. However, he goes on to make the important point that this is a two-way street. If an explanation lends support to a religious view, that





Letters to the Editor

Ultimately, in his main thesis, Taner Edis (*The Ghost in the Universe* (Amherst [NY]: Prometheus Books, 2002; reviewed by David Eller, *RNCSE* 2003 Jan/Feb; 23 [1]: 29–30) probably has his finger on the issue that will distinguish the science of the future from the science of the past and that will forever remove the “gaps” into which theists

thrust their god(s). While science cannot prove that there are no gods, it can do what Edis, along with Weinberg and Laplace, have suggested it does: demonstrate that there are no “ghosts” in the universe at all — no need for any other hypotheses than the ones naturalistic science offers.” I disagree with the phrase “science cannot prove that there are no gods.” Many theists that I have written to have said the same, adding: “But neither can I prove that God exists;

absence of evidence does not mean lack of evidence.”

If “gods” existed, science could prove it. Why is it that we Positive Secular Atheist Humanists cannot say: “If gods exist, science would be able to prove the hypothesis/theory that they exist”? Since there is absolutely no empirical evidence for any gods, they do not exist.

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alone does not bar it from being scientific or from being taught in public schools. After reviewing the Supreme Court cases of *Epperson v Arkansas* and *Edwards v Aguillard*, he concludes:

The dominant neo-Darwinian account has enough conundrums for text writers, science teachers, and boards of education to conclude that teachers could usefully discuss them and, further, suggest that whether the dominant theory, and particularly the pre-eminent place it accords natural selection, may require substantial revision or supplementation is an open question. I do not claim that scientific evidence supports this qualified presentation of neo-Darwinism better than an unqualified account, only that the choice is within the range of constitutionally permissible judgment — something judges have to assess by the balance of scientific opinion and their own sense of the strength of arguments. (p 124)

However, Greenawalt immediately goes on to say:

Were educators to go further and insist that *intelligent design* is probably a needed supplement to natural selection and other aspects of neo-Darwinism, or that intel-

ligent design is *the alternative* to unvarnished neo-Darwinian theory, they would step over the constitutional line, because such judgments could now be made only on religious grounds. (p 124)

That the proponents of ID may have taken Greenawalt’s positions to heart in recent days should now be clear. In the case of the Dover, Pennsylvania, school district’s attempt to present ID, the local school board — at least following the court challenge — has denied that it will curtail the teaching of evolution in any way and presents ID merely as *one* possible alternative to evolutionary theory (see *RNCSE* 2004 Sep/Oct; 24 [5]: 4–9).

Those interested in strong science education in US public schools may be disappointed that Greenawalt would open the door to the “teach the controversy” ploy. When implemented, these programs may well degenerate into spurious philosophical claims, selective quotations and arguments from incredulity, instead of sound science education. That does not mean that he is wrong about the constitutional permissibility of attempting them.

If there is one serious flaw in Greenawalt’s analysis, it is that he makes no attempt to elucidate how any “conundrums” might properly be presented or whether it is even appropriate to address the *real* controversies in evolu-

tionary theory in K–12 education. We are left in the dark as to whether any limitations exist on what can be claimed to constitute conundrums, how the courts could evaluate those limitations, if any, or what constitutional standards they could apply. Certainly, courts would be loath to micro-manage the science curricula of public schools but, as we all know, the devil is in the details.

Greenawalt is right enough when he says:

I have proposed a middle course somewhere between what evolutionists insist is the only sound scientific approach and what proponents of Genesis creation and intelligent design seek. This counsel of moderation may have little appeal for opposing camps who standardly accuse one another of dogmatism and dishonesty. (p 125)

The problem is that he has left us with no way to tell what his “middle course” might look like in practice.

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more Letters to the Editor

13 Questions for ID

A few years ago, when I began teaching high school biology, I ran across an article in *Scientific American* about Darwinian medicine (RM Nesse and GC Williams, "Evolution and the origins of disease," *Scientific American* 1998 Nov; 29 [5]: 86-93). It seemed to me that this is a topic that actually shows the importance of evolutionary thinking in the lives of just about everyone even high school freshmen. So I began using these ideas in my classes.

In 2003, when the Texas State Board of Education held its annual textbook circus (they call them hearings), I signed up to testify concerning biology textbooks, which were under attack, as usual, from the creationists. Citizens are allowed to testify for or against any books under consideration; however, each person is allowed only 2-3 minutes. I spent quite a bit of time trying to make a meaningful statement supporting the coverage of evolution in the textbooks in question. Finally, I realized that this was probably not possible, so, based on my interest in Darwinian medicine, I came up with a list of 13 questions that can be answered using evolutionary principles but not by using the creationists latest nonsense: "intelligent design" (ID). I now give these questions to my students to try to figure out.

I thought some of your readers might be interested in the questions.

13 QUESTIONS THAT ID CANNOT ANSWER

1. Why does giving vitamins and mineral supplements to undernourished, anemic individuals cause many of them to die of bacterial infections?
2. Why did Dr Heimlich need to develop a maneuver to dislodge food from people's windpipes?
3. Why does each of your eyes have a blind spot and a significant tendency for retinal detachment, but a squid's eyes, which provide equally sharp vision, do not have either problem?
4. Why are depression and obesity at epidemic levels in the US?
5. When Europeans came to the Americas, why did 90% of the native Americans die of European diseases, but hardly any Europeans die of American diseases?

6. Why do pregnant women get morning sickness?

7. Why do people in industrialized countries have higher rates of Crohn's disease and asthma than people in undeveloped countries?

8. Why does malaria still kill over one million people each year?

9. Why are annual sales of the product Depends so high?

10. Why do people given anti-diarrheal medication take twice as long to recover from dysentery as untreated people?

11. Why do people of European descent have a fairly high frequency of an allele, which, in the homozygous condition, confers resistance to HIV infection?

12. Why do older men often develop urinary problems?

13. Why do so many people in Austin, Texas, suffer from cedar fever?

Steve Bratteng
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[Look for the answers in the next issue.]

Dembski Misunderestimates

My math is very rusty but I feel that something is not correct in "Dembski misunderstands" (*RNCSE* 2004 Sep/Oct; 24 [5]: 15). You quote Dembski's estimate "that only one or two percent of biological scientists believe in God." Then you go on to show "that 42.5% of the biologists responding to a 1996 survey agreed "I believe in a God in intellectual and affective communication with mankind, [that is,] a God to whom one may pray in expectation of receiving an answer." Then you go on to say "Dembski's uninformed estimate was thus off by about 1.5 orders of magnitude." It would seem to me that he is off much more.

Douglas T Hawes
Plano TX

Your notice of Dembski's mis-estimate of the percent of biological scientists [who] believe in God as "off by about 1.5 orders of magnitude" while technically correct ($42.5: \sim 1.5 = 30x = 10^{1.5}$), would be both more dramatic and

thought-provoking if it were stated as "off by a relative 3000 percent."

This would open up the discussion that so many use to hide bad facts: to many the difference between 42.5 and 1.5 is "only 41%" difference. When in reality we are concerned about the relative difference in the population of biological scientists, where an error of a factor of 30 or 3000% can be characterized for what it is: either a deliberate deception, or a marked lack of information casting doubt on any other so-called fact.

Marty McGowan
Elizabeth NJ

Glenn Branch replies:

Perhaps it was the phrase "order of magnitude" that confused Douglas Hawes. In general, if two numbers differ by n orders of magnitude, one is about 10ⁿ times larger than the other.

I was thus comparing Dembski's estimate — 1–2%; taking the midpoint of 1.5% for simplicity — with the 1996 survey result of 42.5%. Since 42.5 is 28½ times larger than 1.5, and the logarithm of 28½ (to base 10) is about 1.45, 42.5 is about 10^{1.5} larger than 1.5.

Marty McGowan's representation of the same fact is more striking than mine, I concede, but perhaps just as in need of explanation.

When I talk about evolution to friends and colleagues, the most common misconception I encounter is the idea that the phenomenon of organic evolution is an unproven "theory".

As you know, there is a crucial distinction between the scientific fact of evolution and the theory of evolution, which involves the mechanisms that propel evolution. The best clarification of this distinction that I have read is Stephen Jay Gould's essay "Evolution: Fact and theory." Again as you know, this muddling of theory and fact is a powerful weapon in the anti-evolutionists' arsenal. As a proud member of the NCSE, I read every issue of the excellent *Reports of the NCSE* with great interest. One suggestion: Make it editorial policy to use the terms "evolution" and "theory" of evolution carefully so that the distinction between them is kept clearly delineated and hammered home.

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

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

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

Waters IC, Rivers HI, and others.- 1995. Swept away in a flood of enthusiasm [editorial]. *Reports of the National Center for Science Education* Jan/Feb; 1015 (1): 22-9.

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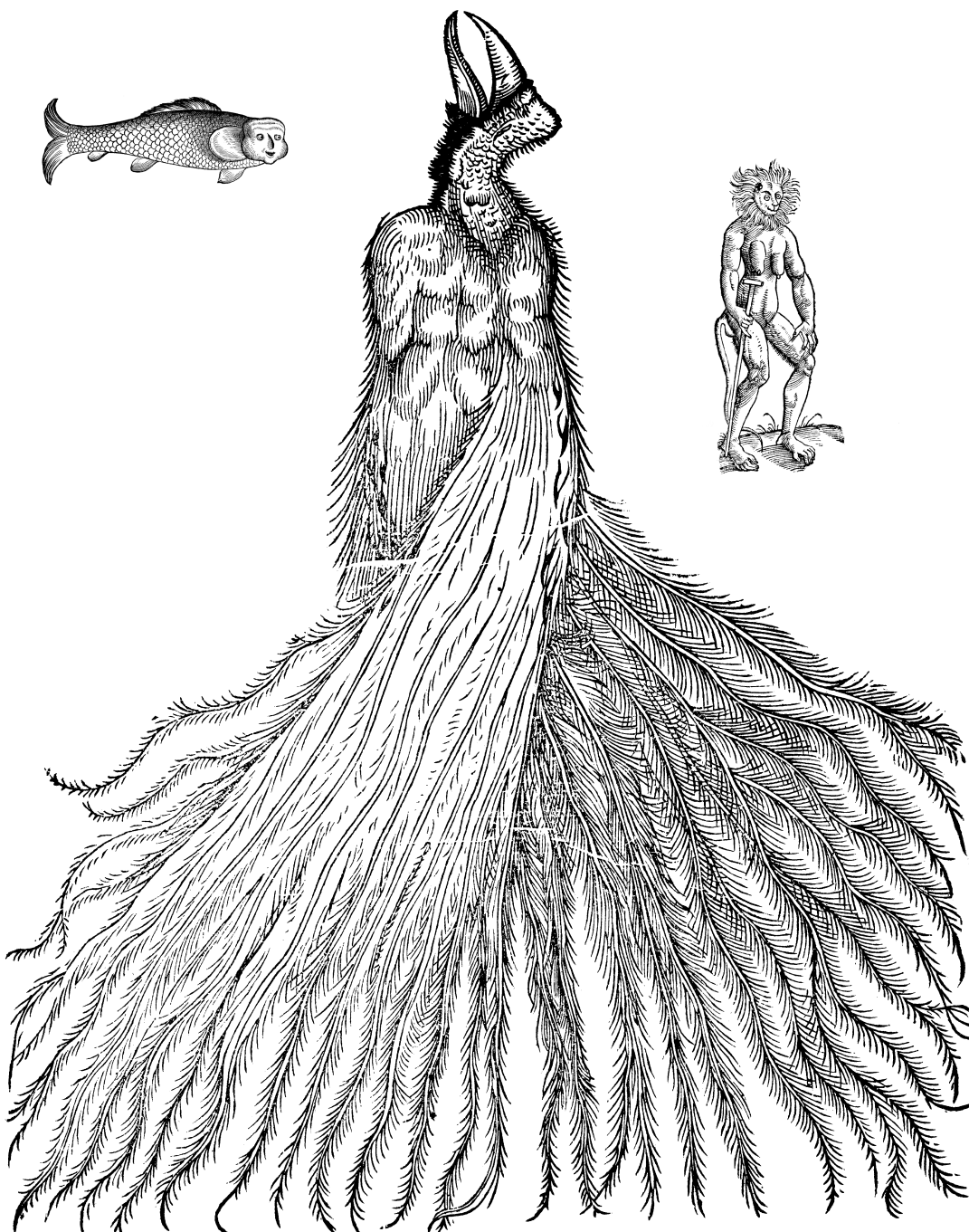
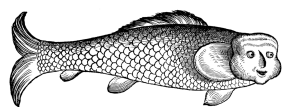
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Volume 25, Numbers 3-4

MAY-AUG, 2005

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Over in Dover!

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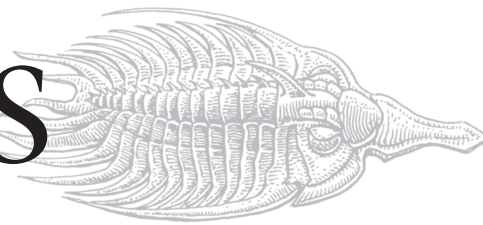
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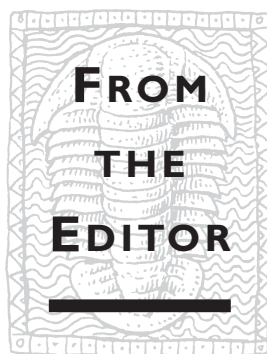
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One of the main pillars of our understanding of the history and diversity of life is that evolutionary change is both caused and recorded by genetic change. It is perhaps a truism that everything about living things is related in some way to their genes. As natural selection acts, some individuals succeed in passing on their genes to future generations, and others do not. As a result, the "gene pool" in subsequent generations is altered by this differential success.

However, it is often a significant challenge to connect specific genes with specific selective advantages, especially for complex traits. Therefore, it should come as no surprise that a research focus meant to elucidate the genetic underpinning of the evolution of behavior would be the subject of quite a bit of disagreement.

The still-maturing field of evolutionary psychology (EP) is based on a reasonable premise — that behaviors can have selective consequences, and thus it is likely that the genetic basis of behavior is subject to the same selective pressures as that of any tangible biological feature.

In this issue, we present several features that explore the implications of evolutionary psychology for our understanding of behavior and its importance to evolutionary studies. David Barash shows how EP models help us to understand common tendencies in human behavior, even if we do not like or condone them. While James Miles agrees with the basic premise, he is concerned that EP theorists stop short of the logical outcome of their studies with respect to the evolution of behavior. And finally, Douglas Allchin explores the ways in which the evolutionary study of behavior might give clues to what we humans regard as "moral behavior" — that one aspect of humanity that creationists often claim cannot be a product of evolution by natural selection. In our members' pages, we excerpt a classic NCSE brochure penned by Bill Thwaites, "Would We All Behave Like Animals?", which looks at what our evolutionary roots mean for modern behavior and morality.

The other main theme in our features section revolves around recent statements by President Bush on science, including his recent call to include "intelligent design" in public school classes. A commentary reprinted from *Indian Country Today* worries about the impact on science of this administration's policies. Other commentaries in this section show how important evolution is for biotechnology, vaccine development, and control and prevention of disease.

IN THE NEWS

To the surprise of many, things are heating up in California. Creationists are suing

the state university system over its refusal to recognize certain texts and instructional materials as valid for the preparation of students for higher education. And a small town in northern California celebrates the work of pseudoarchaeologist Carl Baugh.

Marshall Berman and David Thomas report the outcome of an attempt by "intelligent design" advocates in New Mexico to re-interpret the actions of the committee reviewing science education standards. In a cunning move, these proponents tried to get their interpretation of the board's actions read into the record. These efforts were rebuffed, but this did not stop "intelligent design" advocates from around the country from declaring victory anyway.

And Utah is the site of an on-again-off-again effort by a state legislator to introduce a bill requiring "divine design". At press time, the bill was introduced and approved by committee. We also present updates from events in California, Idaho, Indiana, Michigan, Pennsylvania, and Texas. And the plaintiffs triumphed in *Kitzmiller v Dover*!

IN PRINT

Look to our book reviews section for an assessment of a variety of interesting publications. Two new books that combine wide-ranging ideas and materials into unique pseudoscientific conglomerations are Giuseppe Sermonetti's *Why is a Fly Not a Horse?* and the late Vine Deloria Jr's *Evolution, Creationism, and Other Modern Myths*. Sermonetti is a current darling of the "intelligent design" crowd, while Deloria was popular among a variety of intellectuals and public officials.

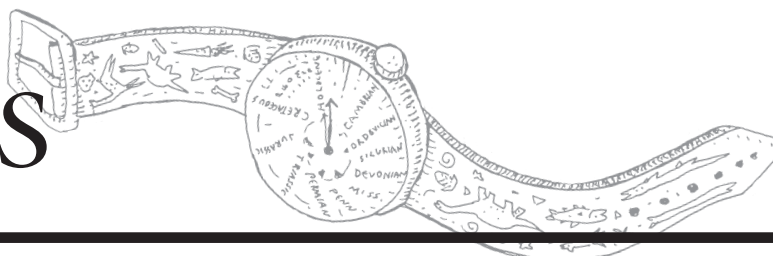
Norman Johnson reviews *Speciation* by Jerry Coyne and Allen Orr. It may be slow going, but Johnson says that the book is worth the effort to be brought up to date on the history and current status of models of speciation.

Robert Park reviews Chris Mooney's *The Republican War on Science*. It is not just scientific illiteracy, but an intentional disregard for science that should concern us, Park says.

Francis Beckwith's *Law, Darwinism, and Public Education* is another in a recent string of books trying to shift the First Amendment debate over "alternatives to evolution" in science education to allow for "intelligent design". Reviewers Todd Mollan, Bradley Consentino, and Jason Williams write that Beckwith only succeeds by redefining key terms and concepts in non-standard ways.

All this and more ... in this issue of RNCSE.

RNCSE 25 (3-4) was printed in February 2006.



New Mexico's Science Standards Do not Support the Concept of "Teach the Controversy"

Marshall Berman and
David E Thomas

On August 21, 2005, *The New York Times* published an article entitled "Politicized scholars put evolution on the defensive." This otherwise excellent article unfortunately contained several errors that resulted from treating some false information from the Discovery Institute as accurate. One major error was accepting the claim that New Mexico has "embraced the institute's 'teach the controversy' approach." This is absolutely false, as the following evidence will show.

NEW MEXICO STANDARDS DEVELOPMENT PROCESS AND HISTORY

New Mexico's Public Education Department states on its website (<http://www.nmlites.org/standards/science/index.html>), "The Science Standards, Benchmarks, and Performance Standards revision process began in 2002. Writing teams consisting of educators and scientists developed draft standards, which were reviewed by teachers, scientists, parents, and other community members; over 200 responses were received during the review process."

Marshall Berman is founder of New Mexico's Coalition for Excellence in Science and Math Education and a former member of the New Mexico state Board of Education. David E Thomas is president of New Mexicans for Science and Reason.

On August 28, 2003, the New Mexico State Board of Education unanimously (13-0) approved a new set of public school science standards that had been strongly supported by scientists, science teachers, the New Mexico Conference of Churches, and dozens of other state and national organizations (see *RNCSE* 2003 Sep-Dec; 23 [5-6]: 9-12).

NEW MEXICO INTELLIGENT DESIGN NETWORK INTERVENTION AND DISTORTION

The evolution portions of these standards had been opposed by the New Mexico Intelligent Design Network (IDnet-NM; <http://www.nmidnet.org/>) for many months, and they continued to propose massive wording changes right up to the day of the vote.

Four days before this vote, on August 24, IDnet-NM capped months of intense lobbying of state education officials by publishing a full-page ad (<http://www.nmidnet.org/IDNet.pdf>) in the Sunday *Albuquerque Journal*, saying that "the goal of completely objective language has not yet been met," and pleading for people to get involved.

What was the "objective language" that "intelligent design" promoters wanted? IDnet-NM posted a document on its website in the summer of 2003, entitled "IDnet-NM Proposal for Alternative and Added Language to the 2003 Field Review Draft Science Standards, dated May 27, 2003, Submitted to the individual members of the New Mexico State Board of Education, July 21, 2003."

In the proposal, IDnet-NM objected to the following draft standard as being "dogmatic":

Examine the data and observations supporting the conclusion that one-celled organisms evolved into increasingly complex multi-cellular organisms.

IDnet-NM formally asked the State Board to replace that statement with this one:

Evaluate the data and observations that *bear on the claim* that one-celled organisms evolved into increasingly complex multi-cellular organisms.

And what was finally adopted? Here's the statement the State Board approved 13-0 on August 28, 2003:

Understand the data, observations, and logic supporting the conclusion that species today evolved from earlier, distinctly different species, originating from the ancestral one-celled organisms.

There were sixteen other changes proposed by IDnet-NM, and *none* of those was accepted by the Board of Education. IDnet-NM's plea to the board to delete the phrase "Explain how natural selection favors individuals who are better able to survive, reproduce, and leave offspring" was denied, as were all the rest of their suggestions. (For details, see the article "Do NM's science standards embrace intelligent design?" available on-line at <http://www.nmsr.org/embrace.htm>.)

However, just prior to the board vote, and to the shock and dismay of most of the audience and the board, Joe Renick, executive director of IDnet-NM, used his final opportunity for public comment to try to trick the Department of Education staff — Steven Sanchez and Sharon Dogruel in particular — into expressing support for his views and to try to "place on the record" his false interpretation of the board's support for the standards. This display of arrogance and disregard for the staff and the board was halted by board member Flora Sanchez. As reported by



IT'S OVER IN DOVER

The decision in *Kitzmiller v Dover* was issued on Tuesday, December 20, 2005, and the plaintiffs triumphed. In his 139-page decision, Judge John E. Jones III concluded, "The proper application of both the endorsement and Lemon tests to the facts of this case makes it abundantly clear that the Board's ID Policy violates the Establishment Clause. In making this determination, we have addressed the seminal

question of whether ID is science. We have concluded that it is not, and moreover that ID cannot uncouple itself from its creationist, and thus religious, antecedents."

The Associated Press reports (December 20, 2005) that Pepper Hamilton's Eric Rothschild, the lead attorney for the families who challenged the Dover Area School Board's "intelligent design" policy, described the ruling as "a

real vindication for the parents who had the courage to stand up and say there was something wrong in their school district." NCSE agrees, and congratulates the plaintiffs and their lawyers from Pepper Hamilton, the ACLU of Pennsylvania, and Americans United for Separation of Church and State, for their well-deserved victory. Expect further details of the tremendous victory in future issues of *RNCSE*.

For the Associated Press story (via CNN), visit: <http://www.cnn.com/2005/LAW/12/20/intelligent.design.ap/index.html>.

For Judge Jones's decision (139-page PDF), visit: http://www2.ncseweb.org/kvd/main_docs/kitzmiller_342.pdf.

And for NCSE's collection of information on *Kitzmiller v Dover*, visit: <http://www.ncseweb.org/kitzmiller>.

Diana Heil of the *Santa Fe New Mexican* (2003 Aug 29), "Board member Flora Sanchez put a stop to mixed messages, though. She clarified this point: The state is not asking teachers to present all the alternatives to evolution and 'put them on an equal footing.'"

Renick then reversed himself. The *Albuquerque Journal* reported (2003 Aug 29): "Joe Renick, executive director of the New Mexico branch of the Intelligent Design Network Inc, on Thursday reversed course and recommended that the board adopt the science standards without changing the language on evolution. 'All we wanted to do was have an opportunity to state our concerns,' Renick said after the board vote."

The IDnet-NM "intelligent design" strategy then metamorphosed into a different public relations approach to turn their defeat into victory. Two other members of IDnet-NM, Rebecca Keller and Michael Kent, wrote a letter to the *Albuquerque Journal* (2003 Sep 4) extolling the standards, but inserting once again their distorted view of what the standards say: "There must be an opportunity to analyze the data critically from an open philosophical view. This is an area where it is necessary to present the evidence and the arguments for and against, and let the students decide for themselves what to believe."

Renick then further advanced this propaganda in a piece for the website of the Center for Reclaiming America, which describes itself as a project of D James Kennedy's Coral Ridge Ministries which enables

Christians "to defend and implement the Biblical principles on which our country was founded" (<http://www.reclaimamerica.org/pages/NEWS/newspage.asp?story=1416>). Disregarding the actual text in the standards, Renick bragged about his success, and considered his rude interrogation as "for-the-record" support for his misrepresenting the standards. The article reported:

While much language in the standards was not changed, an important caveat was added which stated in part, "... these standards do not present scientific theory as absolute. ...

Further, "for-the-record" questions posed by ID-net confirmed that the SDE's [State Department of Education] intent for the new standards was that (1) evolution would not be taught as absolute fact and (2) teachers would be allowed to discuss problems with evolution.

Renick's final evaluation of the situation: "If there is ever a dispute over intent and meaning of the Standards in the area of biological evolution, these policy statements may be referenced for clarification ... [and] will essentially neutralize the impact of the remaining dogmatic language.

Here is the only portion of the New Mexico standards (available on-line at <http://www.nmlites.org/standards/science/index.html>) directly relevant to this issue:

Strand III, Content Standard V-A, Benchmark 9-12.16:

"[Students shall] [u]nderstand that reasonable people may disagree about some issues that are of interest to both science and religion (e.g., the origin of life on earth, the cause of the big bang, the future of earth)."

Even the word "controversy" does not appear anywhere in the standards.

Here are some of the other standards related to evolution:

K-4 Benchmark II: Know that living things have similarities and differences and that living things change over time.

5-8 Benchmark II: Understand how traits are passed from one generation to the next and how species evolve.

9-12 Benchmark II: Understand the genetic basis for inheritance and the basic concepts of biological evolution.

and:

Strand II, Standard II, 5-8 Benchmark II:

Biological Evolution

7. Describe how typical traits may change from generation to generation due to environmental influences (e.g., color of skin, shape of eyes, camouflage, shape of beak).

**WHAT THE STANDARDS
ACTUALLY SAY ABOUT
EVOLUTION**

8. Explain that diversity within a species is developed by gradual changes over many generations.

9. Know that organisms can acquire unique characteristics through naturally occurring genetic variations.

10. Identify adaptations that favor the survival of organisms in their environments (e.g., camouflage, shape of beak).

11. Understand the process of natural selection.

12. Explain how species adapt to changes in the environment or become extinct and that extinction of species is common in the history of living things.

13. Know that the fossil record documents the appearance, diversification, and extinction of many life forms.

and:

Strand II, Standard II, 9–12
Benchmark I:

Biodiversity

8. Understand and explain the hierarchical classification scheme (i.e., domain, kingdom, phylum, class, order, family, genus, species), including:

classification of an organism into a category

similarity inferred from molecular structure (DNA) closely matching classification based on anatomical similarities

similarities of organisms reflecting evolutionary relationships.

9. Understand variation within and among species, including:

mutations and genetic drift

factors affecting the survival of an organism

natural selection

and:

Strand II, Standard II, 9–12
Benchmark II:

Biological Evolution

8. Describe the evidence for the first appearance of life on Earth as one-celled organ-

isms, over 3.5 billion years ago, and for the later appearance of a diversity of multicellular organisms over millions of years.

9. Critically analyze the data and observations supporting the conclusion that the species living on Earth today are related by descent from the ancestral one-celled organisms.

10. Understand the data, observations, and logic supporting the conclusion that species today evolved from earlier, distinctly different species, originating from the ancestral one-celled organisms.

11. Understand that evolution is a consequence of many factors, including the ability of organisms to reproduce, genetic variability, the effect of limited resources, and natural selection.

12. Explain how natural selection favors individuals who are better able to survive, reproduce, and leave offspring.

13. Analyze how evolution by natural selection and other mechanisms explains many phenomena including the fossil record of ancient life forms and similarities (both physical and molecular) among different species.

Benchmark 9 above may be (deliberately?) misinterpreted by suggesting that “critically analyze” means “criticize” or “reject”, when in fact it is intended to have the students apply the scientific method. Both Benchmarks 9 and 10 include the phrase “supporting the conclusion”, with no suggestion that the conclusion is not, in fact, well-supported. The phrase “critically analyze” appears several times in the standards on other topics ranging from technology and scientific knowledge to ecology. It appears to be misused only by the “intelligent design” movement with reference to evolution.

RENICK’S “FOR-THE-RECORD” CLAIM

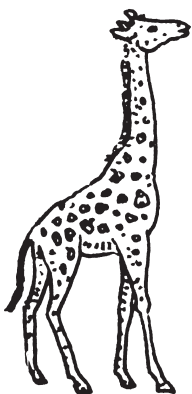
So the standards themselves disprove the “intelligent design” pro-

paganda. But the Center for Reclaiming America’s article, which clearly relied on Renick, said that his “for-the-record” *cross-examination* “confirmed that the SDE’s intent for the new standards was that (1) evolution would not be taught as absolute fact and (2) teachers would be allowed to discuss problems with evolution.” His public attack was directed at two Education Department officials who managed and led the standards revision effort: Steven Sanchez and Sharon Dogruel. What do the victims of his interrogation say about this episode?

Steven Sanchez, former Director of Curriculum, Instruction, and Learning Technologies, notes:

From the beginning of the development of these science standards to their adoption by the State Board of Education, we were guided by two principles. First, important content should be introduced in early grades and strengthened year after year, so that our students will be scientifically literate when they leave high school. Since evolution is the only accepted scientific theory of the history and unity of life on earth, it is unambiguously central to our life-science standards, beginning in middle school and with increasing sophistication in high school. Second, students should understand the process of scientific inquiry in addition to specific scientific content, so our standards require that students learn to use scientific thinking to develop questions, design and conduct experiments, analyze and evaluate results, make predictions, and communicate findings. In a classroom where those standards are met, students will understand that scientific methods produce scientific knowledge that is continually examined, validated, revised, or rejected, and they will understand the difference between scientific knowledge and other forms of knowledge.

Mr Renick tried to use our scientific-inquiry standards to attack our life-science standards when he addressed the



Board of Education on the day of their final deliberations. However, the members of the New Mexico Board of Education saw science as a unified whole, not as a house divided against itself, and unanimously adopted the standards without modification or caveat.

Sharon Dogruel, Program Manager, Curriculum, Instruction and Learning Technologies, said:

Over 14 months, members of the science standards writing team worked diligently to craft standards in which science content, scientific thinking and methods, and societal and personal aspects of science were integrated into a coherent framework for exemplary science education. Members of this team considered all issues at great depth and, in the area of biological evolution, they were confident that the standards respected the backgrounds and beliefs of all students while remaining perfectly true to science. Based on the extensive development and thorough public review process completed for the science standards, coupled with the strong support from New Mexico teachers, and the praise and congratulations from numerous state and national science organizations, the team and the Department recommended that the New Mexico State Board adopt the standards without further modification.

The board was poised for [its] final vote when Joe Renick attempted to distort the intention of the standards by suggesting that teachers had to treat evolution according to his own perspective. Using a tactic that focused on student inquiry, he tried to manipulate the meaning of scientific inquiry, as elaborated in the standards, into a discussion of a controversy that may be political, philosophical, or even religious, but is not scientific. The writing team was clear: There is no controversy regarding the principles of evolution as presented in the standards. Mr

Renick's attempt to undermine the standards failed.

I was appalled at this attempt to discredit the hard work of so many educators, scientists, parents, and the public, including Mr Renick's fellow members of [IDNet-NM]. Any statements that the New Mexico science standards open the door to "alternatives to evolution" or that science instruction in New Mexico should cast doubt on the principles of evolution are completely false. New Mexicans can be extremely proud of their science standards, and it is unfortunate that some people continue to advance misrepresentations at a time when we need support for strong science education.

It appears that Renick and the people he interrogated disagree about whether his comments reflected any reality in the standards. In our view, his behavior was boorish and his conclusions are disingenuous.

OFFICIAL PUBLIC EDUCATION DEPARTMENT CLARIFICATIONS

As the "intelligent design" advocates continued to misinterpret the standards and even conduct teacher workshops to promote this misinformation, the Public Education Department issued two memoranda to all the state's school districts, describing in no uncertain terms how the department interpreted the standards; in addition, Berman also received a third memorandum. Excerpts from these three memoranda, written by Richard Reif, science consultant for the department, follow:

The Public Education Department requires all school districts to align their curricula to the New Mexico Science Content Standards, Benchmarks, and Performance Standards. Therefore, all science teachers in New Mexico should be teaching about evolution in the appropriate grades and courses, according to their districts' curricula.

Further, because of the Establishment Clause in the First Amendment to the Constitution of the United States and a wide-reaching

United States Supreme Court case, New Mexico public schools are not permitted to endorse a particular religion, teach religion, or teach "creation science" or any of its variations that advance the religious belief that a supernatural being created humankind.

... Third, the state must remain neutral in matters pertaining to religion. In no way do the science standards support the teaching of notions of intelligent design or creation science or any of its variations.

Fourth, fundamental to science and the New Mexico science standards is the role of inquiry in learning about the world. There is no place in science instruction for the teaching of notions that are not or have not been investigated through rigorous scientific means or that are not considered by the mainstream scientific community to be consistent with sound scientific inquiry.

So far, nothing that the "intelligent design" movement has produced meets the criteria of acceptance by mainstream science or is consistent with sound scientific inquiry.

CONCLUSION

The claim that New Mexico's science standards support the teaching of "intelligent design" or any other alternative "theory" to evolution, or encourages teachers "to present the "evidence and the arguments for and against" evolution, is baseless and false.

Nevertheless, this disingenuous and/or self-deluding misrepresentation has been widely circulated, including by the Discovery Institute, which has published similar claims on its website. These misrepresentations have infected such outlets as the *Washington Post*, which claimed (2005 Mar 13) that "Alabama and Georgia legislators recently introduced bills to allow teachers to challenge evolutionary theory in the classroom. Ohio, Minnesota, New Mexico and Ohio [sic] have approved new rules allowing that," and *The New York Times*.





New Mexico is not the only state to have been misrepresented in “Politicized scholars put evolution on the defensive” (*The New York Times* 2005 Aug 21), which (like the *Washington Post*’s article) claimed, “Ohio, New Mexico and Minnesota have embraced the institute’s ‘teach the controversy’ approach. In Ohio, as Patricia Princehouse of Ohio Citizens for Science explained (*RNCSE* 2004 Jan/Feb; 24 [1]: 5–6), the problem was not primarily with the standards but with the “secret process ... used to build the model curriculum in 2003, incorporating creationist mischaracterization not only of the content, but also of the process of science itself.” As for Minnesota, Glenn Branch of NCSE reports that on seeing the story, he alerted a public relations official in the Minnesota Department of Education, who promptly e-mailed the *Times* to request a correction with regard to his state.

A correction of sorts followed in the August 24, 2005, edition of the *Times*, reading: “The article also referred incorrectly to recent changes in science standards adopted by Ohio, Minnesota and New Mexico. While those states encourage critical analysis of evolution, they did not necessarily embrace the institute’s ‘teach the controversy’ approach.”

If there’s anything to be learned from the saga, it’s that claims from proponents of “intelligent design” ought to be taken, as we used to say in Latin class, *cum grano salis* — with a grain of salt.

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Carl Baugh ... Archaeologist?

Christopher O’Brien

As NCSE executive director Eugenie C. Scott recently suggested in an article for *California Wild* (“In my backyard: Creationists and California”, *California Wild* 58 [2]: 6–11), blue state California is not immune to creationist chicanery, particularly in the rural counties. In the north-

eastern California town of Susanville, I recently responded to articles appearing in the *Lassen County Times* highlighting a recent visit from none other than “Dr” Carl Baugh of the Creation Evidences Museum.

Although Baugh and others from the museum gave the usual creationist spiel to small partisan church audiences (and discussed Baugh’s newest discovery: a “fossilized” human leg bone within a cowboy boot), the local paper focused less on creationism than on Baugh’s 2004 expedition to the Holy Land. Baugh’s group, including two local Susanville residents, reportedly conducted excavations at the Pool of Siloam, where Jesus is said to have healed a blind man.

In a series of articles earlier this year, the *Lassen County Times*, citing Baugh and two locals who accompanied him, portrayed the trip as a legitimate archaeological expedition, directed by Baugh and other professional archaeologists, and “commissioned” by the Israeli Antiquities Authority. Local residents were clearly left with the impression that Baugh’s group held professional credentials and were invited to participate with Israeli scholars to conduct official archaeological research. Ultimately readers were told that under the auspices of Baugh’s team, science is continually validating the Bible as historically accurate.

This was not simply a local newspaper objectively reporting the experiences of local residents. The *Times* has a history of reporting in the style of Christian apologetics, prompting many in the community to complain that it reads more like a church bulletin than a newspaper. At best, the *Times* staff failed to check into the professional credibility of Baugh and his group of Christian “scientists” before presenting their views to the community.

In an opinion piece published following Baugh’s visit and more recently in a letter to the editor, I

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corrected erroneous reporting of science in general and archaeology specifically, and challenged the professional legitimacy of Baugh and his team as depicted by the local paper. In researching the issue, I also contacted professional archaeologists in Jerusalem, who claimed no knowledge of Baugh’s group and insisted they would not have “commissioned” the Creation Evidences Museum to conduct archaeological excavation.

That Baugh and his cohorts would attempt to paint themselves as professional archaeologists and trot out fake creationist evidence for an uncritical audience will not be a surprise to NCSE members. For me, the surprise (and the bigger story) is the incredible positive reinforcement I received on a personal level from people in a conservative rural county, including educators, parents and students. Fully expecting to be a lone voice crying in the desert, I instead found a strong undercurrent of support for efforts to challenge local creationists and other pseudo-scientists directly. I received numerous phone calls, personal visits, and e-mails thanking me for standing up to the fraudulent claims of Baugh and others.

The larger lesson is that rural counties are not as uniform in their culture as the media would suggest: a single voice can awaken long-silent sentiment. A significant proportion of rural county residents is trying to find a voice in opposition to the pseudoscientific claims from pretenders who would wrap themselves in the cloak of science, and NCSE members can lend a helping hand.

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Divine Design in Utah?

Glenn Branch
NCSE Deputy Director

From June 2005 on, Utah was abuzz with the news that a state senator plans to introduce legislation to teach “divine design” in

the state's public schools.

Not so long ago, a piece on evolution education in Utah referred to "Utah's non-war over evolution." Writing in the *Deseret Morning News* (2005 Mar 19), Elaine Jarvik observed:

One might suppose, given that Utahns tend to be both conservative and religious, that evolution would be a contentious topic in Utah's schools; but yet another legislative session has passed with no mention of Charles Darwin. And Brett Moulding can count on his fingers the number of anti-evolution phone calls he's gotten in the past 10 years, first as science education specialist and then as curriculum director for the Utah State Office of Education.

Part of the lack of controversy may be due to the fact that in Utah, as elsewhere, teachers frequently succumb to pressure to downplay or omit evolution. Additionally, Jarvik wrote, "Utah students often don't believe what they've been taught anyway, because they've learned something different from teachers in LDS Church seminary classes," although it is disputed whether or not the Mormon faith in fact rejects evolution. The article concluded by reporting Gayle Ruzicka, president of the Utah Eagle Forum, to have plans "to tackle evolution" — and so she did.

According to a story in the *Salt Lake Tribune* (2005 Jun 5), Senator Chris Butters (R-West Jordan), with the support of the Utah Eagle Forum, promised "to lead the fight for instruction of divine design in Utah public schools" when the Utah state legislature reconvened in January 2006. "Divine design," according to Butters, "doesn't preach religion. ... The only people who will be upset about this are atheists. ... It shocks me that our schools are teaching evolution as fact." The Eagle Forum's Ruzicka explained her motivations for supporting the proposed legislation: "What an insult to teach children that they have evolved from a lower life to what they are now, and then they go home and learn that they are someone special, a child of God. ... This is not right." But Brett Moulding, the curriculum director

for the state board of education, explained, "We don't teach religion in school," and Scott Berryessa, president of the Jordan Education Association, representing about 2100 Utah teachers, lamented, "Teachers wish that our Legislature would stop micromanaging the process of education — especially when it comes to issues as personal as these."

A pointed editorial in the *Salt Lake Tribune* (2005 Jun 6) criticized Butters's proposal as not only wrong but also counterproductive: "Except for his new label for an idea called 'intelligent design' — itself a euphemism for the oxymoron 'creation science' — the proposal from the West Jordan Republican is an echo of battles that are already being fought in Kansas, Missouri, Georgia and Alabama, battles that consume a great deal of the oxygen that ought to be expended solving real problems, from health care to poverty to war." It concluded, "Forcing religion to stand in for science does no favor to religion, to science, or to our children. How wonderful it would be if Utah understood that." And a similarly trenchant editorial in the *Ogden Standard-Examiner* (2005 Jun 9) also ridiculed Butters's coinage of "divine design" before deploring how, "[b]y trying to inject religious indoctrination into the schools, Butters and his fellow supporters of 'divine design' are inviting state control over matters now exclusively left to parents and families."

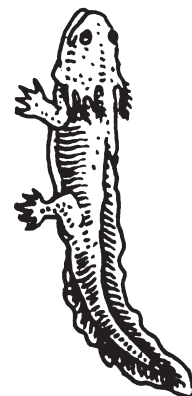
Then Butters reconsidered. On July 15, 2005, the Associated Press reported that "after talks with the state Superintendent of Public Instruction Patti Harrington, he's comfortable — at least for now — with what Utah classrooms are teaching." According to Butters, Harrington told him that "we should not be teaching human evolution of any kind," while Harrington herself was quoted as saying, "There is not evidence yet to claim how the earth was created and no evidence to connect the family of apes with the family of man." In a subsequent article in the *Salt Lake Tribune* (2005 Jul 17), Butters was quoted as saying, ominously, that his conversation with Harrington assured him that teachers who teach human evolution "will be dealt with". If not, he

added, he would reconsider introducing his "divine design" legislation in the 2007 legislative session.

But Brett Moulding told the *Tribune* that although teaching human evolution is not specifically mandated by the state science standards, it is not prohibited either, adding that no action would be taken by the state against teachers who taught human evolution. Moulding suggested that Harrington's remarks quoted by the Associated Press were misunderstood; she was unavailable for comment. University of Utah professor Dennis Bramble was aghast at the very idea that teachers might be penalized for teaching human evolution: "I think the job of public schools is to present modern science as we know it and inform students about how science works," he said. "The genetic similarity between modern apes and modern humans is extremely high. ... That combined with an increasingly complete fossil record ... is compelling."

The *Tribune* subsequently noted in a July 18, 2005, editorial that "the Utah public schools have a state board, a state superintendent and officials, and experts of various specialties seeking to do what is, under the best of circumstances, a difficult job. What Utah schools clearly do not need is a Grand Inquisitor, no matter how badly state Sen Chris Butters wishes to secure the position." The editorial also argued that while the state standards mandate "the teaching of evolution as exactly what it is, 'central to modern science's understanding of the living world,'" they also stress that "'[s]cience is a way of knowing,' not the way of knowing, and thus the necessary understanding of evolution should not be seen to challenge any religion or other belief system." The *Provo Daily Herald* (2005 Jul 16) was briefer: it awarded a "buffalo chip" to Butters "for mucking around where religion doesn't belong — in the public school curriculum."

In the following month, Butters enjoyed a brief burst of national publicity, when his op-ed "Evolution lacks fossil link" appeared in *USA Today* (2005 Aug 8). Emphasizing supposed gaps in the fossil record ("There is zero scientific fossil evidence that demonstrates organic evolutionary linkage between pri-



mates and man”), Buttars was anything but coy about the religious underpinnings of his position, writing, “The argument over classroom discussion of evolution vs divine design is just the latest attack on everything that would mention a belief in God.” *USA Today* may have regarded his op-ed as a counterbalance to its editorial “‘Intelligent design’ smacks of creationism by another name” (also 2005 Aug 8), which noted that “intelligent design” “ascribes creation to a vaguely undefined cosmic force that sounds a great deal like the God of Genesis but usually isn’t named as such,” opined that “intelligent design” “isn’t science. It can’t be tested with rigorous experimentation. It is at best a philosophical concept, or a matter of faith,” and concluded, “creationism, by whatever name, doesn’t belong in a science class.”

At its meeting on September 2, 2005, the Utah state board of education unanimously adopted a position statement that described evolution as “a major unifying concept in science and appropriately includ-

ed in Utah’s K-12 Science Core Curriculum” (see below). The statement, according to the *Deseret Morning News* (2005 Sep 3), was prepared at the behest of board chairman Kim Burningham “by a group of 22 scientists, professors and community members, including members of the Coalition of Minorities Advisory Committee and the Catholic Diocese” in reaction to the ongoing controversy over evolution education across the country. Buttars, who attended the meeting, requested that the board defer its vote until he presented a two-hour exposition of “intelligent design”; the board declined his request. The *Morning News* quoted Buttars as telling the board that evolution “has more holes than a crocheted bathtub” (a line he used in his *USA Today* op-ed as well).

According to the *Salt Lake Tribune* (2005 Sep 2), only Buttars and two supporters protested the adoption of the statement, while about a dozen scientists in attendance endorsed the statement, telling the board that “intelligent design” is not good science. Duane

Jeffrey, a professor of biology at Brigham Young (and NCSE board member) compared “intelligent design” to astrology and pyramid power, while Gregory Clark, a professor of bioengineering at the University of Utah, told the board, “‘Intelligent design’ fails as science because it does exactly that — it posits that life is too complex to have arisen from natural causes, and instead requires the intervention of an intelligent designer who is beyond natural explanation. Invoking the supernatural can explain anything, and hence explains nothing.”

In its editorial “Resisting temptation: Board stands on firm scientific ground” (2005 Sep 7), the *Salt Lake Tribune* praised the board for its vote, writing, “The board was not only correct, but also refreshingly quick and unanimous, in approving last Friday a new position statement affirming that evolution is, indeed, ‘a unifying concept in science’ and ‘a necessary part of science classroom instruction.’” The editorial also criticized Buttars for dismissing “evolutionary theory as ‘a theory, not a

Utah State Board of Education Position Statement on Teaching Evolution

The Theory of Evolution is a major unifying concept in science and appropriately

This position is consistent with that taken by the National Academy of Sciences, the American Association for the Advancement of Science (AAAS), and most other scientific and educational organizations. The Utah State Board of Education and these organizations affirm science as an essential way of understanding for all students and the importance of evolution as a unifying concept in science.

SCIENCE: A WAY OF KNOWING

Science is a distinctive way of understanding the natural world. Science seeks to increase our understanding through empirical evidence. As a way of knowing, science assumes that anything that can be measured or observed is amenable to scientific investigation. By the very nature of scientific inquiry, there are infinite possibilities for further refinement of current knowledge and understanding.

Understanding may be derived from sources and perspectives other than science such as historical and logical analyses, art, religion and philosophy. These sources rely upon other ways of knowing, such as emotion and faith. While these ways of understanding and creating meaning are important to individuals and society, they are not amenable to scientific investigation and thus not appropriate for inclusion in the science curriculum. Science relies nearly exclusively on observation and empirical evidence. Since progress in the modern world is tied so closely to this way of knowing, scientific literacy is essential for a society to be competitively engaged in a global economy.

EVOLUTION: A UNIFYING CONCEPT

Evolution in the broadest sense can be defined as the idea that the universe has a history and has changed

over time. Observation of the galaxies, stars, planet earth, and life on earth clearly demonstrates that significant changes have occurred. There is abundant and consistent evidence from astronomy, physics, biochemistry, geochronology, geology, biology, anthropology, and other sciences that evolution has taken place. This evidence is found in widely divergent areas, from the geologic fossil record to DNA analysis.

Evolution is an ongoing process with crucial implications for disciplines such as medicine, agriculture and conservation biology. The theory of evolution provides a unifying basis upon which the elements of life are understood and upon which predictions can be made. Moreover, viewing present-day organisms as products of evolution provides the most productive framework for investigating and understanding their structure and function. As such, evolution is a uni-

fact,' when scientifically literate people know that theories are models for describing facts, not mere shots in the dark," adding, "Shots in the dark such as intelligent design."

At the meeting, Buttars told the board that he intended either to introduce legislation calling for the teaching of "intelligent design" or arrange for there to be a referendum on next year's ballot. He told the *Deseret Morning News* that his "Academic Freedom Act" would "enhance the effectiveness of science education while at the same time ensuring that students are given credible alternative explanations for the origin of life on earth"; the newspaper quoted the act as saying, "We believe that excluding recent scientific discoveries simply because they run counter to the Darwinian model of origins is not good educational policy."

It was then unclear how much support Buttars's bill would enjoy if introduced. Previously, Utah governor Jon Huntsman Jr (R) was reported in the *Salt Lake Tribune* (2005 Aug 29) as disagreeing with President Bush's apparent endorse-

ment on August 1 of teaching "intelligent design" in the public schools (see p 13). "It is a *science* class," he told the *Tribune*. "Our schools are largely secular institutions. ... I would expect my kids in *science* class to be instructed in those things that are somewhat quantifiable and based on thorough and rigorous empirical research" (emphasis in original). Huntsman said that he had no objection to "intelligent design" as a topic for a sociology or a psychology class.

Nevertheless, in a November 15, 2005, post on the Utah senate majority's blog, Buttars wrote, "I'm asked on an ongoing basis if I plan to introduce a bill concerning the Utah State Board of Education's position on teaching evolution. The answer to that question is yes. I've opened a bill file and I'm currently working on the language. The bill text is not yet public and will remain private until I'm satisfied that 1) the intent of the bill is clear, 2) how it will be administered is also clear, and 3) it can withstand a court challenge" (<[http://senate-site.com/blog/2005/11/teaching-](http://senate-site.com/blog/2005/11/teaching-evolution.html)

[evolution.html](http://senate-site.com/blog/2005/11/teaching-evolution.html)>).

Subsequently, Buttars filed Senate Bill 96 on January 4, 2006. If enacted, SB 96 would direct the Utah state board of education to require "that instruction to students on any theory regarding the origins of life, or the origins or present state of the human race, shall stress that not all scientists agree on which theory is correct" and to "ensure that all policies and positions of the State Board of Education relating to theories regarding the origins of life or the origins or present state of the human race: (i) do not endorse a particular theory; and (ii) stress that not all scientists agree on which theory is correct." SB 96 was approved by the Senate Education Committee by a 4-2 vote along party lines on January 17, 2006.

NCSE continues to monitor the situation and to provide advice to concerned Utahns. Expect further details in the next issue of *RNCSE*.

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included in Utah's K-12 Science Core Curriculum.

ifying concept for science and provides the foundation for understanding nature. The National Science Education Standards from the National Academies of Science and Benchmarks for Science Literacy from the American Association for the Advancement of Science identify evolution as a unifying concept across the major disciplines of science. Scientific disciplines with strong historical components — such as astronomy, geology, biology, and anthropology — rely upon the concepts of evolution to understand the nature of changes that have occurred or can be predicted.

There is little or no debate among credible scientists about whether evolution has taken place. However, since our understanding is still incomplete, there is considerable and productive debate about processes of evolution. Research questions remain, and scientists often disagree

about their explanations, as they should. The nature of science encourages ongoing and meaningful investigation of all assertions made by science. Scientific conclusions are tested by experiment and observation as all scientific theories are subject to continued evaluation.

While some describe the principle of evolution as "just a theory," the scientific definition of a theory is far more rigorous than may be commonly understood. In science, a theory is a systematic explanation of observed phenomena. It must be consistent with all natural laws and withstand the scrutiny and inquiry of the scientific community. The National Academy of Sciences has stated, "Evolution is one of the strongest and most useful scientific theories we have." As a fundamental scientific concept, evolution is a necessary part of science classroom instruction, and it will continue to be taught and pro-

gressively refined as a key scientific principle.

STUDENT BELIEFS AND TEACHING EVOLUTION

Teachers should be aware that students bring with them a set of beliefs. Teachers and students should respect and be nonjudgmental about students' beliefs, and teachers should help students understand that science is an essential way of knowing. Teachers should encourage students to discuss any seeming conflicts with their parents or religious leaders. Science teachers should make available to interested parents their planned instruction and the context for that instruction.



Creationists Sue the University of California

Glenn Branch
NCSE Deputy Director

Creationism is prominent in a recent lawsuit — *Association of Christian Schools International et al v Roman Stearns et al* — that charges the University of California system with violating the constitutional rights of applicants from Christian schools whose high school coursework is deemed inadequate preparation for college. (The lead defendant, Roman Stearns, works in the university system's Office of Undergraduate Admissions.)

The complaint (available on-line at <http://www.acsi.org/webfiles/webitems/attachments/007875_2.%20ACSI%20CA%20Complaint.pdf>) was filed in federal court in Los Angeles on August 25, 2005, on behalf of the Association of Christian Schools International (ACSI), the Calvary Chapel Christian School in Murrieta, California, and a handful of students at the school. Representing the plaintiffs are Robert H Tyler, a lawyer with a new organization called Advocates for Faith and Freedom, and Wendell R Bird of the Atlanta law firm Bird and Loechl.

Bird is no stranger to litigation over creationism. As a law student in the late 1970s, he published a student note in the *Yale Law Journal* (87 [3]: 515-70), sketching a strategy for using the free exercise clause of the First Amendment to secure a place for creationism in the public school science classroom. Bird later worked at the Institute for Creation Research, where he updated its model "equal-time" resolution. The ICR's resolution eventually mutated, in Paul Ellwanger's hands, to become model "equal-time" legislation. A bill based on Ellwanger's model was passed in Arkansas in 1981 and then ruled unconstitutional in *McLean v Arkansas*.

Although Bird was not able to participate in the *McLean* trial — he sought to intervene on behalf of

a number of creationist organizations and individuals, but was not allowed to do so — he was involved in *Aguillard v Treen*, which became *Edwards v Aguillard*. Named a special assistant attorney general in Louisiana, Bird defended Louisiana's "equal-time" act all the way to the Supreme Court, where in 1987 it was ruled to violate the Establishment Clause. His *The Origin of Species Revisited*, which compared evolution and "abrupt appearance," was subsequently published in two volumes (New York: The Philosophical Library, 1989).

At issue in the present suit are the guidelines set by the University of California system to ensure that first-year students have been adequately prepared for college in their high schools. The complaint cites a policy of rejecting high school biology courses that use textbooks published by Bob Jones University Press and A Beka Books as "inconsistent with the viewpoints and knowledge generally accepted in the scientific community." Such a policy, the complaint alleges, infringes on the plaintiffs' rights to "freedom of speech, freedom from viewpoint discrimination, freedom of religion and association, freedom from arbitrary discretion, equal protection of the laws, and freedom from hostility toward religion."

Robert Tyler told the *Los Angeles Times* (2005 Aug 27), "It appears that the UC system is attempting to secularize Christian schools and prevent them from teaching from a [Christian world] view." But creationism is a matter of theology, not of science, Robert John Russell of the Center for Theology and Natural Science told the *Oakland Tribune* (2005 Aug 31). "It's almost ludicrous anyone would even take this seriously," Russell said. "It seems absurd that a student who had poor biology would meet the same standards as a student with 'good' biology. ... This has nothing to do with First Amendment rights."

A spokesperson for the University of California system would not comment on the specific allegations leveled in the complaint, but told the *Los Angeles Times* that the university was entitled to set course requirements for

incoming students, adding, "[t]hese requirements were established after careful study by faculty and staff to ensure that students who come here are fully prepared with broad knowledge and the critical thinking skills necessary to succeed."

In its fall 2005 newsletter (available on-line at <http://www.acsi.org/webfiles/webitems/attachments/007875_1.%20Overview%20of%20ACSI%20Law%20Suit.pdf>), ACSI expresses concern that the University of California system's "secular intolerance might spread to other institutions and to other states. ... If this discrimination is allowed to continue unchallenged, it is only a matter of time before secular institutions in other states will join the bandwagon." Interviewed by *Education Week* (2005 Sep 7), however, a spokesperson for the American Association of Collegiate Registrars and Admissions Officers expressed the opposite concern, reportedly worrying "about the potential implications of asking a university to ignore its course requirements — which had been shaped by experts in various fields — in favor of a 'free-for-all,' in which any interest group is allowed to shape policy."

