REPORTS OF THE NATIONAL CENTER FOR SCIENCE EDUCATION

DEFENDING THE TEACHING OF EVOLUTION IN THE PUBLIC SCHOOLS

Volume 26, Number 5 SEP-OCT, 2006

CONTINUES *NCSE REPORTS* & *CREATION/EVOLUTION*

CONTENTS

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Cover: A storm at sea aboard the CSS John Tully at Ocean Weather Station P in the Northeastern Pacific Ocean (50°N, 145°W). Courtesy of John Berges, who also reports that the chloride ion concentration was 19.344g/kg water. John Berges ©2007.

FROM THE EDITOR

The earth is old; the universe is older. There is no contemporary scientific research that indicates otherwise. This is as certain a conclusion as any scientific study can make ... and yet, young-earth creationists spend a lot of time every year looking for ways to prove that the universe and everything in it are of recent origin. The most common arguments follow several principal themes — most of them based on the lack of direct observation of cosmologic or geologic events as they occurred.

There is another, perhaps braver, approach among creationists in this arena — some actually try to carry out "scientific" investigations that will demonstrate the young age of the earth. Two such examples — and their shortcomings — provide the basis of our lead articles in this issue.

Lorence Collins shows the problems with simple creationist "extrapolations" used to estimate the age of the earth. In submitting this article for publication, he described the typical creationist challenge to geologists:

> More than a year ago, a creationist gave me some data about salt in the oceans. [He claimed that] if all the dissolved salts in the oceans were precipitated back on the continents, where presumably they came from, these salts would form a layer that would cover the exposed land surfaces with an average thickness of about 500 meters thick. Since the present continents have an average thickness of 1800 meters, I asked: "How do you get 500 meters of salt out of 1800 meters of continental rocks?" Of course, that would be impossible. I assumed that the salts would have been weathered out of the Precambrian igneous and metamorphic rocks, but I soon realized that no one in the geologic community had really looked at this issue. My investigations led to the article that I wrote.

Collins demonstrates in his article how a model that incorporates *all* the known geological, chemical, and biological processes that affect the accumulation of important ions in ocean water estimates that the oceans are at least 3.6 billion years old.

The second article, by Paul Caton, takes a more practical approach. With gasoline prices on the rise again, he challenges young-earth creationists to create their own petroleum exploration company and use only YEC geologic models to locate, drill, and make profitable petroleum reserves in three potential locations in North America. Caton argues that those petroleum geologists who claim to be YECs are only successful insofar as they are using scientific models that are based on an ancient earth and the evolution of species — whether or not they are aware of or admit it.

Our book reviews also look at recent works about the earth and its history. Two books from Reasons To Believe try mightily to fit the ministry's particular old-earth creationism into both biblical and scientific jackets. On the other hand, Richard Fortey's volume takes a new approach to geology — telling the "story" of the land and writing its history in a way that makes the ancient earth come to life.

IN THE NEWS

Evolution was a powerful issue at the elections in November 2006, and with the start of new legislative sessions in many states, we are seeing the introduction of legislation that seeks to find a way to include creationism or deprecate evolution in the public-school science curriculum.

Across the Atlantic, there is more activity. Ulrich Kutschera reports that the European Parliament sponsored a briefing on "intelligent design" (reminiscent of the congressional briefing here a few years ago), and Turkish anti-evolutionist Harun Yahya has sent his books to French schools. Yahya's followers are also attacking evolution on US college campuses, as Pat Shipman reports.

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NEWS

Evolution and the Elections

Glenn Branch and Eric Meikle, NCSE

During the campaign season in 2006, the issue of evolution education seems to have been in the minds of the voters and the media alike, probably owing to the decision in *Kitzmiller v Dover* and its aftermath. Here is a sampling of relevant news — some encouraging, some disquieting — from congressional, gubernatorial, and state-level educational races. In some races, the views of the candidates on evolution education surfaced only incidentally and in passing. In some races, they were understood as part of a package of views: in Michigan, for example, Republican candidate Dick DeVos's star seemed to wane after he was associated in the public mind with a number of religious right causes, including (and especially) teaching "intelligent design" in the public schools. And in some races, the views of the candidates on evolution education was front and center, as in the battle for control over the Kansas state board of education. For reasons of space, details about evolution in state legislative and local and county school board races are omitted, but the pattern was similar.