The lawsuit was subsequently criticized in a trenchant editorial published in the *San Jose Mercury News* (2005 Oct 3). Mincing no words, the author of the editorial argued, "The suit appears to be baseless — a case of substandard academics hiding behind a false cry of religious persecution," but warned that the suit must be taken seriously "because a victory by Calvary Chapel Christian would weaken UC's ability to require strong curriculums and would open the door to more bad science and sectarian courses in high schools."

Commendably, the author took the trouble to examine one of the textbooks at issue, Bob Jones University Press's *Biology for Christian Schools*, which the University of California system regards as not providing students with "knowledge generally accepted in the scientific and educational communities and with which a student at the university level should be conversant." Accompanying the



editorial was a sidebar with excerpts from the textbook, such as “Many current scientific observations, therefore, are open to various interpretations. We can be sure, though, that anything that contradicts the Word of God is wrong.”

“The issue is not whether religious and private schools should be able to teach religion or other courses tied to the core mission of their schools,” the author of the editorial emphasized. “They have a right to. The issue is what can be used for college entrance requirements.” And the editorial concluded by exhorting the University of California system to resist pressure to compromise those requirements: “The suit against UC is part of a campaign by religious conservatives to put public educators on the defensive and insinuate their beliefs into the classroom. UC must stand firm, in defense of students who need to be taught objective content and critical thinking.”

A hearing on the defendants’ motion to dismiss the charges was scheduled for December 12, 2005, but then cancelled; the judge is expected to rule on the motion without the benefit of oral argument. As always, NCSE is monitoring the situation.

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President Bush Addresses “Intelligent Design”

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During a press conference with a group of Texas reporters on August 1, 2005, President George W Bush responded to a question about teaching “intelligent design” in the public schools. The reporter referred to “what seems to be a growing debate over evolution versus ‘intelligent design’” and asked, “What are your personal views on that, and do you think both should be taught in public schools?” In

response, Bush referred to his days as governor of Texas, when “I said that, first of all, that decision should be made to local school districts, but I felt like both sides ought to be properly taught ... so people can understand what the debate is about.” (It is noteworthy that Bush tacitly equated “intelligent design” and creationism.) Pressing the issue, the reporter asked, “So the answer accepts the validity of ‘intelligent design’ as an alternative to evolution?” Bush avoided a direct answer, construing the question instead as a fairness issue: “You’re asking me whether or not people ought to be exposed to different ideas, and the answer is yes.”

Although there was nothing unexpected about Bush’s response, which is consistent with his previous statements on the topic, the present heightened awareness of issues involving evolution education ensured a media frenzy. NCSE was widely consulted for comment. *The New York Times* (2005 Aug 3) quoted NCSE’s Susan Spath on the specious appeal to fairness: “It sounds like you’re being fair, but creationism is a sectarian religious viewpoint, and ‘intelligent design’ is a sectarian religious viewpoint,” she said. “It’s not fair to privilege one religious viewpoint by calling it the other side of evolution.” NCSE’s Glenn Branch concurred, telling the *Los Angeles Times* (2005 Aug 3) that because “[t]he question was presented to him as a fairness issue,” it was not surprising that Bush expressed the view that “both sides ought to be taught.” Branch also told the *Financial Times* (2005 Aug 3) that “Bush would have done better to heed his White House science adviser, John Marburger, who [has] said that evolution was the ‘cornerstone of modern biology’ and who has characteriz[ed] ID as not even being a scientific theory.”

When interviewed by *The New York Times*, Marburger reiterated that “evolution is the cornerstone of modern biology” and that “intelligent design is not a scientific concept.” According to the *Times*, Marburger — who is Science Adviser to the President and Director of the White House’s

Office of Science and Technology Policy — suggested that it would be “over-interpreting” Bush’s remarks to endorse equal treatment for “intelligent design” and evolution in the public schools. Instead, he said, Bush’s remarks should be interpreted as recommending the discussion of “intelligent design” as part of the “social context” in science classes. Marburger’s charitable interpretation was not shared, however, by Richard Land, the president of the ethics and religious liberties commission of the Southern Baptist Convention, whom the *Times* quoted as construing Bush’s remarks as supportive of the view he favors: “if you’re going to teach the Darwinian theory as evolution, teach it as theory. And then teach another theory that has the most support among scientists” — presumably alluding to “intelligent design.”

The scientific community rushed to deplore Bush’s remarks. The American Geophysical Union issued a press release (2005 Aug 2) in which its executive director Fred Spilhaus stated, “President Bush, in advocating that the concept of ‘intelligent design’ be taught alongside the theory of evolution, puts America’s schoolchildren at risk.” In its press release (2005 Aug 4), the American Physical Society accepted Marburger’s interpretation of Bush’s remarks, but emphasized that “only scientifically validated theories, such as evolution, should be taught in the nation’s science classes.” The American Institute of Biological Sciences issued a press release (2005 Aug 5) in which its president Marva Lee Wake stated, “‘Intelligent design’ is not a scientific theory and must not be taught in science classes.” And in a letter to President Bush dated August 5, 2005, Robert Kirschner, the president of the American Astronomical Society, commented that “intelligent design has neither scientific evidence to support it nor an educational basis for teaching it as science.”

The education community expressed its concern, too. According to a statement dated August 3, 2005, the National Science Teachers Association, the world’s largest group of science educators, was “stunned and disappointed that President Bush is



Q&A ON ID WITH POTUS

Q I wanted to ask you about the — what seems to be a growing debate over evolution versus “intelligent design”. What are your personal views on that, and do you think both should be taught in public schools?

THE PRESIDENT: I think — as I said, harking back to my days as my governor ...

Then, I said that, first of all, that decision should be made to local school districts, but I felt like both sides ought to be properly taught.

Q Both sides should be properly taught?

THE PRESIDENT: Yes, people — so people can understand what the debate is about.

Q So the answer accepts the validity of

“intelligent design” as an alternative to evolution?

THE PRESIDENT: I think that part of education is to expose people to different schools of thought, and I’m not suggesting — you’re asking me whether or not people ought to be exposed to different ideas, and the answer is yes.

[From the transcript posted on the Washington Post’s website, August 2, 2005.]

endorsing the teaching of intelligent design — effectively opening the door for nonscientific ideas to be taught in the nation’s K–12 science classrooms” (see p 38). In a statement dated August 4, 2005, the American Federation of Teachers, with over 1.3 million members, described Bush’s remarks as “a huge step backward for science education in the United States,” adding that “[b]y backing concepts that lack scientific merit, President Bush is undermining his own pledge to ‘leave no child behind.’”

On editorial and op-ed pages, Bush’s remarks took a hammering. The *Washington Post’s* editorialist wrote (2005 Aug 4), “To pretend that the existence of evolution is somehow still an open question, or that it is one of several equally valid theories, is to misunderstand the intellectual and scientific history of the past century.” Referring to “intelligent design,” the *Baltimore Sun’s* editorialist wrote (2005 Aug 4), “It’s creationism by another name, and if it makes its way into schools at all, it should definitely not be part of science classes.” In its editorial (2005 Aug 4), the *Sacramento Bee* connected the dots between Bush’s remarks and the Wedge strategy for promoting “intelligent design,” commenting, “America’s children deserve a first-rate education in science in public school and not a false, politically motivated ‘Teach the Controversy’ debate between science and religion.” And in his August 5, 2005, column in *The New York Times*, the economist Paul Krugman perceptively remarked, “intelligent design doesn’t have to attract significant support from actual researchers to be effective. All it has to do is create confusion, to make it seem as if there really is a

controversy about the validity of evolutionary theory.”

Nevertheless, two prominent Republican politicians subsequently echoed Bush. According to the Associated Press (2005 Aug 18), Senator Bill Frist (R-Tennessee), the Senate majority leader, told reporters in Nashville that students ought to be exposed to different ideas, including “intelligent design”: teaching “intelligent design” alongside evolution, he said, “doesn’t force any particular theory on anyone. I think in a pluralistic society that is the fairest way to go about education and training people for the future.” According to the *Arizona Daily Star* (2005 Aug 24), Senator John McCain (R-Arizona) “told the *Star* that, like Bush, he believes ‘all points of view’ should be available to students studying the origins of mankind.”

Senator Rick Santorum (R-Pennsylvania), who as the Senate Republican Conference Secretary is third in the Republican leadership, took a different tack, however. Speaking on National Public Radio (2005 Aug 4), he said, “as far as intelligent design is concerned, I really don’t believe it has risen to the level of a scientific theory ... that we would want to teach it alongside of evolution.” Santorum’s reaction represents a departure for him: writing in the *Washington Times* (2002 Mar 14), for example, he stated, “intelligent design is a legitimate scientific theory that should be taught in science classes.” Like Frist and McCain, Santorum is reportedly contemplating a run for the presidency in 2008.

A welcome congressional response appeared in the following month. Writing as a guest colum-

nist on the popular TPMCafe blog (2005 Sep 8; available on-line at <<http://houseoflabor.tpmcafe.com/story/2005/9/8/183216/1039>>), Representative Rush Holt (D-New Jersey) — one of the very few research scientists who serve in Congress — contributed a piece entitled “Intelligent design: It’s not even wrong.” “As a research scientist and a member of the House Education Committee,” Holt wrote:

I was appalled when President Bush signaled his support for the teaching of ‘intelligent design’ alongside evolution in public K–12 science classes. Though I respect and consistently protect the rights of persons of faith and the curricula of religious schools, public school science classes are not the place to teach concepts that cannot be backed up by evidence and tested experimentally.

He added, “It is irresponsible for President Bush to cast ‘intelligent design’ — a repackaged version of creationism — as the ‘other side’ of the evolution ‘debate.’” His incisive essay ends with the sobering thought, “When the tenets of critical thinking and scientific investigation are weakened in our classrooms, we are weakening our nation. That is why I think the President’s off-hand comment about ‘intelligent design’ as the other side of the debate over evolution is such a great disservice to Americans.”

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UPDATES

California: Speaking at the Los Angeles Natural History Museum on September 28, 2005, State Superintendent of Public Instruction Jack O'Connell declared that "intelligent design" was unwelcome in California's public school science classes. "The introduction of 'intelligent design' theory in natural science courses would be a blow to the integrity of education in California," O'Connell said. "Our state has been recognized across the country and around the world for the quality and rigor of our academic standards. Just like I will fight tooth and nail to protect California's high academic standards, I will fight to ensure that good science is protected in California classrooms."

In studies of state standards conducted by the Fordham Foundation, California was among only a handful of states to earn the grade of A, for both its science standards in general and its treatment of evolution in particular. From Pennsylvania, where the trial in *Kitzmiller v Dover* was ongoing (see *RNCSE* 2004 Sep/Oct; 24 [5]: 4-9), NCSE's executive director Eugenie C. Scott commented, "California's unsurpassed state science standards treat evolution appropriately: as the central, powerful, unifying principle of the biological sciences that it is. I am gratified that Superintendent O'Connell recognizes the need to defend the teaching of evolution against religiously motivated and scientifically unwarranted attacks."

O'Connell also said, "The goal of public education is for students to gain the knowledge and skills necessary for California's work force to be competitive in the global, information-based economy of the 21st Century. ... We also want to give students the tools to become critical thinkers and to be able to discuss and reflect on philosophical questions. But, the domain of the natural sciences is the natural world. Science is limited by its tools — observable facts and testable hypothesis. Because reli-

gious beliefs are based on faith, and are not subject to scientific test and refutation, these beliefs should not be taught in the realm of natural sciences." His statement is available on-line at <<http://www.cde.ca.gov/nr/ne/yr05/yr05rel118.asp>>.

Idaho: In a statement issued on October 4, 2005 (available on-line at <<http://www.president.uidaho.edu/default.aspx?pid=85947>>), the president of the University of Idaho, Timothy P. White, articulated the University's position on evolution. "As an academic scientific community and a research extensive land-grant institution," he wrote, "we affirm scientific principles that are testable and anchored in evidence." Hence only evolution, and not supposed "alternatives" to it, is taught in the university's science classes, he explained. White noted that such views might be appropriately discussed in "religion, sociology, philosophy, political science, or similar courses," and that the university respects the right of individuals to hold such views, but emphasized that they are inappropriate for the science classrooms. President White's statement appeared at a time when the University of Idaho was taking a special interest in the issue, as the Associated Press noted (2005 Oct 6). Scott Minnich, a professor in the university's Department of Microbiology, Molecular Biology, and Biochemistry, and a Fellow of the Discovery Institute's Center for Science and Culture, was shortly to testify for the defense in *Kitzmiller v Dover*, the first legal challenge to teaching "intelligent design" in the public schools. Moreover, NCSE's executive director Eugenie C. Scott was shortly to speak at the university on October 12, 2005, in the Randall Seminar Series, on "Why scientists reject intelligent design."

Indiana: The *Indianapolis Star* (2005 Nov 3) reported that a group of Republican state representatives is preparing to introduce "intelligent design" legislation

when the legislature reconvenes in early January 2006. A questionnaire including a question about whether there should be equal time for "intelligent design" in science classes was circulated by 36 of the 52 Republican state representatives to their constituents. The *Star* noted that House Speaker Brian Bosma (R-Indianapolis) and a few of his colleagues solicited help from Carl Baugh, who runs the Creation Evidence Museum in Glen Rose, Texas. Baugh, of course, is notorious for accepting claims rejected even by fellow young-earth creationists, such as the presence of human footprints in the Cretaceous limestone of the Paluxy River basin in Texas.

Although interest in such legislation is apparently strong in the House of Representatives, Senate President Pro Tempore Robert Gorton (R-Columbus) was lukewarm. The executive director of the Indiana School Boards Association told the *Star* that the legislature ought to defer to the state board of education. And Fran Quigley, executive director of the Indiana Civil Liberties Union, said that the ICLU would oppose any such legislation as violating church/state separation. Governor Mitch Daniels (a Republican) expressed reservations, too, saying, "I'd have to think hard about a bill that would require any particular curriculum or assignment" (Associated Press, 2005 Nov 5).

Editorial reaction in the state's newspapers was also negative. The *Star* (2005 Nov 4) expressed opposition to the idea of legislatively mandating "intelligent design" in the state's public schools, although, disturbingly, it described the Discovery Institute's "teach the controversy" approach as "reasonable." The *Fort Wayne Journal Gazette's* editorial (2005 Nov 4) was more astute, describing "intelligent design" as "the Trojan horse that critics of evolution push to avoid the clearly unconstitutional practice of teaching creationism in science class," criticizing Bosma for taking advice from "such a source for advice on Indiana's academic standards" as Carl Baugh, and firmly stating that "[a]dopting science standards that include instruction in intelligent design — ideas reject-



ed by mainstream scientists — would seal the state's backwater reputation."

A subsequent story in the *Star* (2005 Nov 13) reported that initial responses to the questionnaires circulated by the Republican state representatives were positive, with 53% and 63% of respondents in two districts favoring the idea of teaching "intelligent design" alongside evolution. It also reported a split of opinion about whether "intelligent design" would be a "wedge" issue in Indiana politics: Representative Ed Mahern (D-Indianapolis) described it as "their Pledge of Allegiance or Ten Commandments issue for 2006," while Representative Luke Messer (R-Shelbyville), the executive director of the Indiana Republican Party, disagreed. Gary Belovsky, who teaches biology at the University of Notre Dame, told the *Star* that evolution was good science and not antithetical to faith and God, and lamented, "This shouldn't even be an issue."

Michigan: On September 29, 2005, Michigan House Bill 5251 was introduced and referred to the House Committee on Education. If enacted, HB 5251 would require the state board of education to revise the state science standards to ensure that students will be able to "(a) use the scientific method to critically evaluate scientific theories including, but not limited to, the theories of global warming and evolution [and] (b) Use relevant scientific data to assess the validity of those theories and to formulate arguments for or against those theories."

Michigan Information & Research Service reported (2005 Oct 1) that the lead sponsor of the bill, Representative John Moolenaar (R-Midland), introduced the legislation in part in reaction to Barbra Streisand's characterization of the recent spate of hurricanes as due to global warming. He was quoted as explaining, "If we, as a society, didn't pursue the truth on scientific theories we'd still believe the earth was flat and bloodletting was an effective cure for the common cold ... Current events such as the hurricanes or evolution lead to great teachable moments. We must make sure students are given the tools to

critically evaluate the world around them."

"While critical and deductive reasoning is essential to the scientific method," responded Gregory Forbes, "this bill singles out two theories for special attention that Representative Moolenaar happens to find objectionable to his personal views: global warming and biological evolution. Since Michigan's science standards already require that students to be able to think scientifically and to use scientific knowledge to make decisions about real-world problems, it's clear that the only point of HB 5251 is to lead students to believe that evolution and global warming are somehow less scientific than other scientific theories. In fact, evolutionary theory is the most critically tested and robust theory in modern science." Forbes is Professor of Biological Sciences at Grand Rapids Community College and serves as the Education Director for the Michigan Scientific Evolution Education Initiative and as the National Course Director for the National Science Foundation's course on evolution. He is also on the board of the grassroots group Michigan Citizens for Science.

Moolenaar was a cosponsor of previous anti-evolution legislation in Michigan in the previous (2003-2004) legislative session: HB 4946, which would have amended the state science standards to refer to "the theory that life is the result of the purposeful, intelligent design of a Creator," and HB 5005, which would have allowed the teaching of "the design hypothesis as an explanation for the origin and diversity of life" in public school science classes. Both bills were opposed by the Michigan Science Teachers Association; both seem to have died in committee.

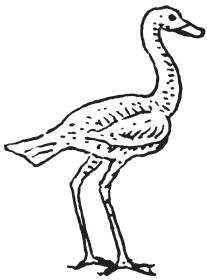
In October 2005, the Michigan Science Teachers Association issued a statement (available online at <<http://www.msta-mich.org/positions/evolution2.php>>) denouncing HB 5251, noting that, because the Michigan state science standards "already require students to 'use scientific knowledge to make decisions about real-world problems' and to be 'able to make

informed judgments on statements and debates claiming to have a scientific basis," there is apparently "no valid reason for legislative intervention that would modify the existing standards as developed and adopted by the MDOE working in collaboration with Michigan's professional science education community."

Additionally, noting that "global warming and evolution are the only two theories selected for mandatory 'critical evaluation' in HB 5251," the MSTA statement observes that the proposed revision "may suggest to students and the public that these theories are somehow less robust or less scientific than are other scientific theories that were not selected for mandatory evaluation ... in clear contrast to the preponderance of scientific evidence supporting both of these theories and would represent a dishonest and unprofessional approach to the sciences and science education in Michigan."

Gregory Forbes reports that the MSTA statement was subsequently endorsed by the Michigan Earth Science Teachers Association, the Michigan Science Education Leaders Association, and the National Association of Biology Teachers.

Michigan, Gull Lake: According to the *Kalamazoo Gazette* (2005 Jun 14), the Gull Lake Community Schools Board decided that although "intelligent design" might be appropriate for elective classes in political science, humanities, or philosophy at the high school level, it is not appropriate for biology classes in high school or for any classes at the middle school level. The decision agrees with the recommendation of a committee appointed to study the question of whether and how to teach "intelligent design" in the district's schools, in the wake of a controversy involving two middle school science teachers who were using *Of Pandas and People* and other creationist material in their science classes (see *RNCSE* 2004 Sep/Oct; 24 [5]: 12-15 and 2004 Nov/Dec; 24 [6]: 12-14). "This is a very emotional issue, and the committee did a good job of taking emotion out of it and looking at the



NCSE NEWS

News from the Membership *Glenn Branch, NCSE Deputy Director*

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

Responding to the threatened “divine design” legislation in Utah

(see p 8), **David F Bailey** contributed an op-ed column to the *Salt Lake Tribune* (2005 Jun 16). “As a Mormon,” he wrote, “I definitely believe that our world was created by an intelligent designer. Indeed, it seems to me that an open-minded

philosophy of this sort is entirely consistent with modern scientific knowledge. But I find that on almost all specific issues, I disagree with the ‘intelligent design’ (ID) movement, and I do not believe this material has any place in public schools.” After

facts,” school board president Deb Ryan told the *Gazette*. In a story published in the *Detroit News* (2005 Jul 24), superintendent Richard Ramsey added, “We couldn’t find a science department in any public university in Michigan that thought [teaching ‘intelligent design’] was a good idea.”

Pennsylvania, Dover: Just days after the close of testimony in *Kitzmiller v Dover*, the first legal challenge to the constitutionality of teaching “intelligent design” in the public schools (see *RNCSE* 2004 Sep/Oct; 24 [5]: 4-9), the Dover electorate voiced its opinion at the ballot box in the November 8, 2005, election. Opposing eight pro-“intelligent design” incumbents on the Dover Area School Board were eight candidates — Bernadette Reinking, Terry Emig, Bryan Rehm (one of the plaintiffs in *Kitzmiller*), Herbert “Rob” McIlvaine, Judy McIlvaine, Larry Gurreri, Patricia Dapp, and Phil Herman — running as the Dover CARES (Dover Citizens Actively Reviewing Educational Strategies) slate. Dover CARES is bipartisan, although all of its candidates ran as Democrats because incumbent members of the board won the Republican primaries. Although “intelligent design” was not the only focus of the Dover CARES campaign, it took a firm stand on the inappropriateness of teaching “intelligent design” and related religious ideas in the science classroom: “Science class is not the proper curriculum for these concepts.”

According to election returns published in the *York Dispatch* (2005 Nov 8), it was a clean sweep for the Dover CARES candidates.

Ousted were board president Sheila Harkins and former board president Alan Bonsell, both of whom voted for the policy that provoked the *Kitzmiller* suit, as well as James Cashman, Sherrie Leber, Dave Napierskie, Eric Riddle, Ed Rowand, and Ron Short, all of whom were appointed by the anti-evolution majority on the board to fill vacancies that have arisen during the current term. Remaining on the board is Heather Geesey, who was not up for reelection; she voted for the anti-evolution policy. The turnover in the board’s composition was not expected to affect the outcome of the *Kitzmiller* case: the ACLU’s Witold Walczak told the *Harrisburg Patriot News* (2005 Nov 8) that the plaintiffs’ request for a declaratory judgment and nominal damages of \$1 were designed to “prevent the case from being mooted” by the election. The newly elected board’s first meeting was on December 5, 2005; a ruling for the plaintiffs was issued on December 20, 2005 (see p 5).

On November 10, 2005, the Reverend Pat Robertson offered a warning to Dover. “I’d like to say to the good citizens of Dover, if there is a disaster in your area, don’t turn to God,” Robertson advised. “You just rejected him from your city, and don’t wonder why he hasn’t helped you when problems begin, if they begin, and I’m not saying they will. But if they do, just remember you just voted God out of your city. And if that’s the case, then don’t ask for his help, because he might not be there.” Reaction from Dover was reportedly cool. Newly elected school board member Larry Gurreri told the *York*

Daily Record (2005 Nov 11) that Robertson’s comments were desperate and radical, and added that he would pray for him. Former school board member Jeff Brown, who resigned in protest of the controversial policy, told the *York Dispatch* (2005 Nov 11), “According to sworn testimony, intelligent design has nothing to do with God ... Then Pat Robertson says if you don’t support it, God will hate you. These clowns want it both ways.”

Texas: House Bill 220 died in committee when the Texas legislature recessed on May 30, 2005. If enacted, HB 220 would have amended the state’s education code to require that textbooks approved by the state be free from factual errors, “including errors of commission or omission related to viewpoint discrimination or special interest advocacy on major issues, as determined by the State Board of Education,” and satisfy general textbook content standards to be defined by the board. Its sponsor, Representative Charlie Howard (R-Sugar Land), told the *Fort Worth Star-Telegram* (2004 Apr 22) that HB 220 would enable the board to ensure that creationism was taught alongside evolution and to remove evolution segments from science textbooks. Two similar bills, HB 973 and HB 2534, also died in committee, although neither seems to have been publicly linked to issues involving evolution education. (For background, see *RNCSE* 2005 Jan-Apr; 25 [1-2]: 12-16.)

[NCSE thanks Heather Alden of the Texas Freedom Network, Ed Brayton, and Gregory Forbes for information used in this article.]

detailing the similarities between “intelligent design” and its precursor, creation science, he recommended, “Leave questions of science to science. Bringing sectarian religion into scientific controversies only sows confusion and strife.” Bailey is the chief technologist of the Computational Research Department at Lawrence Berkeley Laboratory.

Daryl Domning, Professor of Anatomy at Howard University in Washington DC, gave two invited talks to students at McLean High School in McLean, Virginia, in February 2005 as part of the school’s “Darwin Day” observance. He spoke on the historical background and reasons for the creation/evolution controversy, fossil seacows as examples of intermediate forms in evolution, and “The 10 most extreme misconceptions about evolution.” In May 2005, Domning was the keynote speaker at a day-long teachers’ workshop on evolution organized by Sandra Madar of Hiram College, held in Akron, Ohio, in conjunction with the Fourth Triannual Conference on Evolution of Aquatic Tetrapods. His theme was the importance of existential concerns, rather than doubts about scientific evidence, as motivators for most people who question evolution. And in June 2005, he addressed some of these existential concerns directly in an invited lecture to the annual Cosmos and Creation Conference at Loyola College in Baltimore, Maryland. There he argued that the nature of material existence and the self-centered behavior enforced on all organisms by natural selection provide an explanation for both physical and moral evil and the Christian doctrine of original sin.

Barbara Forrest and **Paul R Gross**, the authors of *Creationism’s Trojan Horse: The Wedge of Intelligent Design* (New York: Oxford University Press, 2004), teamed up again to contribute “The wedge of intelligent design: Retrograde science, schooling, and society” to *Scientific Values and Civic Virtues*, edited by Noretta Koertge (New York: Oxford University Press, 2005; Forrest and Gross’s article is on pages 191–214). In it, they describe “a facet of the ID movement that has not received the scrutiny proportionate to its pivotal significant in this larger effort — national in scope — to restructure American institutions and government policy on a sectarian, theistic

foundation.” Also of interest in the same volume are **Michael Ruse’s** “Evolutionary biology and the question of trust” (99–119), which discusses trust and violations of trust in the history of evolutionary biology, Frederick B Churchill’s “The evolutionary ethics of Alfred C Kinsey” (135–53), and Keith Parsons’s “Defending the radical center” (159–71), which argues against critics of science on the left (such as Sandra Harding) and on the right (such as Phillip Johnson and Alvin Plantinga).

Ursula Goodenough reviewed Richard Dawkins’s *The Ancestor’s Tale* (Boston: Houghton Mifflin, 2004) for *BioScience* (2005 Sep; 55 [9]: 798–9). She was particularly impressed with the innovative narrative structure of a backward journey in time, describing it as “a most effective antidote to forward chronologies that so readily convey the sense, however unintentionally, that other species in the diagram are lower or more primitive, while humans are the apex and hence the point,” adding, “[g]oing backward also allows us to experience, rather than just know about, the deep time involved.” Of interest in the same issue of *BioScience* was a review of NCSE Supporter **Douglas J Futuyma’s** new book *Evolution* (Sunderland [MA]: Sinauer Associates, 2005) by NCSE Supporter **Francisco J Ayala** (801–3). Ayala described *Evolution* as “an excellent compendium of the modern theory of evolution” and praised the book’s final chapter “Evolutionary science, creationism, and society” in particular, commenting, “Futuyma effectively disposes of various red herrings adduced by creationists.”

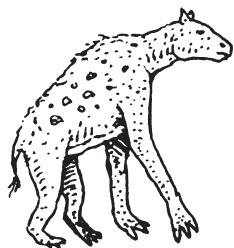
Marie Greider’s guest column, “Intelligent design theories unscientific, unfit for school,” was published in the August 23, 2005, issue of *The Advocate* of Newark, Ohio. Responding to a previous column in the paper as well as to President Bush’s remarks seeming to endorse the teaching of “intelligent design” in the public schools, Greider commented, “Evolution is taught in our public schools as an essential science subject for students to understand the complexity, the close intertwining relationship and the history of the living world. ... In contrast, [“intelligent design”] is based on a recent Christian religious belief that a higher power must have had a hand in creation, for life is too complex to have developed through the present-day knowledge of evolution.

... Such a dogma without scientific evidence has no place in science classes of our public schools.” Greider is a retired professor of pathology at the Ohio State University and Washington University in St Louis.

The July 2004 issue of *Perspectives on Science Education*, published by the New York State Science Leadership Association, recently arrived at NCSE. The issue was devoted to articles on evolution education, including **Bryce Hand’s** “Evolution, creationism, and the teaching of science” (4–7), in which Hand noted, “there’s not a single creationist argument that the community hasn’t heard ... again and again. Many creationist claims are so outrageous as to be laughable; others are sophisticated enough to require some advanced knowledge or a bit of careful examination for proper rebuttal. But every one of them is demonstrably spurious.” After debunking a few of the most prevalent claims, he ended by suggesting, “the best classroom approach to countering misinformation of creationists may lie not in attempting to challenge their individual assumptions, but in matter-of-factly providing information to improve students’ ability to assess and effectively counter claims that are clearly contradicted by scientific knowledge.” Hand is Professor Emeritus of Geology at Syracuse University. [Thanks to Jack Friedman for the news.]

Mark Isaak’s *The Counter-Creationism Handbook* (Westport [CT]: Greenwood Press, 2005) was published. Based on his invaluable “Index of creationist claims” on the Talk.Origins Archive website (<<http://www.talkorigins.org/indexcc/index.html>>), *The Counter-Creationism Handbook* offers a single resource listing the most prevalent creationist claims and offering succinct and scientifically accurate rebuttals with references to further discussions. In his preface, Isaak writes, “Much of the strength of creationism comes not from its having good arguments but from its creating so many arguments that educators cannot easily teach the answers to all of them.”

Gregory S Paul’s article “Cross-national correlations of quantifiable societal health with popular religiosity and secularism in the prosperous democracies: A first look” was published in *Journal of Religion & Society* (2005; 7: 1–17; available online at <<http://moses.creighton.edu/>



JRS/pdf/2005-11.pdf>). Paul argues, "Large-scale surveys show dramatic declines in religiosity in favor of secularization in the developed democracies. Popular acceptance of evolutionary science correlates negatively with levels of religiosity, and the United States is the only prosperous nation where the majority absolutely believes in a creator and evolutionary science is unpopular. Abundant data [are] available on rates of societal dysfunction and health in the first world. Cross-national comparisons of highly differing rates of religiosity and societal conditions form a mass epidemiological experiment that can be used to test whether high rates of belief in and worship of a creator are necessary for high levels of social health. Data correlations show that in almost all regards the highly secular democracies consistently enjoy low rates of societal dysfunction, while pro-religious and anti-evolution America performs poorly."

Ronald H Pine, who lives in Kansas, was invited to give a talk entitled "The clash in Kansas: Science vs religion: A report from the front," at the Center for Inquiry-West in Los Angeles on August 7, 2005. After providing an update on the situation in the Sunflower State, Pine discussed the total lack of science in "intelligent design", arguing that all its proponents have to show for their efforts is a mishmash of essays (although some are of book length). Unlike the young-earth creationists, "intelligent design" proponents have made no efforts to create a model of the earth's history. Pine presented all of the possible "models" he could think of that would be compatible with "intelligent design" and pointed out the absurdities of each. Why have proponents of "intelligent design" offered no such model? Pine suggested three reasons: the absurdities he cited, the likelihood of not achieving a consensus among ID's disparate factions, and its irrelevance to their political aims in any event. Thus "intelligent design" — or "creationism without a model," as Pine quipped — will never achieve even the broadest outlines of a consistent and predictive explanation of the facts of paleobiology.

Noticing that there were far fewer cicadas chirping in his backyard than in the previous summer, **Steve Rissing** took the opportunity to instruct the readers of the *Columbus Dispatch* (2005 Jul 5) about how cicada cycles are gov-

erned by natural selection. "Sometimes we get lulled into thinking that the dynamic and exciting aspects of nature occur only in exotic places far away," he wrote. "But then a few or 200 000 cicadas can bring us back to the reality of fundamental natural processes occurring in our own backyard." Rissing is Professor in the Department of Evolution, Ecology, and Organismal Biology at Ohio State University.

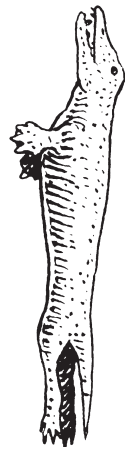
NCSE Supporter **Michael Ruse** wrote two articles for the July/August 2005 issue of *Science & Theology News*. His op-ed "Tough-minded thinking needed for today's vital topics" (7) urged scholars in the burgeoning area of science-and-religious studies to improve their understanding of the history of philosophy and theology, to "stop avoiding the science when we find it uncomfortable," and to "get serious about our theology" — "if we must get into natural theology," he pointedly remarks, "let us do this without slipping into Creationism-lite, like the ID enthusiasts." And he reviewed (64-5) NCSE Supporter **Sean B Carroll's** *Endless Forms Most Beautiful* (New York: WW Norton, 2005), which he describes as "an attractive and accessible introduction to the field of evo-devo," adding, "If you want to understand how organisms are put together, such as how the wing of the butterfly got its spots, then this is the book for you."

Responding to a paid advertisement advocating "intelligent design" creationism in the *Sacramento News & Review*, **Kevin Schultz** (a life member of NCSE) wrote to comment, "[The advertisement] argues scientific research must be 'taught, debated, modified, discarded or proven and built upon not only in ... laboratories but in our schools.' Do we really expect students to do all that in the five days they spend learning about scientific evolution each year? And do we really expect kids to learn in a scientific environment corrupted by the politics and religion of the radical conservative religious right?" His letter was published on September 8, 2005.

Mark Terry contributed "Intelligent design, or not: Dr Strangescience, or how I learned to stop worrying and love the wedge" to the on-line quarterly journal of New Horizons for Learning, an "international network of people, programs, and products dedicated to successful, innovative learning"; his article is available on-line at

<<http://www.newhorizons.org/trans/terry.htm>>. Noting that biology teachers frequently "refrain from dealing with evolution because of their own misunderstandings or lack of background or local religious objections," Terry offers a brief overview of how, in contrast, he and his colleagues at the Northwest School present "evolution as a central idea in biology while also looking at its cultural roots, uses, misuses and relationship to religious thought. We're able to put Pennsylvania, Georgia, and Kansas, and all the other related activities of the Discovery Institute into an already rich context, meanwhile studying good, solid, contemporary evolutionary science." He concludes with the thought, "If science educators ... sharpen up their evolution curricular offerings, we may all be able to thank the industrious Fellows of the Discovery Institute and their deep pocket donors for helping re-energize science education. The loud hammering of the Wedge may backfire on its designers."

Before Darwin: Reconciling God and Nature (New Haven: Yale University Press, 2005), by **Keith Thomson**, was published. From the jacket copy: "For 200 years before the publication of Darwin's *On the Origin of Species*, findings in the sciences of the earth and of nature threatened religious belief based on the literal truth of the Bible. This book traces out the multiple conflicts and accommodations within religion and the new sciences through the writings of such heroes of the English Enlightenment as David Hume, Robert Hooke, John Ray, Erasmus Darwin (Charles'[s] grandfather), Thomas Burnet, and William Whiston. ... Thomson finds surprising and direct connections between the anti-evolutionary writings of natural theologians like William Paley and the arguments that Darwin employed to turn anti-evolutionist ideas upside-down." A review in *New Scientist* (2005 May 14) described *Before Darwin* as "a book of sheer pleasure. Beautifully written and epigrammatic, it is full of characters of talent, disputatious skill and wit." Thomson is Professor Emeritus of Natural History at Oxford University.



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The Ugly Underside of Altruism

David P Barash, University of Washington

“How do I love thee?
Let me count
thy genes.”

There has been a revolution in evolution ... or, rather, in biologists' understanding of how natural selection works. This revolution derives from a new sense of what is important, what is the biological “bottom line,” what is — as evolutionists put it — the appropriate “unit of selection.” More and more, it has become clear that the crucial unit is the gene: not the species, nor the group, nor even the individual, but the smallest meaningful entity that can persist through evolutionary time. After all, genes are potentially immortal, whereas individuals come and go. As Richard Dawkins so brilliantly emphasized in his book *The Selfish Gene*, living things are essentially constructed by their genes, for their (the genes') benefit. And when individuals behave, such actions are “adaptive” insofar as they contribute, ultimately, to the success of those genes in promoting copies of themselves into the future. (Equally important: activities that do not contribute to genetic success are selected against.)

Accordingly, biologists had been perplexed to find animals behaving altruistically, doing things that helped others to survive and reproduce, but at some cost to the altruist, such as giving an alarm call when a predator approached (thereby aiding the listeners but at some cost to the alarm-givers, who are rendered more conspicuous), or sharing food, or simply tolerating a free-loader. The problem for altruism, and thus for evolutionary biologists, was simple: Evolution rewards selfishness. Insofar as a

trait or behavior increases reproductive success, that trait or behavior should become more abundant, along with its corresponding gene(s). At the same time, any trait or behavior or gene(s) that reduced reproductive success should quickly disappear to be replaced with its selfish alternatives.

Natural selection, in short, helps those who help themselves. And it penalizes those who help others. As a result, biologists were troubled — not ethically, mind you, but as scientists — by the very fact of altruism's perseverance, since it should quickly be selected against and replaced by selfishness, which, by definition, helps itself and thus prospers. Another way of stating the problem: How to explain the endurance of traits that are, by definition, self-defeating?

But endure they do. It turns out that altruism not only astounds, it abounds. Why?

Here is where the revolution comes in. Part of the charm of the gene's-eye perspective is that it solved much of the altruism question. Thanks to English biologist William D Hamilton, the paradox of altruism was resolved by revealing that it wasn't really a paradox after all! Hamilton's crashing insight was that if individual altruists direct their benevolence preferentially toward others who are close relatives, then genes are actually benefiting themselves, and that this process is, literally, what natural selection is all about. Hamilton thus pointed out that what often appears to be altruism at the level of bodies can actually be selfishness ... at the level of genes, which benefit themselves by proxy.

Isaac Newton opened physicists' eyes to why things fall; Hamilton, in effect, opened biologists' eyes to why living things behave as they do; even what they are. Hamilton's now-classic article, “The genetical evolution of social

behavior,” published in 1964, is, more than any other single piece of research, the intellectual cornerstone of the modern evolutionary revolution. In effect, Hamilton's insight was to recognize that genes promote their success via copies of themselves in other bodies.

Even before Hamilton, biologists had never been troubled, interestingly, by the ubiquity of reproduction, even though *at the level of bodies*, breeding is just as altruistic as alarm-calling or food-sharing. After all, reproduction is costly. It takes time and energy. It involves risk and imposes penalties on the would-be breeder. (Think of the time and energy spent in courtship, the vulnerability associated with mating, the sheer metabolic cost of constructing a placenta, lactating, defending and provisioning one's offspring, and so on.) Reproducing, in short, benefits someone else — the offspring — while it imposes a cost on the parent.

Yet parental behavior is not normally considered altruistic; making children is not surprising, nor is it in any way counter-intuitive, or against what an evolutionary biologist — or anyone else — might expect. Quite the opposite: Most people take reproduction for granted, and biologists have long considered that successful breeding is central to evolutionary success. For decades, in fact, biologists equated breeding with “fitness.” Reproduction is costly? Of course. But it would be absurd to think that as a result, reproduction would be selected against! What would replace it? All living things are the offspring of parents who successfully reproduced, costs and all. A genetic basis for non-reproduction would have a dim evolutionary future indeed.

But here's the point: At the gene level, the important thing about

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reproduction is that genes are packaging copies of themselves into new bodies, and then (in varying ways, depending on the species) trying to promote the success of these new bodies. How? By feeding them, keeping them warm, protecting them, teaching them, taking them to soccer games and the orthodontist, maybe sending them to college and paying their bills. With this new perspective, having babies and then caring for them is seen for what it is: a perfectly good route to evolutionary success. But not the only route. Hamilton's genius came in recognizing that there are other ways for genes to be successful, if not via those bodies that we call offspring, then via other bodies that we call genetic relatives, such as nieces, nephews, cousins, grandchildren, and so on.

The only difference between these more distant relatives and those that we call offspring is that the more distant the relative, the lower the probability that a gene present in any given individual is also present in that relative. This, after all, is what people mean when they talk about a "distant" relative: genetic distance, even though most of us lack the ability to calculate exactly how great the distance and precisely what genetic "distance" really means. (No matter: most of us don't understand the details of neurophysiology, either, yet are pretty good at thinking.) Hamilton went further, showing the conditions necessary for altruism to evolve. To make a long mathematical story short, "Hamilton's rule" is that altruism will be selected for in proportion as (1) the cost to the altruist is low, (2) the benefit to the recipient is high, and (3) the altruist and recipient are closely related. The first condition means that low-cost altruism — for example, taking a small risk for someone else — should be easier, and thus more frequent, than running extreme risks. The second means that all things being equal, altruists should be more likely to act in proportion as their altruism helps the individual being assisted. And the third condition means that "the more closely related, the more altruism" and conversely, "the less closely related, the less altruism." Why? Because

the closer the genetic relationship, the higher the probability that any altruism-promoting gene(s) present in the altruist will also be present in the recipient.

The result is a new picture of evolutionary fitness, one that reveals how the net of natural selection is spread more widely than pre-Hamiltonian Darwinists had imagined. Previously, when biologists thought about fitness, they considered only direct reproductive success; its importance has never been in doubt. But breeding is only part of the story. The full tale, known as "inclusive fitness", is more, well, inclusive. It includes not only reproductive success but also any action that increases another's survival and reproduction. But — and here is a very important point — not all "others" are equal, at least insofar as a would-be altruist is concerned. The importance of each "other" (to the altruist) is greater in proportion as he or she is more closely related ... because that means a greater probability of shared genes.

Actually, there are two noteworthy precursors of Hamilton's important insight. Both were brilliant evolutionists — in fact, they were two of the most prominent founders of the field of population genetics — but for some reason, neither carried this particular idea very far. In the late 1920s, Ronald A Fisher wondered why certain bad-tasting caterpillars were brightly colored. He acknowledged that conspicuous coloration would make it more likely that a hungry bird, for example, after eating one caterpillar, would leave the others alone. But, Fisher pointed out, such an "advantage" would come a bit late for the caterpillar who sacrificed its life in order to educate predators not to make the same mistake twice. Fisher went further, suggesting that perhaps this is why such insects tend to be found in groups: If these groups consist of brothers and sisters, then the dying caterpillar (rather, the relevant genes within the caterpillar) would be repaid — not in this life, but in evolutionary time — through the success of kin.

The other biologist who caught a glimpse of the genetics of altru-

ism but apparently did not realize its generalizability was JBS Haldane, like his contemporary Fisher and his successor Hamilton, a British mathematics whiz. The story goes that Haldane was at his favorite pub when the conversation happened upon self-sacrificial bravery. Haldane was asked if he would give his life for his brother. No, he said, he wouldn't do that. Then he made a rapid calculation on the back of a napkin and added that he'd do so for two brothers or eight cousins! (Genes within any of us enjoy a $\frac{1}{2}$ probability of occurring within a full sibling; hence, two brothers equals one self. Similarly, cousins are, on average, $\frac{1}{8}$ genetically identical, so it takes eight cousins to comprise the genetic equivalent of one's self.)

This, apparently, is as far as the realization went, until Hamilton revisited the paradox of altruism, bequeathing us a new view of ourselves and of life more generally. The result is also sometimes called "kin selection," since it speaks to a predictable bias toward kin: relatives over non-relatives, and closer relatives over more distant ones. Kin selection — or "inclusive fitness theory" — suggests that nepotism is likely to be universal, or nearly so, in the living world. It even provides a way of calculating it. Thus, one self equals two brothers, or four grandchildren, or eight cousins, etc. Faced with the question, "Save your skin or save your kin?", the balance point occurs when the likelihood of genes present in relatives equal those present in one's self.

Armed with this new view of behavior, biologists began reinterpreting the living world.

And by and large, predictions based on Hamilton's "inclusive fitness" model have been confirmed. Across a remarkable range of species and a wide array of behaviors, animals preferentially direct beneficence toward relatives over non-relatives, also favoring close relatives over distant relations. Not only that, but thinking in terms of shared genes has helped elucidate such "cross-cultural universals" as nepotism among human beings. It even refocuses basic understanding of life itself, shedding new light, for example, on why multi-



cellular bodies remain as coherent as they do. (After all, why should the liver cells uncomplainingly undertake the unpleasant task of detoxifying the blood, leaving all the evolutionary success to the gonads? Because liver and gonad cells are genetically identical, so that success for the latter leads to exactly the same triumph for all other body cells.)

There are certainly additional factors that underpin altruism, in human beings as well as other animals. Thus, reciprocity is sometimes important, and occasionally what appears to be altruism is simply selfishness — even at the personal level. Nonetheless, Hamilton's insight into the significance of shared genes and altruism has been so powerful that it can fairly be identified as one of the greatest advances in modern evolutionary theory.

I assume that most readers are with me at this point ... even though some may part company at the assertion that what's sauce for the biological goose also applies — albeit with reservations — to the human gander. But what of altruism's "ugly underside," as indicated in the title of this article?

After all, a vision of Darwinian competition without shared genes to soften the blows is far more unpleasant. In his book *The Economy of Nature and the Evolution of Sex*, marine biologist and historian of science Michael Ghiselin put it chillingly and well:

No hint of genuine charity ameliorates our vision of society, once sentimentalism has been laid aside. What passes for cooperation turns out to be a mixture of opportunism and exploitation. ... Where it is in his own interest, every organism may reasonably be expected to aid his fellows. Where he has no alternative, he submits to the yoke of communal servitude. Yet given a full chance to act in his own interest, nothing but expediency will restrain him from brutalizing, from maiming, from murdering — his brother, his mate, his parent or his child. Scratch an 'altruist,' and watch a 'hypocrite' bleed.

By contrast, gene-based altruism seems downright delightful.

Of course, to some people, nepotism is itself ugly. That's why we have laws against carrying it too far. And to others, it is demeaning to consider that something as lofty as altruism may have an underlying selfish component. Reductionism may be the stuff of science (at least, most science), but when applied to understanding ourselves, it often fails to make the heart sing. What's really unpleasant about the biology of gene-centered altruism, however, is much more troublesome, and — if true — far more deserving of universal condemnation.

It is this. Insofar as shared genes underpin much of human altruism, the apparent absence of shared genes may well lead to altruism's nasty inverted doppelganger: intolerance, hatred, and bigotry. "How do I hate thee? Let me count thy genes."

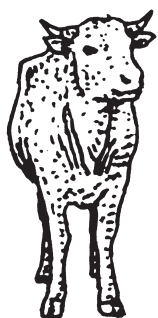
If genes are predisposed to behave nicely toward identical copies of themselves housed in other bodies, they presumably have ways of achieving this identification. For some species, simple physical proximity may do the trick: close neighbors are somewhat more likely to be relatives. For others, behavioral cues may be available: someone in your nest, or den, or household is likely to be more closely related to you than is someone in a different social unit. (Sociologists have long been intrigued by "in-group amity, out-group enmity"; now biologists are too.) There also remains the possibility that genes predispose their bodies to behave benevolently toward other bodies whose physical and behavioral traits give cues that they are harboring similar genes. In short, their inner selves may whisper, "Be nice toward those that resemble yourself." But at the same time, this angelic advice offered to one ear may be matched by a more subversive suggestion, whispered by a counterbalancing evolutionary devil perched on the other shoulder: "Be nasty toward those who are different."

This, then, is the ugly underbelly of kin selection: not selfishness, but racism, a special form of intolerance toward others, those who are biologically different, or, if nothing else, who look that way.

Although some people claim that the various human races are socially constructed and thus biological fictions, the reality is otherwise. To be sure, there is no simple answer to the question, "How many races are there?" or "Are such-and-such a distinct race?" And there is absolutely no doubt that all human beings are members of the same species. It is also evident that the genetic differences between human races are biologically trivial, constituting less than 1% of one percent of total genetic make-up. But it is also clear that Caucasians, for example, are easily recognized as distinctly different from Chinese, and that either group is different from black Africans. Moreover, there can be no doubt that such differences — superficial as they are — reflect genetic differences: After all, black parents produce black offspring, pink parents produce pink offspring, and so forth.

Let me be clear: This is not to say that "race" is a particularly meaningful characteristic, nor is there any way that the human races can be in any way ranked as better or worse, superior or inferior. Moreover, nearly all of the differences among the races are more apparent than real; there is more genetic diversity, for example, among black Africans than between Caucasians and Asiatics. Nonetheless, racial traits exist, just as eye color exists, along with earlobe shape or blood type, and at least some of the differences among the races result from differences in their genes. This recognition, although it may make some well-meaning people uncomfortable, is demanded by old-fashioned intellectual honesty.

Those physical traits that characterize the various human races are the relics of genetically isolated groups of people (tribes) who remained isolated for many generations. Australian aborigines evolved kinky hair, residents of the Mongolian steppe evolved eye-folds, and so forth. Geography was presumably the cause of this genetic isolation. Even as the races came increasingly into contact, interbreeding has been limited by cultural traditions which have generally kept individuals from marrying far



The Accidental Creationists: Why Evolutionary Psychology is Bad for the Teaching of Evolution

James Miles

Before we begin, let me declare an interest. I hold the distinction of being the only truly vocal critic of evolutionary psychology (EP) to write from within what is called the genic selection, or “selfish gene”, tradition. This is the tradition that sees natural selection as operating predominately at the level of the gene, and it is the tradition to which all evolutionary psycholo-

gists profess to belong. However, this is not to say there are not many highly influential critics of EP within genic selection. In this paper I shall argue that all those who actually developed genic selection theory in the 1960s and 1970s reject the foundational assumptions of EP; it is just that, unlike me, they prefer to stay largely silent about their opposition. My contention has always

been, though, that by staying silent about the serious errors of EP we do a tremendous disservice to Darwin’s legacy, to science, and to important organizations like the NCSE.

LEVELS OF SELECTION

In the *Origin of Species*, Darwin wrote that “natural selection can act only through and for the good

outside their social/biological group.

What does this have to do with kin selection, or with racism? Just this. As we have seen, human beings — like other living things — may well be predisposed to behave benevolently toward close relatives over distant relatives, and to favor distant relatives over strangers, at least in part because the closer the relative the higher the probability that genes will be shared. When it comes to recognizing one’s kin, it seems highly likely that physical similarity has long been important: Everyone knows that relatives tend to resemble each other. And conversely, the less the resemblance, the less the likelihood of a close genetic relationship.

Skin color, eye shape, hair texture, physical size, nose shape and other phenotypic differences among human beings reflect different ancestries. In general, the more differences, the more distant the genetic relationship. And the more differences, one can predict with some dismay, the less altruism.

The result may well be that human beings are naturally inclined — as a regrettable consequence of kin selection — to behave nonaltruistically toward others whose physical traits mark them as truly

Other, that is, unlikely to be closely related. Once again, since this issue is so fraught with emotion and the potential for misunderstanding, let us be as clear as possible: Racism is in no way rendered acceptable just because it may be, to some extent, “natural”. To the contrary, it is a practical and moral wrong that human beings are obligated to struggle against. But the fight against racism is not abetted by ignorance as to its possible origin.

Ironically, those racial categories that appear so prominent to so many people evidently reveal our tendency to establish social categories far more than they reflect biological reality. Nonetheless, human beings are acutely sensitive to the details of “exterior packaging” by which we identify each other as family, friends, or foe. It may be a tragic paradox that in unconscious pursuit of kin-selected benefits, we have come to exaggerate the significance of superficial differences that are just that: superficial.

In the musical *South Pacific*, a Caucasian lieutenant falls in love with a Polynesian woman. Reacting angrily to the racism of his society, he sings, “You’ve got to be taught, before it’s too late, before you are six or seven or eight, to hate all the

people your relatives hate ... You’ve got to be taught, to be afraid, of people whose eyes are oddly made, and people whose skin is a different shade. You’ve got to be carefully taught ...” Racism undoubtedly *can* be taught, and regrettably, it often is. So, fortunately, can racial tolerance and compassion. The point is that to some extent — exactly how far is unknown — people may indeed *have to be taught* tolerance, because left to their own devices, the whispers of kin-selected genes within most people seems to predispose them to a degree of bigotry that our species cannot afford.

We are children of the same mother — evolution — all of us nourished by the earth’s good juices, yet our genes may well be programmed to see only narrower distinctions. To transcend ourselves, and our genes, is the uniquely human prerogative, as well as, increasingly, our responsibility.

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of each being" (1859: 84). Darwin is here being what is called an individual-selectionist; arguing that nature can select only for the benefit of the individual. But as the philosopher of biology Paul Griffiths notes (1995), Darwinian theory has gone beyond this first position and today largely boils down to a dispute between two different schools in biology and the philosophy of biology.

In 1966 George C Williams developed "the formally disciplined use of the theory of genic selection for problems of adaptation" (Williams 1966: 270). The genic selection tradition begun by Williams, further developed from the work of Hamilton (1964) and the late John Maynard Smith (1964, 1974), but popularly known after Dawkins (1976) as "selfish gene" theory, re-interprets apparent individual selection as not what is good for an individual, but as what is good for its genes. Since the fate of an individual and the fate of its genes are very closely — though not perfectly, and see for example Ridley (2000) — linked, individual selection is often for practical purposes synonymous with gene-level selection. Selfish gene-ery was also formulated in antipathy to 1960s theories of group selection, the idea that nature might select for the advantage of the group even at the cost to the individual (Maynard Smith 1964; Williams 1966; Dawkins 1976).

The other school in this debate sees things differently. If one accepts that genes must co-operate to "run" an individual efficiently, why cannot one take co-operation to even higher levels, to a hierarchy of levels? Hierarchical — also known as "multilevel selection" — theorists argue that group selection, properly understood, is an important part of the evolutionary process (Lewontin 1970; Griffiths

1995; Sober and Wilson 1999). A group consisting almost entirely of altruists can do better than a group consisting entirely of selfish individuals, because the altruism benefits the entire group. Their opponents argue, however, not that group selection is impossible, just that it is likely to be a very weak force in evolution because the conditions required are so onerous, and "lower levels of selection are inherently more powerful than higher levels" (Hamilton 1975: 134).

This seemingly esoteric disagreement has theoretical implications that it is unnecessary to detail fully here. What it is important for readers to understand is the fallout of this dispute, because unless one understands this, one will never understand where evolutionary psychology comes from and how it should be evaluated.

A HISTORY OF HERESY

But natural selection ... implies concurrently a complete disregard for any values, either of individuals or of groups, which do not serve competitive breeding. This being so, the animal in our nature cannot be regarded as a fit custodian for the values of civilized man. (Hamilton 1971: 83)

Steven Pinker calls Williams's *Adaptation and Natural Selection* "the founding document of evolutionary psychology" (1997a: 56). All evolutionary psychologists profess to operate from within the genic selection tradition, "the new math" as EP popularizer Robert Wright calls it (1994: 161). In addition to vowing allegiance to the selfish-gene tradition, evolutionary psychologists have often been vocally hostile to the alternative multilevel selection tradition. "Gould and Lewontin's potshots do not provide a useful model of how to reason about the evolution of a complex trait" (Pinker 1994: 359; see also Wright 1999).

All evolutionary psychology, and the sociobiology from which it sprang, ultimately rests on the foundational belief that morality is a biological adaptation (see for example Wilson 1975; Barash 1979; Alexander 1987; Tooby and

Cosmides 1992; Wright 1994). As sociobiologist and philosopher Michael Ruse summarizes: "The position of the modern evolutionist, therefore, is that humans have an awareness of morality — a sense of right and wrong ... Morality is a biological adaptation" (1989: 262). But unfortunately for the evolutionary psychologists, this is not what selection at the level of the gene actually implies, or ever could imply, as Hamilton explains above. Or as Dawkins more pithily puts it: "civilized human behavior has about as much connection with natural selection as does the behavior of a circus bear on a unicycle" (Ridley and Dawkins 1981: 32; see also Maynard Smith 1988, Williams 1988). Yet while Maynard Smith, Williams, Hamilton, and Dawkins understand that selection at the level of the gene cannot produce morality, EP — with a breathtaking disregard for the underlying principles of selfish-gene theory — produces wholly misleading arguments that it can.

Where morality actually comes from and what genic selection theory truly tells us about the underlying human genetic code, I have already explained in detail elsewhere (Miles 1998, 2004). Briefly, the biggest problems with EP are that it rejects a four-billion-year pattern of evolution in favor of a more "comfortable" genetic conclusion. Orthodox selfish-gene theory concludes that selection at the level of the gene cannot produce morality. Morality is not found outside the human world; "there is no charity in nature," as the geneticist Steve Jones reminds us (1999: 160). The problem with trying to argue that nature can produce morality is that one would have to junk the entire selfish-gene theory on which the argument is supposedly built. Morality can evolve when selection is at the level of the group, but selection at the level of the group to explain complex adaptations is something selfish-gene theory vehemently rejects. To explain human large-group cohesion and co-operation as an evolved trait requires either group selection (Sober and Wilson 1999) or the evolution of forms of reciprocity seen nowhere else in the natural world, such as "indirect"

James Miles is a British evolutionary theorist. His first paper on the human implications of Darwinism was published in the journal Philosophy in October 1998. His most recent work is Born Cannibal: Evolution and the Paradox of Man (London: IconoKlastic Books, 2004), with a foreword by George C Williams.

reciprocity (Alexander 1987; Nowak and Sigmund 1998). But the problem remains; explaining the stability of such hypotheses, as “subversion from within” automatically acts to prevent the evolution of large group cohesion or morality. Furthermore, not only do the principles of contemporary selfish-gene theory rule out the evolution of morality, but also the putative evolution of morality would have required huge leaps in genetic design space (known as saltations) in order to remove much of the behavioral code we shared with the last common ancestor shared by humans and chimpanzees and to replace it with the antithetical coding sought. But saltations are a neo-Darwinian heresy. All selfish-gene theorists therefore conclude that to explain human morality we cannot look to evolution by natural selection for answers.

STRANGE BEDFELLOWS

But why, if the conclusions of EP are so very different from the conclusions of the selfish-gene theory upon which EP is purportedly based, have we not heard this before? For the purposes of this paper there can be seen to be two main reasons: (a) the internal conflict within biology that has provoked in selfish-gene biologists an inclination to shield the heterodox, and (b) the largely comforting nature of the claims of EP when viewed against the more uncomfortable implications of genic selection theory.

(a) My Enemy's Enemy ...

Maynard Smith, Williams, Hamilton, and Dawkins ... have largely eschewed the deeply unpleasant task of pointing out more egregious sins in the work of those who enthusiastically misuse their own good work. (Dennett 1995: 485)

When evolutionary psychologist Helena Cronin was sent for a period by the London School of Economics to Oxford University to help her gain background for her PhD, she began to move in the tight circle of academic selfish gene-ery. The book that resulted from her PhD, *The Ant and the*

Peacock (1991), has a foreword by Maynard Smith. She is gratefully thanked by Dawkins for her help in updating the second edition of *The Selfish Gene*. Williams describes her as a good friend. She is, above all, a hard-working ally in the war against the hierarchicalists. Because, as the hierarchical theorist Paul Griffiths writes, “group selection is the villain of much of Cronin's book” (1995: 132).

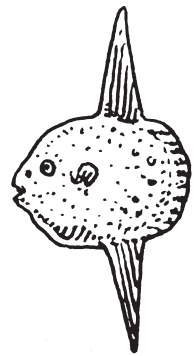
The fear of a resurgent group-selectionism is difficult to overestimate in the minds of selfish-gene theorists. Evolutionary biology had been severely damaged in the mid-20th century by a long history of appealing, sometimes only implicitly, to “greater good-ism” and the idea that nature may select for the good of the group, local population or species. This came to a head in 1962 when Wynne-Edwards interpreted a wide range of social behaviors as adaptations for the regulation of population size. Some animals, suggested Wynne-Edwards, regulate their reproduction to control population density which otherwise “undermines the safety of the race” (1962: 20). Maynard Smith came back at Wynne-Edwards with a vengeance: “every time a group possessing the socially desirable characteristic is ‘infected’ by a gene for anti-social behaviour, that gene is likely to spread through the group” (1964: 1145). It was, however, to be Williams's book-length 1966 work, *Adaptation and Natural Selection*, subtitled *A Critique of Some Current Evolutionary Thought*, a plea for greater care in adaptationist thinking, that would ultimately prove to be “devastatingly effective” (Sober and Wilson 1999: 37). While noting that group selection was not impossible, Williams concluded that the adaptations cited in support of group selection could almost invariably be explained in terms of selection at levels lower than the group. Biologists did not need to appeal to group-level benefits where a lower-level benefit explained the adaptation.

The leading gene-selectionists do fear the damage that the evolutionary psychologists are doing to Darwinism, but they fear losing ground to the hierarchical tradi-

tion even more as it risks bringing back a immature understanding of group-selection theory. They worry that any public admission of the flaws of EP would be seized upon with relish by the hierarchicalists and used to try to damage selfish-gene theory itself (partly in revenge: though selfish-gene theorists never actually supported EP, they never sufficiently distanced themselves from it either). To be fair though, and as I explain in Miles (2004), responsibility for the mess we are currently in lies as much with hierarchical theorists and philosophers as it does with selfish-gene theorists. There has been fault on all sides.

(b) A Comforting Take on Evolution

Meanwhile, Lukaja handed the infant to the alpha male Ntologi, who dragged, tossed, and slapped it against the ground. Ntologi ... finally killed it by biting it on the face. ... Conspicuous competition for meat and meat-sharing was observed as usual. Three adult males and an adult female obtained meat from Ntologi. Two adult females, two juvenile females, a juvenile male, and an infant recovered scraps from the ground or were given scraps. At 1300h, Ntologi was still holding the skin of the carcass. (Hamai and others 1992: 152)



Why does selection at the level of the gene produce such horrific behavior as the within-group infanticide and cannibalism catalogued above in chimpanzees? Maynard Smith, pioneer of biological game theoretic modeling and father of the concept of the evolutionarily stable strategy, wrote: “Thus it would only be plausible to suggest that there are genetic reasons why anti-social behaviour should not increase if it were also suggested that selection had already produced an extreme degree of anti-social behaviour, and this is precisely what Wynne-Edwards denies. In fact, ‘anti-social’ mutations will occur, and any plausible model of group selection must explain why they do not spread” (1964: 1146). Selfish-gene theory

says that anti-social behavior increases until it levels out at that stable but “extreme degree” of anti-social behavior beyond which there is harm to the individual, not the group. In *The Selfish Gene* Dawkins tells us about blackheaded gulls as a paradigm of gene-selfish behavior: “It is quite common for a gull to wait until a neighbour’s back is turned, perhaps while it is away fishing, and then pounce on one of the neighbour’s chicks and swallow it whole. It thereby obtains a good nutritious meal, without having to go to the trouble of catching a fish, and without having to leave its own nest unprotected” (1976: 5). Or as Sarah Hrdy noted of monkey infanticide: “infanticide is adaptive behavior, extremely advantageous for the males who succeed at it” (1977: 43; see also Williams 1988).

In essence, sticking to the rules of gene-level selection we are faced with this: a human species-wide genetic code for cannibalism, infanticide, horrific violence, and perhaps even sexual eclecticism (Miles 1998, 2004). Well, that was always going to be a vote winner. What makes EP attractive is its denial of this view of our place in nature. What we are really being offered here is not so much evolutionary psychology; it is more psychologically-attractive evolution (or “PAE”, perhaps?). EP simply flatly denies most human beings carry this four-billion-year genetic code, a code that evolutionary psychologists are still happy to admit exists across all other animal life. EP effectively argues that in one giant saltation 100 000 years ago on the savannas of Africa ancestral humans out-evolved this natural-world code. And in this regard, EP is not very easy to distinguish from the creationism that argues that humans were divinely created a few thousand years ago according to another unique set of rules.

“WISHFUL THINKING AT BEST”

As Darwin lay dying in March 1882, the last words he wrote to zoologist Thomas Huxley, his disciple of 30 years, were: “I wish to God there were more automata in the world like you” (Desmond 1997: 519). “Darwin’s bulldog”, as Huxley was known, had fought for

Darwin in public for a quarter of a century while the reclusive Darwin stayed silent. Huxley fought to combat the idea that we were not animals, and the idea that we were not biochemical machines, the “automata” of nature. Darwinism has no room for free will; it is what Darwin called a “delusion” (see Barrett and others 1987: 608), wishful thinking akin to the belief that God made the world in six days and the earth is just 6000 years old.

But a century and a quarter after Darwin penned these final words to Huxley, evolutionary psychology appears to have resurrected free will. Despite professing to be a passionate evolutionist, Cronin is careful to delineate the Darwinian kingdom: “we should not look on free will and biological ‘constraints’ as pulling in opposite directions” (1991: 377). Vocal evolutionary psychologist Matt Ridley is keen to tell us there is nothing inconsistent with free will within EP (1994). Free will, says David Barash, is a “useful inconsistency” (2003: 222; see also Pinker 1997b). In Miles (2004) I described using belief in free will as the litmus test of a true Darwinian, as the litmus test to see who will cut and run from the implications of evolutionary theory. There is no room for free will in a theory which connects us in an unbroken four-billion-year chain of evolution. Even Darwin’s greatest 19th-century critics, like “Soapy Sam” Wilberforce, accepted this truth: “man’s free-will ... [is] utterly irreconcilable with the degrading notion of the brute origin of him who was created in the image of God” (Wilberforce 1860: 258).

Yet this is another area where selfish-gene theorists refuse to challenge evolutionary psychologists, maybe because at least one influential selfish-gene theorist wants to believe in this particular self-serving delusion. In *Elbow Room: The Varieties of Free Will Worth Wanting*, Dennett tells us that the implications of rejecting the idea of free will are, for him, “almost too grim to contemplate.” Consequently when testing this belief “we should be highly motivated to look on the bright side,” he says, even though the arguments for free will invite the suspi-

cion of “wishing thinking at best.” “Still, what one hopes very much to be true may be true” (1984: 168–9). Not to be rude, but in what sense is Dennett’s special pleading for free will in any material sense different from the creationists’ apologies for a 6000-year-old Earth?

Why is free will so germane to this investigation into EP? Because it cuts to the chase. It asks just how far we are willing to go for science. Darwin called free will a “delusion”. George Williams, founding father of modern evolutionary biology, described free will to me as “a stupid idea” (see Miles 2004: 155). Darwin, who tried to place humans in nature, had no time for free will. Evolutionary psychology, which seems to try in all ways to separate humans from nature, crows about our free will. Evolutionary theorizing does not need EP and its blind faith in free will, nor does it need Dennett’s bland rationalization that free will is “worth wanting”.

CONCLUSION

In *A Devil’s Chaplain*, Dawkins writes that even though he and the late Stephen Jay Gould disagreed about so much, with widely publicized differences “and even animosities”, at the end of 2001 they planned to co-author an open letter to the *New York Review of Books* explaining why they declined to debate creationism. To contest with creationists is to give sustenance to the belief that there is something in creationism that is genuinely worth debating; it is to give creationists “free publicity and unearned academic respectability” (2003: 221). Scientists, they both believed, are wiser just to stay silent.

I am not disagreeing with Dawkins that there may be times when it is truer to Darwin’s legacy to stay silent. But this is not that moment. Evolutionary psychology gains free publicity and unearned academic respectability precisely because those with the knowledge of its limitations refuse to speak out. This is not to say that EP can not in principle, one day, merit respectability; just that currently it gains plaudits and disciples

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Would We All Behave Like Animals? A Conversation

by William Thwaites

Does a “belief” in evolution lead to a loss of morals and ethics?

No. People who fear this result from teaching about evolution are mistaken. They are confusing a philosophy called “Social Darwinism” with biological evolution. “Social Darwinism” is an oversimplified and naive extension of biological evolution to human social systems. Theorists such as Herbert Spencer (1820–1903) proposed and popularized much of what we now know as “Social Darwinism.”

But doesn’t evolution claim the same things as Social Darwinism?

No. Biological evolution is very different from Social Darwinism. “Survival of the fittest” is not as accurate a slogan for evolution as “survival of the fit enough,” but either way, it is important to realize that biological “fitness” can be achieved in many different ways. Biological “fitness” usually has little to do with physical strength or the use of force or coercion.

Then what does “biological fitness” mean?

Biological fitness is defined as the long-term ability, compared to others, to leave offspring or descendants. There are many factors involved in the ability to leave descendants in the long run (that is, to have great-great-great-great [and so on] grandchildren.) Among humans, for example, the abilities to communicate and to cooperate have gone a long way towards making our species successful.

But doesn’t evolutionary thought emphasize competition over cooperation?

No, that is another result of confusing evolution with Social Darwinism. Insects and flowering plants are just two examples of evolution’s resulting in cooperative behavior. Most flowering plants use insects for pollination and the insects use the flowers as a source of food. “Cleaner” fish eat parasites off larger fish who, in turn, refrain from eating the “cleaners.” The list of cooperative relationships between species is long, indeed. All, as far as we know, are the result of evolution. Furthermore, everyone knows of examples of cooperation within a species. Many social mammals will collectively defend the young, and elephants will help sick and injured members of the herd keep up. These cooperative relationships are also the result of evolution.

Competition or cooperation, evolution still teaches that we are just animals. If we think that, won’t we behave like animals?

What is “behaving like an animal”? Porpoises are gregarious, intelligent, and fun-loving. Baboons are protective of the

young and show cooperative group behavior. Gorillas are docile, family-oriented, and vegetarian. Chimpanzees form “bands” of more than one family, while orangutans live alone. From an evolutionary viewpoint, natural selection has produced people who behave like people. Humans, like all other species, are unique. There is no reason why we should behave the same way as some other species.

What does evolutionary thought teach us about the natural behavior of humans?

It is important to realize that we are a highly social species. Most of our behavior is learned, though influenced, but not strictly determined, genetically. We can learn behavior that will contribute to group well-being, and our long-term survival as a species. We can even “unlearn” whatever traces of instinctive behavior we may have inherited. Even if war between tribes is “natural” human behavior, we can learn not to make war. Systems of morals and ethics serve, in part, to channel our behavior away from behavior that is socially and biologically destructive.

When I was taught about evolution, we learned what you are calling “Social Darwinism.” Won’t the same thing happen if my children are taught about evolution?

Not if we do something to make sure that outdated and misleading information is no longer taught. Anti-evolutionists actively promote such misinformation to increase public resistance to evolution. Many science teachers receive too little formal education about evolution. And because in scientific research has led to specialization and fragmentation in college programs, a college student can sometimes get a degree in some aspect of biology without learning about evolution or ecology! Often, there is no course that will teach students in other majors, including education, about the nature of evolution and its scientific importance. Instead, much of what teachers know is derived from textbooks that give too little space to the subject.

It is vitally important to set the record straight. Evolution is the foundation principle of biology. If our children are going to understand 20th-century science, and our country is going to be ready for the 21st century, we have to end the misunderstanding and fear surrounding this important aspect of biology.

[This summary is adapted from a longer discussion on the NCSE website. Read more at <http://www.ncseweb.org/resources/articles/5249_would_we_all_behave_like_animals_12_7_2000.asp>.]

EVOLUTIONARY PSYCHOLOGY: SIC ET NON

If the anti-evolutionist proponents of the “teach the controversy” slogan were genuinely interested in teaching legitimate controversies in the evolutionary sciences rather than instilling scientifically unwarranted doubts about evolution, the ongoing disputes about evolutionary psychology would provide suitable fodder! NCSE itself takes no particular position on the merits or demerits of evolutionary psychology; our staff, members, board directors, and Supporters have a wide variety of opinions. What is clear and indisputable is that humans are the product of evolution; it remains to be scientifically ascertained to what extent human behavior, especially human social behavior, is driven directly by evolutionary forces. So for books arguing for and against evolutionary psychology (and its predecessor, sociobiology), as well as a couple that seek merely to document or explain the controversy, check out the following books, all of which are now available through the NCSE website: <<http://www.ncseweb.org/bookstore.asp>> — look in the “In the latest *RNCSE*” section. And remember, every purchase through the website benefits NCSE!



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

SIC

The Adapted Mind: Evolutionary Psychology and the Generation of Culture

edited by Jerome H Barkow, Leda Cosmides, and John Tooby
In the introduction to *The Adapted Mind* (published originally in 1992 and a recognized classic in the field), the editors explain, “we hope to provide a preliminary sketch of what a conceptually integrated approach to the behavioral and social sciences might look like.” Their approach is premised on the existence of a universal human nature, manifest primarily as psychological mechanisms constructed by natural selection to adapt humans to the way of life of Pleistocene hunter-gatherers, and the contributors use the approach in considering such phenomena as cooperation, mating and sex, parental care, and perception and language. The reviewer for the *Journal of Anthropological Research* described *The Adapted Mind* as “a critically important book.”

Evolutionary Psychology: The New Science of the Mind, second edition

by David Buss
In its first edition, *Evolutionary Psychology* immediately became

the standard textbook for the discipline; the second edition (published in 2003) is thoroughly revised and brought up to date. Topics covered include scientific movements leading to evolutionary psychology, the new science of evolutionary psychology, survival problems and solutions, women’s long-term mating strategies, men’s long-term mating strategies, short-term sexual strategies, principles of parenting, problems of kinship, cooperative alliances, aggression and warfare, conflict between the sexes, status, prestige, and social dominance, and toward a unified evolutionary psychology. David Buss is Professor of Psychology at the University of Texas, Austin; he is also the author of *The Evolution of Desire: Strategies of Human Mating*.

The Blank Slate: The Modern Denial of Human Nature

by Steven Pinker
“When it comes to explaining human thought and behavior,” Pinker writes in his preface, “the possibility that heredity plays any role at all still has the power to shock.” In *The Blank Slate*, he proceeds to articulate, defend, and consider — all with his trademark humor and eye for detail — the implications of “the new view of human nature and culture” that is emerging from cognitive science, cognitive neuroscience, behavioral

genetics, and evolutionary psychology. Eugenie C Scott writes, “A humane and thoughtful book, *The Blank Slate* will surprise many who are fearful of the ‘consequences’ of a biologically informed conception of what it means to be human.”

On Human Nature

by EO Wilson
From the publisher: “No one who cares about the human future can afford to ignore Edward O Wilson’s book. *On Human Nature* begins a new phase in the most important intellectual controversy of this generation: Is human behavior controlled by the species’ biological heritage? Does this heritage limit human destiny? With characteristic pungency and simplicity of style, the author of *Sociobiology* challenges old prejudices and current misconceptions about the nature-nurture debate. ... His goal is nothing less than the completion of the Darwinian revolution by bringing biological thought into the center of the social sciences and the humanities.” *On Human Nature* won the Pulitzer Prize for general non-fiction in 1979.

The Moral Animal: Why We Are the Way We Are

by Robert Wright
In *The Moral Animal*, the popular science journalist Robert Wright — author of *Three Scientists and Their*

Gods: Looking for Meaning in an Age of Information and Non-Zero: The Logic of Human Destiny — turns his attention to the new science of evolutionary psychology. Summarizing and synthesizing a wealth of state-of-the-art scientific information, Wright provocatively argues that human moral behavior was — and is — largely shaped by our adaptation to the ancestral environment. His points are cheekily exemplified with episodes from the life of Charles Darwin himself. The reviewer for *The Economist* writes, “This clever and stimulating book is destined to become a classic.”

NON

Adapting Minds: Evolutionary Psychology and the Persistent Quest for Human Nature

by David J Buller

Buller, a philosopher of science, takes on evolutionary psychology, arguing that the conventional wisdom of the field is misguided: human minds are not adapted to the Pleistocene; rather, they are continually adapting, both over evolutionary time and within individual lifetimes. Elliott Sober writes, “Buller’s critique of evolutionary psychology is measured, logical, and clearly developed. It is also devastating. Buller does not seek to refute the entirety of evolutionary psychology by finding a single magic bullet. Rather, he attends to the details, finding a variety of serious problems in the different arguments that evolutionary psychologists deploy. This is philosophy of science in the trenches, and it is excellent.”

Why We Do It: Rethinking Sex and the Selfish Gene

by Niles Eldredge

Assaulting evolutionary psychology at one of its apparent strongholds — sexuality — Eldredge argues that life is not wholly driven by the gene’s need to replicate itself. At least as important, he contends, is staying alive: he writes, “Sex is so clearly separated from pure reproduction in humans — and there is so much interplay between sex and economics, and even between economics and reproduction in human life — that this ‘human triangle’ of sex, reproduction, and economics makes us the very least likely creatures on the planet to conform to ... evolutionary determinism.” Eldredge is curator in the

Department of Invertebrates at the American Museum of Natural History and a Supporter of NCSE.

Vaulting Ambition: Sociobiology and the Quest for Human Nature

by Philip Kitcher

Published in 1985, *Vaulting Ambition* sought to “explain as clearly as possible what sociobiology is, how it relates to evolutionary theory, and how the ambitious claims that have attracted so much public attention rest on shoddy analysis and flimsy arguments.” While acknowledging the scientific contributions of sociobiology, Kitcher, a philosopher of science (and Supporter of NCSE), castigated what he called “pop” sociobiology for a lack of evidential and theoretical rigor. Such a lack is particularly important, he writes, because “the true political problem with socially relevant science is that the grave consequences of error enforce the need for higher standards of evidence.”

Not By Genes Alone: How Culture Transformed Human Evolution

by Peter J Richerson and Robert Boyd

From the publisher: “*Not by Genes Alone* offers a radical interpretation of human evolution, arguing that our ecological dominance and our singular social systems stem from a psychology uniquely adapted to create complex culture. Richerson and Boyd illustrate here that culture is neither superorganic nor the handmaiden of the genes. Rather, it is essential to human adaptation, as much a part of human biology as bipedal locomotion. ... In abandoning the nature-versus-nurture debate as fundamentally misconceived, *Not by Genes Alone* is a truly original and groundbreaking theory of the role of culture in evolution and a book to be reckoned with for generations to come.”

Alas, Poor Darwin: Arguments Against Evolutionary Psychology

edited by Hilary Rose and Steven Rose

The authors whose essays appear in *Alas, Poor Darwin* argue that “the claims of evolutionary psychology rest on shaky empirical evidence, flawed premises, and unexamined political presuppositions.” Included are essays by Dorothy Nelkin, Charles Hencks, Gabriel Dover, Mary Midgley, Stephen Jay Gould, Hilary Rose, Barbara Herrnstein

Smith, Annette Karmiloff-Smith, Patrick Bateson, Anne Fausto-Sterling, Tom Shakespeare and Mark Erickson, Ted Benton, Tim Ingold, and Steven Rose. Richard Lewontin praised *Alas, Poor Darwin* as “a superb collection of essays debunking this latest attempt to hijack Darwin,” adding, “Anyone who has been seduced by the claims of ‘evolutionary psychology’ should read this book.”

ABOUT

Sense and Nonsense:

Evolutionary Perspectives on Human Behaviour

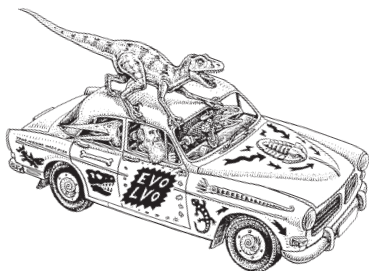
by Kevin N Laland and Gillian R Brown

In *Sense and Nonsense*, Laland and Brown seek to introduce the ideas, methods, and results of the five main approaches of applying evolutionary theory to human behavior: sociobiology, human behavioral ecology, evolutionary psychology, memetics, and gene-culture evolution. Henry Plotkin (the author of *Evolution in Mind: An Introduction to Evolutionary Psychology*) writes, “Laland and Brown have written an up to date, blessedly balanced and refreshingly critical review of the application of evolutionary theory to the human sciences based upon the single, and surely correct, view that human behaviour is multiply determined.” Laland and Brown are both researchers in the Department of Zoology at Cambridge University.

Defenders of the Truth: The Sociobiology Debate

by Ullica Segerstråle

Twenty-five years in the making, *Defenders of the Truth* offers a lively and comprehensive history-cum-analysis of the debate over sociobiology by a sociologist who followed it closely as it developed, interviewing such luminaries as Stephen Jay Gould, EO Wilson, Richard Lewontin, Richard Dawkins, and John Maynard Smith — who, Segerstråle writes, “are all defenders of the truth — it is just that they have different conceptions of where the truth lies.” The reviewer for *Science* commented, “she provides details with an apposite quote each time one hero’s cutting review strikes another’s bloody helm, and the details accumulate into an epic whole.” Segerstråle is Professor of Sociology at Illinois Institute of Technology.



NCSE on the Road

A CALENDAR OF SPECIAL EVENTS, PRESENTATIONS, AND LECTURES

DATE April 4, 2006
CITY San Francisco CA
PRESENTER Eugenie C Scott
TITLE The Pillars of Creationism
TIME TBA
EVENT A talk for a symposium on teaching evolution at the Experimental Biology meeting of the Federation of American Societies for Experimental Biology.
LOCATION Moscone Convention Center
CONTACT Peter Farnham, pfarnham@asbmb.org

DATE May 8, 2006
CITY Seattle WA
PRESENTER Eugenie C Scott
TITLE What's the Fuss about Intelligent Design?
TIME 7:00 PM
EVENT Public lecture
LOCATION University of Washington
CONTACT Richard Olmstead, olmstead@u.washington.edu

DATE May 21, 2006
CITY Orlando FL
PRESENTER Eugenie C Scott
TITLE The New Anti-Evolutionism and Science
TIME 5:30 PM
EVENT A talk for a symposium on evolution education at the annual meeting of the American Society for Microbiology
LOCATION Orange County Convention Center
CONTACT Ferric Fang, fcfang@washington.edu

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Evolution and the Biology of Morality

Douglas Allchin, University of Minnesota



Critics of evolution contend that there can be no basis for morality if only “selfish” natural selection acts. For them — and for many evolutionists, as well — Darwinism implies Social Darwinism. If humans evolved, many imagine, moral relativism follows. Of course, one cannot derive values — even absence of values — from facts alone. Still, if one accepts the evolution of humans based on other evidence, a historical question remains. How did (or might) the behavior we call moral originate in humans?

Speculations on the biology of morality are as old as the ideas of human evolution itself. Darwin himself reflected deeply on

human nature. He documented his ideas in several notebooks, even before the publication of the *Origin of Species*. He devoted an entire chapter of his renowned *Descent of Man* to the origins of morality. Skeptics today may feel that science can say nothing informative about morality. Science deals with facts, not values. However, evolutionary study might explain how humans came to develop moral values. That knowledge might fruitfully inform moral discourse and thinking. A recent renaissance in biological and philosophical studies contributes to our growing understanding. They help address deep-rooted objections to evolution.

THE CASE OF VAMPIRE BATS

Consider, for example, vampire bats. They must eat every few nights to survive. What if one fails in foraging? Perhaps a neighboring bat has returned to the roost more successful than those particular nights? Might it share? Watch carefully. The bat grooms the second bat, licking its fur and eventually its lips. Note the response. The second bat regurgitates a small amount of blood, nourishing the first bat. How could this be? Natural selection supposedly acts selfishly. Only traits that benefit the individual will be inherited. Surely vampire bats do not have some abstract notion of “the

continued from page 26

because those who should challenge it will not. Let EP earn its praise if it is merited, but it is not yet merited because it is undeniable that EP is not based on the contemporary genic selection principles it *claims* to be founded upon. Selfish-gene theory, as currently formulated, does not — cannot — support the claims of the evolutionary psychologists. Morality is not a biological adaptation. And free will is, as Darwin said, a delusion.

Evolutionary theory is not necessarily supposed to be easy to understand or to accept. It is, like any science, supposed to be about debate, honesty and the search for truth. When we make it otherwise it becomes no better than creationism.

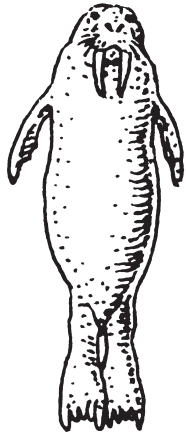
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good of the species"? Is the vampire bat *moral*? How do biologists explain this paradoxical behavior?

First, expand your observations. Watch the bat colony on successive nights. Sooner or later, the second bat will face the same dilemma. Now the circumstance is reversed. Does the first bat reciprocate? Generally, *yes*. The trade seems complete. Both bats have survived by cooperating. Food sources are patchy. Not every bat succeeds every night. By sharing, each *individual* benefits, in accord with natural selection. Sharing, here, seems to be an *adaptation*.

But wait! Suppose one bat cheats. She begs for meals, but never "repays the favor." That individual would reap the benefit, while bearing no cost. The trait of cheating could proliferate in the population. Any system of sharing would collapse ... unless, of course, the bats are "wise" to cheaters. If they can recognize individuals and remember past events, they can learn if any specific bat does not reciprocate. Then the bat who cheats will *not* benefit. Tit for tat. A potential violator of the system is kept in check. The behavior persists.



This case opens many questions on the often overlooked biology of morality:

- What constitutes morality biologically?
- Do the bats share "knowingly"? Is intention important?
- Is denying cheaters a primitive system of justice?
- How did this sharing behavior evolve?
- Does this example offer clues for interpreting human morality?

For those who wonder about a naturalistic perspective on morality, addressing such questions is essential.

THREE CONCEPTS OF MORALITY — AND THREE BIOLOGICAL INTERPRETATIONS

What is morality, biologically? Simply put, it is a form of behavior. In this sense, one can begin to study it objectively, by observation. (One need not rely on uncertain introspection or speculation about mental states.) It thus fits in a standard biological curriculum along with studies of instinct, learning,

social organization, animal communication and social dynamics.

The next challenge is: what concept of morality does one use? For centuries, philosophers have recognized at least three basic ways of conceptualizing morality:

- moral *acts*, evaluated primarily by their consequences or outcomes;
- moral *intentions*, evaluated by principled reasons or motives;
- moral *systems*, involving rewards and sanctions at the social level.

Each poses a different challenge. Yet each can be explained or addressed biologically.

MORAL ACTS

For some, morality is about maximizing the ultimate good. "The greatest good for the greatest number," many say. Philosophers label such approaches utilitarian, or consequentialist. Biologically, one would assess specific behaviors. Here, what might matter is that as a result of sharing, more vampire bats survive.

In this view, altruism, or a non-selfish *act*, poses an evolutionary

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puzzle. In the competitive framework of natural selection, only traits that benefit an individual's fitness should persist. But many organisms seem to help others at their own expense:

- A Belding ground squirrel acting as sentry may alert others to an approaching predator, drawing attention (and greater risk) to itself while allowing others to escape.
- Florida scrub jays remain with their parents to help raise siblings, rather than raise offspring of their own.
- Honeybees work in a hive helping the "queen," not reproducing themselves.

Some altruistic acts, like the vampire bats' sharing, may be reciprocated. The ultimate benefit is mutual. The behavior is *both* self-ish and cooperative. Does that negate its morality? If one measures morality by the act alone, only the overall benefit matters.

Other apparently altruistic acts may benefit the individual in a different context. The scrub jays ultimately benefit themselves. By staying at home, males secure better territories. Females can choose better mates. When sentries raise alarms, they may generate such confusing commotion that they, too, are safer from any predator. A biological perspective thus invites one to ask whether "unselfish" acts have hidden ("selfish") payoffs.

For honeybees, many social insects, and mole-rats, the "payoff" is hidden in the genetics. Honeybees, due to their chromosomal make-up, are more related to (share more genes with) their sisters in the hive than to their own offspring! In such cases, a honeybee that sacrifices its life "for the hive" benefits the long-term survival of its own genes indirectly. In the same way, a parent might sacri-

fice its life for a child under appropriate conditions. The ground squirrels, too, seem to be alerting their kin. Such "kin selection" can explain many apparently puzzling altruistic behaviors.

Although natural selection explains how certain behaviors originated, it does not determine any values. Traits that enhance survival and reproduction are "selected," but they are not thereby *valued*. Facts alone do not dictate values. "Is" does not imply "ought". The notion of "good" is a concept developed and discussed by humans. Values come from minds. Thus, for some, discussion of *acts* alone does not answer the fundamental questions about morality. One must address *intentions*.

MORAL INTENTIONS

For others, then, morality is about good motives more than good outcomes. What matters is "conscience," or what Darwin called the "moral sense." Here, respect for others and honoring certain principles are fundamental. Philosophers call this general view deontology.

Do vampire bats choose consciously or deliberately? If so, the behavior appears ultimately "selfish." The exchange might be prudent, not motivated *morally*. (Of course, the same analysis might apply to humans who support some charity for tax reasons or are motivated to behave well merely by fear of punishment.)

Intention, too, seems to pose a fundamental evolutionary puzzle. Natural selection cannot project into the future. The process is *non-teleological*. Adaptations do not develop for some anticipated benefit. How, then, can an individual organism have purpose or imagine a desired outcome? Many organisms do, of course. Nervous systems and brains do this admirably. Memory allows expectation and even imagination based on past patterns, enhancing survival. *Valuing* is also a mental process. In this sense, the bats do seem to know crudely what their sharing means — inherent, for example, when they deny non-sharing roostmates. The response differs depending on the nature of the complex stimulus. There seems to be authentic *choice*.

Darwin's own interests focused on "the moral sense." He wondered about sympathy, for example, and what stimulus triggered it. Darwin studied how facial features could reflect internal mental states, such as pain or joy. His book *The Expression of the Emotions in Man and Animals* examined the ways in which organisms communicate feelings, even if unconsciously. Darwin believed that feelings aroused by an infant's distress, for example, would lead to parental behavior enhancing the lineage's survival. If such motivation was partly hereditary, as it is for hunger, thirst, or desire for pleasure, Darwin reasoned, emotions such as sympathy could evolve. Even dogs seem able to display shame or guilt, he noted: a simple moral feeling.

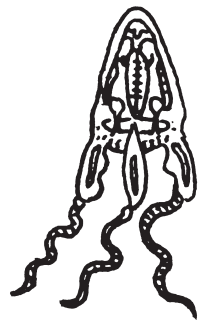
MORAL SYSTEMS

Finally, morality may be defined or conceptualized as a social system. This reflects the philosophical tradition of ethics as an implicit social contract. Here, an individual alone cannot establish an act or feeling as moral. Other organisms in the society acknowledge it as such. For example, the Golden Rule may express an expectation about mutual social relations. Morality would be evident in a system of rewards and punishments, for example.

In terms of evolution, moral systems may arise naturally in societies where:

- individuals can value or rate each others' behavior,
- they can learn and remember favorable and unfavorable acts, and
- they can reward or sanction others.

When individuals collectively reward "good" behavior and punish "bad" behavior, a set of social expectations — a definition of fairness, for example, or norm of truth-telling — is established. Individual behavior adapts to that social environment. The case of vampire bats is thus important because it seems to illustrate a simple system of justice among non-humans. Similar practices have also been observed in primates. In a colony of rhesus



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monkeys, where individuals call to the group when they find food, cheaters are again punished. They are more likely to be bitten, hit, chased, or rolled. As a result, cheaters eat less food. There are costs to deception. Social sanctions shape behavior.

If morality is fundamentally social, one would not expect to find a simple "morality" gene. Instead, moral values would all be learned. Likewise, ethical concepts and appropriate responses to feelings would all be reinforced through social incentives and disincentives. Biologically, organisms seem to exhibit a wide range of potential behavior. Depending on learning and motivational context, a society can potentially generate a serial killer as well as a philanthropist. Most important, perhaps, moral systems do not guarantee moral behavior. They merely generate the conditions that shape behavior.

Socially established values may potentially be quite complex in shaping behavior. With certain conditioning, even "self-sacrifice" or disregard for one's own survival could be taught and learned (whether one calls it terrorism or martyrdom). The nature of the system that evolved would depend on the organism's social organization and its history. For humans, this might involve the faculties of reason and foresight, as well as sophisticated communication of both ideas and emotions.

ETHICS FROM EVOLUTION?

Evolution seems able to explain how morality originated. It even seems able to explain how some behavior can be moral, while other is immoral. But can it say anything about moral principles? It is quite tempting to think so — and many have sought to make the connection. But no study of the way nature *is* can tell us how we *ought* to feel or what we *ought* to do. Still, the various evolutionary accounts may help us understand our moral resources and *how* we justify moral principles. Ultimately, it is humans who establish their own values, based on their own experience and interactions with one another. An evolutionary perspective thus leaves us with the

very questions that have challenged moral philosophers for centuries: to articulate what we idealize as good and what we expect from one another.

Many assume that Darwinism implies Social Darwinism. They assume that if one accepts evolution as fact, one must forego beliefs in foundations of human morality. But this is a unjustified transition from facts to values. Charles Darwin himself was, by all biological accounts, a gentle, moral man. Far from the Social Darwinist many take his theory to imply! On the contrary, Darwin was interested in understanding and explaining moral behavior. The doctrine of the "survival of the fittest" was not Darwin's. The phrase was coined by Herbert Spencer, who used it first in a social context. He voiced an ideology of Victorian England which ostensibly gave the upper classes a rationale to maintain their privilege. It was political ideology

then as it is now. One can accept Darwinism in nature without adopting Spencer's doctrine for human society. As exemplified by the vampire bats, perhaps, morality is up to the society to define and to the individuals in it to secure it.

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FURTHER READING

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RECOMMENDED READING AND VIEWING

De Waal F. *Good Natured*. 1996. Cambridge (MA): Harvard University Press.

Enjoy vivid anecdotes of primate behavior as a noted primatologist reflects on sympathy, rank and order, *quid pro quo* (tit for tat), and getting along.

Farber F. 1994. *The Temptations of Evolutionary Ethics*. Berkeley (CA): University of California Press.

A historian surveys the repeated efforts — and repeated failures — to justify particular human values from the facts of evolution. One chapter highlights Herbert Spencer, who introduced the phrase "survival of the fittest" and launched what is now known (misleadingly) as Social Darwinism. Here are the lessons for learning from our past mistakes.

Ridley M. 1996. *The Origins of Virtue*. New York: Penguin.

"Our minds have been built by selfish genes, but they have been built to be social, trustworthy and cooperative. This is the paradox this book has tried to explain," notes this lucid and personable science writer.

Stent GS, editor. 1980. *Morality as a Biological Phenomenon*. Berkeley (CA): University of California Press.

This early volume maps how to

reorient from morality as ideological rules to morality as behavior to be studied objectively. Topics include: phylogeny, analogs of cooperative sanction, fidelity, and so on, among non-human primates, psychology of prosocial behavior in early childhood, cognitive tools in moral decision-making, Asian perspectives on morality, and analysis of goal-oriented actions.

Sober E, Wilson DS. 1998. *Unto Others*. Cambridge (MA): Harvard University Press.

The two authors untangle, with philosophical sophistication, the evolutionary puzzle of altruism, notably teasing apart explanations at the level of genes and kin selection from motivations and psychological mechanisms.

The New Chimpanzees [video]. 1995. Washington DC: National Geographic Society.

Seeing is believing: compelling images of tool use and tool-teaching, organized hunting, grief, love of play, and infanticide all display — without anthropomorphizing — affinities of human behavior with that of our primate cousins.

and (of course?) Darwin's chapter on "the moral sense" in *The Descent of Man*.



Bush science is dangerous slope

The level of distortion of science is becoming quite high. The game of pushing a Christian agenda through public institutions is both terribly disingenuous and yet front and center. President Bush is seemingly sincere that his religious conversion and perspective is the right one. His born-again experience is public knowledge, as is his policy of breaking the barriers to religious influence in governmental programs. In Bush, the evangelical political movement got just the partner it wanted in the Oval Office.

Recently, speaking to his Texas constituency from the heart of the White House, Bush stepped over the line by announcing his support of "intelligent design" in the teaching of natural history (see p 13). Said the President: "Both sides ought to be properly taught ... so people can understand what the debate is about." He added, "You're asking me whether

or not people ought to be exposed to different ideas, and the answer is yes."

The "intelligent design" Bush is talking about begins with the biblical story of Genesis; it follows the particular story of the Christian biblical creation, with its inherent and particular logic. The hop from the parent concept of "creationism" to the concept-child named "intelligent design" is short indeed. The president's public testimony as a born-again Christian, following a long struggle with alcohol, is his foundational and inspirational driver for deepening the fundamentalist message from the bully pulpit.

The battle is an old one: religious conservatives, certain of their beliefs, argue that the opposite of their certainty is simply secular "relativism," which they portray as believing that all philosophies are equally valid. The hard-edged pundits on the right blast this charge constantly at the "wishy-washy" liberals. Since the

established science of evolution challenges directly the suppositions and timeframes of the biblical story, it becomes the object of attack — no matter how irrational, anti-scientific and utterly foolish the argument.

Fundamentalism of any sort leads to absolutist thinking, a derailing of public discourse in a democratic country. Now the argument — completely devoid of science and pretentious to the core — comes from the president of the most powerful country on earth. This is a source of worry for anyone in this country who can still appreciate empirical knowledge.

The President cannot be implying that we must explore "intelligent design" as a search for the creative genesis in nature and biology. Nor, as Shoshone Bannock columnist Mark Trahan pointed out recently, is he likely talking about the many complex, philosophical and wonderfully compelling Native creation stories, as recorded and retained in the tribal memories of the Americas.

Philosophical debate on the nature of human existence is one thing; again, there are many such stories from this hemisphere, many quite engaging and actually more suitable to peoples and places here than one imported from the far-away Middle East. It is quite another thing, as the

Bird Flu, Bush, Evolution — and Us

Steven Salzberg, University of Maryland

The emergence of the new, highly virulent bird flu is just the latest example of how the microscopic world is constantly evolving into new forms that threaten to devastate the human population. The seriousness of the threat was underscored yesterday by President Bush's announcement of a new \$7.1 billion national preparedness plan.

To fight off this threat, we need to understand everything we can about the influenza virus. But even if we succeed completely in defeating the flu today, the problem is not going

away. Not only will flu pandemics continue, but also we never know when a new disease such as SARS or West Nile virus will appear.

To keep ahead of these diseases, we need to continue our scientific research, and we need to educate our citizens about what they can do both to protect themselves and to help control the spread of disease. The current assault on the teaching of evolution greatly undermines our efforts to do this, now and in the future. If we stop educating our children about science, our society runs the risk of losing many of the wonderful advances that make our lives better.

Why has the debate about evolution re-emerged? Perhaps because few people see the obvious effects of evolution that geneticists and evolutionary biologists see every day.

Consider the influenza virus. Like

many viruses, it mutates very fast, creating many slightly different strains that compete to see which ones can infect their host most efficiently. Each year, we create a new flu vaccine, which although not perfect, is very effective.

Why do we need a new vaccine every year? In a word, evolution. Each year, the flu accumulates many mutations, and some of those mutations allow it to avoid the existing vaccine. These resistant strains quickly take over — that's what Darwin meant by phrase "natural selection" — and become next year's flu strain. The same thing happens with bacteria, and this is why our over-use of antibiotics — in animal feed, hand soaps, and a growing number of other products — is hastening the evolution of frightening new antibiotic-resistant bacteria.

What about the feared bird flu, the H5N1 strain that has jumped from birds to humans and killed more than half the people it has infected? Most people do not understand that H5N1

Steven Salzberg is Director of the Center for Bioinformatics and Computational Biology and Horvitz Professor of Computer Science at the University of Maryland; he co-led the team that recently sequenced the genomes of over 200 strains of the influenza virus.

president has done, to propose that a quasi-religious evangelical theory be taught in schools as a science on the same plane as evolution, which is a vast, tried-and-true method completely interlaced within the biological and physical sciences.

No one can doubt that evolutionary science is complicated and at times difficult to absorb, given its calculus of biological changes and developments played out over vast stretches of time, but even this is part of the method through which, with critical assessment, a field of study can achieve answers to complex questions. It misinterprets the development of science over more than a century to propose that "creationism" or so-called "intelligent design," particularly if conceived from only one overwhelming religion, is an alternative to evolutionary theory.

Again, Bush's roots in the religious, evangelical mind-set appear to overarch the public reality of a democratic America. In 2004, across the political spectrum, some 60 scientists, led by several Nobel laureates and medical experts, requested that the present administration desist from distorting scientific fact to arrive at "partisan political ends." This is evident in a variety of issues relating to energy, the environment and natural resources, where the administration is unrelent-

ing in what Robert F Kennedy Jr called a "campaign to suppress science that is arguably unmatched in the Western world since the Inquisition."

Once, important Western Christian thinkers saw their biblical exegesis in much broader terms. Not the literal but the broader, metaphorical implications of the Bible were the proper approach to its study. Evolution could fit then; it can make sense within the broader interpretations of Judeo-Christian-Islamic religions and even as a millennial guide to biological, geological or even historical fact-patterns.

In the context of creation stories, again, there are many from this hemisphere that are quite compelling. Just the wonderful narrative that names North America the great Turtle Island, from the eastern woodlands, proposes that the first human being was actually a pregnant female who fell from the Skyworld. The teachings of that story in the context of humans and the natural world are worth considering in these ecologically treacherous times.

Indian Country Today columnist John Mohawk this year published a succinctly edited book, *Iroquois Creation Story: Myth of the Earthgrasper*, which inspires with its clarity from ancient America. In

fact, the Iroquois (Haudenosaunee) creation story is the living basis of the ceremonial cycles in the long-houses of several reservations, source of origin and the truth of existence for traditional Haudenosaunee. Yet, no one here is suggesting that it be taught as "science" in the public schools.

Every Native culture across the hemisphere (and cultures from all over the world) would be in its right to line up, then, each with its origin story and each justifiably, as much as the Judeo-Christian Genesis, with its right to believe that its story is the true way that human beings came into existence.

Given the choice, we prefer the non-religious and secular space, such as public schools guided by universally shared scientific values and methods. Let each people have its religious approach and way of prayer. The other approach is a slippery slope to dangerous manipulation and intolerance. What little the various human cultures and societies have in common resides in the life of science and its search for open-minded truth.

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is evolving not in people, but in birds. We do not yet know what genetic changes will turn this flu strain into a pandemic, but we do know that it will continue to evolve. Each time it jumps to humans, there's a chance that this one will be the new pandemic strain.

Scientists in my lab and others can tell you that developing a vaccine for the flu absolutely requires that we understand its evolution. We can also tell you that the flu does not "care" if we believe in evolution. It will keep evolving anyway, and it will kill us if we ignore it.

A major misconception about evolution is that it is a theory of the origin of life. It isn't. It *is* about the origin of species. It does not explain how life came to be in the first place, but rather it explains how, once life appeared, it separated into distinct forms that led to the wonderful diversity of life on our planet. (Darwin himself believed that the first life was put here by a divine being.)

The evidence for evolution is over-

whelming and increases every year. Among the many astonishing things we have learned through the sequencing of the human genome is that we share hundreds of genes with the lowly *E coli* bacterium. These genes are so essential to life that their DNA has been preserved for two billion years, and today we can read the evidence in our genomes.

Several polls have reported that a majority of Americans believe that religion-based alternatives to evolution should be taught in science classes in our schools. These polls are called evidence that perhaps we should teach these alternative views. Reporters and pollsters deserve much of the blame here: Science is not like politics, where outcomes are determined by polls. Another recent poll revealed that less than half of the US population knows that the earth revolves around the sun. Does this mean we should teach that the sun revolves around the earth? What these polls do highlight, sadly, is the failure of science education. Of course it

would be a huge mistake, and a disservice to our children, if we used polls to decide what to teach in school.

Let's drop the artificial debate about evolution and "intelligent design" and teach our children what science really is. Let's teach them that science requires a skeptical mind and that scientific theories must be supported by objective facts. If we want to teach children about scientific debates, let's pick a real debate — there are plenty of them — rather than an artificial one. And let's equip the next generation of scientists to bring us new cures and new technology, rather than burying our heads in the sand.

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Evolution is a winner – for breakthroughs and prizes

James McCarter

In 1965, the young American scientist Leland Hartwell had to make a decision crucial to his research on understanding how cells divide, a key step toward curing cancer.

Hartwell had to decide whether to place his bet on simple single-celled organisms like baker's yeast, which were easy to study but might be too distantly related to humans for the information to matter. Or he had to cast his lot on cells from humans and mice, which were clearly relevant but difficult to study. Hartwell gambled that over the course of evolution, certain genes would be so important that natural selection would conserve their key features, making them recognizable even between yeast and humans. Over the next few decades, this speculation was confirmed, and in 2001 Hartwell was awarded the Nobel Prize.

The importance of evolution to Hartwell's work exemplifies a key perspective that has been overshadowed by recent attacks on science and evolution from creationist ideologues advocating "intelligent design". While it is

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essential to explain the flaws in the pseudoscience of "intelligent design" and to review the overwhelming evidence supporting the facts of evolution, such discussions of fossils and extinct species can seem irrelevant to everyday concerns. So let's focus on some of the many practical applications of evolution in an area that matters to all of us: breakthroughs in medicine.

Evolution, in addition to being solid science, provides us with a practical and powerful tool-kit. Applied techniques based on evolution play central roles in the biotechnology industry, and in recent advances in genomics and drug discovery. Bioinformatics, the application of computers to biology and one of the hottest career opportunities in science, is full of evolution-based computer code. Tens of thousands of researchers in the multibillion-dollar field of biomedical research and development use evolution-based discoveries and concepts as a routine part of their important work.

For instance, our interpretation of the human genome is largely based on comparisons to genomes of other species. Coincidentally, the statement by President George W Bush in sup-

port of teaching "intelligent design" (*see p 13*) occurred just weeks before the publication of the chimpanzee genome, work led by Washington University's Genome Sequencing Center.

In a peer-reviewed article, many of the same world-renowned scientists responsible for sequencing the human genome presented in detail the differences between the DNA of humans and chimps. Consistent with chimpanzees' being our closest living relatives, the researchers reported that across billions of bases in the genomes, about 97.4% of the human and chimp DNA is identical. And the differences in the remaining 2.6% are fascinating, showing the signatures not of creation or design but of evolution. The DNA sequence differences show change driven over the last 6 million years by the forces of mutation and natural selection, from the selection for genes that aid in our defense against infection to the movement of transposable elements (parasitic DNA).

To see the integral role of evolution in biomedical research, consider Nobel Prizes, a good indicator of the most important breakthroughs in biology. Reviewing the last 50

NATIONAL SCIENCE TEACHERS ASSOCIATION RESPONSE TO PRESIDENT BUSH

The National Science Teachers Association (NSTA), the world's largest organization of science educators, is stunned and disappointed that President Bush is endorsing the teaching of intelligent design — effectively opening the door for nonscientific ideas to be taught in the nation's K-12 science classrooms.

"We stand with the nation's leading scientific organizations and scientists, including Dr John Marburger, the president's top science advisor, in stating that intelligent design is not science. Intelligent design has no place in the science classroom," said Gerry Wheeler, NSTA Executive Director.

On Monday, Knight Ridder news service reported that the President favors the teaching of intelligent design "so people can understand what the debate is about."

"It is simply not fair to present pseudoscience to students in the science classroom," said NSTA President Mike Padilla. "Nonscientific viewpoints have little value in increasing students' knowledge of the natural world."

NSTA strongly supports the premise that evolution is a major unifying concept in science and should be included in the K-12 education frameworks and curricula. This position is consistent with that of the National Academies, the American Association for the Advancement of Science, and many other scientific and educational organizations.

[From a NSTA press release issued August 3, 2005. Available on-line at <http://www.nsta.org/main/news/stories/nsta_story.php?news_story_ID=50792>.]

years of Nobel Prizes in medicine or physiology, I asked, "Is training in evolutionary biology necessary for a thorough understanding of the award-winning discoveries and work resulting from each breakthrough?" By my criteria, understanding of evolution is necessary in 47 of 50 cases. From vaccines, viral cancer genes, and nerve cell communication to drug trials, and genes controlling cholesterol and heart disease, evolutionary insights are crucial.

In Hartwell's case, a bet on the simple yeast cell revolutionized our understanding of how cells of all organisms replicate. Versions of most of the genes found in yeast cells by Hartwell and his co-recipients Tim Hunt and Paul Nurse were later found in humans. Despite over a billion years of evolution since they diverged from their common ancestor, humans and yeast still maintain similar gene-encoded machinery for cell replication. Drugs aimed at this replication machinery are currently in clinical trials for the treatment of breast, lung, kidney and other cancers.

In Kansas, backers of "intelligent design" have scoffed at the idea that watering down the evolutionary biology curriculum would have a negative effect on that state's fledgling biotech industry.

What does evolution have to do

with biotechnology? As the president of a biotech firm in St Louis, I can tell you that evolutionary biology is an integral part of what we and other companies do. I hire scientists who are well-trained in molecular evolutionary biology; who know how to recognize the business end of enzymes simply by looking at DNA sequences; who know which changes in a protein are important; who can design research tools based on the way a species manipulates the genetic code. Today, these skills are as important to discoveries in the laboratory as knowing how to use a microscope, and it takes an understanding of evolution to master them.

Creationists ask, "Do you really think an ape was your ancestor?" Biologists are actually saying something much more profound. From anatomists, biochemists and immunologists to molecular biologists, neurobiologists and cell biologists, we are stating that all aspects of biology support the conclusion that humanity shares ancestry not only with primates, but with mammals, reptiles, fish, insects, worms, plants, and yes, even yeast and bacteria. We have evolved as part of one inseparable living world — one ancient tree of life that inhabits this planet. And for many scientists of diverse religious traditions, this realization

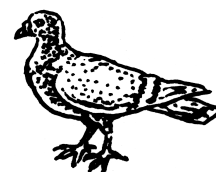
does not pose the conflict with their faith that fundamentalist ideologues assert.

Americans, in addition to being a passionate people of many faiths, are also practical people. We are innovators who expect to lead the world in medical breakthroughs and products. Open-minded Americans must know that the assault on evolution in the science curriculum not only puts at risk our understanding of natural history, ecology and environmental change, but also jeopardizes the science literacy of our students and our international competitiveness in making biomedical breakthroughs of Nobel-Prize caliber. Americans have been awarded the Nobel Prize in Medicine in 39 of the last 50 years. At a time when we face international competition that is more intense than ever, a good start toward success is to put the attacks on evolution, biology, and science behind us.

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CHIMPANZEE GENOME SEQUENCED

The common chimpanzee was highlighted in the September 1, 2005, issue of *Nature*, which featured the eagerly anticipated draft genome sequence of *Pan troglodytes*. Chris Gunter and Ritu Dhand (*Nature* 2005 Sep 1; 437: 50-1) commented:

Until now, genome sequence information has shown us how many seemingly very different organisms are amazingly like humans. At a conservative estimate we share about 88% of our genes with rodents and 60% with chickens. ... So it's no surprise that we are still asking, "What makes us human?" To apply genomics to this quest, we need to shift the focus to look at our closest living relative, the chimpanzee. Given that we share more than 98% of our DNA and almost all of our genes, chimps are the best starting

point to study not the similarities, but the minute differences that set us apart.

In addition to the draft genome sequence and three further research papers on the chimpanzee genome, the same issue of *Nature* contains a report on the first unequivocal fossil evidence of the genus *Pan* as well as a suite of articles reviewing recent work on chimpanzee culture, behavior, psychology, neuroanatomy, and neurogenetics — a wealth of material, in short, for the chimpanzee enthusiast.

[*Nature's ensemble of literature on the chimpanzee, including the contents of the September 1, 2005, issue as well as work previously published in Nature, is available on-line at <<http://www.nature.com/nature/focus/chimpgenome/index.html>>. A portion of the material is available only to subscribers to the journal.*]

BOOKREVIEWS

SPECIATION

by Jerry A Coyne and H Allen Orr
Sunderland (MA): Sinauer Associates, 2004. 525 pages

Reviewed by Norman A Johnson, University of Massachusetts, Amherst

Although Darwin's *Origin of Species* provided compelling evidence for evolution and showed that it could occur via natural selection and other natural processes, ironically it said little about how species originate. Speciation as a subject of active research started during the 1930s and 1940s during the fusion of Mendelian genetics and Darwinian evolution that is known as the Modern Synthesis. The founders of this Modern Synthesis (notably Theodosius Dobzhansky and Ernst Mayr) viewed species as populations that could interbreed with each other but which were reproductively isolated from other populations. Under this definition, which Mayr called the Biological Species Concept (BSC), speciation is the acquisition of reproductive isolating barriers. These barriers can be premating, such as when behavioral differences cause females of one nascent species to reject males of the other, or postmating, such as hybrid sterility.

Studies of speciation, particularly the genetics of speciation, languished for several decades after the pioneering works of Dobzhansky, HJ Muller, and their associates. This lack of attention was due in part because speciation studies were overshadowed by such topics as measuring the extent of genetic variation within and among populations and the

developing methodologies to determine evolutionary relationships. Starting in the 1980s, evolutionary biologists, using classical and molecular techniques, began paying increasing attention to speciation and its underlying genetics. Today speciation is once again at the forefront of evolutionary research.

Although there have been a couple of excellent edited volumes on speciation and monographs on various aspects of speciation published in the last 20 years, there had been no comprehensive account of studies in speciation since before the speciation "renaissance" until now. Jerry Coyne and Allen Orr, who have alone and together made several seminal discoveries in speciation, have written a magisterial, comprehensive volume, simply called *Speciation*. Their book contains at least 1600 references, many of which are from the 21st century. Had Coyne and Orr just published their annotated bibliography, that would be a great service for professional evolutionary biologists and their students. But they do so much more!

Coyne and Orr begin by addressing whether species are real or just arbitrary constructs of the human mind. It's not surprising that Coyne and Orr think that species are real and not just constructs — after all, if they didn't think species were real, why would they write a 500-page book on the formation of new species? What is more of interest is the nature of the evidence used to support the reality of species. One line of evidence is based on folk taxonomy — indigenous peoples categorize nature into species almost

exactly in the same way that professional biologists do. Intriguingly, folk taxonomy breaks down with the higher taxa: indigenous peoples and biologists don't recognize the same genera and higher levels. The other line of evidence is based on statistical identifications of clusters using either morphological or molecular data. Although we sorely need more of these studies, the current studies allow us to draw the tentative conclusion that species are real.

Although a variety of other species concepts have proliferated since the modern synthesis, Coyne and Orr support a modified version of the BSC: "distinct species are characterized by *substantial but not necessarily complete reproductive isolation*" (p 30, emphasis theirs). They state their reasons for supporting the BSC in chapter 1 and in a very detailed appendix on species concepts. Aside from these two sections, Coyne and Orr use the evolution of reproductive isolation as a proxy for speciation.

The standard view of speciation is that populations that are separated by geographical barriers genetically diverge from one another via mutation, natural selection, and other evolutionary forces. Without the geographical barriers, gene flow among populations can counteract this divergence. In addition, reproductive isolation usually is not in itself adaptive but is instead a byproduct of that genetic divergence, which may or may not be adaptive. Evolutionary biologists generally accept that speciation often occurs as per this standard view but hold that speciation can occur via other means. As Coyne and Orr illustrate, debates about speciation are usually about the importance of various alternative modes of speciation.

To what extent can speciation occur in the absence of geographic barriers? In recent years, there has been what Coyne and Orr describe as a "wave of enthusiasm" for "sympatric speciation", reproductive isolation evolving despite the diverging populations' being in the same place. Proponents of sympatric speciation have said that it may be a rather common mode of speciation, especially for plant-eat-

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ing insects and cichlid fish in crater lakes. Coyne and Orr conclude that this current enthusiasm is hard to justify based upon the data at hand. In their critique of possible cases of sympatric speciation, the authors demand a much higher standard of evidence for the claim that the speciation took place in sympatry than they do that it took place in allopatry. Their rationale for this higher standard of evidence is that "... it seems reasonable to accept a controversial standard only when it appears more likely than a well established one" (p 142), and sympatric speciation is controversial. A substantial part of the debate between those who are enthusiastic about sympatric speciation and those like Coyne and Orr who are more skeptical revolves around standards of evidence.

Can reproductive isolation be adaptive and not just a byproduct of divergence? In the 1940s, Dobzhansky championed a mode of speciation in which premating isolation can evolve when two formerly allopatric population that have developed some postmating isolation meet again. In what has become called "reinforcement", selection works to reduce the number of "mistakes" females make in mating with males of the other nascent species. During the 1970s and early 1980s, theoretical models and a lack of solid case examples led most evolutionary biologists to reject reinforcement as a plausible mode of speciation. Starting in the late 1980s and spurred by some of Coyne and Orr's own research, there has also been a wave of enthusiasm for reinforcement. Reinforcement does better than sympatric speciation from Coyne and Orr's critical review of the evidence, but the authors do caution that not all (or even most) premating isolation has evolved via reinforcement.

In their final chapter, Coyne and Orr tackle the relationship between speciation and evolution at levels above the species (macroevolution). Are there evolutionary trends that cannot be predicted by examining selection within species? If so, the species would be a level of selection above the individual. The existence of

species selection has been a major debate with paleontologists (such as the late Stephen Jay Gould) generally championing species selection and population geneticists generally being more skeptical. Coyne and Orr argue that the presence of biological traits that facilitate or impede speciation would be evidence of species selection and demonstrate that there are such traits. In the concluding two sentences of the book (excluding the appendix), they state: "Those who continue to debate the possibility of species selection fail to realize that comparative studies have already settled the issue. What remains is to determine how often this type of selection has shaped evolutionary trends" (p 445).

In addition to these intellectual questions, Coyne and Orr explore detailed studies of particular isolating mechanisms, in particular hybrid sterility and hybrid inviability. In fact, these are among the most interesting sections of *Speciation*. Coyne and Orr demonstrate that real progress has been made along several fronts in the last two decades, including studies of the numbers of genes involved in reproductive isolation, the localization of these genes to ever-smaller chromosomal regions, and the identification of what a handful of these genes actually do. These genes that contribute to hybrid sterility and inviability appear to have a variety of functions, but most probably have some role in the regulation of other genes. In addition, molecular evolution studies find that these genes all show the hallmarks that show that natural selection operated on them. Hybrid sterility and inviability thus are often the byproduct of adaptive rather than neutral divergence.

Although most of the work on the genetics of speciation has been with fruit flies of the genus *Drosophila* and Coyne and Orr are committed Drosophilists, their book is taxonomically diverse, at least within animals and plants. While an excellent book for professionals and graduate students in the area, *Speciation* would be hard going for the non-specialist. While there are few typos and the figures are well done, more illustrative and

instructive diagrams would have been useful for non-professional readers. Hopefully, these changes would be made in an update. And updated regularly this book should be! One of the most attractive features of *Speciation* is that it directs us to where new studies should be headed. It will be interesting to see how the field develops and how subsequent versions of *Speciation* cover it.

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LAW, DARWINISM, AND PUBLIC EDUCATION: THE ESTABLISHMENT CLAUSE AND THE CHALLENGE OF INTELLIGENT DESIGN

by Francis J Beckwith
Lanham (MD): Rowman &
Littlefield, 2003. 177 pages

**Reviewed by Todd Mollan,
Bradley J Cosentino, and
Jason J Williams**

In *Law, Darwinism, and Public Education (LDPE)*, Francis Beckwith analyzes the legality of teaching "intelligent design" (ID) in United States public schools. He uses the landmark decision of *Edwards v Aguillard* and several related cases to make inferences about Supreme Court jurisprudence related to ID. He also extensively discusses ID as it relates to creationism and evolution. The book is meticulously well researched, and the ideas are pre-

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sented in a clear and straightforward manner. However, the subtext of the book is plainly that ID is legitimate science, and that teaching it in public schools should be found constitutionally acceptable. In advocating this view, the book fundamentally mischaracterizes certain aspects of evolutionary theory. Though Beckwith maps out some of the relevant legal issues for teaching ID in public schools, his analysis is noticeably biased in several key sections.

The book is divided into an introduction and four chapters. In the introduction, Beckwith briefly informs the reader of some of the main tenets of ID, but spends most of his time listing notable intellectuals, institutes, scholarly works, and political leaders supportive of ID. The list gives a misleading view of ID's scientific validity, as an overwhelming majority of the works cited are popular pieces rather than empirical and peer-reviewed. Further, while ID has clearly gained more attention within mass media and academic circles, that attention has not always been positive. Beckwith concludes his introduction by setting forth the question he attempts to answer in his book: "Given the Supreme Court's holding in *Edwards*, would a statute or government policy requiring or permitting the teaching of ID in public schools violate the Establishment Clause of the First Amendment?" (p xxii).

In chapter one, Beckwith purports to clarify and define important terms and review prior court cases. Unfortunately, he adopts a remarkably broad definition of evolution. He defines it as "... the view that the entire universe and all the entities in it can be accounted for by strictly material processes ..." and as a "grand materialist explanation" in which "... there is neither need, nor room, to fit any nonphysical substances or properties..." (p 5-6; citation omitted). Throughout the book, the breadth of this definition causes serious problems for LDPE.

First, courts have not previously recognized evolution as synonymous with materialism. Beckwith observes that the holdings of *McLean v Arkansas* (p 21) and *Peloza v Capistrano School*

District (p 62), as well as Justice Powell's comments in *Edwards v Aguillard* (p 55-6), did not use this definition of evolution. Moreover, the Louisiana Balanced Treatment for Creation-Science and Evolution-Science in Public School Education Act was struck down because its definition of evolution stipulated "... scientific evidences for [creation or evolution] and inferences from those scientific evidences" (p 50; citation omitted).

Second, although Beckwith believes his definition is accurate (and therefore that the definition used in the cases above is wrong), he clearly mischaracterizes evolutionary biology. Neither evolution nor any other individual scientific discipline provides an overarching, cosmological explanation of universal origins and processes. Beckwith says that evolution is a "view [concerning] ... the entire universe and all the entities in it" (p 5). However, evolutionary biologists do not investigate the stock market, supernovas, or quarks, for instance, though these are certainly included in "the entire universe and all entities in it" (p 5).

Third, Beckwith assumes that the science of evolution entails specific philosophical worldviews (that is, materialism and atheism). Yet even Pope John Paul II, who clearly did not subscribe to the exclusive materialism entailed in Beckwith's definition, affirmed scientific evolution and recognized that materialism is not the only possible underpinning:

Rather than the theory of evolution, we should speak of several theories of evolution. On the one hand, this plurality has to do with the different explanations advanced for the mechanism of evolution, and on the other, with the various philosophies on which it is based. Hence the existence of materialist, reductionist and spiritualist interpretations. (John Paul II 1996)

Furthermore, Beckwith's interpretation fails to distinguish between evolution as a science and as a secular religion (Ruse 2003: 1524). This is an especially

important distinction in the context of this book, for it is science, not materialism (or any other secular worldview that could be inferred from evolution), which is actually taught in science classrooms, despite Beckwith's claims. Beckwith's chosen definition becomes a recurring problem and in chapter 3 leads him to pursue some bizarre philosophical arguments for ID (such as "Souls, minds, and essences" [p 103], "Moral claims and properties" [p 105], and so on), in addition to summarizing standard ID fare (such as "specified complexity" [p 107], "irreducible complexity" [p 110], and so forth).

Beckwith's biases are far less pronounced in chapter 2, which is devoted mainly to providing a judicial history of *Edwards* as well as an analysis of the Court's majority, concurring, and dissenting opinions in this case (p 49). Chapter 2 also discusses several lower court cases. Beckwith cites apposite cases and critiques the opinions supporting the holdings. One of the major problems he struggles with, however, is distinguishing between an intelligent designer and a divine creator. Since binding legal authority strongly and uniformly militates against teaching about a divine creator in public schools, Beckwith has a lot of work to do to show that teaching about an intelligent designer in public schools is permissible. Indeed, the holdings for each of the main cases he cites in chapter 2 are discouraging for ID advocates.

In *Edwards*, for instance, the Supreme Court invalidated an act that prohibited the teaching of evolution unless accompanied by creation science. In *Webster*, *Peloza*, and *LeVake*, the courts severely limited high-school teachers' freedom to teach alternatives to evolution or non-evolutionary theories of creation. In the last main case cited in this chapter, *Freiler*, the Court invalidated a disclaimer stating that the teaching of evolution is not intended to dissuade high school students of the biblical version of creation or any other concept.

In keeping with the chapter's stated purpose of merely providing a judicial overview, Beckwith



does not spend much time expounding on how these cases may be distinguished or overruled. However, he makes it apparent that the Establishment Clause is very hostile toward laws that promote or permit teaching about a creator or an intelligent designer. This is undeniably a serious problem for ID proponents — one that is perhaps tacitly acknowledged in Beckwith's highly qualified conclusion to chapter 2, where he states that nothing in these cases, "*when [their narrow holdings] are rightly understood, would prohibit, in principle, the teaching of ID in public schools*" (p 78; emphasis added).

Finally, after describing ID and pursuing a few unusual philosophical arguments in chapter 3, chapter 4 provides us with the central conclusions of the book. In this chapter, Beckwith argues that a carefully drafted statute for teaching ID would probably not run afoul of the Establishment Clause. His stated approach is to look at the constitutional definition of religion and then to ask whether ID is a religion. Beckwith concludes that the relevant cases do not provide a clear constitutional definition of religion, but that Christianity, Judaism, and Buddhism are paradigms of religion. This part of the chapter seems evenhanded and informative, though it is curious to note that even if ID is not a religion, it still may be unconstitutional to teach it in public schools (for example, old-earth creationism is not a paradigm of religion, yet it is still unconstitutional to teach it in public schools). Thus, it is not entirely clear why this framework is helpful to *LDPE*'s stated goal.

Regardless, in the second section of chapter 4, Beckwith initially spends some time trying to convince the reader that evolution and ID provide different answers to the same question (that is, what is the origin of apparent design in biological organisms and/or other aspects of the natural universe?). Then he explicitly sets forth the reasons that the statute in *Edwards* was struck down, and argues that these reasons do not apply to ID. Beckwith's *a priori* commitment to his own views reaches perhaps the highest vol-

ume in these pages. He looks at the doctrines used in *Edwards* and other Establishment Clause cases, and roundly concludes that teaching ID in public schools is constitutionally acceptable under almost every test. Moreover, Beckwith by implication characterizes academics and mass-media articles that cast ID in a negative light as narrow-minded near the end of the section. He says that they are guilty of professional marginalization, and likens the editor of *Scientific American* to Tony Soprano.

In the end, several common approaches seem to stand out in Beckwith's analysis: (1) overstate evolution so that it looks theoretically extremist and absurd; (2) make ID look more moderate and like a mere secular criticism of evolution; (3) attack the rationales of cases unfavorable to creationism; (4) analogize ID to evolution in order to show that it is no more religious than evolution; (5) argue that ID is not a religion and that it is a purely secular theory; and (6) argue against those who do not embrace ID without presenting their views adequately. These approaches undercut the credibility and persuasiveness of *LDPE* because they run counter to the book's stated goals. That is, *LDPE* purports to provide legal analysis aimed at answering important questions, but its argument are based on an overly-broad, overwhelmingly unaccepted definition of evolution, and therefore the book's conclusions are contingent on accepting Beckwith's unorthodox views. Overall, *LDPE* is more an argument against materialism and naturalism (and therefore *all* of science) rather than an analysis of ID's legality in public schools.

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WHY IS A FLY NOT A HORSE?

by Giuseppe Sermonti
Seattle: Discovery Institute Press,
2005. 176 pages

**Reviewed by Andrea Bottaro,
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At the ripe age of 80, Giuseppe Sermonti can hardly be considered the new kid on the block of creationism, even more so because he has been pushing his personal brand of anti-evolution, an idiosyncratic brew of supernaturalism, structuralism, and postmodernist anti-rationalism, already for a couple of decades. Judging by the treatment this retired Italian genetics professor recently received in the United States by the local creationist "intelligent design" honchos, however, one would be almost forgiven for thinking that Sermonti might be the movement's next star. Much of the newfound enthusiasm is, I suspect, due to his editorship of *Rivista di Biologia/Biology Forum*, a third-tier but historical and, importantly, ISI-indexed biology journal which he has turned into a haven for all sorts of creationist and anti-Darwinian material. Sermonti's *Rivista* provides "intelligent design" advocates a much-needed back door to the "mainstream scientific literature" without the inconvenience of proper peer-review — a unique opportunity that they have already started to exploit. Hard on the heels of Sermonti's trans-Atlantic travel to appear at Discovery Institute-sponsored lectures and as an "expert witness" at the Kansas anti-evolution hearings, now comes a translation of his book *Dimenticare Darwin* ("To forget Darwin"), published by none else but the Discovery Institute itself, under the title *Why is a Fly not a Horse?*

Despite the back-cover claim that the book is "loaded with sci-

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entific facts,” it can hardly be called a scientific treatise. In fact, the book lacks any coherent thread, any substantial argument that is logically developed. In its place, two main ideas reverberate and echo throughout the book: first, that modern evolutionary theory and the current mechanistic models of development — indeed, the scientific method itself — are utterly inadequate to explain biological form in all its fascinating and rich complexity, and second, that abstract form exists apart from, and precedes — indeed *must* precede — its physical ontogenetic and phylogenetic realization. Sermonti bounces these two ideas around, roaming across themes as diverse as fractals and paleoentomology, prions, and anthropology. This could have even been an instructive approach, if it were not for the fact that the treatment is mostly superficial, and often outright misleading, practically overwhelming the reader with an avalanche of factoids, pseudo-claims, and anecdotes which, due to the general lack of proper citations and attributions, a general reader will not even be equipped to confirm and evaluate properly.

The lack of citations is actually strategic, because for the most part Sermonti runs through the usual gamut of well-known creationist rhetorical arguments and scientific misrepresentations (key transitional forms are missing, no models exist for the origin of genetic information, evolution contradicts the Second Law of Thermodynamics, natural selection is a purely conservative force, and so on), sometimes with highly personal twists, such as his creative claim that the evidence indicates that *Homo sapiens* appeared first (and abruptly) among hominids, and that all other fossil hominids and extant great apes are its degenerate forms. When support for an argument is missing, Sermonti does not turn away from inventing some, for instance when he argues that modern evolutionary theory, via its adherence to the “Central Dogma” of molecular biology, posits that DNA must act as a thermodynamically closed system (and therefore is subject to the Second Law).

In most cases, Sermonti’s arguments are based on mere misrepresentations or cherry-picking of the existing evidence; I can’t say whether intentionally or due to ignorance. Thus, the finding that homologous “master” genes (hox genes, pax6) can drive similar developmental programs in morphologically different organisms is cited as a strong argument that morphological differences cannot be genetic in origin, but must be due to “some vague ‘field’ that unfolds to the point of being the very form of a fly or a cat” — a view, Sermonti assures the reader, that is “gaining ever wider support” (which may be news to developmental biologists). Later, he claims that leaf insects, or phasmids, predated the appearance of the leafy plants they mimic (angiosperms) in the Cretaceous. This is simply false.

First, there is no fossil evidence at all of Phasmida before the radiation of angiosperms. Second, the Permian fossil insects of the order Protophasmida, which Sermonti cites as problematic evidence, do not particularly mimic sticks or leaves, and certainly not angiosperm leaves. (As Sermonti notes with characteristic suspicion for scientists’ motives, they are unfortunately named: they are not even related to modern Phasmida at all.) Third, leafy plants, such as ferns and gymnosperms, existed in the Paleozoic anyway, and with visual predators such as amphibians and early reptiles around, it would hardly be a surprise if some insects did find an advantage in forms of camouflage. Sermonti says, “The entomologists I have consulted prefer to gloss over the phasmids.” Quite possibly, he simply did not like their answers.

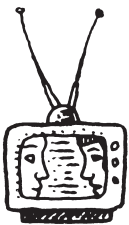
Also on an insect topic, Sermonti cites as another case of impossible evolutionary “premonition” the fact that most of the extant insect mouth apparatuses existed before angiosperms (Labandeira and Sepkoski 1993). He asks, “How did it happen that these complex and delicate apparatuses existed millions and millions of years before they had a job to do?” The straightforward answer is, because they had a job to do on non-angiosperm plants, as

highlighted by the damage detected on plant fossils.

A review paper by Labandeira (1998) describes insect feeding modes for which Paleozoic evidence already exists: “spore feeding and piercing-and-sucking” (extending to the early Devonian), “[e]xternal feeding on pinnule margins and the intimate and intricate association of galling” (in the Carboniferous), “hole feeding and skeletonization” (in the early Permian), “surface fluid feeding” and possible but inconclusive evidence of “mutualistic relationships between insect pollinivores and seed plants” by the end of the Paleozoic. In other words, insects pierced, sucked, gnawed, crushed, lapped, imbibed, scraped and otherwise fed on non-angiosperm plants then, much as they do on angiosperms today (the only exception being the current highly specialized flower-feeding apparatuses, whose appearance in the fossil record not surprisingly overlaps that of flowering plants).

Quite amusingly, these supposed entomological “evolutionary mysteries” so struck “intelligent design” advocate and biochemist Michael Behe’s fancy that he made them the centerpiece of his endorsement of Sermonti’s book: “With charming prose Sermonti describes biology which contradicts Darwinian expectations: leaf insects before leaves, insects before plants [sic] ...” It would have taken Behe some basic knowledge of biology and paleontology and a few hours of checking the appropriate literature to figure out the facts. Perhaps Behe blindly trusted Sermonti’s scholarship, but he should have asked the book’s editor (Jonathan Wells of *Icons of Evolution* fame) and translator first, who (to their credit) went to the trouble of correcting several banally gross errors from the Italian version of the book (such as the claims that all animal phyla, including Protozoa, Porifera, and Cnidaria, appeared in the Cambrian, and that there are no known fossil transitional forms in cetacean evolution).

The alternative view of the biological world Sermonti proposes has less to do with science, even anti-Darwinian structuralism, and



more with some sort of passive, contemplative mysticism. Ultimately, Sermonti seems to suggest, we should just marvel at nature's intricacies, and give up on trying to understand it with our faulty tools: "The budding flower of the world is a cathedral of cathedrals, and it remains to us to bend our knee and say '*Domine, non sum dignus*'".

I am all for being transported by contemplation of nature at times, but Sermonti is not St Francis, and his anti-scientific approach ultimately sounds alternatively resentful (of the veil-piercing successes of science) and defeatist (of its future prospects). The goal of Sermonti's approach, however, is not knowledge but, as he states in a 1996 open letter to Rupert Sheldrake in *Rivista di Biologia* (Sermonti 1996), to endow the modern world with an "enchanted and magic aura" (interestingly, Sermonti is also the author of several books and articles of literary criticism of fables and fairy tales).

If one has to look for a positive aspect in the book, it may reside in the exposure of creationist and "intelligent design" readers to some of the more respectable structuralist ideas, which although limited may be something not often encountered in their pamphlets. As one of the founders of the Osaka Group, Sermonti should at least have a reasonable understanding of structuralism. Alas, he barely runs through the topic in a couple of chapters (most effectively in the one entitled "Prescribed forms of life"). He talks about D'Arcy Thompson and even describes Brian Goodwin's more pragmatic approach to structuralist embryology, only later to essentially apologize for its empirical nature, and fall back on empty fluff such as Rupert Sheldrake's "morphic resonance" and the "inherent collective memory" of natural systems.

So, all in all, between the poor arguments, the many errors, and the misrepresentations, what is left of this book to leave a mark on the reader is the "charming prose" Behe alludes to. Certainly Sermonti loves to turn out flourishing phrases and rich descriptions — possibly even too much for many

English readers, more used to terse and utilitarian prose. Another Discovery Institute Fellow, Jonathan Witt, crow's, "Anyone who believed in reincarnation would say Sermonti was a poet in a former life." Judging solely from this book, any knowledgeable reader would have a hard time believing that Sermonti has been a scientist in this life.

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[Some material and ideas in this essay first appeared on the Panda's Thumb website <www.pandasthumb.org> in Bottaro's review of the Italian version of Sermonti's book and later commentaries.]

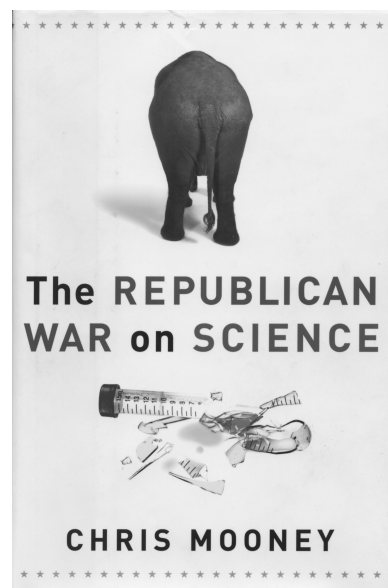
THE REPUBLICAN WAR ON SCIENCE

by Chris Mooney
New York: Basic Books, 2005. 342 pages

Reviewed by Robert L Park,
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FAITH-BASED GOVERNMENT

On August 1, 2005, in an interview with Texas reporters, the President of the United States of America publicly declared war on science. Siding with biblical literalists, George W Bush called for "intelligent design" to be taught in public schools alongside the theory of evolution (see p 13). An undeclared war that had smoldered behind the headlines suddenly broke out on the front



pages. The war on science was now national news.

It was certainly not the first time that George W Bush had embraced ideologically driven pseudoscience. Large blocks of the scientific community had already been alienated by the President's stand on such issues as climate change, missile defense, abortion, stem cell research, the environment, the test ban treaty, energy, and so on. But now, as if by design, he had found the one issue that seemed to offend every scientist. Darwin's theory of evolution by natural selection occupies a special place in the world of science. When it was published in 1859, the reaction of the great biologist Thomas Huxley was "why didn't I think of that?" Every scientist since, whatever his or her field, has felt that same sense of awe. How could an idea of such clarity and simplicity, an idea that explains so much of what is known, have eluded scientists for so long? Darwin's theory of evolution demonstrates what the human mind is capable of when it's freed from the shackles of tradition. It is treasured by scientists in every field — even as it is despised by the religious right.

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By fortunate coincidence, even as the President was calling for a religious fable to be taught beside science in our schools, the story of how the most advanced nation on earth came to reject science, Chris Mooney's *The Republican War on Science*, was already at the printer's.

The Republican dismissal of mainstream science actually began two decades ago with Ronald Reagan's Strategic Defense Initiative, a missile defense program commonly referred to as "Star Wars". Technological optimism was substituted for scientific reality. The reckless Reagan "dream" of "rendering nuclear weapons impotent and obsolete" never had any realistic prospect of working and risked initiating a peremptory strike from the Soviets. "Star Wars" — overwhelmingly opposed, even ridiculed, by the scientific community — simply did not work. Now, under George W. Bush, a vastly scaled-down version of Star Wars is also opposed by scientists, and it also does not work.

George W. Bush, like Ronald Reagan, has no interest in science. Bush, like Reagan, saw no urgency in appointing a science advisor and listens to whoever tells him what he wants to hear. It was almost a year before Jack Marburger, a physicist and director of Brookhaven National Laboratory, was confirmed as director of a scaled-down White House Office of Science and Technology Policy. Moreover, the job had been stripped of the rank of Special Advisor to the President, greatly reducing the influence of science in this administration. None of this seemed to perturb Marburger, a registered Democrat, who was President of the State University of New York at Stony Brook prior to becoming director at Brookhaven.

Following the President's comment on teaching "intelligent design", however, Marburger, whom the President had not bothered to consult, told *The New York Times* that the President had been misunderstood. "Evolution," he said, is the "cornerstone of modern biology," whereas "'intelligent design' is not a scientific concept." All of this is perfectly true, but he needed to be telling this to the President, not

The New York Times. The President did not bother to take notice of Marburger's comments.

Scientists have traditionally been reluctant to take public stands as a group on partisan political issues, believing that science should be a high priority for both parties. But as Mooney points out, that changed on February 18, 2004, when 60 leading scientists, including 20 Nobel laureates, signed a statement denouncing the Bush administration for distorting scientific information and manipulating the process by which science advice is factored into government decisions. To the charge of manipulating the science advisory process, the eloquent White House response was to eject two advocates of stem cell research from the Council on Bioethics, replacing them with three appointees whose opposition to stem cell research is solidly faith-based.

The number of Nobel laureates signing the statement eventually rose to an astonishing 48, along with 62 recipients of the National Medal of Science. The administration response was to trivialize the issue. John Marburger was assigned the task of belittling the statement. Marburger, after all, had nothing else to do. He told *The New York Times* that it was just a matter of a few scientists "getting their feathers ruffled."

It is one thing to point out how pervasive the Republican war on science has become, another to devise a strategy for deterring future abuse. In a final chapter, or "Epilogue," Mooney makes it clear there is no one solution. Legislative reforms are needed to safeguard science advice and rescind measures that have served to further politicize science. Moderate Republicans might convince their more extreme colleagues of the dangers of science abuse, but so far he points out, "we can detect no evidence" that they are having any effect. Indeed, in the short time since Mooney wrote those words, the lure of the White House has pushed Republican moderates such as McCain and Frist, who witnessed the power of the Christian right in the last election, to endorse the teaching of "intelligent design" alongside evolution.

Strong belief in "fair play" is one of the most appealing characteristics of Americans, but it is often exploited by fringe groups who have little rational justification for their positions. Reporters also justify giving "balanced" treatment to such issue on which one side has little or no sensible support.

But in the end, Mooney says, "We must mobilize the natural defenders of Enlightenment values: scientists themselves, who all too often fail to engage anti-evolutionists and other know-nothings in defense of what they hold dear."

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PARADIGMS ON PILGRIMAGE: CREATIONISM, PALEONTOLOGY, AND BIBLICAL INTERPRETATION

by Stephen J. Godfrey and
Christopher R. Smith
Toronto: Clements Publishing,
2005. 207 pages

**Reviewed by Daryl P.
Domning, Howard University**

There are plenty of books today that counter the arguments of "creation scientists" with catalogs of hard evidence from legitimate science. These are useful sources for teachers and debaters who have to confront creationists, and for the occasional reader who is genuinely seeking answers to the scientific questions being raised. They are much less useful, I suspect, to the many who are wrestling with the deeper, existential issues, such as the meaning of life, the explanation of evil, and the existence of God.

These sincere questioners, non-scientists for the most part, are not

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passionately concerned about DNA or radiometric dating. What they are passionate about is the tension they feel between science and their own religious faith. By failing to address these deeper issues (which are the real driving force of the perennial controversy over evolution) and playing the creationists' game (arcane scientific disputes in which doubts about evolution can easily be planted in laypeople's minds), many earnest evolutionists just help perpetuate the present stalemate.

Paradigms on Pilgrimage is a rarity: a book that can be recommended to people who are trying to think their way through the conflicting claims of fundamentalism and modern biblical scholarship as well as natural science. It should appeal to such readers, and maybe persuade them, because it is the highly personal story of two former fundamentalists who made that same intellectual and spiritual journey themselves.

Stephen Godfrey is a paleontologist and curator at the Calvert Marine Museum in Solomons, Maryland. A Canadian with a PhD from McGill University, he has worked on a variety of fossil vertebrates, most recently whales. Raised an evangelical Christian and young-earth creationist, he encountered more and more contrary evidence as he pursued his studies in biology and paleontology from elementary through graduate school. In the first half of this book, he recounts his inner struggles with the implications of superposed fossil forests, footprints, and faunas in layered rocks; resemblances between *Archaeopteryx* and dinosaurs; and other evidence that finally convinced him to abandon creationism.

Godfrey's story is neatly complemented by that of his brother-in-law, Christopher Smith, a Baptist minister and Bible scholar. In the second half of this joint intellectual autobiography, Smith describes the very different but convergent path that led him to their eventual co-authorship. In his teens he converted from mainline Christianity to fundamentalism and creationism. Pursuing his aptitude for languages and literature through stud-

ies at Harvard, seminary training, and a Boston College PhD, he too had his fundamentalist beliefs increasingly challenged. In his case, however, the challenges were to his literal reading of the Bible and came from the biblical text itself and his growing grasp of literary criticism.

By this time he was married to Godfrey's sister, and witnessed Godfrey's disillusionment with creationism at close range. Already perplexed by evidence for evolution (though not understanding it well) and impressed by his paleontologist in-law's sincerity of moral purpose, Smith increasingly came to see a middle ground between "moral though unscientific" creationism and "scientific but amoral" evolutionism. Together they moved toward a new understanding of God as having created by means of evolution, and agreed to share their stories through this book.

The result fascinatingly documents the thinking of real people as they move into and out of the creationist worldview. Along the way, they also provide some gems of original, ingenious arguments against creationism and biblical literalism — which are of all the more interest because they were ones that actually helped change these individuals' minds.

Why, asks Godfrey (p 76), would God have made the first tetrapods look so much like contemporaneous fish, when they could have been created so different in time or morphology as to raise no suspicion that they evolved? Moreover, the Bible says that God sent rain on the land of Palestine; but even creationists do not see the meteorological explanation of rain as a denial of God. So couldn't biological diversity, which the Bible also attributes to God's action, likewise have come about through natural means (p 83)?

Most enlightening to the average scientist will be Smith's comments on the literary, rather than literal, sense of Genesis 1–3. For example, the clear contradictions between the creation accounts in Genesis 1 and 2 can only mean that the editor(s) of Genesis who juxtaposed them did not understand them to be works of history

(p 122). Furthermore, Genesis does not teach that physical death was the result of Adam's Fall: before the Fall, God told humans and animals what to eat (Genesis 1:29–30), but why would they need to eat if they could not die (p 163–4)?

The final section of the book offers an original reading of Genesis 1 with commentary, to show how this creation account presents (and makes good sense as) a naïve observational cosmology radically different from our objective scientific one. For example, the creation of light on the first day seems to us inconsistent with the sun's creation only on day 4 — but not if the original light is identified as *twilight*, which always appears in the sky even when the sun does not (as on overcast days). We now know this light comes from the sun, but the ancients would have been justified in thinking it to be an independent entity. The authors' argument — that the biblical authors were not and did not claim to be omniscient about the natural world — restores to the biblical text the integrity it loses in the hands of literalists.

This book is an enjoyable and stimulating read that will give evolutionists insight into the minds of their opponents, and give creationists persuasive reasons to change their minds. To my mind, it's a valuable contribution.

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THE TRIAL OF JOHN T SCOPES: A PRIMARY SOURCE ACCOUNT

by Steven P Olson
New York: The Rosen Publishing Group, 2004. 64 pages

Reviewed by Glenn Branch,
NCSE

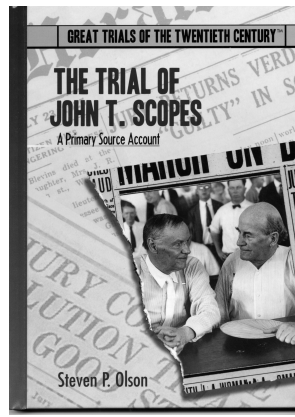
Eighty years on, the Scopes trial continues to fascinate. Steven P Olson's *The Trial of John T Scopes*, in a series called Great Trials of the 20th Century, is aimed at readers

between 9 and 12 years old. (The author is a freelance writer in Oakland, California, not to be confused with the science writer Steven Olson, whose publications include *Mapping Human History* [New York: Houghton Mifflin, 2002].) The book is equipped with a variety of useful aids, including a glossary, a page listing a few sources for more information (and giving a link to a regularly updated web site with relevant links), a short list of further readings, and a brief but adequate index. It is also extraordinarily well illustrated, mainly by sepia-toned photographs from the time of the trial.

Populated by a colorful cast of characters, teeming in anecdotes hilarious and touching, and redolent with antecedents in and implications for science, religion, education, law, and popular culture, the Scopes trial might overwhelm any writer. To his credit, Olson proceeds in workmanlike fashion, establishing the scene with a compelling opening chapter ("The meeting at the drugstore"), sketching the scientific and religious background and the preparations for the trial, detailing the eight days of the trial at a brisk pace in four chapters, and pondering "The meaning of the Scopes trial" in a concluding chapter. He writes clearly and, for the most part, at a suitable level for his intended readership, and, given the limits of the space available to him, he succeeds in sketching the essential contours of the trial.

Such a brief book is almost bound to contain a variety of trivial errors, both of commission and omission, and much can be excused in the name of brevity and simplicity. Unfortunately, the value of Olson's book is vitiated by substantive errors — in law, the history of science, and religion — that cannot be so easily excused.

Olson's grasp on the legal issues involved in the case is shaky. At two points (p 37, 53) he writes as though he thinks that the First Amendment is only about the freedom of speech, and he misreads two passages in such a way as to



corroborate that impression. On page 30, he quotes John R Neal as saying, "The legislature spoke for the majority of the people of Tennessee, but we represent the minority that is protected by this great provision [freedom of speech] in our constitution." But the interpolation is wrong; Neal was arguing that the Butler Act violated the constitutional guarantee of freedom of religion (Anonymous 1990: 55). Similarly, on page 53, Olson wrongly claims that *Epperson v Arkansas* was decided on freedom of speech grounds. Nowhere in his book is the First Amendment actually stated.

Olson also struggles with the task of explaining the defense's legal strategy. True, it is frequently difficult to tell exactly what the strategy was, since the factions in the defense team differed among themselves about how to argue the case, and in the trial they adopted a scattershot approach: as Olson notes, the defense's motion to quash the indictment involved 14 separate points of Tennessee and federal constitutional law. Nevertheless, the major theme of the defense strategy was to argue that the statute under which Scopes was prosecuted — which forbade teachers in the public schools "to teach any theory that denies the story of the Divine Creation of man as taught in the Bible, and to teach instead that man has descended from a lower order of animals" — presupposed and thus privileged a particular religious view, that evolution is incompatible with divine creation. By concentrating on issues about freedom of speech and academic freedom, Olson's account distorts the trial.

The scientific content of the book is understandably limited, but still inadequate. Olson incorrectly describes Darwin's conception of natural selection as occurring at the level of species (p 13-4). Moreover, he fails to distinguish Darwin's argument for evolution (in the sense of common ancestry) from his proposal of natural selection as its driving force. The result is manifest in his discussion of *The Fundamentals*, which, he says, "argued that the stories of the Bible were truly the word of God and there was no room for interpretation. The Book of Genesis was right, and Charles Darwin was wrong" (p 16). To be sure, *The Fundamentals* contained such essays as "The decadence of Darwinism" and "The passing of evolution". But the primary target of the essays was not evolution as such but selectionism (or "Darwinism"), and the fundamentalist assault on Darwinism was bolstered by the fact that natural selection, then just beginning to emerge from its eclipse (Bowler 1983), still looked scientifically dubious.

Finally, although Olson is clearly striving to be appropriately respectful of religious sensibilities, he seems at times to be persuaded by Darrow's portrayal of the trial as a clash between religion and science. Besides his caricature of *The Fundamentals*, he stresses Darrow's objection to the court's opening with prayer (p 55), without noticing that modernist clergy were later allowed to alternate with their fundamentalist colleagues (Larson 1997: 167). In his account of the grueling interrogation of Bryan, he writes, "Darrow finally got Bryan to agree to the moment when God created Earth: October 23, 4004 BC, at 9:00 AM" (p 46) — which, to be pedantic, is wrong; only the year was mentioned, and Bryan was hesitant about it (Anonymous 1990: 287-90) — and then describes Bryan's disavowal of a "six days of twenty-four hours" creation as a disavowal of "the plain text of the Bible" (p. 48), as if only a young-earth creationist reading of the Bible were conceivably legitimate.

The Trial of John T. Scopes is not a bad book about the Scopes trial for its intended readership.

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But with greater attention to the legal issues and greater sensitivity to the scientific and religious milieu of those eight hot days in Dayton, it could have been a much better one.

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EVOLUTION, CREATIONISM, AND OTHER MODERN MYTHS

by Vine Deloria Jr
Golden (CO): Fulcrum Publishing,
2002. 274 pages

Reviewed by H David Brumble,
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I was channel surfing last night, when a nest of dinosaur eggs caught my eye. It turned out that they were plaster casts of dinosaur eggs, but that was okay. A professorial type — tweedy jacket, scruffy beard, haircut a couple of weeks overdue — was pointing out that each of the eggs in this nest was found with the narrow end down. This was *not* the way they were laid. No, this orientation is clear evidence that all the eggs in this nest had *floated* — and so, these eggs turn out to be evidence of the biblical flood. Genesis is history.

Now, this was wonderful: Noah's flood picked up these very eggs, floated them about upon the bounding main, and then, when the waters abated 150 days later (Genesis 8:3), gently floated those eggs down to rest still in perfect

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formation. But we were supposed to believe this delicious absurdity because it was delivered by a man costumed as a *professor*. His hair was carefully mussed, his tie was a bit askew, and he had the plaster eggs set up on one of those laboratory-bench tables with the faucet and sink, the kind of thing that we find down front in chemistry and physics lecture halls. Behind the table was a blackboard — again, just the kind of thing we all remember seeing in science lecture halls. Occasionally this TV professor would dash back there to draw something on the board. He did this quickly and carelessly, just as an excited physics professor might do.

This is American Indian provocateur/lawyer Vine Deloria's method exactly. In his first anti-science diatribe, *Red Earth, White Lies* (1995), Deloria donned a professor costume — footnotes, scholarly citations, and impressive bibliography — to tell us that the Genesis account of Noah's flood is real history, that humans and dinosaurs were probably on earth at the same time, and that college basketball players are taller now than they were a generation ago because of higher levels of carbon dioxide in the air. In *Evolution, Creationism, and Other Modern Myths*, Deloria pulls the costume out of the closet again, this time to scrawl upon the studio blackboard that:

the earth's mountain chains were probably formed as wave-action response to planetary fly-bys (p 107);

ancient Chaldean star charts going back 370 000 years might well have been based on actual observations (p 166);

ancient Sumerian civilization was probably installed, all in one piece, by extra-terrestrials (p 169);

American Indians might well have seen the flying machines of such ancient extra-terrestrials (p 174);

all of Judeo-Christian theology might well have been developed in response to oppressive rule by space

aliens (p 175).

Deloria is careful not to make definite assertions in some of these matters. He wants us to understand that he is open-minded, that he is not bound by dogma, as is that credulous and pitiful tribe, the Scientists. He does not claim to *know*, for example, that the ancient astronaut theory is correct, but he *does* "believe that it has much to tell us and should be a topic for serious historical investigation" (p 179).

But Deloria's professor costume consists of more than an open mind. The book is graced by 372 footnotes. But anyone who takes the trouble to check the footnotes will find pseudo-scholarship. At one point, for example, Deloria assures us that science is now rapidly coming to accept Velikovsky's idea that tribal oral traditions preserve accurate memories of civilization-ending "celestial events" (p 211). Deloria's authority for this extraordinary claim? A one-page article in the *Denver Post*. Deloria provides neither source nor explanation for the strange assertion that the Dead Sea Scrolls "revealed evidence" that Jesus was a "deluded revolutionary hero" (p 115). For his summary statement of the nature of Western religious thought, Deloria relies on *Newsweek* (p 126).

Deloria suggests that perhaps the ancients *burned* their sacrificial animals because their gods were in fact space aliens — and those aliens had "experienced an illness from badly cooked food early in their occupation of the valley in which the Garden of Eden was located" (p 176). Deloria's source is CA O'Brien, an "English prehistorian" (p 175). But Deloria does not cite a particular work by O'Brien, and so, alas, we will never know just what evidence there might be for this interesting idea.

Some of Deloria's sources are "creation scientists", such as Donald Patten, and the book brims with old creationist canards: that scientific attitudes toward evolution is basically religious, that the earth is far younger than the geologists would have us believe, that humans are not related to apes, that Noah's flood was real, and that



all creationists want, really, is openness to ideas.

In fact, Deloria's insistence that this book offers "no comfort to religious fundamentalists" (p ix) is merely a part of his scholar's costume. Deloria's second-hand evolution bashing — his summaries of anti-evolutionist books by Richard Milton, Jonathan Wells, Phillip Johnson, Patten, and others — is comfort indeed for fundamentalists. (On the other hand, fundamentalists will probably be as amused as I am by Deloria's space aliens obsession.)

And goodness, we are supposed to be impressed by the breadth of Deloria's learning. He moves confidently from biblical and classical scholarship, to theology, European and American history, astronomy, geology, paleontology, anthropology, archaeology, ancient and American Indian mythology, physics, the law, philosophy, and the history of science. But his scholarship is a quarter-inch deep, merely another part of his costume.

One of the points that Deloria most wants to make, for example, is that, unlike tribal peoples, both science and Christianity are sadly limited by their sense that time is linear. It was, he assures us, St Augustine who "firmly implanted the idea of the absolute progression of time in the Western mind so that it became a constant" (p 131). This casual reference to Augustine does seem impressive. But those who have read some Augustine will remember that he distinguished between time, which was *created*, and God's eternity, which exists outside of time (see, for example, *City of God* 12.6). Strange, then, to say that Augustine could think of time only as a single "absolute". It is also strange to think that no one in the Western tradition had thought of time as linear, *until* Augustine in the 4th century. What about all those Old Testament genealogies? Think of all the ancient Egyptian chronicles. Deloria provides no citation here and no explanation, so we are left with no idea as to what he has in mind. (Toulmin and Goodfield's account of *The Discovery of Time* [1965], by the way, mentions Augustine only twice, briefly.) We

are left with the impression that Deloria's reference to Augustine is decoration merely, a shiny button on his costume.

The scary thing about the book is that a wide range of those who know better put on "political correctness" spectacles when evaluating Deloria's pronouncements on science, religion, and oral traditions. Historians Dee Brown and Alvin M Josephy Jr provided dust-jacket praise for Deloria's *Red Earth, White Lies*. Can you imagine these men praising a creationist's book that argued that humans and dinosaurs were on earth at the same time? Studs Terkel claims to regard the present book as "revelatory". Does Terkel really believe that the people of the Old Testament were worshiping space aliens? And Deloria was one of 70 authors and illustrators invited to speak at the National Book Festival, hosted by Laura Bush in October 2002. Deloria's anti-evolutionist, ethnic-creationist speech was televised by C-SPAN. Imagine a Southern Baptist being provided such a forum to expound Biblical creationism!

Those who are inclined to give to Deloria's ideas a free pass from scholarly criticism for any reason should realize that loopy ideas can have serious consequences. In *Red Earth, White Lies*, for example, Deloria castigated geologists and paleontologists (the most deluded sub-tribes of the Scientists) for their obstinate neglect of American Indian oral traditions. His argument went like this: The earth is not nearly so old as the geologists would have us believe; and tribal memories going back thousands of years are accurately preserved in oral traditions; therefore, geologists should learn about the formation of the earth from tribal oral traditions. Similarly, paleontologists should look to tribal oral traditions for accurate information about dinosaurs.

This theme is continued in the present book. Here the idea is that geologists need to study tribal oral traditions that describe various "ages" or "worlds". Geologists should notice that these "ages" were bounded by catastrophes — and so, if only they would pay attention to ancient "non-Western"

oral traditions, geologists would be able to work up a *vastly* abbreviated, *much* more accurate geological time-line.

Now, geologists and paleontologists are unlikely to follow this advice — but the uncritical, acceptance of these ideas by so many public figures is shaping the public sense of the reliability and extent into antiquity of oral traditions. This has real-world consequences in land-rights cases, such as in the famous case of Kennewick Man.

In this case, skeletal remains found near the Columbia River were determined to be nearly 10 000 years old, a good deal older than the earliest evidence of American Indian habitation in this region. Some Umatilla Indians argued that the bones ought to be handed over to them for "reburial" on the grounds that, since their oral traditions tell of the creation of the Umatillas in this region some 10 000 years ago, Kennewick man *must* be Umatilla (see Chatters 2002: 87). A Portland court recently decided this case in favor of the scientists (*Bonnichsen et al v US Army Corps of Engineers et al*, 2002) — but it was a near thing. The loss to science would have been considerable, since these bones seem to be important evidence that there was more than a single pre-Columbian immigration to the Americas. And this is but one example of the sort of damage that uncritical acceptance of the ideas in this book could cause.

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VINE DELORIA JR DIES

Vine Deloria Jr, a Standing Rock Sioux who championed the rights of Native Americans through his writing and activism, died on November 13, 2005, at the age of 72. Born in 1933 in Martin, South Dakota, near the Pine Ridge Oglala Sioux Indian Reservation, Deloria served in the United States Marine Corps in the 1950s before receiving a degree in general science from Iowa State University and a master's degree in theology in 1963 from the Lutheran School of Theology in Illinois. In 1970 he received a law degree from the University of Colorado, where he taught history from 1990 to 2000. The most famous of his twenty-plus books is *Custer Died For Your Sins* (New York: Macmillan, 1969), in which Deloria incisively criticized the stereotyping of Native Americans.

Deloria's commendable respect for Native American tradition seemed to go too far, however, with *Red Earth, White Lies* (New York: Scribner, 1991), which distorted science in the service of upholding traditional accounts of creation. Writing in *American Literary History* (1998; 10 [2]: 335-346; reprinted in *RNCSE* 1998 Nov/Dec; 19 [6]: 10-14), H David Brumble of the University of Pittsburgh described the book as "ethnic pseudoscience," noting its affinities and debts to young-earth creationism. Similarly, Deloria's later book *Evolution, Creationism, and Other Modern Myths* (Golden [CO]: Fulcrum, 2002) brimmed, as Brumble noted in his review for *RNCSE* (p 49), with "old creationist canards" and "second-hand evolution bashing."

See also the obituary in *The New York Times* (2005 Nov 15).

GLIMPSES OF THE WONDERFUL: THE LIFE OF PHILIP HENRY GOSSE 1810-1888

by Ann Thwaite
London: Faber and Faber, 2002.
387 pages

Reviewed by Robert Ackerman

Philip Gosse's life was one of unrelentingly energetic achievement. It began unpromisingly: his family was poor (his father was an itinerant portrait painter), he lacked influential connections who might have opened doors for him, and his formal education ended at the age of 15. Nonetheless, through extraordinary industry, remarkable powers of observation, an accessible literary style, and artistic talent in illustrating his work, by middle age he had become the most popular writer on natural history in Britain, a fellow of the Royal Society, and a wealthy man. In addition he was blessed with an optimistic temperament and a happy marriage. All in all, truly an admirable person and (I intend the phrase unironically) an eminent Victorian.

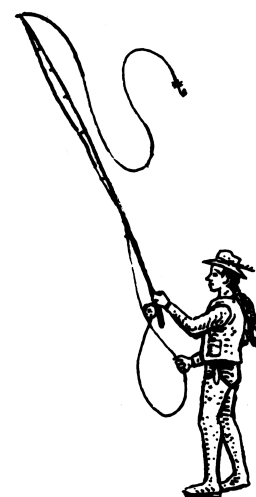
Inevitably there were clouds as well. The first was the devastating loss of his wife to cancer after only eight years of marriage. (The upbringing of his son, Edmund, about whom more below, was a continuing worry later.) Further, Gosse was a member of the fundamentalist denomination known as the Brethren (often mistakenly called Plymouth Brethren) and as such committed to a literal understanding of the Bible as the inspired word of God. In his own scientific work, primarily on microscopic marine creatures (especially the rotifers), he was keenly aware of the exquisite adaptation of species to their environments, and had he lived a century earlier this awareness would probably not have caused him any special anxiety. As an almost exact contemporary of Darwin, howev-

er, he could not avoid the evolutionary ideas that seemed to be "in the air" everywhere, and he felt keenly the implied threat to the basis of his religious life. The evidence for continuing geological change presented by Lyell in the 1830s, along with his intimate familiarity with the work of the leading naturalists of his day (he was a friend of Darwin, Huxley, and Wallace among others), precipitated an intellectual and emotional crisis. After much thought and prayer, in 1856 he came to believe that the Lord had shown him an ingenious way to reconcile the biblical timetable of creation and immutability of species with the implications of evolutionary natural and physical science.

His answer was "prochronism", which he presented in *Omphalos* (1857). If, as he assumed, Genesis is literally true and therefore species do not and cannot change, it then must also be true that God created the whole of the natural and physical world *as we know it*. That is, the trees in Eden came complete with growth rings, God included fossils in the rocks, and Adam and Eve were fashioned with navels ("omphalos" is Greek for navel) even though they were not born of woman. The appearance of "pastness," then, was an inherent and therefore benign attribute of the divine plan for the world. Gosse thus concluded that the conflict between the biblical account of creation and the evidence for evolution and the new chronology implicit in geology and biology implied by it was illusory.

Thinking that he had thus resolved the conflict between science and Christianity, he was shocked when neither the godly nor the worldly appreciated *Omphalos*. His friend the novelist Charles Kingsley rejected prochronism because if he accepted it he would also have to accept a God who was a deceiver, whereas those who approached the natural world without supernatural assumptions saw prochronism as the makeshift that it transparently was. (Of course, the flaw lay in its complete untestability — explaining everything, it explained nothing.)

Omphalos, however, was one of Gosse's few failures, and its



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adverse reception, though personally hurtful, did not dent his reputation as an exponent of science, which continued to grow through the 1860s and 1870s. (Gosse's greatest innovation was his development of the aquarium, which permitted those whom he had inspired to enjoy at home the creatures they found at the seaside and which also did a great deal to nourish the infant tourism industry; its development concomitantly created the trade of dealers in marine specimens.)

Philip Gosse, though known today only to historians of science, also figures as the dour, even tyrannical parent in the classic autobiography by his son, the Edwardian man of letters Edmund Gosse, *Father and Son* (1907). As Ann Thwaite narrates Philip Gosse's life, she takes pains to show how frequently and significantly Edmund darkened the colors in the portrait of his father. In *Father and Son*, which I warmly recommend, Philip Gosse appears to be overbearingly protective, driven by his anxiety lest Edmund, his only child and the living reminder of his beloved dead wife, drift away from the true path of faith — which of course he did. Thwaite is able to offer this useful corrective to Edmund's revenge (if that is what it was) because she is blessed by access to an abundance of written sources, both by and about Philip Gosse.

The book, which contains many photos and illustrations from Gosse's books, is a pleasure to read. The narrative flows easily, and the author has done an immense amount of research, especially in setting Gosse within the larger intellectual and social context of the nineteenth century. Thwaite is neither a scientist nor a historian of science and must rely on the judgments of others in assessing Gosse's contributions to scholarship, but in the event this is no serious shortcoming because historians of science are unanimous in their appreciation of his work. She also offers a sympathetic description of Gosse's spiritual life, and especially of his passionate hope that he might be one of the elect who are on earth when the Second Coming occurred. The absence of polemic on Thwaite's part gives

her book an extra resonance for readers today because of the disinterested insight it offers into a critical early moment in the modern history of the relations between science and religion.

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THE PILTDOWN FORGERY

by Joseph S Weiner
Oxford: Oxford University Press,
2004. 248 pages

Reviewed by Jim Foley

"Piltdown Man" was discovered in Sussex, England, by Charles Dawson, an amateur fossil hunter, and unveiled in 1912. Consisting of a human braincase and an ape-like jaw, it quickly became England's very own celebrity ape-man. Further finds by Dawson strengthened its status as an early ape-human intermediate. But by the 1940s, Piltdown was increasingly being forced into the periphery because nothing else in the fossil record remotely resembled it. Scientists were divided over whether the Piltdown fossils belonged to one species or were a mixture of ape and human fossils, but both explanations faced great difficulties. While pondering the problems with all the natural explanations of Piltdown, it occurred to Weiner that there might be an unnatural explanation. Once he and some colleagues examined the Piltdown fossils with that possibility in mind, the hoax collapsed quickly. Many tests, most of them unavailable when Piltdown was first found, showed beyond a shadow of a doubt not only that the Piltdown Man was a fraud, but so were most and probably all of the other fossils and artifacts found with it.

Jim Foley has written extensively on the hominid fossil record for the TalkOrigins Archives, <<http://www.talkorigins.org/faqs/boms/index.html>>.

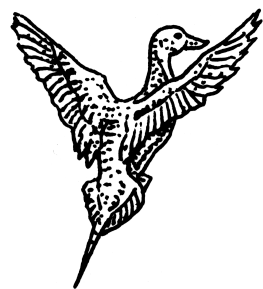
Stephen Jay Gould, for one, has argued that the Piltdown hoax was not all that well executed, and it is probably true that it was lucky to remain uncovered as long as it did. Nevertheless, it is evident from Weiner's book that the hoaxer or hoaxers went to a lot of effort and showed considerable ingenuity and persistence in the fabrication of the hoax. It is also clear from Weiner's descriptions of the tests that could be brought to bear on fossils, even in the 1950s, that it would be virtually impossible to create another fraud to rival Piltdown nowadays.

The most interesting question about Piltdown is, of course, who-dunnit? The difficulty is not in finding plausible culprits, but in ruling them out. Like some detective novels in which all the characters are suspects, virtually everyone associated with Piltdown Man has been fingered as the hoaxer at some point.

Once the fraud was discovered, Weiner immediately started investigating it. At that point the fraud was already over 40 years old, and some of the principals were already dead. However, Weiner was still able to interview some of the participants and many other people with knowledge of the affair. It was not until about 1980 that the cottage industry of solving the Piltdown fraud really kicked into high gear. (One suspects that until then, the scientific community was so horribly embarrassed by Piltdown that scientists could not bring themselves to look at it.) By then, of course, everyone with first-hand knowledge of the events at Piltdown was dead. So, although later researchers have uncovered further information not available to Weiner, this book (originally published in 1955) remains an invaluable primary resource about the Piltdown fraud.

In his conclusion, Weiner found it extremely difficult to see how Dawson could not be implicated, but felt that his guilt could not be established beyond reasonable doubt.

Chris Stringer's new afterword briefly brings the reader up to date on developments in the 50 years since Weiner's book was originally written. Ronald Millar, in his book *The Piltdown Men* (London: Victor



Gollancz, 1972), felt that precisely *because* Dawson was such an obvious culprit, he would not have committed the hoax. Millar thought that the anatomist and anthropologist Grafton Elliot Smith was involved, with Dawson's help, since Smith would not have been able to commit the fraud on his own. Gould felt that Teilhard de Chardin was involved, as did a number of other prominent scientists, including Louis Leakey. Frank Spencer, building on the research of Ian Langham, argued after a comprehensive study that the anatomist and anthropologist Sir Arthur Keith was guilty along with Dawson. In the 1970s a suitcase belonging to Martin Hinton, a paleontologist at the British Museum, was discovered which contained fossils apparently stained in a similar manner to Piltdown. It looks very suspicious, but were these Hinton's early attempts at working out how to forge Piltdown, or later experiments to determine how it was done?

And these are only a few of the most prominent accusations; at least 25 men have been implicated in the forgery by various accusers. John Evangelist Walsh in his book *Unraveling Piltdown* (New York: Random House, 1996) shows that Dawson was involved in many shady dealings involving fossils and archeological items. (Stringer considers this the best modern book on Piltdown, and I agree.) The fact that Dawson, the person most closely involved with Piltdown, had a record of similar forgeries makes for a strong case against him. In the end, Stringer agrees with Weiner's initial verdict that Dawson was probably the culprit (though he also has his suspicions about Hinton) — but that, short of some startling new evidence, we will probably never know for sure.

For more information about Piltdown, visit the Piltdown Man Home Page at <http://home.tiac.net/~cri_a/piltdown/piltdown.html>.

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CONTROVERSY, CATASTROPHISM, AND EVOLUTION: THE ONGOING DEBATE

by Trevor Palmer
New York: Kluwer Academic/
Plenum Press, 1999. 450 pages

Reviewed by Hiram Caton

Trevor Palmer, an enzyme biologist at the University of Nottingham, provides in this volume a chronicle of the emergence of catastrophe evidence and thought. He explores planetary science, paleontology, geology, and evolution, with emphasis on human evolution, from about 1970 to 1999, but with substantial expeditions into the history of astronomy and evolutionary theory, plus some early 20th-century material. The author puts flesh and bone on his chronicle by including contextual detail about authors, about specific books and articles, conference proceedings, special issues of journals, and other factors bearing on the conduct of science. These supplements are requisite for dealing with the principal theme — controversy — but they do not constitute a philosophy or a sociology of science of controversy. He also abstains from interpreting the significance of contemporary catastrophism for understanding “man's place in nature”. One indication of this restraint is the temper of the book's conclusion. Titled “Postscript — The hammer and the pendulum”, it is a brief statement promoting reconciliation by calling on TH Huxley's 1869 pronouncement that catastrophism and uniformitarianism are compatible. Palmer does not mention that no one paid this admonition the least mind, including Huxley himself, who, a decade later, declared that geologists had completely

Hiram Caton was Professor of Politics and History at Griffith University, Brisbane, Australia, until his retirement. He was among the founding members of the Association for Politics and Life Sciences. His current writing activity includes a history of evolutionary thought from 1800 to 1900, entitled Evolution in the Century of Progress.

refuted catastrophism. There is the additional infelicity that, either way, Huxley's advice pertains to a state of science that, on the author's own showing, bears little comparison with its present state.

If Palmer's book proposes no philosophy of controversy, it is nonetheless a major contribution to understanding the growth of the present position. Contemporary catastrophism begins with Luis Alvarez's 1980 article proposing that a 10-km-diameter asteroid strike caused the Cretaceous-Tertiary (K-T) boundary mass extinction. It is the beginning in the sense that the old idea of catastrophic impact now, for the first time, escaped the stigma of fringe science to compel the attention of geologists and paleontologists. It was the beginning also in the sense that the experimental methods and instruments needed to canvas the question fruitfully were available and continued to be refined.

The explosion of information about the solar system initiated by space exploration was, of course, a major contributor to establishing the revisionary premise that our planet is subject to numerous cosmic perils, of which impacts are one. Geology and paleontology were primed for uptake of fresh debate by immediately antecedent developments. Geology had passed through the anguish of the plate tectonics controversy, which raised the spectre of a catastrophe interpretation of earth history. Paleontology was eight years into its adventure with the alternative to gradualism, punctuated equilibrium. Impacts dealt the insurgents a strong card by delivering a mechanism of mass extinctions while rattling the confidence of gradualists at the very time when the advent of sociobiology strongly stimulated reassertion of the gradualist position. Exciting times.

Palmer thoroughly documents the K-T extinction dispute. At that time the geochemistry of meteorites and of impact traces was reasonably well known, but there was no candidate crater of the size and time of the hypothetical impact. Much of the debate concerned the interpretation of impact traces (iridium, shocked quartz, microtektites), whether the extinction was

more or less instantaneous or phased over as much as a million years, whether flood basalt volcanic activity was involved as an independent cause or as an activity generated by an impact, and whether climatic and ocean changes associated with tectonic activity figured in the scenario. In 1991 a candidate crater, dubbed Chicxulub, 180 km in diameter, was found off the coast of the Yucatan Peninsula. Some protagonists interpreted this finding as marking the end of the debate as to whether impacts figured significantly in extinction events. It was not an isolated finding, but yet another in a roster of about 140 impact craters dating over a period of 1.4 billion years, which in turn is nested in an increasingly sophisticated planetary science of comet and asteroid behavior that transformed the impact concept from the improbable to the expected.

Gradualists nevertheless continued to dispute the K-T boundary mass extinction by contending that the species turnover rate was inconsistent with a single event or a cluster of temporally closely associated events, but consistent with long-term climatic change associated with tectonic movement. Is it then a stand-off? Not at all. The controversy contributed significantly to understanding the complexity of extinction and radiation events and stimulated the improvement of evidence gathering and evaluation methods. On this criterion the debate was good science. In addition, the debate compelled gradualists to change their tune. In 1980, they dismissed, often derisively, impacts as causal factors in earth or evolutionary history. By 1995, even the most hard-nosed accepted impacts in principle. This admission entailed relinquishing a key gradualist premise, that extinctions result exclusively from ordinary evolutionary competition.

The import of this concession may be minimized by invoking the adage "One swallow doth not a summer make." Even if mass extinctions are acknowledged, and even if all five of the supposed mass extinctions were due in part or in whole to impacts, the gradualist position still holds for the grand tableau of evolutionary history. Palmer, as I interpret him, ever

so gently prods his readers to reject this position. The reason is — and again I am interpreting delicately phrased passages — that "revised gradualism" preserves the continuity of evolutionary thought from Darwin forward, whereas today's evidence, properly evaluated, requires recognition of a fundamental departure from that history — a departure still in the making.

The evidence falls under four headings. First, there is a new conception of the solar system. Second, the old vision of a straight march from anthropoid apes to hominids to the human genus to *Homo sapiens* has been replaced by an erratic pattern in which times and places of origins and migrations are still undecided. In particular, Chinese paleontologists excavating two fossil-rich sites are a new source of surprising evidence of the early origin of *Homo erectus* far from Africa. Third, the punctuated equilibrium pattern, even if it characterizes only a portion of evolutionary history, is a major departure from traditional gradualism that requires specific explanations for stasis and sudden bursts of change. Finally, non-linear dynamics, which made its debut in thermodynamics, may have a future in the long-sought explanation of the origin of life (to mention but one field). I shall confine my remarks to the first of these headings, partly because it bears most directly on catastrophism, and partly because few areas of science have undergone such stupendous growth in the past quarter century.

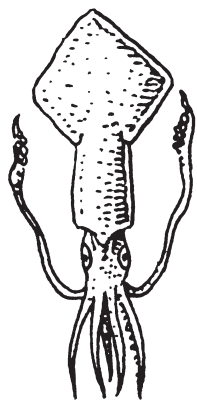
Charles Lyell's *Principles of Geology* is the sacred text for uniformitarianism; Archibald Geikie's *Founders of Geology* (1905) set the text in stone thanks to his authority as Britain's leading geologist. Palmer shows, by referencing many authors over a two-century

period, that uniformitarians stigmatized catastrophism as miraculous causality parading as objective science. This is a *pars pro toto* fallacy. The great exponent of catastrophism, Georges Cuvier, was a dust-bowl empiricist hostile to speculation. His example was followed by his influential geologist disciple, Elie de Beaumont. Palmer dwells on the now well-known criticism (first stated by Whewell) of Lyell's formulation of uniformitarianism, which confounds a sound methodological principle (actualism) with an empirical thesis that geological processes are uniform because they flow from universal laws. The effect of this blunder was to present earth history as cyclic. Lord Kelvin's deeply resented intervention brought geologists around to admitting time's arrow, but this was done as a largely unacknowledged concession that avoided an explicit re-analysis of principles.

I conclude this review by advising that it falls woefully short of conveying the complexity and quality of the author's achievement. As one who converted some time ago from the standard position to catastrophism, I leave it at noting that the conversion process, at least in my case, was not effected by mere acknowledgement that catastrophic impacts have happened and will happen. One must ponder the evidence in detail and over time, because the transition involves a profound discontinuity of thought that alters also one's own sense of self. Palmer's thorough, polemic-free volume is a worthy point of departure for those wishing to try this adventure.

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EVOLUTION RESOURCES ON-LINE

I am developing two websites which, taken together, include more than ten full-length books on the evidence for evolution and the arguments against creationism and "intelligent design". See <<http://bio.sunyorange.edu>> and <<http://oclwatches.net>>.

There are hundreds of photos and drawings and it is my hope that these websites will serve as a valuable resource for those involved in this battle. Although the key resources are in place, I am still in the process of editing these texts and producing summary versions



Letters to the Editor

13 Answers

[In *RNCSE* 2005 Jan-Apr; 25: (1-2): 54, Steve Bratteng provided a list of 13 questions that can be answered by evolution but not by "intelligent design". Now that readers have had a chance to ponder these questions, here are his suggested answers.]

As a follow-up to "13 questions for ID" in the previous issue of *RNCSE*, here are some answers that provide the basic outline of the way in which evolutionary theory addresses them. In most cases, there is considerable elaboration available, beginning with Nesse and Williams's "Evolution and the origins of disease" (*Scientific American* 1998 Nov; 279 [5]: 86-93).

1 During infections, the body locks up iron in the liver. Although this lowers levels of iron in the blood, it also deprives bacteria of iron and prevents their running wild. However, if we give iron supplements to undernourished people (who have a reduced ability to make antibodies to fight off infection), the bacteria flourish thanks to the higher blood levels of iron and the reduced immune response.

2 The first vertebrates adapted to life out of the water had inherited a structure that could exchange gases with the blood stream — the swim bladder. It was located close to the spinal column above the digestive system and, as today's lungfishes show, adaptations to life on land included opening a passageway on the top of the snout. Later, what became the lungs filled the chest cavity, and the digestive system moved back toward the tail end. So, the lungs became a ventral (belly-side) organ derived from a dorsal (back-side) organ. The air passageway, of course, followed

the migration, and crossed paths with the food passageway. While there is a mechanism to avoid choking, it fails from time to time, making the Heimlich maneuver a lifesaver.

3 Vertebrate eyes evolved from an extension of the brain, with the light-sensitive cells of the retina and the blood supply coming in from the outside. On the other hand, squids' eyes are produced by in-pocketing of the outer layer of the body. The photo-sensitive cells are on the outside and the blood and nerve supplies are behind. The difference shows two evolutionary pathways to a structurally similar result and illustrates the way that developmental and anatomical pathways taken by ancestral organisms can affect a wide array of evolutionary descendants. The tendency of the vertebrate retina to detach is a direct result of our evolutionary heritage.

4 Depression, as well as other issues in behavioral health, can be traced to variations in behavioral adaptations to a variety of environmental challenges and filtered through changes in human lifestyles as we adjust to the conditions of "civilization". Since these conditions are relatively recent in evolutionary terms, humans may lack specific responses that are effective in coping with these conditions. The same could be said for changes in diet and physical activity due to agricultural, industrial, and economic transformations; human populations have not had time to adapt evolutionarily.

5 The Europeans who emigrated to the New World had endured a long evolutionary relationship with endemic disease organisms, resulting in a small pool of susceptible individuals. This was the result of evolution in both the pathogen and the host populations. However, among indigenous people who had not been exposed, the diseases spread rapidly because of the greater likelihood that any person in contact with an infected individual was also susceptible to infection.

6 Morning sickness is most often associated with the stages of embryonic development that are most sensitive to toxins and compounds that would cause serious birth defects. The sensitivity to certain smells and tastes is a mechanism shown to prevent ingestion of substances that might contain these substances. Once a certain stage has been reached the embryo (now a fetus) is no longer as vulnerable, and morning sickness tends to go away.

7 Immunoglobulin E (IgE) seems to be involved in this story. In non-industrialized countries, where sanitation is less developed, populations tend to have a fairly high load of intestinal parasites, IgE helps combat these parasites and other pathogens. People in industrialized countries have few, if any, intestinal parasites, and live in "clean" environments, so IgE appears to respond instead to the body's own tissues.

8 Malaria is transmitted by mosquitoes, and the sicker someone is, the easier it is for mosquitoes to acquire malaria. Therefore, increased virulence enhances the survival of the parasite and the spread of the disease. Increased virulence also results in more deaths among infected individuals.

9 In our upright posture, the tissues associated with keeping the abdominal organs in the proper place fail to do this as we age. In addition, pregnancy puts particular stress on the muscles that control urinary, reproductive and digestive organs passing through the pelvic outlet. In combination, these result in a reduced ability to control bladder function.

10 Diarrhea is the body's way of getting rid of nasty organisms; suppressing it allows the organisms to hang around longer.

11 It is thought that this allele was advantageous in helping avoid tuberculosis, which apparently enters cells in the same manner as the HIV particle. This is another example in which selection for resistance to one pathogen can provide the basis for a new adaptation to another.

12 The urethra is surrounded by the prostate gland, which enlarges with age. This often leads to problems as the enlarged organ restricts the passage of urine. This is another case in which selection that puts off design failure to advanced age (see #9 above) is overtaken by other adaptations that increase the average length of life.

13 Hay fever and allergies in general seem to be the body's over-responding to essentially harmless antigens. This could be likened to having a smoke detector that goes off when you burn your toast, but then saves your life when there is a real fire.

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of these materials that might be more useful to general audiences and for resources for students in younger grades.

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DEFENDING THE TEACHING OF EVOLUTION IN THE PUBLIC SCHOOLS



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Fossil or Not?

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Evolution and
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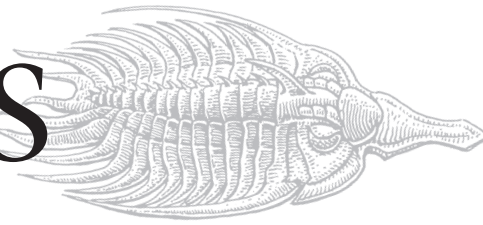
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Cover: *Edmontosaurus annectens*, photographed by AJ Petto at the University of Wisconsin, Madison, Museum of Geology

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For more information on Ray's work explore his website at <www.trollart.com>.

Anyone who has seen the remains of ancient organisms cannot help but be amazed at all the ways that life has appeared and changed in the course of the last several billion years. Perhaps nothing matches the awe that is produced by encountering the bones of giant reptiles, especially the large carnivores like *Tyrannosaurus rex*. These fossils are undeniable reminders of a world that was different in the past than it is now (we certainly are thankful for that), and so it is perhaps not surprising that anti-evolutionists invest so much energy in arguing that dinosaurs cannot be millions of years old, but only thousands. Indeed, dinosaurs figure prominently in the creationist museums of the Institute for Creation Research and Answers in Genesis.

Dinosaurs are a big draw in museums around the world, and in this issue, NCSE board member Robert "Mac" West reviews the "lay of the land" in natural history and general science museums. How well are museums seizing the opportunity to leverage the public's fascination with dinosaurs into a clear presentation of the evolutionary foundations of all our knowledge of these great reptiles? And how well do they transfer that knowledge to other exhibits and organisms? According to West, this can best be described as "an area for improvement". The record is spotty, and often the presentation tactfully avoids using the "e-word" even though all the information, conclusions, and interpretations are firmly based in evolution. Is this just a missed opportunity, or is it a careful response to public pressure?

It took less than a week after an article in *Science* by Mary Schweitzer and her colleagues on the recovery of some nonmineralized components of dinosaur bone before creationists were filling up internet venues with this "proof" that the earth must be young. Joe Skulan points out that some of the popular misunderstandings of fossilized remains may stem from the ways in which scientists write and talk about them. Regardless of the final verdict on the recovery of non-mineralized tissues from fossil remains, Skulan points out that we ought to be more careful about how we use the word "fossil" — or at least be clear on what we mean.

Another perennial argument by anti-evolutionists revolves around the Second Law of Thermodynamics. These arguments, of course, are not sound, but Steven Morris proposes a new rebuttal: he calculates how long it would take to provide enough energy from the sun to support the appearance of the current biomass of living things on the planet. Even with the radiation of much of this energy back out into space, the accumulation of the appropriate amount of ener-



gy occurs within a surprisingly short amount of time.

IN THE NEWS

It may be "over in Dover" but anti-evolutionism is not resting in other parts of the country. There was serious legislative action in Utah, as Glenn Branch reports, and bills in several

other states, which have either been defeated or failed to progress to a vote. In Wisconsin, however, a legislator introduced a bill that will define science for the public schools in a way that will implicitly exclude "intelligent design" and other forms of creationism.

RECAPITULATIONS

Every so often, something we publishes draws a powerful response. This is the case with John C Greene's reflections on the Claremont Conference (in *RNCSE* 2004 Sep/Oct; 24 [5]: 34-7). NCSE member Sheldon Gottlieb objected strongly to some of Greene's conclusions and suggestions. Greene's reply is also included.

IN PRINT

Look to our book reviews section for assessments of a variety of interesting publications. Sonya Bahar reviews a book aimed at helping a general audience grasp the connection between thermodynamics and life. Tim Berra appreciatively reviews Mark Isaak's *The Counter-Creationism Handbook*, which also includes information on thermodynamics. Apparently, this is a topic that is difficult to explain well to non-specialists, as both books have shortcomings in this area, our reviewers report. And in a detailed review essay of *Icons of Evolution*, Matt Cartmill examines the chapter on human evolution, concluding, "In the final analysis, then, Wells's book is dishonest."

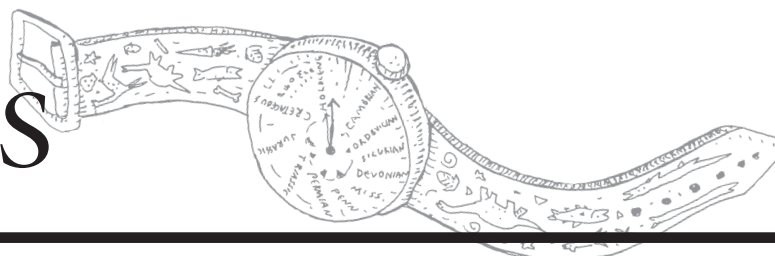
All this and more ... in this issue of *RNCSE*.

RNCSE 25 (5-6) was printed in May 2006.

ERRATA

A photograph on p 18 of *RNCSE* 2005 Jan-Apr; 25 (1-2) appeared without a caption. The picture is of NCSE's Wesley R Elsberry.

In Jason Wiles's "Is evolution Arkansas's 'hidden' curriculum?" (*RNCSE* 2005 Jan-Apr; 25 [1-2]), the reference to the age of Ordovician rocks (p 32) is incorrect: rocks from the Ordovician Period would be between 440 and 490 million years old, not 300 million years old.



On, Wisconsin?

Andrew J Petto, *University of Wisconsin, Milwaukee*

GRANTSBURG

Over the past few months, the Badger State has seen a good deal of action in the creationism/evolution arena. Grantsburg is back in the news, as Superintendent Joni Burgin and School Bboard President David Ahlquist shared with other members of the Wisconsin School Board Association what they “learned” from its recent experiences with its beleaguered policy on teaching evolution (see *RNCSE* 2004 Nov/Dec; 24 [6]: 9-11).

The final text of the board’s policy on teaching evolution read:

Students are expected to analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information. Students shall be able to explain the scientific strengths and weaknesses of evolutionary theory. This policy does not call for the teaching of creationism or intelligent design.

A report in the *Burnett County Sentinel* (2006 Feb 1) made it clear that the board considers the policy a great success and a model for other boards to follow. President Ahlquist characterized the policy this way: “Our curriculum policy asks our science department to address Darwin’s theory, but also

address the controversy, especially over macro-evolution, and teach it critically.” The article also reports that the school board has developed an implementation guide, but to date, the only document about how to implement the policy is a copy of a document reprinted without attribution from the Discovery Institute’s website.

The *Sentinel* also reported that the school board distributed 25 copies each of *Icons of Evolution* and *How to Teach the Controversy over Darwin Legally*. Citizens in Grantsburg are looking into how the board acquired those resources. Parents are poised to challenge inappropriate materials in the science classroom, but so far, none has been introduced into the life sciences classroom, despite Ahlquist’s assurance to the *Sentinel* that “Grantsburg is in the first year of teaching evolution critically.”

WEST BEND

Two parents presented the West Bend School District with an official complaint about the textbooks being used for college-prep and Advanced Placement biology classes. On February 6, 2006, the parents made a presentation to an special committee consisting of library specialists, the assistant superintendent of curriculum and instruction, the science supervisor, biology teachers, the superintendent of schools, and two members of the University of Wisconsin faculty. The parents also requested a presentation by David Menton, who billed himself as a retired cell biologist and faculty member from Washington University Medical School, but who did not mention that he was in Wisconsin on a tour sponsored in part by Answers in Genesis (<http://abide-in-truth-events.cephasministry.com/answers_in_genesis.html>).

The parents said they wanted evolution taught “critically” and presented a stack of articles from

the research literature with lots of highlighting to show how often and severely scientists themselves were critical of evolutionary theory, presumably as an indication that this information should somehow find its way into the curriculum. The materials included the usual random collection of cutting-edge research and unsettled questions. As is generally the case, however, none of the articles challenged the big picture of evolution as a history of life on earth traced through patterns of descent from common ancestry. Nor would they require any significant change in the material taught at the high school level, except to point out that some of these ideas were still under investigation. Indeed, the three texts that were being challenged included language that did indicate areas of unsettled research and unanswered questions.

Menton’s presentation was wide-ranging. His main approach in arguing that the books ought to be replaced seemed to be to point out items in the texts that he contended were erroneous. However, he made several errors in his presentation. For example, he said that a presentation on Robert Bakker’s work on the histology of dinosaur bones erred in its conclusions that the pattern demonstrated that dinosaurs were warm-blooded. However, the material in the text was an illustration of the hypothetico-deductive method of scientific investigation, which Menton dismissed with personal incredulity: “I don’t know how you could develop a hypothesis to test *that*!” Indeed, that was his response to a number of the examples in the text, which were usually making a different point than the one he was criticizing.

Menton’s main rhetorical strategy seemed to be an argument from authority. He invoked his years of teaching at Washington University



Andrew Petto is Lecturer in Anatomy and Physiology in the Department of Biological Sciences at the University of Wisconsin, Milwaukee. He is active in science education in Wisconsin and also serves as the editor of *RNCSE* and a member of the NCSE Board of Directors.

Medical School to say that he never used any aspect of evolution to do his work and neither did any of the physicians he has ever queried. In fact, he put up a slide of Dobzhansky's famous "in light of evolution" quote and declared flatly that there was absolutely no need to know any evolution in order to "do" biology. By the same token, it is probably unnecessary to know any computer science to send e-mail, but without computer science, the computer would be just a pile of electronic parts.

What the parents (and Menton) wanted was for the teachers and the school to *criticize* evolutionary theory as less robust and well-supported than its presentation in the textbooks indicates. According to science supervisor Paul DeChant, there are several opportunities in the text where the authors provide "challenge questions" that allow the students to apply a critical analysis to specific questions in evolution (and other topics) and to their answers. The committee chose not to engage the presenters in debate and not to make statements, except to answer questions of fact from the presenters about the contents of the course. The committee reached its final decision on February 20, 2006, that changes in text and curriculum were unwarranted.

LEGISLATIVE ACTION

In what seemed like a culminating event, State Representative Therese Berceau (D-Madison) ventured into the controversy by introducing a bill to support teaching evolution in public schools. She was appalled by Wisconsin's low grade for its science education standards and by moves such as the one by the Grantsburg School Board. The bill was co-sponsored by Representative Spencer Black (D-Madison) and introduced at a press conference in the morning of February 7, 2006, with the support of over a dozen faculty and research staff from the University of Wisconsin, Madison.

At the press conference, Berceau read the text of the short bill (see sidebar) that, if enacted, would limit the content of the science curriculum to testable hypotheses and natural phenomena

and would require that the state agencies and public schools use a definition of science formulated by the National Academy of Sciences. In her prepared remarks, she identified the weakening of science education as one of the main problems faced by science education in a time when the nation and the state are ever more dependent on the scientific advances that scientific research provides. She characterized the current "controversy" over evolution and scientific naturalism as "invented" and not existing within science. Finally, she pointed the irony of President Bush's recent call at the nearby 3M Company's corporate headquarters for leading the world in research and development and staying on the cutting edge of technology in light of his recent embrace of "intelligent design" and teaching "all views" in the public-school classroom. Berceau concluded by justifying the use of a statute because it would provide a legal obligation for school districts, as well as a legal remedy for aggrieved parents, to assure that only real science was taught in the science classroom.

Biochemistry professor Michael Cox cited the connection between economic well-being and scientific research. He pointed out that the concentration of scientific and biomedical research companies in Boston, San Francisco, and Madison is not accidental. Not only does good science education provide researchers for these endeavors, it also provides a well-trained work

force, bringing economic benefits to the community. Without such support for science education, he suggested, these benefits might easily migrate out of state.

Biochemistry professor Alan Attie followed Cox's lead by pointing out that inventions based on scientific research conducted at the UW Madison campus have generated a \$1.5-billion-dollar endowment for the university, over \$800 000 per year in research grants, and 100 spin-off companies. Compare this to the record for the past 200 years of "intelligent design", said Cox, and the choice is obvious. There is not one patent, not one invention, not one discovery, not even any original research articles generated by ID; it is a sterile field.

Philosopher of science Elliott Sober agreed, "If [ID] is science, then scientists can stop doing research and just proclaim that what we observe is there because an intelligent designer wanted it to be." In his remarks, he said that the bill addresses an important issue that public education faces.

Berceau's bill (AB 1143) now goes through the regular legislative process. She is hoping for a lively debate that draws attention to the real issues for science education. Prospects of the bill's passage in the heavily Republican legislature are dubious.

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SCIENCE EDUCATION BILL (AB 1143) INTRODUCED IN THE WISCONSIN LEGISLATURE

AN ACT to create 118.018 of the statutes; relating to: science instruction in public schools.

The people of the state of Wisconsin, represented in senate and assembly, do enact as follows:

SECTION 1. 118.018 of the statutes is created to read:

118.018 Science instruction.
The school board shall ensure that any material presented as science within the

school curriculum complies with all of the following:

- (1) The material is testable as a scientific hypothesis and describes only natural processes.
- (2) The material is consistent with any description or definition of science adopted by the National Academy of Sciences.

Anti-Evolution Legislation in Utah

Glenn Branch
NCSE Deputy Director

Senate Bill 96, sponsored by Senator Chris Butters (R-District 10), was filed in the Utah Senate on January 4, 2006. As introduced, SB 96 would have, if enacted, directed the Utah State Board of Education to require “that instruction to students on any theory regarding the origins of life, or the origins or present state of the human race, shall stress that not all scientists agree on which theory is correct” and to “ensure that all policies and positions of the State Board of Education relating to theories regarding the origins of life or the origins or present state of the human race: (i) do not endorse a particular theory; and (ii) stress that not all scientists agree on which theory is correct.”

As previously reported in *RNCSE* (2005 May-Aug; 25 [3-4]: 8-11), SB 96 is the culmination of about six months’ worth of public anti-evolution statements by Butters, begin-

ning with his announcement of plans to introduce legislation calling for the teaching of “divine design” — “Divine design,” he told the *Salt Lake Tribune* (2005 Jun 3), “doesn’t preach religion ... The only people who will be upset about this are atheists.” Perhaps in reaction, the Utah state Board of Education unanimously adopted a position statement on September 2, 2005, that described evolution as “a major unifying concept in science and appropriately included in Utah’s K-12 Science Core Curriculum”; the policy statement presumably would have been rescinded if SB 96 had been enacted.

SB 96 was approved by the Senate Education Committee by a 4-2 vote along party lines on January 17, 2006. According to the *Salt Lake Tribune* (2006 Jan 18), Butters defended the bill during the committee hearing by saying, “There is no consensus on the origins of life or how man became as he is today ... ‘All the bill states is ‘Don’t overstate what you know.’” The extent of Butters’s own knowledge is suggested by his description, also reported in the *Tribune*, of the absence of transitional forms: “There is evolution within species

... There are big dogs and little dogs, big cats and little cats, but you haven’t seen a ‘dat.’ You don’t see intermediate species.” Brett Moulding, the state’s core curriculum director, reportedly cited the well-documented bird-reptile transition by way of counterexample.

SB 96’s supporters on the committee insisted that, despite Butters’s prior statements about his intent in introducing such legislation, the bill was not intended to promote a particular religious view and would not “force any other theory to be introduced,” according to a detailed account of the committee hearing that appeared in the *Tooele Transcript-Bulletin* (2006 Jan 19). Brett Moulding noted that if so, the bill was unnecessary, since “the core curriculum understands that science conclusions are tentative and therefore never final ... They’re always subject to revision with new evidence.” But if the bill were to require the presentation of a scientifically credible alternative to evolution, he said, “I cannot think of one.”

The editorial reaction of the *Salt Lake Tribune* (2006 Jan 18) to the vote was unsparing. Referring to Butters’s discussion of evolution, the editorial commented, “every

THE ACLU OF UTAH ON SB 96

[The following letter was dated January 19, 2006, and is reprinted by permission.]

Dear Senator,

I write on behalf of the American Civil Liberties Union of Utah to express our concerns regarding the constitutionality of Senate Bill 96 “Public Education — Instruction and Policy Relating to the Origins of Life,” and to urge you to vote against the bill.

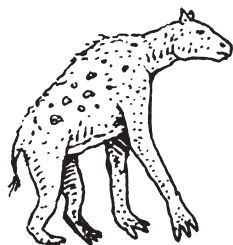
SB 96 is the latest in a series of anti-evolution statutes and policies that have attempted to forbid, limit, or otherwise undermine the teaching of the scientific theory of evolution in public schools. Challenges to evolution have included laws or policies that prohibit the teaching of evolution; that require the presentation of anti-evolutionary views, including religious views not based on scientific evidence, such as creationism or intelligent design; and that, like SB 96, require statements or disclaimers questioning the validity of the scientific theory of evolution.

Courts have reviewed all of the above strategies and consistently ruled against them. Attached is an excellent summary of four major court decisions regarding the constitutionality of anti-evolution statutes and policies, which was prepared by the National Center for Science Education. All of the laws or policies in question were found to violate the Establishment Clause of the First Amendment of the United States Constitution, because they all had the purpose of furthering a religious doctrine or protecting that doctrine from a seemingly competing theory.

The two most recent cases regarding the teaching of evolution are not included in the attached list, and they deserve special attention because of their relevance to SB 96. The first is *Selman v Cobb County School District*. In January 2005, a federal court ordered a Georgia

school district to remove stickers from school science textbooks that warned that evolution is “a theory, not a fact,” because those stickers were an unconstitutional government intrusion on religious liberty. *Selman* is currently on appeal. The second case, decided just last month, is *Kitzmiller v Dover Area School District*. In that case, a federal court found that a Dover, Pennsylvania school district policy requiring that high school science teachers read a statement questioning the scientific theory of evolution and presenting “intelligent design” as an alternative was an unconstitutional endorsement of religion.

Both the *Selman* and *Kitzmiller* courts noted the sectarian motivation behind the school districts’ selection of one, and only one, scientific area for particular scrutiny. In both cases, district officials ignored areas of science where there is more controversy than evolution, and instead chose the one scientific theory that has long been a target of



time the West Jordan Republican opens his mouth to address the subject, he removes all doubt about the fact that he has absolutely no idea what he's talking about," adding, "Senate Bill 96 would probably be the first article, section or clause in our state statute book that is a downright lie." Noting that Governor Jon Huntsman Jr (R) hopes to improve science and mathematics education in the state, the editorial concluded by suggesting that "[t]he governor should have his veto pen at the ready for this one."

Meanwhile, the ACLU of Utah was not idle, sending a letter (see p 6) to members of the state senate urging that they vote against SB 96. The letter cited applicable case law, including *Selman v Cobb County* and *Kitzmiller v Dover*; in both of these recent cases, the letter explained, the court "noted the sectarian motivation behind the school districts' selection of one, and only one, scientific area for particular scrutiny," just as in SB 96. Concluding, the ACLU of Utah urged the Senate to "take note of the current legal landscape regarding the constitutionality of statutes and policies like SB 96, and ... not [to] risk an

expensive and unnecessary lawsuit by passing the bill."

Similarly, in a letter dated January 19, 2006, Americans United for Separation of Church and State urged Utah senators to oppose SB 96. American United's letter argues, "Although SB 96 does not mention 'intelligent design' or creationism by name, there is no doubt that the bill ... comes out of religiously motivated opposition to the scientific theory of evolution," adding, "we have no doubt that if this statute were challenged, it would be found unconstitutional." The letter concludes, "Undermining evolution is not only detrimental to the science education of our children, but is also unconstitutional. We urge you to vote against SB 96, and to support science education and religious liberty."

A story in the *Deseret Morning News* (2006 Jan 19) provided useful background on the variety of religious attitudes toward evolution, especially within the Mormon church, to which a majority of Utahns belong. Highlighted was *Mormonism and Evolution: The Authoritative LDS Statements* (Draper [UT]: Greg Kofford Books, 2005), a compilation of statements

issued or sanctioned by the First Presidency of the Church of Jesus Christ of Latter-Day Saints from 1909 to 2004, edited by two Utah science professors, William E Evenson and Duane E Jeffery. Jeffery told the *Morning News*, "There has been a belief, for years and years and years, that Mormonism and evolution are diametrically opposed," a belief that the book seeks to dispel.

Jeffery, a professor of biology at Brigham Young University and a member of NCSE's board of directors, helped to coordinate the efforts to educate elected officials and the public at large about the scientific standing of evolution, as well as to support those in the state's educational organizations, such as Brett Moulding, who opposed the bill. The controversy, unprecedented in Utah, also provoked scientists to act. For example, Greg Clark, a professor of bioengineering at the University of Utah, told *Stanford Medicine* (2006 Summer; 26 [2]), "[T]his was an attack on science itself ... As a scientist, educator and the father of a middle-schooler, I felt a moral obligation to speak out" — which he did, testifying before the state board of education and the Utah Senate.



religiously-motivated hostility. SB 96 suffers from this same defect.

Additionally, by singling out evolution for particular scrutiny and by playing on the common, non-scientific understanding of the term "theory," the courts found that the district policies misled students about the scientific support for evolutionary theory and the workings of the scientific method. It is likely that a court would similarly find that SB 96 unconstitutionally interferes with scientific instruction for ideological, rather than scientific, reasons.

Often, disclaimer policies require or suggest the teaching of non-scientific religious theories, such as "intelligent design" or creationism, and SB 96 may also be read to require the teaching of similar alternative theories regarding the origins of life. But even if the bill does not have this requirement, that does not save it from Establishment Clause problems. The unconstitutional sticker that the Cobb County School District was required to remove

from science textbooks contained a statement much like SB 96. It stated:

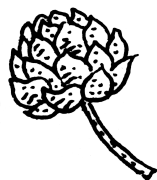
This textbook contains material on evolution. Evolution is a theory, not a fact, regarding the origin of living things. This material should be approached with an open mind, studied carefully, and critically considered.

Similarly, SB 96 encourages students to "critically analyze theories," to "consider opposing viewpoints," and to "form their own opinions." It is important to note that neither SB 96 nor the Cobb County sticker mention alternative theories. In its decision, the *Selman* court noted:

Defendants persuasively argue that the Sticker in this case does not explicitly reference any alternative theory of origin, religious or otherwise. Nor does the Sticker explicitly urge students to consider alternative theories of origin or remind them that they have

the right to maintain their home teachings regarding the origin of life. Nevertheless, the Sticker here disavows the endorsement of evolution, a scientific theory, and contains an implicit religious message ... which is discernible after one considers the historical context of the statement that evolution is a theory but not a fact.

Americans have the right to believe, practice, and profess their religious beliefs in the public square, and the ACLU defends those rights. However, the government should not accommodate those religious beliefs by misleading public school students about the scientific basis for evolutionary theory. We sincerely hope the Utah State Senate will take note of the current legal landscape regarding the constitutionality of statutes and policies like SB 96, and will not risk an expensive and unnecessary lawsuit by passing the bill.



Despite the outpouring of concern about SB 96, the bill was passed by the Senate on January 23, 2006, by a 16-12 vote. The version of the bill that was passed would have directed the Utah State Board of Education to require “that *if* instruction is *given* to students on any theory regarding the origins of life, or the origins or present state of the human race, *then that instruction* shall stress that not all scientists agree on which theory is correct” and to “ensure that all policies and positions of the State Board of Education relating to theories regarding the origins of life or the origins or present state of the human race: (i) do not endorse a particular theory; and (ii) stress that not all scientists agree on which *scientific* theory is correct.” (The emphasized phrases were added by a floor amendment during the Senate’s debate.) The bill was subsequently introduced in the House of Representatives on January 24 and referred to its Committee on Education on January 31.

The *Salt Lake Tribune* (2006 Jan 21) reported that despite Buttars’s attempts to eliminate SB 96’s allowing religious advocacy in the classroom, “religion is the reason he proposed the bill and religion drove most of the debate,” adding, “Comments on the Senate floor commending God’s creation of man and condemning atheists for pushing their ‘religion,’ could potentially end up as evidence in court should the bill become law.” Senate Majority Leader Peter Knudson (R-District 17) reportedly objected to comments by Buttars that opposition to the bill is driven by “secularists and atheists” and explained that it is possible for religious people to accept evolution. “I will tell you that is not the spirit by which we should be debating this legislation,” Knudson said.

In its January 24, 2006, editorial “Not fit to survive: A bad bill was made even worse,” the *Salt Lake Tribune* objected especially to the addition of “scientific” in the bill, writing, “By adding the word ‘scientific’ at critical points, the bill stopped saying that there were other ideas about the origins and development of life on earth and started saying that there were other ‘scientific’ ways of explaining those

things. There are not. There are religious, philosophical and mythical alternatives to evolution, none of them in conflict with scientific thinking unless someone is stubborn enough to demand a fight to the death where none need exist.” And the *Provo Daily Herald* (2006 Jan 24) commented, “Buttars and his Senate colleagues want to push creationism into the public school curriculum. In truth, this is an attempt to insert a state-endorsed brand of religion into secular life.”

The bill was in the national spotlight thanks to a story published in *The New York Times* (2006 Feb 5). Kirk Johnson reported that although in Utah, “about 90 percent of the elected officials are members of the Church of Jesus Christ of Latter-day Saints. Prayers are commonplace, and lawmakers speak of their relationship with God in ordinary conversation,” support for the bill was questionable. “Some leaders in both parties” — including the Senate majority leader and the majority and minority whips in the House — “have announced their opposition to the bill,” Johnson wrote, “and most lawmakers say that with less than a month left in the legislative session, its fate remains a tossup.”

A commendable feature of Johnson’s story was its insistence on reporting the scientific consensus properly. After quoting Buttars as saying, “I got tired of people calling me and saying, ‘Why is my kid coming home from high school and saying his biology teacher told him he evolved from a chimpanzee?’” Johnson noted, “Evolutionary theory does not say that humans evolved from chimpanzees or from any existing species, but rather that common ancestors gave rise to multiple species and that natural selection — in which the creatures best adapted to an environment pass their genes to the next generation — was the means by which divergence occurred over time. All modern biology is based on the theory, and within the scientific community, at least, there is no controversy about it.”

Part of the reason for the resistance to SB 96, Johnson speculated, is due to the distinctive nature of Mormon theology: “Mormonism, with its emphasis that all beings can

progress toward higher planes of existence, before and after death, has an almost built-in receptivity toward evolutionary thought that other religions might lack.” Also relevant, according to Kirk Jowers, a professor of political science at the University of Utah, is the minority status of Mormonism in the nation. In the case of school prayer, he told the *Times*, there was “kind of a realization that if you push to have prayer in school, then outside of Utah, the prayer would not typically be a Mormon’s prayer, so is that road you want [to] go down?”

Meanwhile, in the House Committee on Education, SB 96 was undergoing further revision. In particular, the directive to the state board of education to emphasize the disagreement among scientists with regard to “any theory regarding the origins of life, or the origins and present state of the human race” was replaced with a directive to “stress that no scientific theory, hypothesis, or instruction regarding the origins of life or the origins of species has been indisputably proven.” The new revision of the bill was narrowly passed by the committee on February 8, 2006, and returned to the House.

In the House, however, the bill was promptly gutted. On February 27, 2006, Representative Stephen Urquhart (R-District 75) amended the bill’s text, leaving only “The State Board of Education shall establish curriculum requirements related to scientific instruction.” The gutted bill was then defeated “to stop the Senate from having the ability to revive the issue,” or so the *Salt Lake Tribune* (2006 Feb 27) explained. Buttars told the *Tribune* that it was “doubtful” that he would propose a similar bill in the future. Joe Conn of Americans United for Separation for Church and State rejoiced, telling *The New York Times* (2006 Feb 28), “If the creationists can’t win in a state as conservative as Utah, they’ve got an uphill battle.” And the *Salt Lake City Weekly* (2006 Mar 2) quipped, “We’re not in Kansas anymore. At least not this year.”

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UPDATES

Alabama: On January 10, 2005, two identical bills — House Bill 106 and Senate Bill 45 — were introduced in the Alabama legislature, under the rubric of “The Academic Freedom Act,” and referred to the Committees on Education of their respective chambers. These identical bills purport to protect the right of teachers to “present scientific information pertaining to the full range of scientific views in any curricula or course of learning” and the right of students not to be “penalized in any way because he or she may subscribe to a particular position on any views.” In language reminiscent of the so-called Santorum Amendment removed from the No Child Left Behind Act, they specify that “[t]he rights and privileges contained in this act apply when topics are taught that may generate controversy, such as biological or chemical origins.” Presumably attempting to avert the charge that their provisions would violate the Establishment Clause of the First Amendment, the bills also provide, “[N]othing in this act shall be construed as promoting any religious doctrine, promoting discrimination for or against a particular set of religious beliefs, or promoting discrimination for or against religion or non-religion.”

HB 106 and SB 45 closely resemble previous anti-evolution bills — three bills introduced in 2005 (HB 352, SB 240, and HB 716) and two bills introduced in 2004 (HB 391 and SB 336) — all of which failed. SB 45’s sponsor, Senator Wendell Mitchell (D-District 30), was a cosponsor of SB 240 and SB 336, of which he reportedly said, “I think there is a tremendous imbalance in the classroom when you can’t discuss all viewpoints. This bill will level the playing field because it allows a teacher to bring forward the biblical creation story of humankind” (*Montgomery Advertiser*, 2004 Feb 18). HB 106’s sponsor, Representative Scott Beason (R-District 51), was the sole sponsor of HB 716. New to HB 106 and SB 45 is section 7:

Nothing in this act shall be construed as protecting as scientific any view that lacks published empirical or observational support or that has been soundly refuted by empirical or observational science in published scientific debate. Likewise, the protection provided by this act shall not be restricted by any metaphysical or religious implications of a view, so long as the views are defensible from and justified by empirical science and observation of the natural world.

Indiana: Anti-evolution legislation materialized in Indiana, but not in the form originally threatened by its sponsor (see *RNCSE* 2005 May-Aug; 25 [3-4]: 15-7). According to the *Indianapolis Star* (2006 Jan 11), Representative Bruce A. Borders (R-Jasonville) introduced House Bill 1388 in the Indiana House of Representatives on January 10, 2006. Although Borders was quoted in the *Star* (2005 Nov 2) as describing himself as “passionate” about “intelligent design” and declaring his intention to submit a bill making it a required subject in Indiana’s public schools, HB 1388, if enacted, would only mandate that “[i]n adopting textbooks for each subject ... the state board shall not adopt a textbook if the state board knows the textbook contains information, descriptions, conclusions, or pictures that are false.”

The target of the bill is clearly the treatment of evolution in textbooks; Borders was quoted by the *Star* as saying, “Many of the things that have been used to support macroevolution have been proven to be lies. ... It will take those out.” Borders also acknowledged to the *Star* that his change in strategy was due to the December 2005 decision in *Kitzmiller v. Dover*, which held that it is unconstitutional to teach “intelligent design” in the public schools.” NCSE Deputy Director Glenn Branch commented that the fallback strategy of deprecating evolution “is

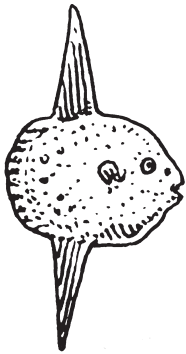
increasingly going to dominate the creationism–evolution landscape” following the *Kitzmiller* decision.

Fran Quigley of the Indiana Civil Liberties Union told the *Star*, “I can’t imagine that the state board [of education] needs to be told by the General Assembly not to give false information to our schoolchildren.” Obviously aware of Borders’s purpose in introducing HB 1388, however, he added, “If this is an effort to run evolution out of the science curriculum, it fails to account for the fact that the scientific theory of evolution has been corroborated by hundreds of thousands of independent observations ... No persuasive evidence has been put forth in 150 years to contradict the theory of evolution.” House Speaker Brian C. Bosma (R-Indianapolis), who was previously enthusiastic about “intelligent design” legislation, downplayed the legislature’s current interest, and Representative Jerry Denbo (D-French Lick), who drafted a bill of his own that would allow teaching “intelligent design”, decided not to introduce it: “There’s no hope,” he told the *Star*.

Michigan: House Bill 5606 was introduced in the Michigan House of Representatives on January 24, 2006, and referred to the Committee on Education, chaired by the bill’s primary sponsor, Brian Palmer (R-District 36). If enacted, HB 5606 would amend the state’s school code in a number of ways, including requiring the Michigan Department of Education to adopt course content expectations for science that “include using the scientific method to critically evaluate scientific theories and using relevant scientific data to assess the validity of those theories and formulate arguments for and against those theories.”

Although evolution is not mentioned in HB 5606, its language about using “the scientific method to critically evaluate scientific theories” and using “relevant scientific data to assess the validity of those theories and to formulate arguments for or against those theories”





is taken verbatim from HB 5251, which specifically targets “the theories of global warming and evolution” (see *RNCSE* 2005 May-Aug; 25 [3-4]: 8-11). Palmer was a cosponsor of HB 5251, as well as of 2003’s HB 4946, which would have amended the state science standards to refer to “the theory that life is the result of the purposeful, intelligent design of a Creator.”

Palmer was reported by the *Detroit Free Press* (2006 Jan 28) as disclaiming any intention to raise the issue of “intelligent design”: “I think some people like to see a bogeyman,” he said. But the primary sponsor of HB 5251, Representative John Moolenaar, regarded it as relevant; the *Free Press* reported that in his view, “Palmer’s [bill] does not require the teaching of intelligent design, but ... such a decision would be up to local school boards. He said Darwin’s theory of evolution is under legitimate scrutiny, and that science students should know about the theory’s possible weaknesses.”

The Michigan educational community was reportedly unhappy with the bill. Margaret Trimer Hartley, spokeswoman for the Michigan Education Association, the state’s largest teacher’s union, told the *Free Press*, “We don’t need to further complicate the process by bringing in the argument of intelligent design or any other battle over specific curriculum.” Kathleen Booher, the executive director of the Tri-County Alliance, representing school districts in three counties, objected to the legislative attempt to micromanage curriculum: “They’re stepping out of their expertise when they’re doing that,” Booher said.

Minnesota, Minnetonka: A proposal to revise the Minnetonka school district’s guidelines regarding evolution failed on December 15, 2005. (Minnetonka is a suburb of Minneapolis, with a population of about 50 000 people.) “Intelligent design” was a hot topic during the last election for school board, according to the *Minneapolis Star Tribune* (2005 Dec 6). The chief voice for “intelligent design” on the board was Dave Eaton, who was involved in efforts to undermine the teaching

of evolution in the Minnesota state science standards (see *RNCSE* 2004 Mar/Apr; 24 [2]: 14-7 and 2003 May-Aug; 23 [3-4]: 5-10) and who visited Grantsburg, Wisconsin, in November 2004 to lobby the school board there (see *RNCSE* 2004 Nov/Dec; 24 [6]: 9-11, 11-2).

According to the *Star Tribune*, “Eaton said the existing Minnetonka guidelines regarding evolution contain ‘careful word-smithing’ to create the impression that evolution has been established as fact. He said the district’s science curriculum must get away from dogmatically teaching the theory as fact.” Among the guidelines to which he took objection was “Students will understand that the great diversity of organisms is the result of more than 3.5 billion years of evolution that has filled every available niche with life forms.” Eaton sought to revise the guideline to remove the suggestion that the diversity of life is indeed due to evolution.

At the December 15 meeting of the board, according to the *Star Tribune* (2005 Dec 16), Eaton explained that the guideline “goes too far” and claimed that the new state science standards require that students learn that evolution is “a theory, not a fact.” Nevertheless, his proposal to revise the guideline was rejected by a 4-2 vote; Bill Wenmark joined Eaton.

TonkaFocus, a local group concerned with education in the Minnetonka public schools, was credited with warning the board that adopting Eaton’s proposal might result in a lawsuit; information on the controversy in Minnetonka is available on the TonkaFocus website <<http://www.tonkafocus.org/>>.

Mississippi: Two anti-evolution bills were introduced in the Mississippi legislature in January 2005. Senate Bill 2427, introduced in the Mississippi Senate and referred to the Committee on Education on January 10, 2005, would have, if enacted, ensured that “[n]o local school board, school superintendent or school principal shall prohibit a public school classroom teacher from discussing and answering questions from individual students on the

issue of flaws or problems which may exist in Charles Darwin’s Theory of Evolution and the existence of other theories of evolution, including, but not limited to, the Intelligent Design explanation of the origin of life.” The chief sponsor of SB 2427 was Senator Charles Edwin Ross (R-District 20). Co-sponsors were Senators Patrick Alan Nunnelee (R-District 6) and William Gardner Hewes III (R-District 49). SB 2427 died in committee on February 28, 2006.

House Bill 953, introduced in the Mississippi House of Representatives and referred to the Committee on Education on January 16, 2005, would have, if enacted, enabled Mississippi school boards “[t]o authorize the teaching of ‘creationism’ or ‘intelligent design’ in the public schools.” Moreover, “[i]f the school’s curriculum requires the teaching of evolution, then the teaching of ‘creationism’ or ‘intelligent design’ shall be required.” The chief sponsor of HB 953 was Representative Mike Lott (R-District 104); the cosponsors were Representatives Virginia Carlton (R-District 100), John L. Moore (R-District 60), Gary V. Staples (R-District 88), and Carmel Wells-Smith (R-District 111). Wells-Smith introduced anti-evolution legislation in previous legislative sessions: HB 888 and 1101 in 2002, HB 1397 in 2003, and HB 1288 in 2004. HB 953 died in committee on January 31, 2006.

Missouri: House Bill 1266 was introduced in the Missouri House of Representatives on January 9, 2006. Dubbed the Missouri Science Education Act, HB 1266 would, if enacted, require public school science teachers in grades 6 through 12 to comply with a list of “best practices” in order “to support the truthful identity of scientific information and minimize misrepresentation while promoting clarity, accuracy, and student understanding” and “to support the objective teaching of scientific information and minimize dogmatism while promoting student inquiry, healthy skepticism, and understanding.” The only topic explicitly identified as in need of such revisions is evolution; the bill provides that “If a theory or hypothesis of biological origins is

taught, a critical analysis of such theory or hypothesis shall be taught in a substantive amount.” The sponsor of HB 1266 is Representative Robert Wayne Cooper (R-District 155), who in 2003 introduced two bills calling for “intelligent design” to be taught in the Missouri public schools. HB 911 would have required that “[i]f scientific theory concerning biological origin is taught, biological evolution and biological intelligent design shall be taught and given equal treatment”; it also contained a provision that would have terminated the employment of teachers and administrators who failed to accord with the bill’s dictates. HB 1722 would also have required “the equal treatment of science instruction regarding evolution and intelligent design”. Both of these previous bills died in May 2004, when the legislative session ended.

New Jersey, Princeton: Delivering the George Romanes lecture at Oxford University on December 1, 2005, Shirley Tilghman, the president of Princeton University, discussed “intelligent design” as a case study “of the dangers that arise when science, politics and religion find themselves at cross-purposes on issues of importance to the future.” A distinguished molecular biologist and a member of the National Academy of Sciences, Tilghman observed, “It is virtually impossible to conduct biological research and not be struck by the power of Darwin’s theory of natural selection to shed light on the problem at hand. Time and again in the course of my career, I have encountered a mysterious finding that was explained by viewing it through the lens of evolutionary biology.” Yet, she added, “under the banner of ‘intelligent design,’ Christian fundamentalists in the United States have launched a well-publicized assault on the theory of evolution.”

After reviewing and criticizing the central claims of “intelligent design”, she said, “There is considerable disagreement within the scientific community regarding the best way to respond to this assault on evolution. One view is to dismiss or trivialize it by pointing out,

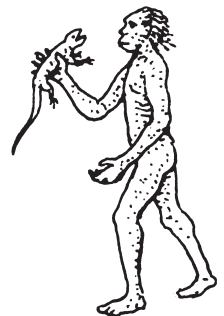
for example, that everything we know about the human knee would suggest that no intelligent being could possibly have designed it. Another faction argues that the scientific community should ignore the opponents of evolution, for by engaging in the public debate over creationism, one inevitably lends credence to its premises.” “The third strategy,” she continued, “is to enter the public debate on the side of science and evolution, and to do so firmly but respectfully.” She expressed her preference for the third strategy, citing Brown University biologist (and NCSE Supporter) Kenneth R Miller as one of its practitioners.

Her lecture, entitled “Strange bedfellows: Science, politics and religion,” is available on-line at <<http://www.princeton.edu/president/speeches/20051201/index.xml>>. Tilghman is not the only university president publicly to criticize creationism recently: Timothy P White of the University of Idaho (see *RNCSE* 2005 Jan-Apr; 25 [1-2]: 15-7) and Hunter R Rawlings III of Cornell University (see below) have also done so.

New York, Ithaca: Hunter R Rawlings III, the interim president of Cornell University, devoted the bulk of his State of the University speech to addressing “the challenge to science posed by religiously-based opposition to evolution, described, in its current form, as ‘intelligent design.’” In his speech (delivered on October 21, 2005; available on-line at <http://www.cornell.edu/president/announcement_2005_1021.cfm>), Rawling accurately and incisively reviewed a number of historical and current controversies over evolution education, calling on universities like Cornell to become engaged: “With a breadth of expertise that embraces the humanities and the social sciences as well as science and technology, we need to be engaging issues like evolution and ‘intelligent design’ both *internally*, in the classroom, in the residential houses, and in campus-wide debates, and also *externally* by making our voices heard in the spheres of public policy and politics” (emphasis in original). His

speech was greeted with a standing ovation, according to the *Cornell University Chronicle* (2005 Oct 21), and received wide press coverage, including in *The New York Times* (2005 Oct 22). Rawlings, a classicist, served as president of Cornell from 1995 to 2003, and is now serving again while a replacement for his successor, Jeffrey S Lehman, is sought. (Interestingly, Lehman was also involved with the creationism/evolution controversy: as a lawyer with Caplin & Drysdale, he prepared a friend-of-the-court brief in *Edwards v Aguillard* on behalf of 72 Nobel laureates and 17 state academies of science.) Rawlings is not the only university president publicly to criticize creationism recently: Timothy P White of the University of Idaho (see *RNCSE* 2005 Jan-Apr; 25 [1-2]: 15-7) and Shirley Tilghman of Princeton University (see above) have as well.

North Dakota: Debate over “intelligent design” is unwelcome in North Dakota — at least in the high school debate competitions. According to *The Forum* of Fargo, North Dakota (2005 Dec 28), the North Dakota High School Activities Association decided that the topic of whether “intelligent design” ought to be taught in the public schools, recommended by the National Forensic League as a debate topic for January 2006, was too controversial. Robert Hetler of the NDHSAA explained, “We’re doing this because we don’t want to exclude any students from public forum debate at state,” adding, “Some schools were afraid parents wouldn’t allow their kids to do this one.” The executive secretary of the National Forensic League took the decision in stride, commenting, “It’s up to the states to determine what’s in the best interest of their students.” Hetler told the *Forum* that about five of the fifteen high schools in the state with debate teams expressed concerns about the topic; a number of debate coaches were quoted in the article, expressing various opinions of the NDHSAA’s decision. North Dakota’s debaters will use the recommended debate topic for February instead. A subsequent editorial in *The Forum* (2005 Dec



30) decried the NDHSAA's decision as "a mushy heap of political correctness" and commented that as a debate topic, "intelligent design" "has it all: powerful conflicting ideas, political implications, religious elements and articulate advocates on both sides." The editorial also acknowledged that "[t]he majority of scientists and most public school districts reject intelligent design as science."

Oklahoma: No fewer than three anti-evolution bills were introduced in the Oklahoma legislature before the legislative session began on February 6, 2006.

First, House Bill 2107, dubbed the Academic Freedom Act, which if enacted would provide:

A. Every public school teacher in the State of Oklahoma shall have the affirmative right and freedom to present scientific information pertaining to the full range of scientific views in any curricula or course of learning.

B. No public school teacher in the State of Oklahoma shall be terminated, disciplined, or otherwise discriminated against for presenting scientific information pertaining to the full range of scientific views in any curricula or course of learning.

C. Students may be evaluated based upon their understanding of course materials, but no student, in any public school shall be penalized in any way because the student may subscribe to a particular position on scientific views.

D. The rights and privileges contained in the Academic Freedom Act apply when topics are taught that may generate controversy, such as biological or chemical origins of life. Nothing in this act shall be construed as requiring or encouraging any change in the state curriculum standards for public schools.

E. Nothing in this act shall be

construed as promoting any religious doctrine, promoting discrimination for or against a particular set of religious beliefs, or promoting discrimination for or against religion or nonreligion.

The reference in (D) to "biological or chemical origins of life" is a clear indication that the bill is aimed specifically at evolution, as is the legislative finding that "existing law does not expressly protect the right of teachers identified by the United States Supreme Court in *Edwards v Aguillard* to present scientific critiques of prevailing scientific theories." HB 2107 was introduced by Representative Sally Kern (R-District 55).

The second, House Bill 2526, would, if enacted, authorize school districts to include "intelligent design" in "any public school instruction concerning the theories of the origin of man and the earth which includes the theory commonly known as evolution." Teachers would be allowed to "use supporting evidence deemed necessary for instruction on the theory of intelligent design," subject to the approval of their school districts, but not to "stress any particular denominational, sectarian, or religious doctrine or belief." HB 2526 is evidently modeled on Pennsylvania's HB 1007, introduced in the House of Representatives there on March 16, 2005. The most significant difference is that HB 1007 contains a provision stating that its dictates "shall not be construed as being adverse to any decision which has been rendered by an appellate court," while there is no such provision in HB 2526. The sponsor of the bill is Representative Abe Deutschendorf (D-District 62), who was listed in 2000 as the coauthor of a House version of a Senate bill, SB 1139, which would have required the state textbook committee to "ensure that the textbooks include acknowledgment that human life was created by one God of the Universe." His bill unanimously passed in the House, but was never enacted.

Third, Senate Bill 1959, introduced by Senator Daisy Lawler (D-District 24), if enacted would provide:

A. Every teacher in a public school in this state shall be authorized to present information and allow classroom discussions that provide for views that may pertain to the full range of scientific views in any science course.

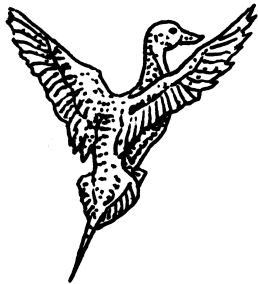
B. No public school teacher in this state shall be terminated, disciplined, or otherwise discriminated against for presenting scientific information authorized pursuant to subsection A of this section.

C. Nothing in this act shall be construed as requiring or encouraging any change in the state curriculum standards for public schools.

D. Nothing in this act shall be construed as promoting any religious doctrine, promoting discrimination for or against a particular set of religious beliefs, or promoting discrimination for or against religion or nonreligion.

While evolution is not mentioned in the text of SB 1959, the phrase "the full range of scientific views" presumably originates in the so-called Santorum language removed from the No Child Left Behind Act. Moreover, Sections A and B resemble sections A and B of HB 2107, section C is identical to the second half of section D of HB 2107, and section D is identical to section E of HB 2107. Unlike HB 2107, however, SB 1959 is silent about "academic freedom," *Edwards v Aguillard*, and "topics ... that may generate controversy, such as biological or chemical origins of life."

Texas: As the extended controversy over biology textbook adoption in Texas came to a conclusion in the fall of 2003 (see *RNCSE* 2003 Sep-Dec; 23 [5-6]: 4-7), a different textbook controversy was brewing. On October 30, 2003, Trial Lawyers for Public Justice filed suit against five past and present members of the Texas State Board of Education for rejecting Daniel D Chiras's text-



book *Environmental Science: Creating a Sustainable Future*, 6th ed. (Sudbury [MA]: Jones and Barlett, 2001). Although the textbook was recommended by the commissioner of education and passed by the official review panel, the board voted to reject it after two Texas conservative policy organizations attacked it as anti-Christian, anti-free-enterprise, and anti-American (see *RNCSE* 2004 Jan/Feb; 24 [1]: 10–15). In its brief (available on-line at <http://www.tlpj.org/briefs/TLPJ_DC;64359;1.pdf>), TLPJ argued that the board's actions thus infringed the First Amendment rights of both Chiras and of Texas students by "limiting the author's expression and by denying access to that expression on the basis of the content and viewpoint of the author's speech."

On July 23, 2004, Barbara MG Lynn, a US district judge in the Northern District of Texas, granted the defendants' motion to dismiss. Even if the plaintiffs were correct in alleging that the textbook was rejected because the defendant board members "disagreed with Chiras's conclusion that the root cause of environmental problems is economic growth, because the oil and gas industry's position was not adequately presented, and because the textbook did not accurately reflect the traditional, conservative values of most Texans," Lynn reasoned, "these alleged motives ... may constitute 'legitimate pedagogical concerns' even though they are viewpoint-discriminatory." Referring to the Texas Education Code, she concluded that they were indeed legitimate pedagogical concerns. (The decision is available on-line at TLPJ's website: <<http://www.tlpj.org/briefs/dismissal%20order.pdf>>.)

TLPJ subsequently appealed the decision to the Fifth Circuit Court of Appeals, but to no avail. On December 12, 2005, a three-judge panel upheld the lower court's decision, although on different grounds. The ruling summarized: "First, the selection of textbooks by the state for use in public school classrooms is government speech, and is not subject to the forum analysis of *Hazelwood* or the viewpoint neutrality require-

ment. As a result, there is no forum to which Appellant Chiras can claim a right of access. Second, even assuming that public school students possess a cognizable right to receive information, that right does not extend to the selection of textbooks for use in the classroom." (The ruling is available on-line at <<http://www.ca5.uscourts.gov/opinions/pub/04/04-10998-CV0.wpd.pdf>>.) Co-counsel Adele Kimmel of the TLPJ told the Student Press Law Center, "We are, of course, disappointed by the Court's ruling, and we are considering whether to petition the US Supreme Court for review" (2005 Dec 15; available on-line at <<http://www.splc.org/newsflash.asp?id=1151>>).

United Kingdom: Lord May of Oxford, the president of the Royal Society of London, criticized "intelligent design" — which he described as a "disguised variant" of creationism — in the course of his fifth and final anniversary address to the Society on November 30, 2005. His address was webcast (<<http://www.royalsoc.ac.uk/page.asp?tip=1&id=3861>>) and also posted in PDF form on the Royal Society's website (<<http://www.royalsoc.ac.uk/downloaddoc.asp?id=2414>>). In the published version of his address, he wrote (p 21–2, notes omitted):

Today, however, fundamentalist forces are again on the march, West and East. Surveying this phenomenon, Debora MacKenzie has suggested that — in remarkably similar ways across countries and cultures — many people are scandalised by "pluralism and tolerance of other faiths, non-traditional gender roles and sexual behaviour, reliance on human reason rather than divine revelation, and democracy, which grants power to people rather than God." She adds that in the US evangelical Christians have successfully fostered a belief that science is anti-religious, and that a balance must be restored, citing a survey which found 37% of Americans (many of them

not evangelicals) wanted Creationism taught in schools. Fundamentalist Islam offers a similar threat to science according to Ziauddin Sardar, who notes that a rise in literalist religious thinking in the Islamic world in the 1990s seriously damaged science there, seeing the Koran as the font of all knowledge.

In the US, the aim of a growing network of fundamentalist foundations and lobby groups reaches well beyond "equal time" for creationism, or its disguised variant "intelligent design", in the science classroom. Rather, the ultimate aim is the overthrow of "scientific materialism", in all its manifestations. One major planning document from the movement's Discovery Institute tells us that "Design theory promises to reverse the stifling dominance of the materialist world view, and to replace it with a science consonant with Christian and theistic convictions". George Gilder, a senior fellow at the Discovery Institute, has indicated that this new, faith-based science will rid us of the "chimeras of popular science", which turn out to be ideas such as global warming, pollution problems, and ozone depletion.

Lord May has won a number of international awards, including the 1996 Crafoord Prize for "pioneering ecological research in theoretical analysis of the dynamics of populations, communities and ecosystems." Between 1995 and 2000 he was Chief Scientific Adviser to the UK Government and Head of the Office of Science and Technology. He became a member of the House of Lords in 2001 and was appointed to be a member of the Order of Merit in 2002. Founded in the 1660s, the Royal Society is one of the most prestigious scientific societies in the world.

[NCSE thanks Ron Fredrickson and Vic Hutchison for information used in this article.]



NCSE NEWS

News from the Membership *Glenn Branch, NCSE Deputy Director*

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

Philip Baringer responded to a confused editorial in the *Lawrence (Kansas) Journal-World* (2005 Sep 7) by explaining, “the issue is not that some people believe in creation and some believe in evolution. No one should ‘believe’ in evolution in the same sense that they believe in their religion. Evolution is a science. Scientific knowledge should always be taken as provisional, subject to change when new evidence comes along. Scientists and science educators do not want anyone to ‘believe’ in evolution, but rather to understand the theory and to understand why scientists accept it as the best explanation of how species developed over time. Scientists get upset with creationists when they try to blur the distinction between science and religion, when they repeatedly assert things that are factually incorrect about science and when they try to distort the science curriculum in public schools in order to promote narrow religious views. That’s what the fuss is about.” His letter appeared on September 14.

Writing to the editor of the *Idaho Statesman*, **Gary L Bennett** noted an ironic juxtaposition in a previous issue of the newspaper: “On page 3 of the Main section we learn that ‘Scientists find chimps, people are 96 percent identical’ while on page 9 we learn the embarrassing fact that 42 percent of our fellow citizens are so uneducated as to reject evolution. If one ever needed proof that creationists don’t study, that was it.” His letter appeared on September 22, 2005, as did a letter from **Terry Maley**, who responded to a previous letter presenting a bogus probability argument on behalf of creationism. Maley wrote, “These probability ‘computations’ about the likelihood of a DNA molecule or protein

happening by ‘random chance’ are dead wrong because they assume, for example, that H₂O is just as likely as O₂H and that there were no initial conditions that would make it more likely for the production of carbonic acid than sulfuric acid,” and also noted that the argument was compromised by its using *post facto* probabilities.

Marshall Berman contributed “Intelligent design: The new creationism threatens all of science and society” to the October 2005 issue of *APS News*, the newsletter of the American Physical Society. Citing the Wedge document, Berman argued, “The current Intelligent Design movement poses a threat to all of science and perhaps to secular democracy itself.” Noting that “[t]he movement is highly political, very astute, extremely well-marketed, disingenuous, and grossly misunderstood by most Americans,” he calls upon his scientific colleagues to help to defend science: “Replacing sound science and engineering with pseudoscience, polemics, blind faith, and wishful thinking won’t save you when the curtain of ‘Dark Ages II’ begins to fall!” Berman has served as vice president of the New Mexico State Board of Education and Executive Director for Education of the Council on Competitiveness.

Tim Berra’s op-ed “Chimps may help show what makes us human” appeared in the *Mansfield, Ohio, News Journal* (2005 Oct 5), in the wake of the publication in *Nature* of a draft sequence of the chimpanzee genome — an “elegant confirmation of evolution,” Berra remarked, that Darwin could not have imagined. After explaining the similarities and differences of the chimpanzee and human genomes in general terms, Berra noted that the new knowledge of the chimpanzee genome may help researchers to find a treatment or even a cure for AIDS and Alzheimer’s disease. He pointedly compared the prospects opened

by the discovery to the sterility of “intelligent design,” which, he noted, “offers no research program for the future, no predictions, and cannot be tested scientifically since it advocates supernatural explanations that [lie] outside the scientific method.” Berra is professor emeritus in the Department of Evolution, Ecology, and Organismal Biology at the Ohio State University, Mansfield, and author of *Evolution and the Myth of Creationism* (Stanford: Stanford University Press, 1990). [Thanks to Andrew Lutes for the news.]

NCSE deputy director **Glenn Branch** contributed “The battle over evolution: How geoscientists can help” to the September 2005 issue (available on-line in PDF form at <http://www.sepm.org/sedrecord/SR_3-3.pdf>) of *The Sedimentary Record*, published quarterly by the Society for Sedimentary Geology. “Eighty years after the Scopes trial,” Branch writes in his abstract, “evolution is still under attack in the public school science classroom. Geoscientists are in a unique position to help, but in order to do so, they need to appreciate the history of the controversy, to understand the variety of ways in which creationists attempt to compromise evolution education, and to work together to use their scientific expertise effectively in the education policy arena.”

Just as the first challenge to the constitutionality of teaching “intelligent design” in the public school science classroom was underway in the trial of *Kitzmiller v Dover*, **Matthew J Brauer**, **Barbara Forrest**, and **Steven G Gey** offered a definitive assessment of the legal issues involved in their law review article “Is it science yet? Intelligent design creationism and the Constitution,” published in *Washington University Law Quarterly* (2005; vol. 83, nr 1). With almost 150 pages of closely reasoned argument and almost 600 footnotes of meticulous documen-



tation, "Is it science yet?" (available on-line in PDF form at <<http://law.wustl.edu/WULQ/83-1/p1BrauerForrestGeybookpages.pdf>>) is sure to become the leading treatment of the constitutionality of teaching "intelligent design" for the foreseeable future. The abstract of the article reads:

On several occasions during the last eighty years, states have attempted either to prohibit the teaching of evolution in public school science classes or counter the teaching of evolution with mandatory references to the religious doctrine of creationism. The Supreme Court struck down examples of the first two generations of these statutes, holding that they violated the Establishment Clause of the First Amendment. A third generation of creationist legislation is now being proposed. Under this new generation of creationism legislation, science teachers would present so-called "intelligent design" theory as an alternative to evolution. Intelligent design theory asserts that a supernatural intelligence intervened in the natural world to dictate the nature and ordering of all biological species, which do not evolve from lower- to higher-order beings. This article considers whether these intelligent design creationism proposals can survive constitutional scrutiny. The authors analyze the religious, philosophical, and scientific details of intelligent design theory, and assess these details in light of the constitutional doctrine developed by the Court in its previous creationism decisions. The Article discusses several factors that pose problems for intelligent design theory, including the absence of objective scientific support for intelligent design, evidence of strong links between intelligent design and religious doctrine, the use of intelligent design to limit the dissemination of scientific theories that are perceived as contradict-

ing religious teachings, and the fact that the irreducible core of intelligent design theory is what the Court has called the "manifestly religious" concept of a God or Supreme Being. Based on these details, the authors conclude that intelligent design theory cannot survive scrutiny under the constitutional framework used by the Court to invalidate earlier creationism mandates.

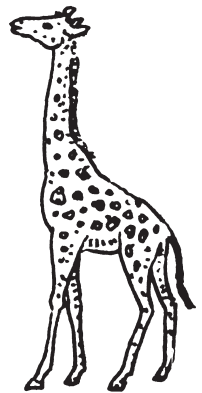
Brauer is a scientist on the research staff of the Lewis-Sigler Institute for Integrative Genomics at Princeton University; with Daniel R Brumbaugh he contributed "Biology remystified: The scientific claims of the new creationists" to *Intelligent Design Creationism and its Critics*, edited by **Robert T Pennock** (Cambridge [MA]: MIT Press, 2001). Forrest is Professor of Philosophy at Southeastern Louisiana University and a member of NCSE's board of directors; with **Paul R Gross** she wrote *Creationism's Trojan Horse: The Wedge of Intelligent Design* (New York: Oxford University Press, 2004). Gey is the David and Deborah Fonvielle and Donald and Janet Hinkle Professor of Law at Florida State University, and is considered to be one of the country's leading scholars on religious liberties and free speech.

Jim Bullion contributed a letter to the editor of the *Bellingham Herald* (2005 Dec 7, with a correction following on Dec 8), noting that "[p]oorly informed critics of evolution are contriving a debate about evolution's validity when non exists within the scientific community, except for a tiny fringe motivated mostly by fundamentalist religion." He cited *Science and Creationism* (published by the National Academy of Sciences), the *Encyclopedia Britannica*, and David Quammen's cover article in the November 2004 issue of *National Geographic* to illustrate his point.

Prompted by his dissatisfaction with a lecturer (Keith Lockitch of the Ayn Rand Institute) whose defense of evolution was coupled with a portrayal of science as intrinsically atheistic, **Robert Camp** contributed an op-ed to the

Orange County Register (2005 Dec 2), noting, "It is not unusual, in fact it's nigh inescapable, for conversations about creationism to veer into dispute as to the relative merits of theism and atheism. But it's usually the creationists who mistakenly think this philosophical dichotomy encapsulates the issue. Here, however, was a defender of biological evolution struggling in the same quicksand that gobbles up so many on the other side. Why was he determined to cast these scientific and pedagogical issues as a battle between reason and religion? Because it suited his personal agenda. Despite his ostensibly sensible beginning, he was really there to talk about 'rational' atheism and 'irrational' religion." For the complete text of his op-ed and a report on Lockitch's lecture, visit Camp's blog at <<http://litcandle.blogspot.com>>.

NCSE Supporter **James E Darnell Jr's** article "Defending science education against fundamentalist attacks" appeared on the website of *Teachers College Record*, a journal of research, analysis, and commentary in the field of education published by Teachers College, Columbia University, on September 13, 2005. Describing the anti-evolutionist movement as "an impediment to science education that the country can surely do without," Darnell reviewed the overwhelming evidence for evolution before suggesting a solution: effective political action, along the lines of the pro-evolution-education resolution introduced by Senator Ken Toole in the Montana legislature in 2005 (see *RNCSE* 2004 Nov-Dec; 24 [6]: 15-20). He concluded, "Although Toole's proposal for a resolution never got out of committee, it should be a call to arms for those who wish America's children to be educated in modern science without interference from fundamentalists. Politicians who fail to understand this problem and move to deal correctly with it must be held to account. It is not, I believe, overly dramatic to claim that America's future depends on stopping this interference with science education, perhaps as a first step in assuring the continued separation of church and state in this country."



ERNIE CONRAD DIES

Long-time NCSE member Ernie Conrad died at age 74 on November 20, 2005. He graduated from Eureka High School and served during the Korean War on board the *USS Yorktown* as a combat medic. He graduated from the University of Utah, then taught for 40 years for Grant Union School District at Don Julio and Rio Linda Senior High, where he was named Teacher of the Year in 1994. He established curriculum in anthropology for high school, originated the "Knowledge Bowl", and presented "character" discussions of World War II events. In summer, Ernie worked as a park ranger/lecturer at Lassen and Mesa Verde National Parks. He received a grant from the National Endowment for the Humanities to work at the "Flower Dew One Hundred" project in Virginia excavating early colonial settlements. In October 2005, he co-authored a McGraw-Hill supplemental college textbook, *Readings in Physical Anthropology*. He was also a long-time member of the Humanist Association of the Greater Sacramento Area (HAGSA). Ernie was a scholar and very funny man who will be missed.

[Adapted from the death notice that appeared in the HAGSA News (<<http://bagsa.org/news/>>) and the obituary in the Sacramento Bee (2005 Nov 22).]

Among those who wrote to the editor of the *Kansas City Star* in the wake of the Kansas Board of Education's vote to adopt science standards in which the scientific standing of evolution is systematically impugned was **Bryce Hand**, emeritus professor of geology at Syracuse University. Hand wrote in part, "Yes, there is controversy surrounding evolution, but only among non-scientists. Those who reject evolution present no arguments scientists haven't heard (and adequately countered) again and again and have no special knowledge that scientists have overlooked. Organic evolution is so well established that to allow room for doubt is to misrepresent science." His letter appeared on November 10, 2005.

NCSE Supporter **Richard Lewontin** reviewed two books for *The New York Review of Books* (2005 Oct 20; 52 [6]; available on-line at <<http://www.nybooks.com/articles/18363>>): NCSE Supporter **Michael Ruse's** *The Evolution-Creation Struggle* (Cambridge [MA]: Harvard University Press, 2005) and Peter J Richerson and Robert Boyd's *Not by Genes Alone* (Chicago: University of Chicago Press, 2005). Introducing his review, Lewontin wrote:

The development of evolutionary biology has induced two opposite reactions, both of which threaten its legitimacy as a natural scientific explanation. One, based on religious convictions, rejects the science of evolution in a fit of hostility, attempting to destroy it by challenging its sufficiency as the mechanism that explains the history of life in general and of the material nature of human beings in particular. One demand of those who hold such views is that their competing theories be taught in the schools.

The other reaction, from academics in search of a universal theory of human society and history, embraces Darwinism in a fit of enthusiasm, threatening its status as a natural science by forcing its explanatory scheme to account not simply for the

shape of brains but for the shape of ideas. *The Evolution-Creation Struggle* is concerned with the first challenge, *Not By Genes Alone* with the second.

It was a pleasure to see that in his discussion of the first of these reactions, Lewontin cited the late **Otis Dudley Duncan** and Claudia Geist's recent paper "The creationists: How many, who, and where?" (*RNCSE* 2004 Sep/Oct; 24 [5]: 26-33).

PZ Myers and his popular blog Pharyngula (<<http://scienceblogs.com/pharyngula>>) were featured in a pair of publications: *City Pages* (2005 Nov 23; 26 [1303]; available on-line at <<http://citypages.com/databank/26/1303/article13908.asp>>), a weekly paper in the Minneapolis/St Paul area, and *Nature* (2005 Dec 1; 438: 548-9). The article in *City Pages*, entitled "The mad scientist", said of Myers, "Sometimes he is the mild-mannered professor, absorbed by scientific minutiae. But when the spirit moves him, he is a fiery cultural critic, bent on keeping the religious right from hijacking school curricula even if it means taking apart their arguments point by point in settings where people used to know better." The article in *Nature*, about the use of blogs in the scientific community, quoted Myers as saying, "The standard scientific paper is irreplaceable as a fixed, archivable document that defines a checkpoint in a body of work, but it's static, it's very limited ... Put a description of your paper on a weblog, though, and something very different happens ... People who are very far afield from your usual circle start thinking about the subject. They bring up interesting perspectives."

Colin Purrington, who teaches biology at Swarthmore College, presented a talk entitled "Why is everyone picking on evolution, for God's sake?" to the Faculty Lunch at Swarthmore on September 21, 2005. In the announcement for the talk, Purrington wrote, "Now that the furor over a Sun-centered solar system is finally dying down, faith-based attacks on scientific knowledge have turned to evolution, the theory that Charles Darwin popu-



larized 146 years ago. My presentation will begin with a summary of this sordid drama and why the nation is currently focused on a court case soon to start in nearby Dover, Pennsylvania. I will spend the bulk of my time analyzing general strategies that might (and might not) be effective countermeasures to anti-evolutionism, with special emphasis on several projects I initiated during my leave year." (To see these countermeasures, visit Purrington's Evolution Outreach Projects website: <<http://www.swarthmore.edu/NatSci/cpurin1/evolk12/evoops.htm>>.)

NCSE's executive director **Eugenie C Scott** was presented with NABT's Honorary Member Award, given to those who have attained "distinction in teaching, research, or service in the biological sciences," at the National Association of Biology Teachers convention held in Milwaukee, Wisconsin, from October 5 to October 8, 2005. Also receiving the award was **Randy Moore**, a professor of biology at the University of Minnesota, Minneapolis, and until recently the editor of *The American Biology Teacher*. Previous recipients of the prestigious award include the Nobel-Prize-winning geneticist Hermann J Mueller, the late biologist **John A Moore**, and NCSE's founder **Stanley Weinberg**.

The trial in *Kitzmiller v Dover* — the first legal challenge to the constitutionality of teaching "intelligent design" in the public schools — was one of the five biggest stories in bioscience for 2005, in the view of *The Scientist* (2005 Dec 5; 19 [23]: 14). NCSE's **Eugenie C Scott** and **Glenn Branch** provided a brief assessment for the journal, writing, "*Kitzmiller v Dover* represents the most important American creationism/evolution trial in 23 years." Comparing the trial with 1982's *McLean v Arkansas*, Scott and Branch note, "With the recent electoral rout of the Dover school board, the defendants are unlikely to appeal if the plaintiffs prevail. Because higher courts will thus remain mute on the constitutionality of teaching ID, additional Dovers may be anticipated, until the issue finally reaches the Supreme Court." Meanwhile, they

add, "savvier anti-evolutionists are likely to emulate the Kansas State Board of Education by promoting policies impugning evolution without directly requiring creationism" — a strategy that will be jeopardized if the decision in *Selman v Cobb County* (holding that evolution disclaimers are unconstitutional) is upheld on appeal.

Writing to the editor of the Wilmington, North Carolina, *Star-News*, **Pete Soderman** lamented what he views as the Bush administration's war on science, especially with regard to evolution: "The fact of Darwinian evolution is the absolute cornerstone of biology, supported by a mountain of incontrovertible evidence, and every scientific and educational body in the world, yet our president 'thinks' that we should give equal time to teaching a repackaged supernatural fairy tale. Even his own science advisor disagreed with him." His letter appeared on November 4, 2005.

Zev Stern responded to Rabbi Daniel Lapin's op-ed column "My way or Foxman's way" (*The Jewish Press* 2005 Nov 11), itself responding to a speech in which the national director of the Anti-Defamation League, Abraham Foxman, warned of the possible consequences of the triumph of the Christian right. Toward the end of his letter (*The Jewish Press* 2005 Nov 29), Stern noted, "Rabbi Lapin cannot seem to write a column without a gratuitous attack on the theory of evolution. I [wish] that he and his ilk would, just once, leave us biologists alone and attack quantum theory or the theory of relativity. If Rabbi Lapin would examine the work of Rav Kook and others he might find that the theory of evolution is no more incompatible with our faith than are the theories of chemistry and physics, but of course Rav Kook is treif in certain circles that, 60 years after the Holocaust, are still ideologically mired in the ghettos of Europe to which Christian believers had consigned us for so long." (Abraham Isaac Kook [1865–1935], to whom Stern refers, was a prominent Jewish scholar and rabbi who regarded evolution as compatible with Jewish theology.)

Responding to a full-page article on "intelligent design" in *The*

Oregonian (2005 Sep 27), **William Thwaites** wrote, "There are two simple reasons why intelligent design is seriously flawed science at best. First of all, science is really not much more complicated than proposing explanations that can be tested. Evolution can be tested, but if someone suggests that God made this or that organism or structure, how can you test that? It might be true, but it can't be science, because it isn't testable. Another fatal flaw in the thinking of intelligent designers is that no one really knows for sure what can and cannot be selected by natural selection from random mutations. I don't see that the intelligent designers are even trying to answer that question," adding, "Explanations based on the principles of nature tend to be testable. Ideas based on religion tend not to be." His letter appeared on October 2.

NCSE Supporter **Tim D White** and Pieter Arend Folkens's *The Human Bone Manual* (New York: Academic Press, 2005) is now available. The book, writes its publisher, "is intended for use outside the laboratory and classroom, by professional forensic scientists, anthropologists and researchers. The compact volume includes all the key information needed for identification purposes, including hundreds of photographs designed to show a maximum amount of anatomical information."

Why Intelligent Design Fails (New Brunswick [NJ]: Rutgers University Press, 2004), edited by **Matt Young** and **Taner Edis**, was reviewed by Arthur Falk for the *Quarterly Review of Biology* (2005; 80 [3]: 350). Falk wrote, "Not only is the book largely successful, but several articles provide interesting updates on evolution science for nonprofessionals, quite apart from this debate. I recommend the articles about recent work on the evolution of flagella in bacteria ([Ian] Musgrave), of avian flight ([Alan] Gishlick), and of wasp net building ([Niall] Shanks and [Istvan] Karsai). Teachers of science, even at the high school level, will enjoy using Gishlick's do-it-yourself demonstration of the mechanics of flight, starting with an uncooked chicken."



ICR's HENRY MORRIS DIES

Henry Morris, the founder of the "creation science" movement, died on February 25, 2006, in Santee, California, at the age of 87. Speaking to *The New York Times* (2006 Mar 4), NCSE's executive director Eugenie C Scott described him as "the most important creationist of the 20th century, much more so than William Jennings Bryan." And the historian Edward J Larson, whose *Trial and Error* is the definitive treatment of the legal history of the creationism/evolution controversy, told the *Washington Post* (2006 Mar 1), "He had an enormous influence ... He literally set the terms of the debate for the second half of the 20th century."

Born in Dallas, Texas, in 1918, Morris graduated from Rice University in 1939 and earned a master's degree and a PhD in hydraulic engineering from the University of Minnesota. He taught engineering at the University of Louisiana at Lafayette, Southern Illinois University, and, beginning in 1957, at Virginia Polytechnic Institute, where he served as department chair. As early as 1946, with the publication of *That You Might Believe* (which he described as the first book "published since the Scopes trial in which a scientist from a secular university advocated recent special creation and a worldwide flood"), he was also attempting to establish creationism on a scientific basis.

With the theologian John C Whitcomb, Morris wrote *The Genesis Flood* (1961), the catalyst for the modern creation science movement. Although the basic idea of flood geology was already presented by George McCready Price a generation earlier, *The Genesis Flood* succeeded in popularizing it among fundamentalist Christians, especially those with scientific and technical training. Subsequently, Morris was among the founders

of the Creation Research Society, established in 1963, which sought to promote and publish research supporting scientific creationism.

In 1970, Morris retired from mainstream academia, even declining Auburn University's offer of a chair in civil engineering. Instead, he moved to California in order to establish the Creation Science Research Center, a creationist auxiliary to Tim LaHaye's new Christian Heritage College. After a split over tactics, the center was severed from the college; Morris reorganized what remained of the center as the Institute for Creation Research. Morris served as the president of the ICR from 1970 to 1995, when his son John Morris succeeded him; he remained president emeritus of the ICR until his death.

At the ICR, Morris was a prolific writer, with such books as *The Genesis Record*, *The Biblical Basis for Modern Science*, *History of Modern Creationism*, *What is Creation Science?* (coauthored with Gary E Parker), and *The Modern Creation Trilogy* (coauthored with John Morris) to his credit. Perhaps most influential was *Scientific Creationism*, intended for use as a textbook; two versions were issued, a general edition and a public school edition, from which a chapter that "places the scientific evidence in its proper Biblical and theological context" was omitted.

In his ethnography *God's Own Scientists: Creationists in a Secular World*, the anthropologist Christopher P Toumey wrote:

For most of the creationist activists in North Carolina, Henry Morris and his organization, the Institute for Creation Research, are the only important sources of creationist knowledge and

belief. For information, they refer to Morris to lead them through Genesis and geochronology; for inspiration, they turn to Morris himself to steer them past doubt and difficulty. No other authority or influence matters nearly as much.

Although Toumey was writing in 1994, before the rise of the prominent young-earth creationist ministry Answers in Genesis and the visibility of "intelligent design" creationism, Morris's influence is still widely felt. AiG's Ken Ham told *The New York Times*, "All of us in the modern creationism movement today would say we stand on his shoulders." And Paul Nelson, a Fellow of the Discovery Institute's Center for Science and Culture, was quoted in the *Los Angeles Times* (2006 Mar 3) as saying, "Ideas can die because there is just no one to think about them ... I love the fact that Dr Morris kept alive dissent from Darwinian evolution."

While opposing his scientifically bankrupt views, Morris's adversaries credited him with sincerity and cordiality. Brown University's Kenneth R Miller told the *Los Angeles Times*, "I found Morris to be unfailingly polite, a real gentleman and a person who was a sincere and committed Christian." (In chapter six of *Finding Darwin's God*, Miller describes a conversation with Morris, ending, "I had sat down thinking the man a charlatan, but I left appreciating the depth, the power, and the sincerity of his convictions.") And NCSE's Scott also described him as gentlemanly to *The New York Times*, adding, "I feel that he was absolutely sincere about his convictions that the Bible was literally true and that science would support it and creation science was good science."

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The NCSE Board of Directors and staff would like to acknowledge and extend our warm gratitude to all individuals, organizations, and firms that donated to NCSE. We also extend special thanks for their much-appreciated support to the following people who donated \$100 or more between July and December 2004.

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Harriet Welsh, in memory of
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The Lay of the Land: The Current Context for Communicating Evolution in Natural History Museums

Robert “Mac” West

[This is a written summary of the presentation given by West at the opening of the Florida Museum of Natural History's conference “Enhancing Natural History Museum Visitor Understanding of Evolution,” Gainesville, Florida, October 22, 2004.]

VISITOR EXPECTATIONS

Visitors to various kinds of natural history attractions arrive with certain expectations for what they will see and do. This is especially the case for “general visits” — those not driven by a special exhibition or event. People going to aquariums anticipate experiences with sharks, whales, and porpoises

(big oceanic things), colorful reef fishes, and maybe some really exotic-looking organisms such as seahorses or jellyfish. Zoo attendees are looking especially for the “charismatic megafauna” — lions, tigers (and bears), elephants, kangaroos, gorillas, and such, as well as newborns, rarities (pandas), and novelties (for example, burying beetles, bats, or capybaras). Visitors

to natural history museums fully expect to see, in addition to dioramas filled with taxidermied large mammals and materials from exotic human cultures, an array of dinosaurs and other big extinct things.

Thus, it is expected that natural history museums present specimens and artifacts that deal with change over time ... or evolution. As a consequence, natural history museum visitors accept evolution and chronology as the organizer for much of their visit, even if they personally do not understand or even like the concept of evolution.

This expectation is not front-and-center at living collections institutions, which work in the present tense and worry more about the future (habitat destruction, impending extinctions) than the past. Therefore, they have to work harder to bring evolution into their programs. To their credit, a number of zoos and aquariums are addressing evolution and its importance in understanding the diversity of their collections. For example, the St Louis Zoo has had an animatronic Charles Darwin addressing its visitors since 1989, and the Miami Metrozoo recently opened a bird exhibit which explicitly relates living birds to their dinosaurian ancestors. Over the last several



Dinosaur diorama in the Milwaukee Public Museum

years, many zoos have had temporary exhibitions of animatronic dinosaurs, thus introducing the concept of geologic time, ancient extinctions, and, by implication, the evolutionary process.

Science centers vary enormously in their programmatic capabilities and approaches. Some, which have evolved from natural history museums (for example, the Science Center of Minnesota, the St Louis Science Center, and the Museum of Science, Boston) historically have had paleontology, and thus evolution, as a program element. Others, such as the Maryland Science Center, recently have added paleontology to their array of offerings. Still others approach evolution through their contemporary science programming in genetics and the biomedical sciences. This is the case with the genetics exhibition at the Museum of Science and Industry in Chicago.

OVERT EVOLUTION IN NATURAL HISTORY MUSEUMS

The word “evolution” does not occur all that frequently in natural history museums — even though they are firmly based on the concept. For instance, at the Milwaukee Public Museum, I was a curator of an exhibition about the evolution of Planet Earth, euphemistically called *The Third Planet*. “Life Over Time” and similar circumlocutions show up regularly, as do gallery titles such as “The Fossil Hall” and “The Dinosaur Exhibit.” On the plus side, the American Museum of Natural History has its Hall of Human Biology and Evolution, which complements its five “fossil halls.” The San Diego Museum of Man in 2002 opened a new permanent exhibition titled “Footsteps Through Time: Four Million Years of Human Evolution”. And the host for this conference, the Florida Museum of Natural History, features the Hall of Florida Fossils: Evolution of Life and Land.

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The explicit use of the word “evolution” is much more common outside of the United States. Just as an example, the Polish Academy of Sciences operates the Museum of Evolution in Warsaw. The Evolution Gallery is in the Melbourne Museum, Australia; Russia has its State Darwin Museum; and the Royal Museum of Scotland, Edinburgh, recently closed its Evolution Gallery for refurbishment. The Grande Galerie de l’Evolution is a unit of the Museum National d’Histoire Naturelle in Paris.

In May 1979, the Smithsonian’s National Museum of Natural History opened a gallery on its main floor called Dynamics of Evolution. Even before it opened, a suit was filed in federal court asserting that the use of federal funds in NMNH exhibits on evolution was a violation of the separation of church and state. On October 30, 1980, a court of appeals ruled that NMNH exhibitions “that focus on the scientific theory of evolution do not violate the First Amendment requirement of separation of church and state” (*Crowley v Smithsonian*). Even so, on July 22, 1981, Rep William Dannemeyer (R-CA) introduced an amendment to HR 4035 to “prohibit the Smithsonian Institution to use funds for public exhibits and performances to present the theo-

ry of evolution as the sole explanation of life’s origins.” That amendment was defeated on a point of order the same day. Despite these actions, the gallery was closed and replaced after several years. This kind of attention directed toward the e-word certainly caused US institutions to be very cautious about how direct they were in their terminology.

A graphical way to see how terminology is applied to exhibitions dealing with evolution is to tabulate the keywords self-selected by traveling exhibition marketers. The following data, taken from ILE’s Traveling Exhibitions Database (October 2004), suggests that there is a preference for talking about the products of evolution — the actual fossils — rather than the process or dynamics.

| Keyword | Number | % |
|--------------|--------|-------|
| Biodiversity | 5 | 0.78% |
| Dinosaurs | 42 | 6.59% |
| Evolution | 7 | 1.09% |
| Fossils | 30 | 4.71% |
| Genetics | 4 | 0.63% |

Today, evolution appears in natural history museums in three exhibition and program locations: paleontology and the fossil record, biodiversity and systematics, and genetics. However, it usually is implied or ignored rather than explicit.



Mounted dinosaur skeletons at the Sam Noble Oklahoma Museum of Natural History



The original Sue at the Field Museum

PALEONTOLOGY/FOSSIL RECORD

Exhibitions of large and impressive fossils have been staples at natural history museums virtually as long as those institutions have existed. Mermin (2002) provides an excellent review of the development of these exhibitions. He documents, and I attest to this from my own experience, a surge of interest in dinosaurs (in particular) but also other large and extinct exotic vertebrates starting in the 1980s and accelerating into the 1990s and 2000s. Exhibitions developed during that time emphasized ancient environments and the adaptations of animals to them, with some attention to the process of discovery and collection. At the same time, some recognizable personalities emerged as prominent spokespeople for fossils and their importance — the Leakey family, Robert Bakker, and Jack Horner stand out as highly visible individuals at the turn of the century.

From a purely practical perspective, natural history museums highlight their dinosaur/paleontology exhibitions as important visitor attractors and revenue generators. They are prominent in logos, identification graphics, slogans (“Home of the Dinosaurs”), and often stand as physical elements, such as the concrete *Triceratops* on the Mall in front of the Smithsonian’s National Museum of Natural History, the *Allosaurus*

cast in front of the University of Wyoming’s Geological Museum, and the bronze statue of *Torosaurus* that will be placed in front of the Yale Peabody Museum in fall 2005.

In addition to the Third Planet gallery in Milwaukee, which opened in 1983, others have opened in the last twenty years — California Academy of Sciences, San Francisco (closed during construction); American Museum of Natural History, New York; Denver

Museum of Nature and Science; Academy of Natural Sciences of Philadelphia; University of Nebraska State Museum, Lincoln; the Field Museum, Chicago (closed for renovation); Cincinnati Museum of Natural History; Museum of the Rockies, Bozeman, Montana; Science Museum of Minnesota, St Paul; Fernbank Museum of Natural History, Atlanta; North Carolina Museum of Natural Science, Raleigh; Texas Tech University Museum, Lubbock; New Mexico Museum of Natural History and Science, Albuquerque; Cranbrook Institute of Science, Bloomfield Hills, Michigan; Canadian Museum of Nature, Ottawa; The Children’s Museum in Indianapolis; Sam Noble Museum of Natural History at the University of Oklahoma, Norman; Sternberg Museum, Hays, Kansas; Museum of the Earth, Ithaca, New York; Calvert Marine Museum, Calvert, Maryland; Yale Peabody Museum, New Haven, Connecticut; Texas Memorial Museum, Austin; Field House of Natural History, Vernal Utah; Idaho Museum of Natural History, Pocatello; and others with which I am not familiar or simply have overlooked.

Others are on the way, at the San Diego Museum of Natural History; the Field Museum, Chicago; the Museum of the



Hall of Biodiversity at the American Museum of Natural History



Model of a Triassic mammal in the Behring Hall of Mammals at the National Museum of Natural History

Rockies, Bozeman, Montana; the Royal Ontario Museum, Ottawa; the Carnegie Museum of Natural History, Pittsburgh; the National Museum of Natural History, Washington; the Dallas Museum of Natural History; the Utah Museum of Natural History, Salt Lake City; and the University of Nebraska State Museum, Lincoln; just to name a few.

In addition, the last twenty years have seen numerous traveling exhibitions of animatronic dinosaurs and other extinct beasts, plus casts of the celebrated *Tyrannosaurus rex*, Sue, from the Field Museum. Several organizations travel collections of both cast and real skeletons, generally highlighting dinosaurs.

BIODIVERSITY AND SYSTEMATICS

Virtually every natural history museum has galleries that are devoted either to the major groups of modern animals, the region's or world's biogeographic zones, or (much less common) to basic ecosystems and their inhabitants. While there are numerous halls devoted especially to mammals, birds, fishes, and so on, there are few exhibitions that attempt to integrate the major taxonomic categories and explore their interrelationships.

The American Museum of

Natural History has entered this arena twice, once explicitly and once implicitly. The explicit case is the Hall of Biodiversity, which clearly talks about the great diversity of animal life and illustrates it through a visually stimulating wall of diverse specimens. The new Hall of Ocean Life (see West 2003) implicitly celebrates the diversity of life, in its case with the ocean environment as the container of that diversity.

The Eastern Ontario Biodiversity Museum in Kempville, south of Ottawa, is the only institution I can find that identifies itself as such. But, as is the case with most natural history museums, it is primarily interested in the contemporary environments of the region, not the evolutionary mechanisms which generated them.

The World Wildlife Fund circulated a traveling exhibition, Biodiversity 911, for several years, and the Royal Ontario Museum operates the interactive "Hands-On Biodiversity" gallery. Both are prospective in nature, presenting ways to interpret current biodiversity and offering remedies for preventing biodiversity loss in the future.

The Dallas Museum of Natural History is planning a second facility with global biodiversity of a primary theme; the Texas Memorial

Museum in Austin recently opened the Biodiversity Discovery Hall, the Coastal Discovery Museum in Hilton Head, South Carolina, has its Biodiversity: A Sea Island Classroom.

While these galleries and programs are the life-blood of natural history museums, evolution is usually a minor thought in their presentation and programming. An exception is the new Kenneth E Behring Family Hall of Mammals at the Smithsonian's National Museum of Natural History. In addition to showing mammalian diversity, it takes mammals back to their common Triassic ancestor in a "meet your relatives" format.

GENETICS/GENOMICS

This topic is considered within the purview of many science museums, and exhibitions and programs about it are increasingly common, especially in science centers. This is clearly an area where museums are trying to present current science and research which is directly relevant to daily life and contemporary issues. Much exhibition and program activity was stimulated by the high public profile of the Human Genome Project as well as by increasing attention to controversies surrounding cloning, genetic profiling, genetically engineered food, and analyses of fetal genetic diseases.

A major permanent exhibition, Genetics: Decoding Life, opened at the Museum of Science and Industry, Chicago, in 2002, and the renovated Tech Museum of innovation includes Genetics: Technology with a Twist. The DNA Zone has been at the St Louis Science Center for many years. Five substantial traveling exhibitions currently are available — Genomics from the American Museum of Natural History, Genome: The Secret of How Life Works from Clear Channel Exhibitions, Genetics! from the Pacific Science Center, The GEEE! In GENOME from the Canadian Museum of Nature, and Traits of Life from The Exploratorium. Three of the above were reviewed in Bossert and West (2002).

A new traveling exhibition, Gregor Mendel: Genius of Genetics, created by the

Vereinigung zur Förderung der Genomforschung (VFG), Vienna, Austria, is opening its North American tour at the Field Museum in fall 2006.

Keyword searches for "evolution" in the descriptions of these genetics exhibitions found it in only two: it appears twice in Clear Channel's Genome teacher guide (once in the WGBH *Evolution* television series web address and once in a quotation from the National Academy of Sciences), and twice in the Mendel description (referring to Mendel's successors who apply genetics to the study of evolution).

OTHER NEW INITIATIVES

The American Museum of Natural History is planning a traveling exhibition on Charles Darwin to open in Fall 2005. Darwin! will include personal effects, collections and books and manuscripts, and examine the modern status of Darwinian evolution.

The Houston Museum of Natural Science is finalizing arrangements with the National Museum of Ethiopia in Addis Ababa to bring the 3.2-million-year-old australopithecine hominid skeleton known as Lucy and other Ethiopian fossils to the US for an exhibition tour from 2006 to about 2009. This proposed exhibition has created a substantial controversy about the wisdom and safety of shipping such a precious and delicate specimen among museums primarily for exhibition, rather than research, purposes.

The University of Nebraska State Museum is spearheading the Explore Evolution Project, partnered with the Exhibits Museum of the University of Michigan, the Kansas Museum and Biodiversity Center at the University of Kansas, the Museum of the Rockies and Montana State University, the Sam Noble Oklahoma Museum of Natural History at the University of Oklahoma, the Texas Memorial Museum at the University of Texas, and the Science Museum of Minnesota. Exhibits will be prepared that focus on seven research projects that have made major contributions to our

understanding of evolution; these will open at each participating museum in late 2005 or early 2006.

SUMMARY

The question driving this survey of the "lay of the land" in presenting evolution is: How well is evolution presented and used in these museum exhibitions? The simple answer is "not very well."

Evolution is implicit in virtually all the paleontology and fossil exhibitions, but evolutionary mechanisms and forces are not included. Concepts of time and extinction, as well as major adaptations, are generally presented through phylogenies and cladograms.

Evolution is implicit in biodiversity and systematics exhibitions, but mechanisms are ignored. There are efforts to investigate environmental pressure, but often they are couched in the form of deleterious impacts on the natural world by humans. Some exhibitions (for example, NMNH's) incorporate fossil ancestors and phylogenies.

Evolution is almost totally ignored in the genetics/genomics exhibitions. Even when the impact of genetic changes, mutations, chromosome reorganizations and other basic elements of gene function are discussed, their impact on phenotypes, relationship to the external environment, and heritability over time simply are not mentioned. Genomics exhibitions deal exclusively with the individual present and the future and do not engage

in discussions of the even larger picture at the population level.

Natural history museums are the one place that the general public comes face to face with the results of evolution. Because of their engaging exhibits and interactive displays, they provide an opportunity to increase knowledge of evolution, its effects, and its implications for life on earth. Yet, by and large, these institutions approach this opportunity gingerly, if at all. Since the public is already captivated by the array of life forms and environments on display in their exhibits, natural history museums could contribute significantly to scientific literacy and to the acceptance of evolutionary theory by drawing these connections more explicitly in their displays and programs.

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Activity station in *Genome: The Secret of How Life Works*



Creationism and the Laws of Thermodynamics

Steven L Morris, Los Angeles Harbor College

INTRODUCTION

Pseudoscientists love to use “abracadabra” words to dazzle an ill-informed audience, and for creationists, the word “entropy” fills the bill nicely. The Second Law of Thermodynamics states that, in an isolated system, the entropy tends to increase. As entropy may be considered a measure of disorder, the orderliness of living systems and the complexity of organic molecules are taken by creationists to be a violation of this law of physics, requiring divine intervention.

An example of this sort of thinking is provided by Henry Morris (1989: 32, emphasis in the original):

The universe is *not* “progressing from featurelessness to states of greater organization and complexity,” as Davies and other evolutionary mathematicians fantasize. It is running down — *at every observable level* — toward chaos, as stipulated by the scientific laws of thermodynamics. Local and temporary increases in complexity are only possible when driven by *designed* programs and *directed* energies, neither of which is possessed by the purely speculative notion of vertically-upward evolution.

An even less intellectual effort is provided by Ross (2004: 108):

One feature of the law of decay (the second law of thermodynamics, or the entropy law) seems especially beneficial in the context of sin: the more we humans sin, the more pain and work we encounter.

Thank God for torture chambers, and congenital diseases!

Steven L Morris received his BSc in astronomy from the University of Toronto and his PhD in physics from the University of Calgary. After two years as a researcher at the Institute of Geophysics and Planetary Physics at UCLA (which included a one-year winter-over at the South Pole, Antarctica!), he spent two years as a physics professor at the University of Puerto Rico before returning to Los Angeles. He currently teaches physics and physical science at Los Angeles Harbor College.

A perfectly adequate response to such nonsense is to point out that the earth is not an isolated system, and therefore the condition required by the Second Law is not met. We can surely say more than just this, however. After all, entropy is not merely some nebulous concept of disorder, but an exactly defined quantity in physics. For example, 18 grams of water at 25° C has an entropy of 70.0 Joules per Kelvin (Lide 2004-5: 5-18; 6-4). Since entropy can be calculated precisely, it is possible to determine what restrictions the laws of thermodynamics really place on evolution. To do this, we should first look at how entropy is defined mathematically.

THE CALCULATION OF ENTROPY

The change in the entropy of a system as it goes from an initial state to a final state is

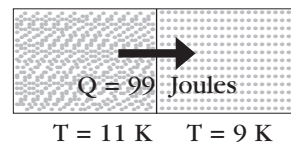
$$\Delta S = \int \frac{dQ}{T},$$

which simplifies to

$$\Delta S = \frac{Q}{T}$$

if the temperature is constant throughout the process. In this equation:

- S is the entropy in units of Joules per Kelvin (or J/K),
- ΔS is the change in the entropy during the process,
- Q is the flow of heat in units of Joules (or J) (Q is positive if heat flows into the object, and negative if heat flows out of the object), and
- T is the temperature in units of Kelvin (or K).



Entropy in Muffins

Why Evolution Does Not Contradict the Second Law of Thermodynamics

Patricia Princehouse, Case Western Reserve University

Anti-evolutionists get a lot of mileage out of this chestnut because it uses scientific terms like “thermodynamics” and “entropy” to bolster their contention that evolution is unscientific. In fact, local increases in complexity/order are not only completely consistent with thermodynamics, but even expected by the theory. Nevertheless, anti-evolutionists contend: “Evolutionary theory stands in obvious defiance of the Second Law” and “Evolution teaches that life increases in complexity, and therefore defies the second law. ...The second law says that everything in our world and in the universe is like a wound-up clock that is running down” (<http://www.pathlights.com/ce_encyclopedia/18law03.htm> or <<http://evolution-facts.org/Ev-Crunch/c18.htm>>; see also <<http://www.cryingvoice.com/Evolution/Physics.html>>). This ruse works best with an audience that is already inclined to hope that evolution is not true, and requires that the audience does not already understand thermodynamics. This burdens the defender of evolution with having to explain not only all of evolutionary theory but thermodynamics on top. I've found that the following explanation often works pretty well to help folks understand basic implications of the Second Law as it relates to life on earth and evolution.

The Second Law of Thermodynamics has to do with entropy — the entropy of the universe increases during any spontaneous process. A traditional way to understand this is that disorder increases in an isolated (closed) system. This is where some muffins come in handy.

1 Imagine you have 6 muffins hot from the oven and 6 frozen in the freezer. You place the dozen muffins in a special box alternating hot with cold muffins. You place a lid on the box, which will not allow any heat inside the box to escape or any outside temperature to affect the muffins. All heat in the muffins will remain in the box (a closed system).

2 Inside the box, your system is highly ordered: hot, cold, hot, cold. The average temperature in the box is obtained by averaging the temperature of all the muffins together. As time goes by, the heat from the hot muffins mixes with the cold from the frozen muffins to produce a situation where all muffins are the same temperature. Notice that the average temperature is still the same as it was when the muffins first went into the box; only the arrangement of the heat has changed. Entropy has increased; your system is no longer ordered.

3 To keep your system ordered, you would have to have some sort of action or intervention system that would continue to heat the hot muffins and cool the frozen ones. This energy would have to come from outside the system (as it does in the case of a refrigerator, which must be plugged into an external energy source). So you *could* keep the system ordered, but to do so you would have to have an open system (where energy can flow in).

4 Life is similar. You might have two human beings who seek to increase order by making the two human bodies into three. In a closed system, this increase in order would be impossible. But humans exist in an open system where they take

matter and energy in and can spin out additional humans at the rate of one every 9–12 months.

5 This is because the earth is not a closed system. Energy from the sun is like a giant generator powering life on earth. Plants increase the order and complexity in their own bodies as they grow from seed to flower (using the sun's light directly plus the minerals and water in the earth and the carbon from the atmosphere). Herbivores use the energy in plants, carnivores use herbivores, and so on. So a huge cascade of complexity is built on the very simple source of energy from the sun.

6 If the earth were a closed system, then every living organism on earth *would* be defying entropy on a daily basis. But ...

7 The earth is not a closed system; thus, respiration, growth, reproduction, and evolution happen on earth on a daily basis without violating the Second Law of Thermodynamics.

8 Many physicists think the universe as a whole is a closed system. That is, not only will the sun burn out some day with the result that life on earth will no longer have the external energy source it needs (actually worse things will probably destroy life on earth before that, as the sun will probably expand and cook everything well before it burns out), but eventually all the energy in the universe — currently arranged like the muffins in the closed box — will even out to the point where no order will exist at all. When the muffins are all the same temperature, the game is over.

9 However, many physicists think that long before the universe falls into total entropy, other things will happen to the overall structure of the universe, so it hardly makes sense to talk about the entire universe as a closed system anyway.

One caveat: Do not look for the muffin example to cover all of physical theory comprehensively. It discusses entropy in terms of the classical theory of thermodynamics. Quantum mechanics and relativity theory put a different spin on it. Since we do not really have conservation of energy in general relativity, it is hard to say what a really comprehensive thermodynamics will look like once the physicists work it out. However, the more Einsteinian versions of thermodynamics thus far all look far worse for the anti-evolutionist objection than does the classical theory. For a more advanced treatment of classical thermodynamics, see <<http://www.entropylaw.com/>>.

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GETTING PHYSICAL

It is not only evolution that is under attack by creationists. Physics, too, is beset. Sometimes physics is misused in order to impugn evolution, as in the perennially popular charge that evolution is thermodynamically impossible — occasionally accompanied by the theological gloss that the Second Law of Thermodynamics is a consequence of the Fall! Sometimes the deliverances of modern physics — especially with respect to the origin of the universe and the age of the earth — are rejected. Small wonder, then, that the American Physical Society noted, “The issues raised by such proposals [to teach creationism in the public schools], while mainly focused on evolution, have important implications for the entire spectrum of scientific inquiry, including geology, physics, and astronomy.” For accounts of thermodynamics, the Big Bang, and the age of the earth, ranging from the basic to the technical, check out the following books, all of which are now available through the NCSE website: <<http://www.ncseweb.org/bookstore.asp>> — look in the “In the latest RNCSE” section. And remember, every purchase through the website benefits NCSE!

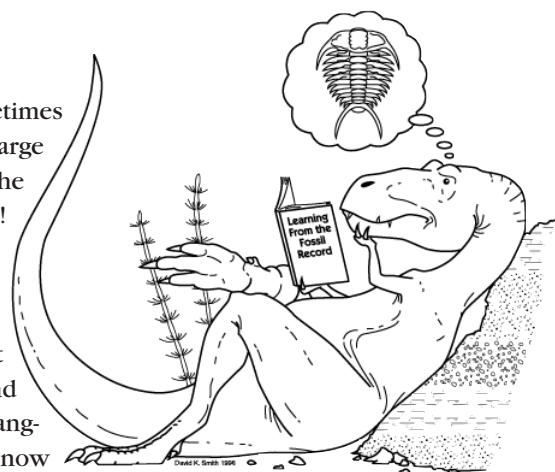


Illustration by Dave Smith, used with permission of the University of California Museum of Paleontology.

THERMODYNAMICS

The Second Law

PW Atkins

Out of print, but well worth the search, *The Second Law* presents a nonmathematical account of the Second Law of Thermodynamics, teeming with vivid examples, ideas, and images. “Mention of the Second Law,” Atkins notes, “raises visions of lumbering steam engines, intricate mathematics, and infinitely incomprehensible entropy. ... In this book I hope to go some way toward revealing the workings of the [Second] Law, and showing its span of application.” Originally published in the Scientific American Library series in 1984, and republished, with updates, in 1994 as a paperback. The reviewer for *Nature* described it as “[a] lovely book, beautifully illustrated and presented.”

Evolution as Entropy, second edition

by Daniel R Brooks and EO Wiley
Originally published in 1986, with a second edition following in 1988, *Evolution as Entropy* ambitiously sought to argue that living systems manifest growing complexity and self-organization as a

result of increasing entropy (contrary, of course, to the canard that evolution is thermodynamically impossible). Reviewing *Evolution as Entropy* for *BioEssays*, Niles Eldredge commented, “Though no one (probably including the authors themselves) will be inclined to think the book an unmitigated success, it will suffice to report that it is a provocative and stimulating exploration of a line of theoretical analysis that is sure to be followed up extensively in years to come.”

Biological Thermodynamics

by Donald T Haynie

From the publisher: “*Biological Thermodynamics* provides an introduction to the study of energy transformations for students of the biological sciences. Donald Haynie uses an informal writing style to introduce this core subject in a manner that will appeal to biology and biochemistry undergraduate students. ... Each chapter provides numerous examples taken from different areas of biochemistry, as well as extensive exercises to aid understanding. Topics covered include energy and its transformation, the First Law of Thermodynamics, the Second Law of

Thermodynamics, Gibbs Free Energy, statistical thermodynamics, binding equilibria and reaction kinetics, and a survey of the most exciting areas of biological thermodynamics today, particularly the origin of life on Earth.”

At Home in the Universe

by Stuart A Kauffman

“The emerging sciences of complexity begin to suggest,” Kauffman writes, “that the order [of the biological world] is not at all accidental, that vast veins of spontaneous order lie at hand. Laws of complexity spontaneously generate much of the order of the natural world. ... Such veins of spontaneous order have not been entirely unknown, yet they are just beginning to emerge as powerful new clues to the origins and evolution of life.” Stephen Jay Gould wrote, “Kauffman has done more than anyone else to supply the key missing piece of the propensity for self-organization that can join the random and the deterministic forces of evolution into a satisfactory theory of life’s order.”

THE BIG BANG

The Origin of the Universe

by John D Barrow

"How, why, and when did the universe begin? How big is it? What shape is it? What's it made of? These are questions that any curious child might ask, but they are also questions that modern cosmologists have wrestled with for many decades," writes John D Barrow in introducing his popular book on cosmology, one in the Science Masters series. Barrow is Professor of Astronomy at the University of Sussex and is the author of several popular books, of which the latest is *The Infinite Book: A Short Guide to the Boundless, Timeless and Endless* (New York: Pantheon, 2005).

Introduction to Cosmology

by Barbara Ryden

The publisher writes, "*Introduction to Cosmology* provides a rare combination of a solid foundation of the core physical concepts of cosmology and the most recent astronomical observations. The book is designed for advanced undergraduates or beginning graduate students and assumes no prior knowledge of general relativity. ... The book is unique in that it not only includes recent major developments in cosmology, like the cosmological constant and accelerating universe, but also anticipates key developments expected in the next few years, such as detailed results on the cosmic microwave background. For anyone interested in cosmology or astronomy."

The Big Bang, third edition

by Joseph Silk

The publisher writes, "Our universe was born billions of years ago in a hot, violent explosion of elementary particles and radiation — the big bang. What do we know about this ultimate moment of creation, and how do we know it? Drawing upon the latest theories and technology, the new edition of *The Big Bang* is a sweeping, lucid account of the event that set the universe in motion. Award-winning astronomer and physicist Joseph Silk begins his story with the first

microseconds of the big bang, on through the evolution of stars, galaxies, clusters of galaxies, quasars, and into the distant future of our universe." Silk is the Head of Astrophysics and Savilian Professor of Astronomy in the Department of Physics at Oxford University.

The First Three Minutes,

updated edition

by Steven Weinberg

A classic exposition of the Big Bang by a winner of the 1979 Nobel Prize in Physics, *The First Three Minutes* sought to explain "the new understanding of the early universe that has grown out of the discovery of the cosmic microwave radiation background in 1965." The afterword in the updated edition of 1988 discusses developments in cosmology since 1976. Writing in *The New Yorker*, Jeremy Bernstein remarked, "one comes away from his book feeling not only that the idea of an original cosmic explosion is not crazy but that any other theory appears scientifically irrational."

THE AGE OF THE EARTH

The Age of the Earth

by G Brent Dalrymple

The Age of the Earth begins with a plain answer: "Four and one-half billion years." But keep reading! Dalrymple's comprehensive, authoritative, and altogether magisterial account of the methods used to determine the age of the earth is, according to the reviewer for *The Quarterly Review of Biology*, "an enormously important book written by an expert for the general scientific public. It is must reading for all interested in the antiquity of nature." Dalrymple, a Supporter of NCSE and a recipient of the National Medal for Science, is Professor Emeritus in the College of Oceanic and Atmospheric Sciences at Oregon State University.

Ancient Earth, Ancient Skies

by G Brent Dalrymple

Whereas *The Age of the Earth* was aimed at the general scientific public, *Ancient Earth, Ancient Skies* is aimed at the common reader, and it succeeds magnificently in clearly

explaining the methods and results used by scientists in ascertaining the age of the earth and of the universe. Writing in *RNCSE* (2005 Jan-Apr; 25 [1-2]: 45-6), Timothy Heaton described *Ancient Earth, Ancient Skies* as "a much-needed contribution to scientific education ... [that] takes a pivotal and complex topic and makes it very easy to understand by non-scientists. ... This book deserves a place in every school and public library."

Measuring Eternity: The Search for the Beginning of Time

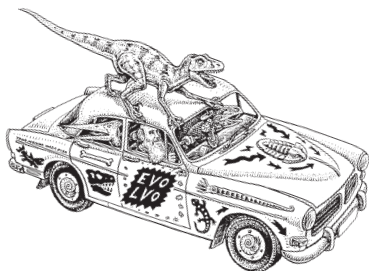
by Martin Gorst

In *Measuring Eternity*, Martin Gorst provides a readable and engaging account of attempts to ascertain the age of the world. Ranging from the time of Ussher, La Peyrère, and Burnet all the way to the Hubble Space Telescope, the book provides delightful glimpses of a variety of eccentric characters devoted to the development of a scientific chronology. "The world has not only existed much longer than was once believed," he writes toward the end of *Measuring Eternity*: "we now know that it is larger and more varied, richer and more complex, than Ussher and his contemporaries could ever have imagined."

Time's Arrow/Time's Cycle

by Stephen Jay Gould

In *Time's Arrow/Time's Cycle*, Stephen Jay Gould reconsiders the discovery of deep time by focusing on "the three cardinal actors on the British geological stage — the primary villain and the two standard heroes," that is, Thomas Burnet, James Hutton, and Charles Lyell. Challenging textbook orthodoxies and Whiggish triumphalism in the history of geology, *Time's Arrow/Time's Cycle* was praised by the reviewer for the *Times Higher Education Supplement* as carrying "an enthusiasm, intelligence and sense of purpose that render it a worthy follower to Gould's earlier work." Gould was a Supporter of NCSE until his death in 2002.



NCSE on the Road

A CALENDAR OF SPECIAL EVENTS, PRESENTATIONS, AND LECTURES

DATE June 4-9, 2006
CITY Pacific Grove CA
PRESENTER Eugenie C Scott
TITLE Creationism, Intelligent Design, and Evolution
TIME 2:00 PM (each day)
EVENT Westar Summer Institute
LOCATION Asilomar State Beach
CONTACT Eugenie C Scott, scott@ncseweb.org

NCSE SPEAKERS AVAILABLE

NAME Eugenie C. Scott
TITLE NCSE Executive Director
CONTACT scott@ncseweb.org

NAME Andrew J Petto
TITLE NCSE Board Member
CONTACT editor@ncseweb.org

DATE October 11-14, 2006
CITY Albuquerque NM
PRESENTER NCSE staff
TITLE (Booth in the exhibit hall)
TIME TBA
EVENT National Association of Biology Teachers
 National Convention
LOCATION Albuquerque Convention Center
CONTACT Nick Matzke, matzke@ncseweb.org

NAME Glenn Branch
TITLE NCSE Deputy Director
CONTACT branch@ncseweb.org

NAME Wesley R Elsberry
TITLE NCSE Information Project Director
CONTACT elsberry@ncseweb.org

NAME Nicholas J Matzke
TITLE NCSE Public Information Project Director
CONTACT matzke@ncseweb.org

DATE October 19-21, 2006
CITY San Francisco CA
PRESENTER NCSE staff
TITLE (Booth in the exhibit hall)
TIME TBA
EVENT California Science Education Conference
LOCATION Bill Graham Civic Auditorium
CONTACT Nick Matzke, matzke@ncseweb.org

NAME Susan Spath
TITLE NCSE Public Information Project Director
CONTACT spath@ncseweb.org

NAME Philip T Spieth
TITLE NCSE Director of Operations
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For example, suppose that two cubes of matter at temperatures of 11 K and 9 K are brought together, 99 Joules of heat spontaneously flow from the hotter to the colder cube (as shown), and the cubes are separated. If the heat capacities of the cubes are so large that their temperatures remain essentially constant, the change in entropy of the entire system is

$$\Delta S = \frac{Q_{\text{colder}}}{T_{\text{colder}}} + \frac{Q_{\text{hotter}}}{T_{\text{hotter}}} = \frac{99}{9} + \frac{-99}{11} = 11 - 9 = +2 \text{ J/K}.$$

Notice that this change of entropy is a positive quantity. The entropy of any system tends to increase, as energy flows spontaneously from hotter to colder regions.

THE ENTROPY OF SUNLIGHT

To examine the change of entropy necessary to generate life on earth, begin with a square, one meter long on each side, at the same distance from the sun as the earth (93 million miles) and oriented so that one side fully faces the solar disk. The amount of radiant power that passes through this area is called the solar constant, and is equal to 1373 Joules/second (Lide 2004-5: 14-2). In the absence of the earth's atmosphere, the entropy of this sunlight would equal this energy divided by the temperature of the sun's surface, known from spectroscopy to equal 5780 K. The result would give the entropy of this amount of sunlight as 0.238 J/K every second.

A more sophisticated analysis of the energy and entropy that reaches the surface of the earth is given by Kabelac and Drake (1992: 245). Due to absorption and scattering by the atmosphere, only 897.6 J of energy reaches one square meter of the earth's surface through a clear sky every second (731.4 J directly from the solar disk, and 166.2 J diffused through the rest of the sky). For an overcast sky, all the energy is from diffuse radiation, equal to 286.7 J, according to Kabelac and Drake's model. The entropy that reaches this square meter through a clear sky every second is 0.305 J/K (0.182 J/K directly from the solar disk, and 0.123 J/K diffused through the rest of the sky). For an overcast sky, all the entropy is from diffuse radiation, equal to 0.218 J/K (see figure, p 32).

So, for one square meter on the earth's surface facing the sun, the energy received every second from a clear sky is 897.6 J, and the entropy received is 0.305 J/K. If we are to apply these numbers to a study of life on earth, we must spread these quantities over the entire earth's surface (of area $4\pi r^2$) rather than the cross-section of the earth (of area πr^2) that receives the rays perpendicular to the surface. Therefore, these numbers must be reduced by a factor of 4 to represent the energy and entropy that an average square meter of the earth receives every second, as 224.4 J and 0.076 J/K, respectively.

THE ENTROPY BUDGET OF ONE SQUARE METER OF LAND

The average temperature of the earth's surface is 288 K ($= 15^\circ \text{C} = 59^\circ \text{F}$) according to Lide (2004-5: 14-3). To maintain this temperature, that one square meter must radiate 224.4 J of energy back into the atmosphere (and ultimately into outer space) every second. The entropy of this radiation is

$$\Delta S = \frac{Q}{T} = \frac{224.4}{288} = 0.779 \text{ J/K}.$$

Assuming sunny skies, this one square meter of ground gains 0.076 J/K of entropy every second from sunlight, and produces 0.779 J/K every second by radiating energy back into the sky for a net entropy creation rate of 0.703 J/K every second. In effect, the earth is an entropy factory for the universe, taking individual high-energy (visible) photons and converting each of them into many low-energy (infrared) photons, increasing the disorder of the universe. As long as life on earth decreases its entropy at a rate of 0.703 J/K or less per square meter every second, the entropy of the universe will not decrease over time due to this one square meter of earth, and the Second Law will be obeyed.

How much energy and entropy are contained in life on the earth's land surface, compared to a lifeless earth? The average biomass occupying one square meter of land is between 10 and 12 kg, mostly as plant material (Bortman and others 2003: 145). Taking 11 kg as an average, we can calculate how much energy it would take to create this biomass from simple inorganic chemicals. This can be done by reversing the process, and asking how much energy is released when combustion reduces plant life to ashes. The answer is the heat of combustion, which for wood (which we may take as representative of plant life) is $1.88 \times 10^7 \text{ J/kg}$ (Beiser 1991: 431). Multiplying these two numbers together, the energy required to generate the amount of life currently found on an average square meter of land is $2.07 \times 10^8 \text{ J}$.

If this life is generated at the earth's average temperature of 288 K, its entropy decrease will be

$$\Delta S = \frac{Q}{T} = \frac{2.07 \times 10^8}{288} = 7.18 \times 10^5 \text{ J/K}.$$

The earth's bodies of water are relatively sterile, and can be ignored; if life on land can be generated, the sparse amount of life in water can certainly be generated as well.

WHAT THE LAWS OF THERMODYNAMICS TELL US

We are now able to determine what restrictions the laws of thermodynamics place upon the evolution of life on earth. According to the First Law of Thermodynamics, heat is a flow of energy and must obey the Law of Conservation of Energy. The average square meter of land surface on earth receives 224.4 J of energy from the sun every second, and contains

2.07×10^8 J of energy stored in living tissue. The ratio of these two values is

$$\frac{2.07 \times 10^8}{224.4} = 9.22 \times 10^5 \text{ seconds} = 10.7 \text{ days.}$$

If all the solar energy received by this square meter is used to create organic matter, a minimum of 10.7 days is required to avoid violating the First Law of Thermodynamics.

The Second Law of Thermodynamics states that in an isolated system, the entropy tends to increase. The average square meter of land may balance the entropy increase due to radiation by generating a maximum entropy decrease of 0.703 J/K every second through the growth of life without violating this law. The difference in entropy between this square meter with life and the same square meter in the absence of life is 7.18×10^5 J/K. The ratio of these two values is

$$\frac{7.18 \times 10^5}{0.703} = 1.02 \times 10^6 \text{ seconds} = 11.8 \text{ days.}$$

A minimum of 11.8 days is required to avoid violating the Second Law of Thermodynamics.

The Third (and final) Law of Thermodynamics, which states that $S = 0$ J/K for a pure perfect crystal at 0 K, has no application to creationism.

CONCLUSION

Shades of a Creation Week! As long as the evolution of life on earth took longer than 10.7 or 11.8 days, the First and Second Laws of Thermodynamics are not violated, respectively. Even for an overcast sky, these numbers increase to merely 33 and 43 days respec-

tively. As evolution has obviously taken far longer than this, the creationists are wrong to invoke entropy and the laws of thermodynamics to defend their beliefs.

Of course, solar energy is not going to be converted into the chemical energy of organic compounds with 100% efficiency. It takes a growing season of several months to reestablish the grasses of the prairie, and forests can take centuries to regrow. What this study has shown is that the time constraints for these two laws are very similar. Can creationists seriously argue that there has not been enough time for the sun to provide the energy stored in the living matter we find on earth today? If not, then they cannot honestly rely on entropy and the Second Law of Thermodynamics to make their case, either.

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One Square Meter of Land Beneath the Atmosphere

ENERGY

Direct: 731.4 J

Diffused: 166.2 J

Sun-overhead
Solar Energy: 897.6 J

Average
Energy: 224.4 J

From Sun

ENTROPY

Direct: 0.182 J/K

Diffused: 0.123 J/K

Sun-overhead
Solar Entropy: 0.305 J/K

Area = πr^2

Surface Area = $4\pi r^2$

Average
Entropy: 0.076 J/K



The Life Science Prize

Michael Zimmerman, University of Wisconsin, Oshkosh

In February 1870, Alfred Russel Wallace, the co-founder with Charles Darwin of the concept of natural selection, responded to an advertisement in a journal entitled *Scientific Opinion* placed by members of the Flat Earth Society. The event, most recently told by Ross Slotten in his biography of Wallace (*The Heretic in Darwin's Court: The Life of Alfred Russel Wallace*, New York: Columbia University Press, 2004), was described by Wallace as "the most regrettable" incident in his life. The ad enticed Wallace because, short on funds, he saw an easy way to make some money. The Flat Earthers "offered a prize of £500 to anyone who could prove that the earth was a sphere." The society said it was ready to put up £500 if the contestant would match. An impartial judge would review the evidence and award the money to the winner. As Slotten says, "The offer was perhaps too good to be true, but because of his knowledge of the techniques of land surveying Wallace knew that he could easily win the bet." Indeed, he did — but the Flat Earthers began years of lawsuits and harassment of Wallace.

On February 14, 2004, a slow Saturday, I received an e-mail from a Teno Groppi inviting me to contend for the "Life Science Prize". Like the Flat Earthers over a century earlier, Groppi and his friends outlined a contest in which both parties would put money in escrow and a "judge" would decide on the winner. Groppi said the "Life Science Prize" required a \$10 000 deposit from me and from my presumptive opponent, one Joseph Mastropaolo. Groppi went on to add, "If the evolutionist proves evolution is science and creation is religion, he wins the \$20 000. If the creation scientist proves that cre-

ation is science and evolution is religion, then the creationist collects the \$20 000. The standards of evidence will be those of science: objectivity, validity, reliability and calibration. The preponderance of the evidence prevails." Groppi concluded his note with the following challenge: "If the task is too threatening for individual evolutionists, Dr Mastropaolo will entertain suggestions for terms that will bolster the courage of Darwinian dogmatists."

COMING TO TERMS

Having decided years before that it is futile to debate creationists, and knowing full well that the "Life Science Prize" was a scam designed to lure the unsuspecting into just such a debate, I decided to have some fun. I immediately wrote back saying how pleased and proud I was to be invited to contend for the prize. I also outlined my terms: "We would agree, at the outset, on our definitions. ... For a definition of evolution, we would use that which is in virtually every biology textbook for the past half century: Evolution is a change in allele frequencies in a population over time. For creation we would use that promoted by the Creation Research Society.

"Members of the society," I continued, "had to sign the following oath attesting to the fact that they believe in the following:

- 1) The Bible is the written Word of God, and because we believe it to be inspired thruout [sic], all of its assertions are historically and scientifically true in all of the original autographs. To the student of nature, this means that the account of origins in Genesis is a factual presentation of simple historical truths.
- 2) All basic types of living things, including man, were made by direct creative acts

of God during creation Week as described in Genesis. Whatever biological changes have occurred since creation have accomplished only changes within the original created kinds.

- 3) The great flood described in Genesis, commonly referred to as the Noachian Deluge, was an historical event, worldwide in its extent and effects.
- 4) Finally, we are an organization of Christian men of science, who accept Jesus Christ as our Lord and Savior. The account of the special creation of Adam and Eve as one man and one woman, and their subsequent Fall into sin, is the basis for our belief in the necessity of a Savior for all mankind. Therefore, salvation can come only thru [sic] accepting Jesus Christ as our Savior.

Alternatively, if you prefer a simpler definition of creation, I would be happy to go with that offered by the now defunct Bible-Science Association. Their statement of faith reads: 'Belief in Special Creation; Literal Bible Interpretation; Divine Design and purpose in Nature; a Young Earth; a Universal Noachian Flood; Christ as God and Man—Our Savior; Christ-Centered Scientific Research.'

I went on to address two additional points. "You talk about some debate. That confuses me. I'm not sure what the contest you propose has to do with a debate. Certainly you are not implying that a collection of individuals who are not necessarily educated in science, religion, or philosophy somehow serve as the judge for this contest.

"You also talk about handing the money to 'the judge,' which leads me to believe that you do not really mean that there will be a debate of the sort alluded to above, but you fail to mention who the judge might be. I propose that we select an individual with impeccable credentials in both science and religion. Perhaps someone like Dr Francisco Ayala. He

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is a past president of the American Association for the Advancement of Science, a member of the National Academy of Science, as well as an ordained [priest]. Of course I would be open to someone else, as long as his or her credentials were appropriate. At a bare minimum, I would require that the judge be a member of the National Academy of Science. I would then propose that both Dr Mastropaolo and I submit a text of, say, no more than 2000 words to the judge outlining our case. The judge will then determine the winner."

"NEGOTIATIONS"

Groppi wrote back telling me that "change in allele frequency is about as meaningless a definition of evolution as can be offered." And then the fun really began. I had been copying Mastropaolo on my e-mails, and he too railed against my proffered definition of evolution and provided his own "rules" for the debate, including his own definitions. He asserted, for example, that "evolution is the development of an organism from its chemicals to its primitive state to its present state." And he said that the "judge" would be "a superior court judge" since, after all, "there is no science outside the intellectual jurisdiction of the superior court judge." He also began a series of *ad hominem* remarks by stating that I "may not be competent to contend for the Life Science Prize."

I responded by indicating that I might be able to make arrangements for a federal district judge from the 9th circuit in California (assumed to be the most liberal circuit in the country) to serve. Alternatively, I said that I could get a local judge in Wisconsin to participate if he preferred. I also said that, through my connections as a consultant a number of years back to NBC, I might be able to attract the interest of either *Dateline* or Jay Leno. And, I added, that because of my past work as a nationally syndicated newspaper columnist, I should be able to generate some fairly hefty media attention — but he would have to firm up the rules and the definitions, as well as set a firm date for our contest. Mastropaolo repeatedly told me that I had the rules and continued with various *ad hominem* attacks. He wrote, for example, "Evolutionist hal-

lucinators so out of touch with reality are psychotic by medical dictionary definition, and therefore not mentally competent to contend for the Life Science Prize."

When I repeatedly said that the "rules" I had been given made no sense, Mastropaolo composed an e-mail to me in the name of Teno Groppi. He chastised me for not "paying attention," and then, under Groppi's e-mail header pasted in rules from his own web page saying that I had been given those rules days before.

KNOWING THE OPPOSITION

After completing a web search to try to figure out who Mastropaolo was, I sent messages to some of the organizations with which he claimed to be affiliated. I wrote, for example, to the Institute for Creation Research where Mastropaolo claimed to hold adjunct faculty status. The response I got back was fascinating: "Dr Mastropaolo is not on ICR's staff." When I wrote back numerous times pointing out that Mastropaolo regularly claimed affiliation with ICR, I was told that while, in fact, he did hold adjunct status, it did not mean anything and that they did not want to correspond with me any longer!

Mastropaolo was also listed on the advisory council of the Kolbe Center for the Study of Creation, so I wrote to the director, Hugh Owen, explaining about the e-mail fabrication undertaken by Mastropaolo. We engaged in quite an extended exchange while Owen claimed to be "investigating" the matter. Somewhat surprisingly, he asserted what I can only call a belief in situational ethics when he claimed that "in our Catholic Christian tradition, the morality of an action depends on the object chosen, the circumstances of the action, and the end in view," and asserted that Mastropaolo did not really do anything wrong because *my* motives were not pure enough! He then demanded that I apologize to Mastropaolo for my attempts to destroy his reputation or he would contact my "superior".

After I told Owen how to file a formal grievance against me at the University, he wrote a letter to my Vice Chancellor demanding that he

do something about my unfair attacks on Mastropaolo. Needless to say, nothing came of his letter. (Indeed over the past two decades, at two different institutions, my supervisors have received many such letters complaining about me because of the very public stances I've taken in support of evolution and sound environmental practices.) Owen also said that he would no longer correspond with me, adding, "I will continue to hope and pray that we will meet in Heaven one day."

ARE THEY REALLY SERIOUS?

My experience with the Life Science Prize extended over two months, involved detailed correspondence with numerous people, all of whom made it clear that they would refuse to discuss the matter any further, and each resulted in a letter of complaint to my supervisor. Since the level of frustration evidenced by my correspondents continued to rise with every e-mail, and since the *ad hominem* attacks on me increased over time, I consider the experience to have been a great success. And none of this even considers the fun I was having responding to each e-mail pointing out the lack of substance in the responses I was receiving while begging for an opportunity to work out an agreeable arrangement to permit me to contend for the Life Science Prize. Because all of this was done in a semi-private setting, with copies of the e-mail exchanges being distributed to a select group of people, the circus-like atmosphere usually associated with "debates" never took place.

One last point! Although the rules associated with the Life Science Prize were similar to the challenge to which Alfred Russel Wallace responded, apparently anti-evolutionary forces took their challenges more seriously a century ago; the "winner" of the Life Science Prize would walk away with \$20 000 while the "winner" of the flat earth challenge would have earned approximately \$91 980 in today's dollars.

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Non-Mineralized Tissues in Fossil *T rex*

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In the March 25, 2005, issue of *Science*, paleontologist Mary Schweitzer and her co-authors reported the discovery of intact blood vessels and other soft tissues in demineralized bone from a 65-million-year-old specimen of *Tyrannosaurus rex* housed at the Museum of the Rockies (MOR). Scientists' reaction to this discovery has been cautious; Schweitzer and others have not provided the biochemical data necessary to decide whether or not the "flexible vascular tissue that demonstrated great elasticity and resilience" is, in fact, *T rex* soft tissue. But while scientists have been appropriately skeptical of Schweitzer's claim, many young-earth creationists improperly have seized on it as evidence that the *T rex* fossil from which Schweitzer extracted the putative soft tissue, and fossils generally, are not more than a few thousand years old.

The absolute ages of all fossils ultimately hinge on radiometric dating techniques, the validity and accuracy of which are beyond reasonable doubt. These techniques are derived from the pre-eminent scientific enterprise of the 20th century: nuclear physics. If we did not know enough about radioactive materials to date things, then we would not be able to build atomic bombs. I would eagerly admit that the earth was young if it

meant that A-bombs were not real, but that Faustian bargain has been made and we must live with it. Multiple analyses using several independent radiometric techniques show that the rocks in which the MOR *T rex* was found are about 65 million years old. The age of this fossil is a settled fact.

The question that I want to ask here is why creationists see the preservation of soft tissue as evidence that the MOR *T rex* is relatively modern. The answer lies not in the muddled thinking of creationists, but in the careless and ambiguous way that paleontologists themselves discuss "fossils" and explain how fossils form.

FOSSILS AND FOSSILIZATION

While "fossil" originally referred to anything that originated in and was dug out of the earth, including gems and metals, the term in English has been used mainly in its modern sense since the early 19th century. But what is this modern sense? This turns out to be a difficult question to answer. Ignoring a handful of etymological fundamentalists, for the past few centuries "fossil" has had two distinct meanings: the remains or traces of ancient life (the time-based definition), and an object of biological origin that has undergone the process of "fossilization" (the process-based definition). The creationist challenge to the age of the MOR *T rex* is an equivocation based on this dual definition:

1. A fossil (time-defined) is old.
2. The MOR *T rex* is not a fossil (process-defined) because

the presence of soft tissue demonstrates that it is not fossilized.

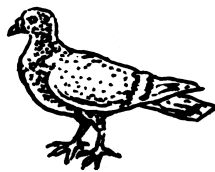
Therefore, the MOR *T rex* is not old.

The argument is invalid because each of the premises defines "fossil" in a different way. Few arguments used by creationists are as easily refuted as this, because most errors in creationists' reasoning are not simple logical fallacies, and arise instead from misinterpretations of empirical evidence and hence requiring detailed refutation. But the equivocal use of "fossil" is not a creationist invention; it is a bad habit that they learned from paleontologists themselves.

It is curious that a term so central to their science should be used so carelessly, but paleontologists rarely differentiate the two definitions of "fossil," and often use them interchangeably, even in situations that demand precision, such as in reference books. For example, Herve Bocherens (1997: 111) writes:

The chemical composition of *fossilized* vertebrate tissues is the result of the uptake, exchange, and loss of chemical elements, in two different sets of circumstances. First, during the life of the animal. ... Second, during the diagenetic evolution of the mineralized tissues (i.e., *fossilization*) this original organization of the chemical elements is altered ... [emphasis added]

Statements such as these are so common in paleontological litera-



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ture — especially as throw-away remarks in prefaces and introductions — that they tend to roll smoothly off the brain without critical evaluation. But this passage is quite ambiguous. *Fossilization*, here defined as the “diagenetic evolution of the mineralized tissues,” is a process. Unmineralized tissues apparently cannot undergo *fossilization*. But can unmineralized tissues be *fossilized*?

“Fossilized” also implies a process-dependent definition of “fossil,” because, under the time-dependent definition, becoming a fossil simply is a matter of getting old, something that hardly qualifies as a process; calling a bone “fossilized” simply because it is old would be as meaningless as calling an old chair “antique-ized.” So if unmineralized tissues can be fossilized, then there must be some way of becoming fossilized other than through fossilization, and *T. rex* soft tissue could be described as “unfossilization-ized fossilized tissue.” But if unmineralized tissues cannot be fossilized, this would imply that unmineralized tissues cannot be fossils. What, then, are “fossil” leaves, soft-body animal “fossils”, and petrified wood?

The topic of Bocherens’s article is not fossils *per se*, and the problems I point out here have no real bearing on the bulk of his excellent and informative article. Nevertheless Bocherens’s confused discussion of “fossilized” and “fossilization” is typical of the careless way that many paleontologists use “fossil,” especially when discussing “unusual” fossils such as ancient soft tissue.

For example, in reference to the purported *T. rex* soft tissue in an interview with a BBC reporter (BBC 2005), Schweitzer said:

This is fossilised bone in the sense that it’s from an extinct animal but it doesn’t have a lot of the characteristics of what people would call a fossil.

As with Bocheren, this statement sounds reasonable until you think about it. “Characteristics of what people would call a fossil” presumably refers to decay of soft tissue, petrification or some other process. But what does “fossilized

bone in the sense that it’s from an extinct animal” mean? Here Schweitzer clearly intended to use “fossil” in the time-defined way, but instead of simply using the word “fossil”, she adds the chronological qualifier “from an extinct animal” to “fossilized” — a term that connotes process. This leads to exactly the same confusion that we encountered in Bocheren. And again, as with Bocheren, I do not mean this as a critique of Schweitzer’s science. I cite these passages in order to demonstrate that we think so little about how we use “fossil” and related terms that even careful and accomplished scientists use them in careless and ambiguous ways.

WHAT WE DON’T KNOW

What accounts for this confusing hybrid terminology? The answer is the widespread assumption that the two definitions of “fossil” are logically dependent on each other; either because organic remains must be fossilized in order to become old enough to be a fossil, or because as things become old they inevitably become fossilized. These assumptions belong to the vast netherworld of scientific pseudoknowledge; bits of received wisdom that crowd encyclopedias and textbook introductions; answers to questions so basic and obvious that they are overlooked as things that must have been thoroughly discussed and decided generations ago. In the conflict over Schweitzer and her colleagues’ discovery, pseudoknowledge confronts pseudoscience.

The standard textbook account of “fossilization” might be termed the “Tin Man” story: soft tissues decay, the resulting cavities are filled with minerals precipitated from groundwater, and the original biominerals transform into or are replaced by other substances. This process results in a replica of the original object in which the original substance has been heavily altered and largely or entirely replaced by other materials.

The Tin Man story of fossilization is something of a fossil itself, having been around in essentially its present form since at least the end of the 18th century. The third edition of the *Encyclopedia*

Britannica, published in 1795, describes “Petrification” as follows:

A petrified substance, strictly speaking, is nothing more than the skeleton, or perhaps image, of a body which has once had life, either animal or vegetable, combined with some mineral. Thus petrified wood is not in that state wood alone. One part of the compound or mass of wood having been destroyed by local causes, has been compensated by earthy and sandy substances, diluted and extremely minute, which the waters surrounding them had deposited while they themselves evaporated. These earthy substances, being then moulded in the skeleton, will be more or less indurated, and will appear to have its figure, its structure, its size, in a word, the same general characteristics, the same specific attributes, and the same individual differences. Farther, in petrified wood, no vestige of ligneous matter appears to exist.

More modern variants simply embellish this story with chemical language, substituting atoms, molecules, or minerals for “diluted and extremely minute” substances, for example. Pulling a book off my shelf at random, I encounter this:

After an animal dies, if it is to become a fossil, it must be buried before the elements destroy the carcass, completely....After burial, minerals carried by percolating groundwater are deposited in vugs within the bone structure, or they may actually replace bone salts, literally turning the bone to stone. (Jacobs 1993: 47)

Both passages give readers the sense that scientists have a pretty good understanding of what happens to fossils in the ground. In reality we have no such understanding. Indeed, it is only in the past 15 years that paleontological geochemists begun to address, in a serious and organized way, basic questions about why some things endure long enough to become fossils. To date, these efforts have



revealed important details about the chemical behavior of some fossils in some settings, but we are a long way from the kind of systematic knowledge implied by the cited passages.

The new understanding we do have of fossils unfortunately has been used to revamp and reinforce the Tin Man story, rather than to challenge it. For example, in the introduction to their textbook on dinosaurs, Fastovsky and Weishampel (2005: 8–10) write:

Bone is made out of calcium (sodium) hydroxyapatite, a mineral that is not stable at temperatures and pressures at or near the surface of the earth. This means that bones can change with time, which in turn means that most no longer have original bone matter present after fossilization. This is especially likely if the bone is bathed in the variety of fluids that is associated with burial in the earth. ... If, however, no fluids are present throughout the history of the burial ... the bone could remain unaltered, which is to say that original bone mineralogy remains. This situation is not that common, and is progressively rarer in the case of older and older fossils.

This explanation of what happens to buried bones is vastly better than most. It makes the important but seldom articulated point that bone will not necessarily decay just because it is unstable, and leaves open the possibility that unaltered bone and soft tissues can survive. The authors make no implausible claims, and it is possible that a century from now we will know that everything they wrote was entirely correct.

But we are not living a century from now, and in the meantime much of what Fastovsky and Weishampel present as fact is really educated conjecture. We do not know that most fossil bone no longer contains its original bone material; we do not know that for bone to survive unaltered it must be isolated from fluids throughout its history; most importantly we do not know that the preservational

state of bone is directly related to its age. As in the previously quoted passages, Fastovsky and Weishampel present their story of how things become fossils as if it were based on well-understood facts. And their story still largely is the Tin Man story: except under extraordinary conditions, fossils undergo the same replacement process that was expounded in the *Encyclopaedia Britannica* over 200 years ago.

It is this habit of presenting conjecture and tentative knowledge as settled fact that makes paleontologists vulnerable to creationist attacks based on “extraordinarily” well-preserved fossils. In reference to the MOR *T rex*, the ICR claims:

Would evolutionary theory have predicted such an amazing discovery? Absolutely not, soft tissue would have degraded completely many millions of years ago no matter how fortuitous the preservation process. Will evolutionary theory now state — due to this clear physical evidence — that it is possible dinosaurs roamed the earth until relatively recent times? No, for evolutionary theory will not allow dinosaurs to exist beyond a certain philosophical/evolutionary period. (Sherwin 2005)

The discovery of intact *T rex* soft tissue indeed would challenge prevailing scientific thinking, if not, as the author claims, “evolutionary theory”. This discovery can be reconciled with the Tin Man story only by invoking extraordinary causes. These invocations come across as makeshift attempts to prop up an exhausted hypothesis — which in fact they are. From the same BBC article previously cited:

Dr Schweitzer is not making any *grand claims* that these soft traces are the degraded remnants of the original material — only that they give that appearance.

She and other scientists will want to establish if *some hitherto unexplained fine-scale process* has been at work in MOR 1125, which was pulled from the famous dinosaur rocks of eastern

Montana known as the Hell Creek Formation. (BBC 2005; emphasis added)

Rich Deem, writing at the creationist site godandscience.org, explains:

[Schweitzer] indicated that the bones have a distinct odor, characteristic of “embalming fluids.” Therefore, it is possible that the bones landed in *some chemical stew* that preserved the soft tissue inside from decomposition.... The new study reveals that the cortical bone within *T rex* [femora] may, under certain conditions, retain cellular and subcellular details. Under normal conditions, fossilization replaces living material with minerals. In this case, the soft tissue was protected from degradation, *possibly through some chemical process*, then desiccated to prevent further changes. (Deem nd; emphasis added)

Creationists know a weak spot when they see one, and dodgy phrases like “some hitherto unexplained fine-scale process” and “some chemical stew” advertise a weak spot like a giant gorilla balloon over a used car lot. The fact that the weakness is in our understanding of fossils, not of evolution or the age of the earth, is a subtle distinction that creationists do not make and their audience does not grasp.

Often the best defense is a frank admission of ignorance. “How do you explain the presence of soft tissue in a 65 million year old fossil?” Based on what we really know about fossils (and assuming the soft tissues are real and not just globs of glue) the best answer to this journalistic question is “I have no idea. But since we don’t know very much about why things become fossils in the first place, that’s not surprising. What we *do* know is that this particular fossil is 65 million years old.” Neat narratives like the Tin Man story are betrayals of the honest ignorance that is the heart and engine of science.

THINGS FALL APART

Everyday experience teaches us that dead organisms and their



traces do not last long when they are exposed to the ordinary wear and tear of the earth's surface: scavengers of all sizes, the effects of sunlight, mechanical and chemical weathering, and so on. From this experience it is easy to apprehend the notion that things spontaneously fall apart unless some process intervenes to preserve them. To the extent that "fossilization" means anything, it means preservation from destruction.

Organic remains must not be destroyed if they are to endure, yet there is a subtle but important error in jumping from this tautology to the view that preservation is an active process. Preservation is nothing more than the evasion of the process of decay. Decay, not preservation, is the active process; and decay can be avoided in many — perhaps in infinitely many — ways. If nothing happens to stop it, a dead organism will become a fossil. This applies to all parts of the organism, soft tissues as well as hard.

Imagine that, before you leave your house in the morning, you put a rock on your kitchen table. When you return home that evening, you expect the rock to be there. It would never occur to you to think of a cause for its still being there, because things that do not happen do not have causes. If nothing happened to change it, the rock still would be there after a week, or a year or a hundred years. *Not* finding the rock where you left it is what would demand an explanation, regardless of how long you left the rock untended.

This reasoning would also apply if you built a house of cards on your kitchen table. A house of cards is intrinsically less stable than a rock, so upon your return you would not be surprised to find that it had collapsed. In fact, you might be surprised to find it still standing, especially if you had been gone for a long time or you owned cats. But even so, if the house of cards did survive, you would not invoke a special process to explain this. You might say "I didn't expect that — it must be stronger than I thought," but I doubt that you would ask yourself what stabilizing force, or process, intervened to spare your creation. Merely extending the time that you left the house of cards

standing would not change this. If you checked back in a billion years from now you would be amazed to find your continent in the same place you left it, not to mention your kitchen and its tabletop sculpture. But if you did find the house of cards intact, it still would not demand a cause. Again, things that do not happen do not have causes.

The same is true of fossils. We may be surprised to find fragile structures and materials, that in ordinary experience are impermanent, preserved after millions of years; but preservation does not have a cause. Preservation simply means that *nothing has happened*. This is not to deny that the continued existence of fossils has explanations, and it is true that certain conditions strongly favor the preservation of fossils; but these explanations and conditions are not the *cause* of the fossil's survival, any more than not taking a pain killer is the cause of pain. The fossil owes its survival to its own intrinsic stability.

THE STABILITY OF UNSTABLE THINGS

No part of any organic remain is absolutely stable. For example Fastovsky and Weishampel are correct when they note that apatite in bone is unstable at surface temperature and pressure. Indeed bone apatite is unstable at *any* pressure and temperature and will tend to recrystallize into other, more stable, minerals. But, as Fastovsky and Weishampel point out, this does not mean that bone mineral actually will make this change. The mere fact that something is unstable does not mean that it will decay, just as the fact that a house of cards is unstable does not mean that it will fall down. Decay happens only if the bone is in an environment that permits it.

But even if we know that a material is unstable and is in an environment that permits it to decay, we still know nothing about how quickly that decay will happen. It can be easy to determine the thermodynamic stability of materials, but it is notoriously difficult to predict the rate at which an unstable material actually will decay into something else, or even if it will decay at all. All forms of

carbon other than carbon dioxide are thermodynamically unstable in the earth's oxygen rich atmosphere, yet we live in a world full of carbon-based paper, plastic, tables, clothes, and carpets; and have adopted one of the most thermodynamically unstable forms of carbon, the diamond, as a symbol of permanence. Many familiar minerals, including pyrite, feldspar, and quartz, are unstable on or near the earth's surface. Yet we do not marvel at the discovery of intact grains of quartz in half-billion year old sandstone.

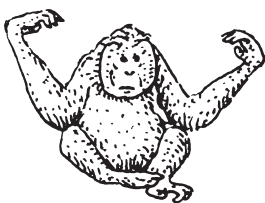
HUMAN VERSUS CHEMICAL TIME

The crux of the creationist argument that the MOR *T rex* could not be more than a few thousand years old is the commonsense idea that the older the fossil, the more altered it will be. This also is part of the Tin Man story. But the relationship between age and alteration is not as straightforward as common sense would suggest, because the humans experience time differently than molecules and atoms.

The various processes that cause decay tend to work on very short time scales. As humans, we would regard a chemical compound that completely degrades after one minute as extremely unstable, but from a molecule's point of view a minute is a very long time. A molecule that has survived for a minute has beat the odds; it has survived trillions of bond-straining vibrations and contortions, and assaults from an army of chemical agents that destroy most molecules almost the instant they form.

Radioactivity provides us with a well-studied example of how decay processes work. Atomic nuclei contain protons and neutrons. In theory protons and neutrons could be combined in an infinite number of ways. For example, we could combine one proton with 100 neutrons and make a nucleus of hydrogen-101. But this nucleus would be so unstable that it would break apart the instant that it formed. Almost all conceivable combinations of protons and neutrons are so unstable that for all practical purposes they cannot exist.

There are about 4800 exceptions, nuclides that are stable



enough to be studied. About 400 of these nuclides are so stable that they are called “stable nuclides”: they either do not decay, or decay so slowly that we have not observed it. The remaining 4400 nuclides are known to decay, with half-lives ranging from a few millionths of a second to over one trillion years.

Among these unstable nuclides, the median half-life is about two minutes. This means that if you randomly assembled nuclei and measured the half lives of those that were stable enough to hold together for a millionth of a second or so, the average half life would be about two minutes. From a human point of view, two minutes is a very short time. But in the first two minutes of its existence, nature has expended half of its destructive arsenal at any randomly constructed nucleus; such a nucleus will experience the same total intensity of destructive forces during its first two minutes that it will experience during the next trillion years. In terms of the likelihood of decay, two minutes is half way to a trillion years. About 97% of unstable nuclides have half-lives shorter than 75 years. So, from a nuclide's point of view, a human lifespan and the age of the universe are about the same.

The same is true of the molecules and crystals that make up organic remains. When thinking of how a dead plant or animal decays, we tend to concentrate on processes that occur on time scales that are easy for humans to observe, and then extrapolate these into the future. But humans observe only the very early stages of decay, a period corresponding to the first few minutes in the life of a nuclide. Even so, we observe the same steep decline in the rate of decay that nuclides display. A raccoon that dies in your attic will decompose rapidly for a month or so, but thereafter will change little for many years. Unless someone moves it, the coyote skull on my shelf will still be there tomorrow, 20 years from now, and 1000 years from now.

From the point of view of a fossil, 1000 years probably is a lot closer to 100 million years than it is to a month. If the preservational

state of a fossil correlates in any law-like way with its age, it most likely is with the nth root of its age, and not its age directly.

CONCLUSION

Anyone who believes that fossils must undergo radical transformations in substance that are proportional to their age will always be confounded by discoveries such as those reported by Schweitzer and others (2005). For over 100 years the scientific world regularly has been surprised by accounts of fossil bones that are so “extraordinarily well preserved” that microscopic details, such as the cavities left by bone cells, still can be seen. Yet such preservation is not only common, but in some categories of fossils it is the rule. Probably most fossil bone preserves microscopic detail, and exquisite preservation also is common in plant, mollusk, and many other kinds of fossils.

Exquisite preservation is surprising only because it clashes with poorly supported preconceptions about what fossils are and how they form, preconceptions that are reflected in loaded yet ambiguous terms like “fossilization.” We cannot properly describe any fossil as “extraordinary” unless we first know what “ordinary” is. This is something that paleontologists only are beginning to understand.

The creationists have found a real weakness in the way scientists discuss fossils and hardly should be blamed for using this weakness to their advantage. The creationist challenge provides us with a good opportunity to clarify our thinking, and with object lessons in the dangers of using poorly defined terms when clarity is needed, and substituting time-honored narrative for real knowledge.

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JUDGE JONES SPEAKS

Federal judge John E Jones III, who presided over *Kitzmiller v Dover*, was interviewed by the *Philadelphia Inquirer* (2006 Feb 26; available on-line at <<http://www.philly.com/mld/inquirer/news/editorial/13961518.htm>>).

Jones said that he addressed the controversial issue of whether “intelligent design” qualified as science because “both sides, plaintiffs and defense, asked me to rule on that issue.” He also clarified his statement that “no one [was] in a better position to decide” the issues than he was, explaining, “What I meant was that no one else had sat through an intensive six weeks of largely scientific testimony.”

Jones remarked that he wanted the opinion “to stand as a primer so that folks on both sides of the issue could read it, understand the way the debate is framed, see the testimony in support and against the various positions,” adding, “it’s now evident that it’s being used that way.”

Asked to discuss his ruling further, Jones replied, “The opinion speaks for itself.” But in light of the length and completeness of the testimony in the case, he added: “To my mind ... it would be a dreadful waste of judicial resources, legal resources, taxpayer money ... to replicate this trial someplace else.”





Framing the Issue: The “Theory” Trap

David Morrison

There is little indication that the hostility of a large part of the American public to the teaching of evolution is abating, in spite of recent court wins. We seem to be losing the battle to explain the central role that evolutionary concepts play in modern science, as indicated by the many sad and disturbing stories in the Jan-Apr 2005 issue of *RNCSE*.

While there are no “silver bullets” in this struggle, there are ways to improve our communications with the public and decision makers, such as school boards. The most obvious is to stop referring to the “theory of evolution”. “Theory” is the wrong word for public discourse. In America today, everyone understands “theory” to be a synonym for an unproven hunch or guess. No wonder that a majority of those polled agreed that “evolution is commonly referred to as the theory of evolution because it has not yet been proven scientifically.” Those who advocate adding “only a theory” disclaimers in textbooks know that to call evolution a theory is sufficient to undermine its acceptance.

We encounter this problem in almost every discussion of evolution, including those reported in the Jan-Apr 2005 issue of *RNCSE*. Typical is the comment from the Texas legislator quoted on page 16: “Evolution is a theory ... It is a theory, not a fact.” The most common rejoinder is to explain that a scientific theory is. William Wisdom, in his fine three-minute statement (p 10), feels he must say, “It is important to understand that scientists do not use the word ‘theory’ to mean a hunch or a guess or

even a hypothesis.” Dina Drits in her article on preventing misconceptions in elementary education says that teachers of even young children “should explain the difference between the scientific usage of a term such as ‘theory’ and the vernacular usage.” Most of the formal statements made by professional organizations in support of evolution devote several sentences to explaining that “theory” has a different meaning in science.

In other contexts, a theory is a hunch that a detective comes up with in a murder mystery. It is one of several competing ideas, none of them proved. It is common to say that something is theoretically true, while the facts are otherwise. We should accept this usage. Is it wise, before asking someone to consider that their opinions about evolution might be wrong, to require that they accept a contrary definition for a familiar word? Anyone who teaches knows how hard it is for students to unlearn things they already know and believe.

Words, too, evolve. Just as we no longer use the term “gay” for any light-hearted pleasure (remember the carol with the verse “don we now our gay apparel?”), we need to drop the anachronistic use of “theory”. In college science or philosophy classes we can retain the older meanings of words such as “theory” and “hypothesis”, but we should not expect the public to revert to this usage.

Even among scientists, however, I rarely hear the “theory of” phrase. When is the last time you read about the Theory of Gravitation, or the Atomic Theory of Matter, or the Theory of Plate Tectonics? These phrases have a vaguely antique flavor. Today, gravitation and atoms and plate tectonics are accepted as legitimate subjects that do not need the preface “Theory of ...”. The only two areas I know where “Theory of” remains in common

use are Theory of Relativity and Theory of Evolution. Among the public, relativity is associated with Einstein, an unworldly genius whose work was abstract and unintelligible. Is that the kind of association we want for evolution?

I suggest that the root problem is allowing the opponents of evolution to frame the discussion. *Framing* involves the selective use of language or context to trigger emotional responses, either support or opposition. The subject is artfully described in the short book by George Lakoff called *Don't Think of an Elephant* (White River Junction [VT]: Chelsea Green, 2004). Channeling the discussion into a debate over the “theory of evolution” is an example of framing.

One possibility is to refer to the fact of evolution. Another is to distinguish between evolution itself (change through time and common ancestry) and Darwinian (or neo-Darwinian) evolutionary theory. There was ample evidence for the fact of evolution even before Darwin, but he supplied the crucial understanding of the mechanism of natural selection. Today, insights from genetics are further clarifying the way evolution works. But in dealing with the public, I prefer discussing simply “evolution”, the same way we might discuss plate tectonics or genetics or any other branch of science.

To debate the “theory of evolution” is a trap. It is letting our opponents frame the discussion for their benefit. Once we stop defending the theory of evolution, we are also free to criticize “only a theory” disclaimers in textbooks without apology or diversionary explanations.

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YOU TELL ME THAT IT'S EVOLUTION ... *Arthur M Shapiro, University of California, Davis*

The study of natural hybridization and hybrid zones has been a lively area in population biology for decades. One of the longest-running case histories is that of the sulphur butterflies, *Colias eurytheme* and *Colias philodice*, which hybridize in cultivated alfalfa fields across most of temperate North America. Rather than having a distinct hybrid zone, they hybridize everywhere they are sympatric, but retain their identities nonetheless. In this regard they behave less like animals and more like plants (oaks, for example, which — to quote Daniel Axelrod — have been hybridizing since the Miocene, but “nothing ever comes of it!”).

Discussions of what was “really” going on with *Colias* began in the 1880s and have continued despite numerous conceptual and methodological advances relevant to the problem. But no one had undertaken a study to track the system through many generations until 1981, when I initiated a long-term study of the frequency of hybridization and its relation to population density on a single ranch in northeastern California. The ranch's owner was bemused at, but fully supportive of, the exercise. I sampled every two weeks, following a strict protocol in exactly the same fields from 1981 through 2004; this amounted to approximately 66 generations

of *Colias*, a unique data set in the annals of hybrid study.

As the study progressed, the owner grew old and became ill. He sold his ranch and retired, but the new owners let me continue the study. Last fall they informed me they intended to convert most of the fields where I sampled to a different crop. I figured that meant the end of the study, since data from another site would not be truly comparable to the previous data, but over the winter I wrote to the owners to explore potential options — basically to say I would come around in spring, observe the situation on the ground and decide whether or not to continue. I wrote on the letterhead of my academic unit at UC-Davis, the Section of Evolution and Ecology. My letter evoked the following reply, reproduced in its entirety, with the names of the senders deleted for privacy:

Dear Dr. Shapiro:

I am writing to let you know that we are ending our agreement that allows you to study the butterflies on our ranches. Until your letter last December, we were not fully aware of your position with the University. We did not understand that you represented the Dept of Evolution and Ecology. I do not believe that we are of the same conviction

as to the creation of our earth. We strongly believe in a literal 6-day creation of earth, by God. That He and He alone sustains all living matter in an orderly fashion. We, as a family, do not support the study of evolution. Because of these differences, we would choose that you no longer continue your studies on our property. We hope and pray that through your studies of God's vast creation that you will come to know Him in a real and personal way.

Sincerely, /s/ Mr and Mrs X

So the study is over, we are finally analyzing the data (and the timing could not have been better), and for the first time in my now 40-year career I have encountered creationism as a factor in my research program. From a sociological standpoint, I am intrigued by the first-person singular pronoun used by the writer of the letter, which nonetheless is signed by Mr and Mrs X (in that form, in one handwriting). Ah, me.

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I know a place ... *Phil Plait, Sonoma State University*

I know a place where the Sun never sets.

It's a mountain, and it's on the Moon. It sticks up so high that even as the Moon spins, it's in perpetual daylight. Radiation from the Sun pours down on it day and night, 24 hours a day — well, the Moon's day is actually about 4 weeks long, so the sunlight pours down there 708 hours a day.

I know a place where the Sun never shines. It's at the bottom of the ocean. A crack in the crust there exudes nasty chemicals and heats the water to the boiling point. This would kill a human instantly, but there are creatures — bacteria — that thrive there. They eat the sulfur from the vent and excrete sulfuric acid.

I know a place where the temperature is 15 million degrees, and the pressure would crush you to a microscopic dot. That place is the core of the sun.

I know a place where the magnetic fields would rip you apart, atom by atom. It is the surface of a neutron star: a magnetar.

I know a place where life began billions of years ago. That place is here, the earth.

I know these places because I'm a scientist.

Science is a way of finding things out. It's a way of testing what's real. It's what Richard Feynman called “A way of not fooling ourselves.”

No astrologer ever predicted the existence of Uranus, Neptune, or Pluto. No modern astrologer had a clue about Sedna, a ball of ice half the size of Pluto that orbits even farther out. No astrologer predicted the more than 150 planets now known to orbit other suns. ... But scientists did.

No psychic, despite their claims, has ever helped the police solve a crime. But forensic scientists have ... and do all the time.

It wasn't someone who practices homeopathy who found a cure for smallpox or polio. Scientists did: medical scientists.

No creationist ever cracked the genetic code. Chemists did. Molecular biologists did.

They used physics. They used math. They used chemistry, biology, astronomy, engineering. They used science.

Those places I talked about before — you can get to know them too. You can experience the wonder of seeing them for the first time, the thrill of discovery, the incredible, visceral feeling of doing something no one has ever done before, seen things no one has seen before, know something no one else has ever known.

No crystal balls, no tarot cards, no horoscopes. Just you, your brain, and your ability to think.

Welcome to science. You're gonna like it here.

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[Originally posted at <<http://www.badastronomy.com/bablog/>> and reprinted with permission.]



RESPONSE TO JOHN C GREENE

As I read John C Greene's, "Impressions of the Claremont Conference & Ernst Mayr" in *RNCSE* (2004 Sep/Oct; 24 [5]: 34-7) I became annoyed, nay, incensed, at the conclusions stated in his last two paragraphs.

I found it unacceptable that someone writing for an NCSE publication would even wonder or suggest that to beat the creationists' efforts at removing the teaching of evolution from the public schools, it would be necessary to give evolution "some kind of religious meaning". For justification of his musings, Greene refers to Denis Alexander of St Edmund's College, Cambridge University, and cites his credentials as being that of a molecular immunologist who is also an ardent Christian and an ardent Darwinian. And why is Greene so enamored of these credentials? Because, as he states: "Alexander finds the biblically-based critical realism of the Bible a solid, intellectually coherent, and morally inspiring framework for both science and religion."

There are several advertent or inadvertent implied insults in Greene's conclusion. First, he is insulting anyone who refuses to accept the concept that the "Bible" refers to the Christian Bible. Jews have the original Bible, called the Tanakh (Holy Scriptures or the Holy Books), which the Christians derogatorily refer to as the "Old" Testament. Mormons have a Bible called *The Book of Mormon* and of course, the Moslems have the Koran. He insults those of us who find the Christian Bible to be a morally repugnant religious-political document that has been, for dozens of centuries, and still is the

cause of some of the greatest evil that one human could ever inflict on another. How quickly and conveniently people tend to forget the lessons of history.

Greene is insulting anyone who does not "believe" in the Bible. He seems to dismisses completely the possibility that others have not and do not find the Christian Bible to be intellectually coherent and morally inspiring. Thomas Jefferson, no slouch when it comes to being an intellect, saw fit to edit the Christian Bible to make it coherent and morally fit for his consumption.

In addition to these implied insults, Greene adds one more: asking rationalists to accept as valid the typical religious claim to knowledge — the appeal to religious authority and not to empirically derived data. Without knowing more about Alexander's specific beliefs, I cannot comment knowledgeably about how an evolutionist could still believe in a concept such as original sin. As I explain in my book, *The Naked Mind* (Flagstaff [AZ]: Best Publishing, 2003), evolution, by its very nature, destroys the underlying basis of Christianity.

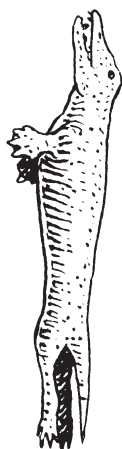
Greene goes on to say that students should be "given a chance to discuss the question freely." There seems to be the implication that this has not been done before. I did it on the college level. Discussing evolution with students who do not even know what science is and what are the basic differences between science and religion is a waste of time. One must spend a considerable amount of time explaining these subjects if there is going to be hope of any meaning-

ful discussion. I discussed issues pertaining to evolution and creationism with non-science majors in the life sciences (Introduction to Biology) and the history of biology courses I taught at the University of South Alabama for over 15 years. I can attest to the fact that trying to teach these subjects to students who are awash with religiosity is very difficult. My experiences have been detailed in *The Naked Mind*.

Greene's suggestion, of having students discuss controversial subjects, without proper foundation, sounds more like a bull session than one designed to teach and enlighten. Before suggesting that these issues be aired in classrooms either at the K-12 or college level so that a variety of student opinions could be heard, Greene and others ought to make sure that students and teachers, irrespective of how open-minded they are, understand the material I mentioned in the preceding paragraph, and also understand fully the meanings of the word "belief" and its derivatives. The subject of belief also is covered in *The Naked Mind*.

As I used to tell my students: This is the USA. You have the constitutional right to believe whatever rationality or irrationality you want. I am not interested in your beliefs — I have had students witness to me — I am interested in what you know and how you know it.

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REPLY FROM JOHN C GREENE

Sheldon Gottlieb, ignoring the main body of my "Impressions of the Claremont Conference," becomes enraged that I should suggest the possibility that the struggle to repel creationist attacks on the teaching of evolution in the public schools might be more successful if "evolution" could be given some kind of religious meaning. Phillip Johnson was inspired to lead the crusade against evolution by reading Richard Dawkins's *The Blind Watchmaker*. "To every action there is an equal and opposite reaction," Newton said in a quite different context, but perhaps the same is true in the battle over evolutionary science. Alfred North Whitehead offers a way of giving evolution religious meaning, as John Cobb and David Griffin have shown. Denis Alexander offers a Christian way of ameliorating the conflict. Still other ways are available.

Gottlieb describes himself as a rationalist who believes the test of truth is "empirically derived data". Thomas Jefferson wrote: "We hold these truths to be self-evident: that all men are created equal ..." Does evolution prove that, or does Jefferson mean "created equal in the sight of God"? Jefferson was a deist believing in a Creator. During the controversy over the Missouri

Compromise he wrote in a letter to a friend: "Indeed I tremble when I think that God is just and that his justice will not sleep forever."

As to discussing controversial issues with students brought up in different intellectual and religious environments without pre-indocinating the students, I learned how to do that teaching the Great Books at the University of Chicago, working with students, some of whom were of high school age. When three such students came to my office to ask me: "Dr Greene, is it true that Freud can explain Luther?" I replied: "Yes, that is true. But it is also true that Luther can explain Freud. It all depends on what your terms of explanation are." Although Ernst Mayr was an atheist and I a Christian, we managed to conduct our two decades of "mutual education correspondence" (as Mayr called it) without rancor. His last letter to me, late in his life, concerning an essay of mine titled "Science and spirituality: A dialogue with Ernst Mayr" was signed "Affectionately yours, Ernst." Neither of us believed in "naked minds".

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THE BUZZ ON EVOLUTION IN SOUTH CAROLINA

In a recent interview, South Carolina's governor, Mark Sanford (R), displayed a stunning degree of ignorance of evolutionary theory: "The idea of there being a, you know, a little mud hole and two mosquitoes get together and the next thing you know you have a human being is," he opined, "completely at odds with, you know, one of the law of thermodynamics." See *The Post and Courier* (Charleston) 2006 Jan 31; available on-line at <<http://www.charleston.net/stories/?newsID=68174>>.

EVOLUTION AND RELIGION

From time to time, readers will raise objections like Gottlieb's that RNCSE in particular and NCSE in general go too far in accommodating religious traditions that grapple with the impact of evolution on their doctrinal positions. This is a good occasion to reiterate that NCSE is religiously neutral and takes no position on the validity of theological or doctrinal perspectives on the meaning and purpose of life. Neither does NCSE take any position on compatibility of evolutionary thinking with specific religious traditions, accepting that it is within the purview of those who follow these traditions to make these judgments.

We recognize that much of the religious opposition to evolution has come from within a conservative Christian theological tradition, and so it is not surprising that most of the attention of NCSE programs that address the interaction of religious and scientific perspectives frequently focus on organizations representing these traditions. We acknowledge that opposition to evolution, as well as reconciliation with it, is not limited to theologically conservative Christians nor their particular interpretation of Scripture.

Still, as Greene suggests, finding a way to address the concerns of members of those religious traditions is an active arena in the science-religion dialog and one at which NCSE intends to be an active participant because of the benefits that we expect to accrue from a fuller and more accurate representation of evolution within these traditions.

BOOKREVIEWS

INTO THE COOL: ENERGY FLOW, THERMODYNAMICS AND LIFE

by Eric D Schneider and Dorion Sagan
Chicago: University of Chicago Press, 2005. 362 pages

Reviewed by Sonya Bahar,
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As readers of *RNCSE* are undoubtedly all too aware, a familiar creationist argument runs as follows: since the Second Law of Thermodynamics says that disorder is increasing, how can evolution, which involves an increase in complexity, possibly have occurred? The answer has been repeated before almost every school board in the country, and in more than a few courtrooms: first, the Second Law of Thermodynamics addresses an increase in the *total* entropy of a system, but does not in any way preclude *local* decreases, and, second, there are other driving forces aside from the Second Law of Thermodynamics, as the last few decades of research on self-organization in complex systems have amply shown. *How* those other “organizing” forces actually drive evolution, self-organization, and complexity, however, remains a wide-open question and a very active area of interdisciplinary research.

Eric D Schneider and Dorion Sagan weigh in on the argument with their new book *Into the Cool: Energy Flow, Thermo-*

dynamics and Life. Their central thesis is contained in the striking catchphrase “nature abhors a gradient”; they propose that it is the *flow of energy down gradients* that is the central driving force that balances the Second Law’s drive toward disorder. It is a striking and provocative thesis and certain to inspire new ways of thinking in many scientists studying complexity in biological systems. Unfortunately, the catchphrase is unlikely to provide as sweeping a solution as the authors propose, and it is packaged in a book that suffers from a number of flaws likely to put off many readers. The book may aim for the sharp clarity of Richard Dawkins, or the charm and scintillating wit of Stephen Jay Gould (the flyleaf even makes a comparison to Darwin!). But, plagued by overblown hyperbole and intellectual sloppiness, it falls far short.

The book begins with a clichéd review of the history of science. Newton enters, straight out of central casting, accompanied by his faithful “clockwork universe”, and endless references to apples. A wince-inducing chapter subheading reads: “Clunk Goes the Clockwork Cosmos”. The section begins with a description of Robert Boyle’s work in the “twilight of thermodynamics”. One would think that authors who show a deep concern for time’s arrow (“Thermodynamics had released the arrow of time,” they write on page 36. “It went quivering into Newton’s shiny smooth apple, generating heat as friction.”) would appreciate the distinction between twilight (end of the day) and dawn (beginning), which is, historically, where Boyle was in relation to the history of thermodynamics. One might be struck by the quivering-arrow metaphor, but the metaphors fall too thick and fast to be taken seriously. “The

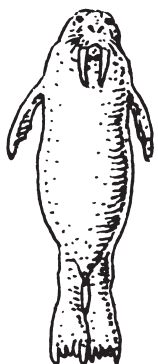
wake-up call [of thermodynamics] is still reverberating in the collective scientific mind, still groggy from Newton’s dreams.” “Classical thermodynamics upset the Newtonian applecart.” You get the idea.

The authors set up a false dichotomy between the “celestial clockwork” and thermodynamics, which “messed all that up. It measured loss, and implied that — despite the magnificent motions of the planets — time moves in only one direction. The direction of burning.” But Newton was familiar with burning: he was an alchemist, whose mystical views strongly influenced his science. Neither scholars nor the readers of a popular science book (and *Into the Cool*, published by a university press, appears to aim to be more than that) should be treated to such a cartoon version of the history of science.

Having dispensed with Newton and Boyle, we enter the history of thermodynamics. Following a discussion of irreversibility, the authors’ attempt at metaphor turns ugly as they refer to Ludwig Boltzmann’s suicide as “an irreversible act”. If this is an attempt at humor, it is unnecessary and cruel.

Into the Cool becomes equally problematic when it moves toward the exposition of the authors’ “grand theory” that thermodynamic gradients drive evolution. This exposition, to the reader’s great frustration, is approached, but never consummated. The *mechanism* by which a system’s motion down a gradient leads to complexity remains unexplained, unless one can infer that this occurs simply because *competition for more efficient methods of exploiting gradients* drives evolution. The authors do make this point, but they constantly imply that more is going on than this — but what that “more” is, they never clearly articulate.

The authors replace clear exposition of a scientific idea by the use of sweeping metaphors that hold little substance. “Separate from the world, we are yet inextricably connected to it.” (How are we separate from the world?) A paragraph later: “Metastable processes underlie the selves we mistake for things.” And



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finally, one which had this reviewer's metastable self reaching for the unstable equilibrium of a stiff drink, "... the cyclical pendulum of scientific overreaction has perhaps reached its apex, coming to just that point where the potential energy of its historical emphasis is ready to give way to the kinetic energy of physics as a factor in macroevolutionary explanation" (p 152).

Excessive tendency toward metaphor and cliché could be forgiven, were it balanced by clear exposition of a strong idea. The idea of the central role of gradients in the organization of life is tantalizing, intriguing, and definitely worth pondering. But the authors never settle down to a clear exposition of how gradients lead to increased complexity. They skitter from one subheading ("Mousetraps and Dynamite", "Toward a Science of Creative Destruction", and so on) to another, never staying in one place long enough to build a coherent argument. The book is also frustratingly filled with scientific inaccuracies: bifurcation is confused with bistability (Figure 6.1), hysteresis is mistakenly defined as "retardation or lagging" (p 129), population biology is confused with population genetics (p 145), and on the same page we are told that "Darwin connected all living beings through time to a single origin." Did he?

More frustrating than the inaccuracies, and the arguments that begin but are never completed, are the arguments that simply make no sense. The authors decry algorithmic models of complexity, inexplicably conflating such models with the idea that the laws of physics change, and condemning both "inevitable casual[ies] of a thoroughgoing evolutionary world-view." How does the emergence of complex structures from simple algorithmic rules relate to the notion of the gradual changing of fundamental constants of nature? If there is a connection, it is far from obvious, and it is certainly not explained.

Despite its inaccuracies and hyperbolic atmosphere, *Into the Cool* raises provocative questions as to the role of thermodynamic gradients in the origin of complex-

ity and in evolution. It is a shame that Schneider and Sagan develop these ideas neither clearly nor fully, and fail to set them in the context of other well-studied influences on the development of complexity in living organisms. Had they done so, the authors might have made a much stronger case for the primacy of gradients.

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THE COUNTER-CREATIONISM HANDBOOK

by Mark Isaak
Westport (CT): Greenwood Press,
2005. 330 pages

**Reviewed by Tim M Berra,
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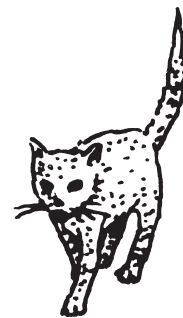
Anti-evolutionists have taken aid and comfort from the political resurgence of the religious right as reflected in the 2004 election. "Intelligent design" creationists are aggressively pushing their agenda in nearly every state and hope to foist nothing less than a redefinition of science upon an unsuspecting public. The scientific illiteracy of the American public allows obfuscation of scientific topics such as global warming, embryonic stem-cell research, and evolution by the current administration. Within this context, Mark Isaak has produced a very useful "baloney detector".

The book rebuts over 400 creationist claims that range from clever to silly in straightforward explanations complete with print

and on-line scientific references. The usual creationist chestnuts are all there, but so are hundreds of other weird ideas that are lesser known. The claims are divided into nine topics: philosophy and theology (33 pages), biology (60 pages), paleontology (40 pages), geology (32 pages), astronomy and cosmology (16 pages), physics and mathematics (10 pages), miscellaneous anti-evolution (4 pages), biblical creationism (44 pages), "intelligent design" (18 pages), and other creationism (2 pages). It is amazing that one person can be knowledgeable over all these diverse fields. The author, a computer programmer with a MS in biology from San Jose State University, is extremely well read on a wide range of topics. He has put a great deal of information at the reader's fingertips. Isaak is editor of the "Index of Creationist Claims" on the website <<http://www.talkorigins.org>>, and this book is an outgrowth of that activity.

The format presents a creationist claim in bold type, then expands it to cite a reference to the claim. This is followed by an eye-catching five-diamond design below which is the scientific rebuttal. Some replies are only a few sentences long; others require several pages. The following is a truncated exchange. Question: "If we are descended from apes, why are there still apes around?" Answer: "Humans and other apes are descended from a common ancestor whose population split to become two (and more) lineages. The question is rather like asking, 'If many Americans and Australians are descended from Europeans, why are there still Europeans around?'" Most topics are easy to follow; however, the explanations of geological dating methods are very technical.

Because the categories are so diverse, even professional scientists will benefit by reading the areas outside their specialties. Did you know that there are several localities where strata from all geological eras exist? Examples given are the Bonaparte Basin of Australia and the Williston Basin of North Dakota. The book also serves as a ready reference to articles you may have read recently, but have



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forgotten where to find them. For example, a computer simulation experiment that showed the evolution of complex organismal features was published in *Nature* in 2003. A check of the index under complexity will lead you to this paper by Lenski and others. Counterarguments to recent news items disparaging peppered moth evolution, Haeckel's embryo drawings, and fraudulent Chinese dinosaur/bird fossils are very usefully included. The book has four photos and four line drawings. The skull photographs on p 107 and the aerial views of flood- and non-flood-shaped terrain on p 239 are particularly effective.

Especially in light of recent endorsements of teaching "intelligent design" by prominent public figures such as President Bush and Senate Majority Leader Frist, the section on "intelligent design" creationism bears special mention. Isaak has some training in bioinformatics and his responses to "intelligent design" creationism are well done and most timely, if a bit repetitive and tedious. This section is most helpful for ideas when composing letters to the editor for local newspapers or for defusing creationist arguments to local school boards.

I have a few quibbles, but they are minor. On page 11, Isaak writes, "Biology without evolution is natural history, not biology." I would point out that it was observations in natural history that led Darwin to the possibility of evolution and that natural history is the study of nature, of which biology is a part. In response to the creationist claim "Evolution says you are descended from a monkey," Isaak does not take the opportunity to point out that no biologist says such a thing. Rather, great apes and humans share a common ancestor. On pages 5 and 205, Isaak calls creationism a theory. It is a religious idea, not a scientific theory. Although there is a section devoted to the scientific method, the steps of that method are not spelled out. No type of creationism utilizes the scientific method, and it is the stated goal of the "intelligent design" creationists to redefine science by allowing supernatural explanations. This would turn science on its head. In the discussion of homology on

page 86, the author should have mentioned that homologous structures come from the same embryonic germ layer and have the same relationship of parts. In refutation of the creationist fabrication of a deathbed conversion by Darwin, the author does not mention a book devoted to tracking down that lie by one of Darwin's biographers, historian James Moore (*The Darwin Legend*, Grand Rapids [MI]: Baker Books, 1994). In a section on the age of the universe, Isaak gives the age of the earth but does not mention that cosmologists are homing in on 13–14 billion years as the age of the universe. These are small matters, and I suspect that a reviewer with a different background might pick up other omissions, but they do not detract from the merits of the book.

This is a very good and useful book, but at \$65 it is much too expensive for the widespread dispersal that it deserves. I encourage the publisher to release an inexpensive paperback version immediately so teachers and concerned parents can own their own copies and will be willing to present them as gifts to school board members. Meanwhile, make sure your local public and school library orders a copy.

The cumulative effect of reading these anti-evolution arguments emphasizes how scientifically ignorant and/or dishonest many creationists are. Unfortunately, since this is a political struggle, not a scientific one, lack of knowledge is not necessarily an impediment in an anti-intellectual culture. It will be interesting to see if science can prevail at the political level in the culture wars with the religious right. Those of us who prefer research to revelation can arm ourselves with the information presented here by Isaak. But we must speak out to influence public opinion, school boards, and politicians. To paraphrase Edmund Burke, the only thing necessary for the triumph of ignorance is for knowledgeable people to do nothing.

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ORGANISMS AND ARTIFACTS

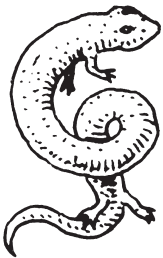
by Tim Lewens
Cambridge (MA): MIT Press, 2004.
240 pages

Reviewed by John S Wilkins,
University of Queensland

Everyone is tired of debates over "intelligent design" (ID), but equally, philosophers of biology are tired of teleology and functions. As Lewens, an up-and-coming philosopher of biology at Cambridge University, observes, teleology is "boring". Still, we might ask whether or not design in organisms and design in made things are sufficiently similar that we *can*, in fact, draw parallels between them as the ID devotees desire. So despite the fact that this book is about an arcane technical matter in the philosophy of biology, it may be useful to those attempting to come to grips with that other matter.

The context of this book is a recent claim, made by Lewens along with colleagues and collaborators Dennis Walsh, André Ariew, and Mohan Matthen, that natural selection is not, actually, a "force", as Elliot Sober had argued earlier that it was, more particularly, that selective explanations were Newtonesque and that it was a theory of forces. This makes sense if you think that selection can either cause or inhibit evolutionary change depending on how the forces are configured. But Lewens and friends hold instead that selection is the average expectations of the fitness of a population, and that the *actual* selective forces are unique to each case of selection. There is a useful and interesting discussion of the so-called etiologic theory of functions, according

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to which a task is a function if tokens of that trait were selected in the past to do that task.

Then, we turn to engineering and artifactual functions. Adaptationist explanations have previously treated organisms as if they were designed, so Lewens therefore discusses the adaptationists approach of Dennett and others. "At least some of the conflict between those who call themselves adaptationists, and those who call themselves anti-adaptationists is, I suspect, a fight over nothing" (page 42). The two versions he calls the "weak" and "strong" reverse-engineering approach attempt to uncover the purpose of a trait in organisms or artefacts. Both rely strongly on the isomorphism of processes between natural selection in nature and design in culture. The major difference is that strong reverse engineering is too quick to conclude that because something *might* have been subjected to the sorts of selection pressures we conjecture, therefore they have been. (An old logical principle has it that if it is real, then it is possible, but not vice versa.) The weak version simply allows that it is *possible* that the artifact was designed/selected in some particular fashion.

The general claim, which he calls the "artifact model", is this: selection works through filtering a range of available variants in the prior generation through selective pressures, resulting in the predominance of one or a few variants (rinse, repeat). Artifacts are made through a process by which a range of prior cultural resources present candidate solutions which pass through criteria for choice, resulting in one or a few artifacts. The process is isomorphic. The substrates are different, as are the processes of construction.

In ID claims, the priority is given to design, as if it were some magical kind of process. Lewens inadvertently puts the lie to this, noting that both design and selection are the same general kind of process. This is not a new claim — it was made (by Huxley) almost as soon as Darwin published. But it is worth repeating — design thinking as selectionist thinking is help-

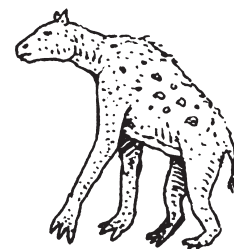
ful to understanding and to problem solving. We find out how a system "solves" a problem this way. However, nothing in this approach presumes that forethought and special methods are involved in either case. We *may* plan ahead, but any engineer or designer will tell you that our designs and goals are one thing; what works is another.

Having put forward the artifact model, Lewens then examines how it relates to five "isms": adaptationism, developmentalism, constructivism, internalism, and externalism. Developmentalists accuse adaptationists of excluding form from functional accounts (he says). Constructivists, led by Richard Lewontin, hold that the conception of adaptation is problematic and ill-formed. Internalists focus on the endogenous properties of organisms, while externalists focus on the properties of their environments (a distinction due to Peter Godfrey-Smith). Lewens maintains that these polar opposites are in fact not opposites but areas in a conceptual map, as it were, in which the organisms can be reconceived in various ways as it suits us. They are aids to problem solving, in understanding how organisms solve problems. They are methodological positions. This discussion is mainly of interest to philosophers.

Chapter 5 is a useful primer on the literature about functions in philosophy of biology. Lewens asks why biologists, but not chemists or physicists, use teleological language when they explain their topics. Of the two main competing view of functions (the etiological, and Cummins's "causal role" [CR] account that a function is any trait that contributes to the capacity of the system), he thinks that a variant on Cummins's function is the better alternative to account for biologists' talk. But there are aspects of functions that CR fails to deal with — the explanatory nature of functional ascriptions (the function of hearts is to pump blood), the normativity of functions (normal hearts are there to pump blood) and the accidental aspects of organisms not being functional (a heart also makes a sound in the chest, but that is not

its function). He contrasts this with the "intended effects" (IE) account of the functions of artifacts: that the function of an artifact is what an agent intended it to do.

There is much more in Lewen's book — what is of interest to the readers of this journal is its relation to ID, and there is, indeed, a short section on this (section 7.9). He notes that ID lacks a coherent notion of design and that intelligence is not explanatory in the abstract. As he has given an account of design that is formally equivalent to selection, this is a strong challenge, one I fear that will get exactly the same treatment that all other good-faith critiques of ID have received — stony silence or dismissal from ID's champions. For general readers the book has moderate interest; for those who wish to understand a more solid foundation for considerations of design and organisms, this is well worth a read.



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ICONS OF EVOLUTION

by Jonathan Wells
Washington DC: Regnery, 2000.
362 pages

**Reviewed by Matt Cartmill,
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WHY MUCH OF WHAT JONATHAN WELLS WRITES ABOUT HUMAN EVOLUTION IS WRONG

Why is Jonathan Wells so fiercely hostile to the notion of "Darwinian evolution" — so much so that he thinks this sort of science should be hustled out of America's textbooks and barred from federal research funding? As far as I can tell, what Wells wants to see is a more pious science — a biology that has room in it for God, spirit beings, providence, and miracles — and he regards Darwinian evolution as the greatest obstacle to bringing religious faith back into the natural sciences. He takes his cue here from some prominent



Darwinists who claim that if Darwin was right, then there is no design behind the order of nature. Wells accepts this implication, but prefers to work it backwards: the world is manifestly full of design and intentionality, and therefore Darwinism must be in error.

But how to prove it? A young-earth creationist might dismiss Darwin by quoting the literal words of Genesis; but Wells apparently accepts the geological evidence that the earth and its organisms are billions of years old. He also grants that ancient faunas are unlike modern ones, that species change through time, that descent with modification occurs, that natural selection can act to produce new adaptations, and that human beings are animals, at least as far as their physical bodies are concerned (p 4-5, 213, 245).

All these concessions to biology and geology do not leave Wells much room to evade the obvious Darwinian conclusion from the facts of the fossil record. The tactic he adopts is the argument *ad hominem* — dismissing Darwinism by discrediting Darwinists. In *Icons of Evolution*, he catalogs as many instances as he can where Darwin and other evolutionists have made mistakes, drawn unwarranted conclusions, or allowed their own biases to distort their interpretations. The implied question — “Why should we believe anything that these people say about anything?” — is not put quite that bluntly by Wells, but Michael Behe obligingly asks it in his blurb on the back cover.

Wells devotes his penultimate chapter to the study of human evolution. He begins by posting two theses from Darwin that he finds particularly objectionable: that human beings share ancestors with other animals (especially apes), and that natural selection

acting on small variations has been mainly responsible for transforming animals into people. These two doctrines imply, he says, “that humans are nothing but animals, and they are not the pre-ordained goal of a directed process” (p 209).

In trying to dispel these odious corollaries, Wells does not offer any actual arguments for thinking that humans are something other than animals, or that our origins were divinely foreordained. That would be too difficult and too nakedly sectarian. He contents himself with trying to show that paleoanthropologists are hopelessly biased ninnyes. Wells recounts the story of the Piltdown fraud and correctly observes that its success reflects the willingness of scientists to accept bogus evidence for ideas they want to believe. The perennial inconclusive squabbles among the experts about how many species of *Australopithecus* or *Homo* there were, and which is ancestral to what, are duly cataloged. The fact that artists can reconstruct a fossil as either more or less apelike by sticking different-looking ears and hair on it is displayed with a particular air of triumph, as if it were a closely guarded scientific secret. Wells quotes a lot of anthropologists (including me) who have complained that many of the tales scientists tell about human evolution are riddled with mythic elements, which express current cultural values and contain at least as much story-telling as genuine science. The evidence that Wells presents unquestionably proves that people who study evolution are capable of distortion, bias, and even fraud.

So — why *should* you believe anything that paleoanthropologists, or other evolutionary biologists, have to say about anything? The answer may come as something of a shock to Wells. Of course you should not *believe* anything that we say. You should not *believe* anything that any scientist says about anything. “Question authority” is a basic rule underlying the whole scientific method. That is why we are required to publish papers that spell out the materials, methods, and results that led us to our conclusions. You are invited to go get some of the same materials,

carry out the same procedures, and see if you get the same results. If the reported phenomena prove to be bogus, let the world know about it. If you have a better interpretation, publish it. If you doubt what scientists say about human evolution, do not just take their word for it; look at the fossils on display in the museums, study the photographs and casts, visit the sites and look at their stratigraphy, learn about the biology of the relevant living animals, and see if you can come up with a better theory. If you can, you will be in for a fight from the partisans of the old theory, but we will all be indebted to you in the long run.

Of course, Wells does not have a better theory of human origins than Darwin's. He does not even want to find one. What he wants is to leave the door open for certain religious beliefs. But if he thought about it a little harder, he would see that that door is already open. Science has no way of closing it, because those beliefs have no testable implications. Conversely, Wells's religious beliefs — even if they are true beliefs — cannot serve as scientific explanations for the facts of biology.

Consider those two Darwinian propositions that Wells objects to most strongly: that humans are descended from nonhuman animals and that the change was effected by natural causes. What are the alternative propositions he would prefer to adopt? Evidently, (1) that humans have no animal ancestors, and (2) that our species was brought into being miraculously by supernatural forces. Are these scientific hypotheses?

I guess Alternative Proposition #1 might be one in principle, though not in the way Wells intends. We can imagine evidence that might support it — say, if humans had no detailed molecular or morphological resemblances to other terrestrial creatures and the remains of a million-year-old spaceship were uncovered in Africa. But as Wells admits (p 223), that is not what the evidence looks like. Two centuries of scientific research have documented untold thousands of detailed chemical, anatomical, and behavioral similarities of humans to other animals.

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Scientists have found hundreds of what Wells grudgingly calls “apparently genuine” fossils, ranging in antiquity from around 6 million years down to less than 100 000 years, that are apelike in some respects and humanlike in others — and the older they are, the more apelike they look.

Like any creationist, Wells wants desperately to find an animal-human boundary somewhere in this assemblage. So do a lot of anthropologists, which is why the inconclusive squabbles persist. Should a fossil creature (*Homo habilis*) that had arms longer than ours but shorter than an ape’s, and a brain smaller than ours but larger than an ape’s, be classified in the long-armed, smaller-brained genus *Australopithecus*, or in our own genus *Homo*? Opinions differ. Since I entered graduate school in the 1960s, the consensus has swung from one opinion to the other, and now it seems to be swinging back again. Similar issues underlie other ongoing arguments over the phylogeny and classification of our fossil relatives — for example, the endless debate over the humanity of the Neanderthals. The perennial nature of these disputes does not imply that paleoanthropologists are dunces. Rather, it suggests that everybody is hunting for boundaries and dividing lines — and not finding them.

Wells stresses the scarcity of likely common ancestors for humans and the living apes in the fossil record between 10 million and 5 million years ago, leading the reader to infer that the “missing link” is still missing. But he carefully avoids pointing out that the fossil record of the human lineage from 5 million years ago onward is vastly richer, and manifests no sharp dividing lines between the ape and the human. The earliest hominid fossils we have are so apelike that specialists argue about whether some of them are on the human or the chimpanzee limb of the ape-human divide.

If there are not any boundaries, does that imply that humans are nothing but animals, as Wells fears? Of course not. A diamond is a chunk of carbon, and nothing else; but that does not mean it has the same market value as a piece of

graphite. The way the constituents are put together makes all the difference. Even if human beings are animals, and nothing else, we can still be things that no other animals are. We can be Muslims, or Republicans, or biochemists, or embezzlers, or all four at once. Apes and dolphins and parrots cannot be any of these things. No one questions these facts. Do humans have immortal souls? Do other animals? Nobody knows — not Charles Darwin, not Jonathan Wells, and certainly not me. It is beyond the domain of scientific inquiry.

So is Alternative Proposition #2: the idea that human beings were brought into being by a special divine intervention in the natural order. Wells does not want to believe that people came into being through the uninterrupted workings of the laws of nature, because he thinks that this somehow implies that God had nothing to do with it. I respectfully suggest that Wells ought to read some more theology. From the standpoint of an eternal God who exists outside of time, a natural law is just an invariable pattern pervading a universal tapestry that has Space as its warp strings and Time as its weft. How can the existence of such an unvarying pattern possibly prove that the tapestry was not designed by a Creator — who presumably had that pattern in mind, along with all the details of the fabric, from the very foundation of the world? Some of the devout theists who brought about the scientific revolution in the 17th century argued the reverse, and they pointed to the happy outcomes of unvarying natural laws as proof of an all-wise Providence. The origin of humanity might have been one such foreordained happy outcome. A belief in divine providence does not entail a belief in miracles.

Maybe miracles do happen. Maybe the patterned fabric of the world is punctuated with rare, off-color spots where the patterns no longer obtain. But even if such spots exist, science cannot identify them as miraculous or supernatural. As far as science is concerned, an event that violates a supposed law of nature does not prove the existence of God; it just disproves

the law. And since a miracle is by definition not a repeatable event, a science of miracles is a contradiction in terms.

Perhaps the most profound objection to invoking God as an explanation of biology was voiced back in the mid-1700s by David Hume. Hume noted simply that a finite effect can never provide evidence for an infinite Cause. It follows that no natural phenomena (which are necessarily finite) can require such a Cause for their explanation — and so nature cannot provide evidence for the existence of God. We can imagine finding proof of the existence of some sort of being with superhuman powers and intelligence. But we can never find reasons for thinking that such a being is infinite, or eternal, or omniscient. If “intelligent design” arguments of the kind Wells seems to favor held water, they might lead us to conclude tentatively that the earth was visited some 3 billion years ago by a race of skilled genetic engineers, who have come back every few million years since then to tune up their handiwork. Again, we can imagine finding ancient spaceships and other evidence that might support such a conclusion. But nothing we can learn about the observable world can ever demonstrate the presence of the eternal *I Am* of Abraham, Isaac, and Jacob. That does not mean that there is no God. It just means that science has nothing to say about the subject.

I do not find much to object to in Wells’s catalog of the shortcomings and frailties of paleoanthropologists. Other and worse sins could be added to the catalog — for example, the racist theories of Ernst Haeckel and Eugen Fischer, which helped to fuel the fires of the Holocaust. We really do sometimes misread evidence, play down or conceal facts that upset our pet theories, fool ourselves into believing things that are not so, and smuggle our cultural, political, and religious biases into our stories about the causes of human evolution. In short, we scientists are fallible, finite, and human. But similar things could be said about the practitioners of any other science. (Consider, for example, the history

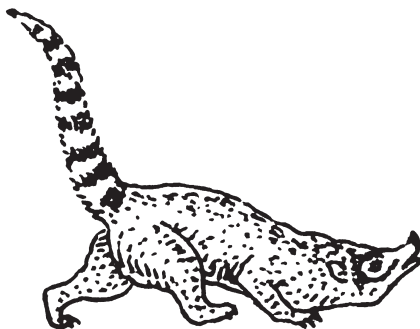


of scientific thought about the Martian canals, or the intimate connections between genetics and eugenics throughout much of the 20th century.) And a number of Wells's examples are themselves distorted or deliberately misleading, like the great show he makes of the irrelevant absence of missing links among Miocene apes.

In the final analysis, then, Wells's book is dishonest. If he had contented himself with complaining that evolutionists of an atheistic bent have unfairly tried to recruit their science to the service of their religious beliefs, I would be among the first to applaud. But he cannot assail the atheists' illogic at its roots, because he himself hopes to refashion biology to serve his own religious beliefs. If he had tried to put up some new, non-evolutionary explanation of the facts of biology, or to array novel evidence for discerning the hand of God in prehistory, I would at least listen to him politely. But he has not got any new theories or evidence to go up against Darwin. All he has is an *ad hominem* stick for beating the dogs of Darwinism. It will not do the job. And if he and his readers will look at all these arguments a little more carefully, they will realize that the job does not need to be done.

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EVOLUTION 101: FINDING A SOLID INTRODUCTION

THE COMPLETE IDIOT'S GUIDE TO EVOLUTION

by Leslie Alan Horvitz

Indianapolis (IN): Alpha Books, 2002. 310 pages

EVOLUTION: A VERY SHORT INTRODUCTION

by Brian and Deborah Charlesworth

Oxford: Oxford University Press, 2003. 135 pages

**Reviewed by Andrew J Petto,
University of Wisconsin,
Milwaukee**

As we travel around the country talking with people about evolution education, one question comes up over and over: "What would you suggest as a good way to get the basics of evolution so we know what we are talking about?" There ought to be an easy answer, but there are very few books available that are suitable for a general audience. There are, however, two books that we always carry to these public events: *The Complete Idiot's Guide to Evolution* and *Evolution: A Very Short Introduction*. Ideally, the book written for a general audience would combine the best aspects of these two ... and eliminate the worst.

The Complete Idiot's Guide is the more "user-friendly" because of its design and format. It is brightly colored and the cover has that distinct bright orange border that marks it as one of a series of *Complete Idiot's Guides*, making it stand out among the books on the shelf. The text is accessible and broken up by a number of boxes, sidebars, highlights, and special features. One of the best of these is a bulleted list at the end of every chapter entitled "The Least You Need to Know". This book is easy

to read, and it is easy to pick up again after a few days without having to go back and re-read several pages or sections. The book is also strong on the historical and cultural contexts of both evolutionary thinking and of anti-evolutionism.

The main problem with *The Complete Idiot's Guide to Evolution* is that it is full of errors. Some of these are terms that are misused throughout. For example, Horvitz uses "development" as a synonym for "evolution" — an error we keep trying to prevent people from making. He defines a mutation as "differences in offspring of an organism" (p 101) — something most biologists refer to as biological variation. On page 215, he asks which of two *Australopithecines* "truly represented early hominids?" The correct answer, of course, is "both", but Horvitz seems to be more interested in which of these taxa is the *direct ancestor* of modern humans, in which case the correct answer is most likely "neither". And on page 287, he conflates hybridization ("cross-breeding") with selective breeding.

For every concept clearly described and explained, there seems to be one of these serious, fundamental errors. Because of these problems, it is difficult to recommend this book, despite its general ease of use and attractiveness to the general public. At least it should not be used without proper supervision.

Evolution: A Very Short Introduction is everything that *The Complete Idiot's Guide to Evolution* is not. The contents are thorough, well-organized, and up-

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to-date. There are eight very succinct chapters with writing that is clear and to the point. The format is not user-friendly, however. The text is densely packed and there are few illustrations and other “diversions” from the text.

The writing is excellent, as one would expect from these authors, and the contents, of course, are accurate. The authors give a clear explanation of the current state of evolutionary theory and research, as well as exploring some unanswered questions and some disagreements among scientists regarding particular models or research issues.

For all that *Evolution: A Very Short Introduction* has to offer, it is not a book that would be picked up off the shelf at the local bookseller's or library. We often recommend it to general audiences, but make it clear that it has to be read carefully, because there is so much “coverage” of important information in a very few words. The reading level is not difficult, but it does require that the reader be conscientious and attentive to the text. This is not for the casual reader.

In the end, the book we would like to see is one that combines the best aspects of these two: one that is accurate and up-to-date, but also “user friendly”. To be useful to a general readership, the many checkpoints, sidebars, marginalia, and end-of-chapter lists help to reinforce what can be complex content. On the other hand, these reference points for the reader can improve understanding of evolution *only* if they contain accurate information.

Even though neither one of these alone completely meets the need for a good, clear account of the basics of evolution, together they contain valuable resources. Neither, however, should be used as the sole source of information for a general audience.

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EVOLUTION - WHY BOTHER?

A film produced by the Biological Sciences Curriculum Study, the American Institute for Biological Sciences, and Why Bother Films. Available in VHS and DVD formats. 27 minutes

Reviewed by Karen Mesmer

Students often ask, “Why do we need to know this?” With a topic such as evolution, this question may be asked even more frequently, since they think that evolution happened only in the past and has no bearing on their lives. The Biological Sciences Curriculum Study (BSCS) and the American Institute of Biological Sciences (AIBS) have produced a 27-minute film called *Evolution — Why Bother?* to answer this question for high school students. The National Association of Biology Teachers (NABT) endorses this program.

The film is divided into eight self-contained chapters on the various topics of drugs, crime, food, education, disease, ecology, invasive species, and endangered species. Each chapter can be watched separately or the film can be watched as a whole. The chapters start with background given by prominent biologists or science educators and then include explanations of how evolution relates to the topic.

An explanation of why evolution is important to biology begins the program. Joel Cracraft of the American Museum of Natural History explains how it can be tied to all aspects of biology while Jerry Waldvogel of Clemson University expresses the idea that evolution is the unifying idea in biology and that it allows us to ask and answer questions that cannot be answered any other way. Specific examples are described

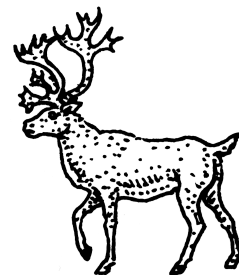
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that enable students to see the types of questions that can be answered using evolution. Ken Miller explains that evolution connects to everyday life and is the central organizing principle in biology. Then evolution is presented in the context of eight contemporary examples.

Evolution and drugs is the first example. This section highlights the biochemical similarities of life on earth that exist because of evolution. We can identify mechanisms of disease and potential treatments found in other organisms because of this relationship. Two examples are offered, that of *Aspergillus terreus* and the development of cholesterol-lowering medications, and *Arabidopsis thaliana* and the BRCA₂ gene associated with increased risk of breast cancer. The narration is sometimes rapid, so stopping the film after each section for discussion is beneficial.

DNA and crime is the next topic to relate to evolution. The narrator says that DNA analysis is based on common descent with modification and different rates of evolutionary change, but these relationships could be made more explicit for students. Some sections could leave students with questions about specifics on how the topic was related to evolution. This criticism also applies to the next section on **Evolution and foods** where higher yields of crops, disease resistance, and pest resistance are discussed. For example, pentachlorophenol is discussed, but not enough information is given for students to understand exactly how it ties in with natural selection. Students either need to take the narrator's word for it, discuss it with their teachers, or research it themselves.

Evolution and ecology is the fourth area. Understanding that endangered species evolved in a certain environment is essential for formulating policies to protect these species. A specific example would be useful here. The fifth example, **Evolution and endangered species**, is directly related to the previous topic. Evolution provides insight into the genetic viability of endangered species and ecological factors that can help



keep them from going extinct. More of an explanation of how this works would be beneficial in this section.

The last two sections on **Invasive species** and **Disease** offer the best examples and explanations of the relationship between evolution and the topic at hand. Kudzu, zebra mussels, and West Nile virus are the familiar examples used in this section. Students are told that these invasive species evolved in one habitat and then were transported to another where they exploit their niche and out-compete the native species. Evolutionary biology can suggest ways to control or eliminate these non-native species. This is presented in a way that I think enables high school students to grasp the relationship between evolution and their everyday lives. The section on disease does an excellent job of discussing herpes, HIV, flu, SARS, and vaccines. There are diagrams of how bacteria become resistant to antibiotics and a discussion on how the predictive power of evolutionary biology can provide us with strategies to prevent antibiotic resistance, design new vaccines and describe where new epidemics might occur.

Science education is the last area identified. It is important to understand evolution to develop a “big picture” of the living world. It is a powerful tool in our lives in the areas of biotechnology, medicine, and farming; as Ken Miller states, we “ignore evolution at our own peril.” It helps us make sense of our lives.

Overall, the program does a good job of identifying the areas of students’ lives related to evolution, but not as good of a job of explaining how evolution specifically connects. Teachers can take this further to help students understand exactly how and why each topic links to evolution. One way to use the DVD is as an introduction to various case studies in evolution and then have students research a particular case in detail.

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THE PLAUSIBILITY OF LIFE: RESOLVING DARWIN’S DILEMMA

by Marc W Kirschner and John C Gerhardt

New Haven (CT): Yale University Press, 2005. 301 pages

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The diversity of life forms throughout the history of life on earth is so engaging and impressive that it is easy to overlook the other side of the coin: the continuity that connects all organisms to an array of common ancestors. In fact, any evolutionary model that used only data on divergence and none on conserved traits would fail to make any sense of the emergence of new species from ancestral ones. In *The Plausibility of Life*, Kirschner and Gerhardt focus on a number of conserved “core cellular processes” shared by all living things. Their thesis is that these core processes represent successful innovations that are inherited by evolutionary descendants. However, they argue that the success of these processes lies not in their highly specified functions, but in their abilities to produce quite variable outcomes under different environmental conditions.

In essence, this is the negation of the “irreducible complexity” argument of “intelligent design” proponents. The authors show how a single molecule with a highly specified function can perform a different one under different environmental conditions. In other words, the molecular imperative for the cell is flexibility, not specificity. The apparent specificity that we observe is so reliably produced, they argue, because the genome is selected for adaptability. How else could such complex organisms so

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full of complex biochemical and developmental pathways be produced with so few genes?

Kirschner and Gerhardt explore several specific examples in the text that illustrate their points quite effectively. They give examples of metabolic processes, body-plan evolution, developmental and regulatory change, and morphological specialization (for example, adaptations for flight). Two of the key concepts are weak linkage and exploratory behavior.

The first of these is based on the observation that there are many steps between the DNA sequence for a particular protein and the outcome of the process in which that protein will participate. In a number of well-documented cases, a protein produces a weak signal that produces a particular effect only under specific conditions. The “linkages” between the form and function are “weak” or “easily forged and broken” without any significant genetic change in the organism (p 110-1). This allows new pathways and new linkages to be formed to produce new pathways and products while retaining substantially the same DNA sequence.

Exploratory behavior is viewed from both organismal and cellular perspectives as the basis for the appearance of complex organization from simple actions. In the case of ant foraging, it is clear that the brains of ants do not encode territorial or resource “maps” but build a successful complex foraging strategy based on the accumulation of the results of random foraging behaviors. In the case of the development of blood vessels and nerves, the authors show how these structures emerge in response to signals generated by the target tissues so that they grow in the “right” directions and connect to the “right” cells. This exploratory behavior — whether cellular or organismal — produces complex outcomes from simple conditions, and, as the authors point out using the examples of the pattern of blood vessels that we all can see in the skin of our arms and hands, highly variable ones even within the same individual.

These two examples capture only a bit of the flavor of this book,



which extracts the results from contemporary research and presents them in a format for nonspecialists. The authors succeed in illustrating their points from the biochemical to the behavioral levels of the organismal hierarchy with examples from each of the levels in between. They are frank about what is known and what is still to be learned, but they present a strong case for the conservation

of core processes that allow for the evolution of complex, highly specific functions, but that also allow organisms to adapt these structure-function complexes to a variety of conditions with a variety of outcomes depending on the environment in which the organisms operates. Indeed, in their view of the evolution of complex structures, what is now a mousetrap could easily have started out as a

starting gate or a spring latch. The conserved core process is geared to producing components, but the assembly and final configuration are anything but foreordained.

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Letters to the Editor

In "Why teach evolution?" (*RNCSE* 2005 Jan-Apr; 25 [1-2]: 27), Andrew J Petto failed to cite the most important reason for learning the truth of evolution. All human beings must understand how evolution has shaped their very (human) nature. Each of us has brain structures that are residual from our reptilian and proto-mammalian evolutionary past. Our drive to do whatever it takes to survive originated in the earliest forms of life, and has been passed down via the genes through all our predecessor species.

Our territorial imperative and the tendency to conform to hierarchy come from the reptile-derived, subcortical part of our brain. Our emotions are generated in the evolutionarily more recent limbic system of the brain, harking back to the offspring-nurturing characteristics of the earliest mammals. Our reasoning capability (such as it is) is very, very recent (deep-time speaking), and subject to an emotion-driven self-deception that masks the cause of most of our actions.

Plato proposed the dictum "Know thyself." Until each of us accepts what we are and why we act as we do, we humans will continue to follow irrational paths to the ultimate destruction of our species. There can be no more

important reason for studying and learning the significance of evolution. Unfortunately, our extreme capacity for delusion and self-deception — a culturally (religiously) acquired trait — will probably preclude the "average" person from learning the most important lesson of evolution. When is NCSE going to learn and promote this truth?

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[I appreciate Richard Neavel's comments, and, of course, understanding the evolutionary roots of our biology and behavior is absolutely fundamental to many critical human endeavors. It is important to note, however, that the list was not meant to be a comprehensive position statement so much as a succinct summary of issues that were being faced by parents and concerned citizens in both Dover, Pennsylvania, and Grantsburg, Wisconsin, at the end of 2004. The content and format of the brochure were shaped by the needs of evolution supporters in those places at those times, and by the space available on standard 8 x 11 inch paper. —Andrew J Petto]

I was stationed in Turkey for a year in 1971-72 with the US Army and developed a liking for the country and its people, and an admiration for their accomplishments. After World War I they overthrew the Ottoman Empire, possibly the most corrupt and inept government in history, successfully resisted plans by the Allies to dismember their country, then deliberately realigned themselves with the West. The stakes in Turkey could not be higher. As one State Department analyst put it, "If you're looking for an Islamic country that is moderate, democratic, and pro-Western, Turkey isn't just the best game in town, it's the *only* game in town."

Despite my deep affection for Turkey and sympathy for the problems it faces, I must sadly note that Turkey is a country where key policies are often rooted in pseudoscience. Harun Yahya and his Islamic creationists are only part of it. Turkish schools teach crank anthropology, that the Turks are descended from a "Turanian" race that also gave rise to all the European peoples. The Turanian race is thus — shades of Afrocentrism — the fountainhead of Western civilization. Until recently there was no such thing in Turkey as a Kurd. To build a sense of nation-

hood, the fledgling Turkish Republic adopted the fiction that everyone in Turkey was a Turk, and that there were no indigenous non-Turkish peoples. The Kurds were called "mountain Turks" despite speaking an Indo-European language. There is, of course, widespread denial of the genocide of the Armenians. A final ironic ingredient in this witches' brew is that often the Armenians were not massacred directly, but simply driven onto the roads, and they were often stripped and robbed of their means of survival by Kurds.

Unlike the Third Reich, the Khmer Rouge, or the Taliban, the government of Turkey is not made up of malevolent lunatics. Despite a blemished human rights record, Turkey is sincerely trying to create a modern, democratic and enlightened society. Unfortunately an insecure sense of identity has caused the Turkish government to embrace pseudoscientific theories in the service of nationalism. Despite a horrific past, modern Turkey has much to be proud of, and its official pseudoscience serves no useful purpose except to prepare the way for cranks like Harun Yahya.

Steven I Dutch
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As a charter member of the Skeptics Society I have the privilege of periodically spending a Sunday afternoon hearing very erudite and accomplished speakers lecture an audience of like-minded colleagues and interested lay people on their attempts to introduce science or new scientific methods to an audience lacking a critical approach. We chortle at tales of mystics, bunco artists, snake oil salesmen and religious fanatics, often shaking our heads at the gullibility of their "victims". Many of the members and speakers write books on the subject of evolution-versus-creationism. They are well-written and line my bookshelves.

None of this has the importance or impact of the reports by William J Gonzalez and Jason Wiles in the Jan-Apr 2005 *RNCSE*. The people they describe as members of the communities that abhor evolution will never see or even want to see

anything written by a member of the Skeptics Society. The only hope for penetration is the NCSE. That is why you have my financial support. I am sorry it is nowhere near Bill Gates's charity in magnitude. He has taken on a noble effort to cure disease in third world countries, so I cannot begrudge his commitment. Unfortunately, our job is no less difficult. We are fighting a very old and pervasive "disease": fear.

To a way of thinking common among some religious communities, evolution challenges a faith position built on the uniqueness of each human and intimately linked to the salvation of the soul. To these people, evolution threatens their salvation. The fear generated by such a prospect cannot be dismissed. It is at the very core of a resistance to an acceptance of modern science, not only of evolution.

Our goal has to be to convince people of faith not to be afraid of evolution. Pope John Paul II gave us a constructive approach of which we should take advantage. Working against this approach is an army of politicians and fanatics that have a vested interest in maintaining the fear. Often it is hard to tell the manipulators from the true believers. How do we accomplish our goal? We have to find a way to have a dialogue with the millions (probably) of local pastors who have direct contact with fearful congregations. We have to convince them that the science that leads to recognizing the evidence for evolution is a viable path to fulfilling the aphorism: "God helps those who help themselves." Science leads to understandings that help us survive and the evolution models are key to these understandings. Personally, I think a great dialogue subject would be the rapid evolution of infectious microorganisms; perhaps the current avian flu situation would be a good example. I'd like to see the matter explored more by NCSE.

I know engineers, surgeons and molecular biologists who are creationists. Some were taught no evolution. Others have an erroneous concept of it. In a recent letter to the magazine *The Scientist*, one senior scientist proposed we drop the teaching of evolution from training most biological scientists

because they will never "use" it in their occupations. The message here is that our own house is not in order. We need to test the knowledge of students entering college for a minimum understanding of evolution. Compared to the efforts of NCSE, mine are small change. But if all we little guys at the periphery do our jobs it may produce a significant number of students with more sense.

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It seems to me, as a long-time reader and supporter, that your articles many times conflate the origin of life and evolution. Evidence for the origin of life is lost in the mists of time, making it entirely speculative. One can speculate that naturalistic processes, extraterrestrials, or the hand of God was causative with equal legitimacy. Evolution, on the other hand, is evidence-based science, and should be treated separately as such.

It may be understandable that many evolutionists believe in a naturalistic origin of life, but they should not be allowed to insert this belief into otherwise cogent arguments for evolution.

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[While we agree that evolution is equally compatible with practically all of the proposed models for the origin of life, we feel it is necessary to refer readers to the special edition of RNCSE (2003 May-Aug; 23 [3-4]) discussing contemporary research into the emergence of the first life on earth. There are significant methodological and data problems, to be sure, but the work of researchers reported in that special issue show that it is substantive research and quite a distance from "entirely speculative". However, we will be careful in the future to be sure that our authors make clear the appropriate distinctions in this area.]



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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.

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

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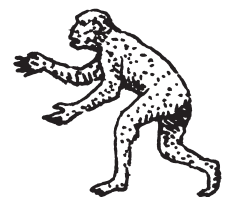
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