Congressional and gubernatorial races

Alaska: Late in the campaign, Republican gubernatorial candidate Sarah Palin expressed support for teaching creationism alongside evolution in Alaska's public schools. During a televised debate on October 25, 2006, she answered a moderator's question about creationism and evolution by saying, "Teach both. You know, don't be afraid of information. Healthy debate is so important, and it's so valuable in our schools. I am a proponent of teaching both," according to the *Anchorage Daily News* (2006 Oct 27). In a subsequent interview, she told the *Daily News* that she was not proposing to add creationism to the curriculum or the state science standards, but only to allow discussions of creationism to arise in class. During the debate, Palin's Democratic opponent, Tony Knowles, said, "We want to teach the best science there is, and there is overwhelming evidence, there's almost incontrovertible evidence that evolution is the science that ... we know. And that's what we should always teach, to never compromise on the principles just because it's politically popular." Although independent Andrew Halcro agreed with Knowles, he added creationism might find a place in a class in religion or sociology. In the November 7, 2006, general election, Palin defeated Knowles by 49% to 41%, with Halcro taking 10% of the vote. Subsequently, a columnist for the *Anchorage Daily News* (2006 Nov 27) wrote of Palin, "Now that she's governor-elect, some of her Republican fundamentalist voters might want her to make good on her talk. Let's hope she has the good sense to shrug them off," adding, "Creationists are entitled to their views, but they're not entitled to air time in public school science class."

Arizona: *Tucson Weekly* (2006 Aug 24) surveyed hopeful candidates for Congressional District 8 on their attitudes toward teaching creationism in the public schools. The Republican hopefuls were split: Frank Antenori was dismissive, Mike Hellon and Steve Huffman said that creationism ought not to be taught in a science class, and Randy Graf and Mike Jenkins said that creationism ought to be taught alongside evolution. (Asked about the age of the earth, Graf answered, "I don't know, and I don't care. ... I've got my Christian faith, and I'm very comfortable with that," while Jenkins offered, "It could be 10 000 years, or it could be 10 billion years. Don't be absolute and finite. You have to look at this with a scientific mind.") All of the Democratic hopefuls opposed teaching creationism in science class, with Patty Weiss and Jeff Latas suggesting that it could be taught in theology classes, Alex Rodriguez suggesting that it could be taught "separately", Bill Johnson suggesting that it could be taught in Sunday school classes, Francine Shacter opining, "the theory of evolution is a pretty solid theory. I think there's enough evidence to support it. Why in the world should we dumb it down?" and Gabrielle Giffords describing herself as having "very strong religious beliefs, but I think that science should be taught in public schools." They all accepted that the earth "is closer to 4.8 billion [*sic*] years old." In the September 12, 2006, primary election, Graf and Giffords won the nomination of their parties; Giffords prevailed in the November 7, 2006, general election.

Arkansas: In 2005, state representative Mark Martin (R–District 87) introduced a bill in the Arkansas legislature that, if enacted, would have required the state Department of Education to include "intelligent design" in its educational frameworks and encouraged teachers in the state to include it in their lesson plans (see *RNCSE* 2004 May–Aug; 24 [3–4]: 4–6). During his re-election campaign, Martin vowed to introduce a similar bill in 2007, prompting the *Arkansas Democrat-Gazette* (2006 Aug 13) to ask candidates for statewide office about their views on "intelligent design". Mike Beebe, the Democratic candidate for governor, said that information on the subject ought to be available to students, adding, "I believe in 'intelligent design' and I don't think 'intelligent design' and evolution are mutually exclusive." He also said, "I believe both should be available because one is the con-

sensus theory of the scientific community, and the other is the predominant belief of most Arkansans and Americans." In a subsequent article (2006 Aug 15), however, Beebe was reported to acknowledge that "intelligent design" cannot be taught in the schools; a spokesperson cited Supreme Court rulings on teaching creationism as well as *Kitzmiller v Dover*, commenting that in the latter case, the judge ruled that "intelligent design" and creationism are "pretty much the same thing." A spokesperson for his Republican opponent, Asa Hutchison, told the newspaper, "Asa sees this as an issue of academic freedom, and he believes teachers should have the option to teach another viewpoint if there is scientific support for that viewpoint." Bill Halter, the Democratic candidate for lieutenant governor, said, "It's not the purpose of science classes to teach religion ... It's the purpose of science classes to teach science," although he added that he did not know enough about "intelligent design" to say whether it qualified as science. His Republican opponent, Jim Holt, said that teachers ought to be allowed to teach about "intelligent design" and students ought to be allowed to learn about it; he also described evolution as "a fraud". (As a first-term legislator, Holt introduced a bill complaining of supposed errors in biology textbooks; part of the bill's language was taken from Jack Chick's cartoon tract "Big Daddy?" and Kent Hovind testified before a legislative committee in support of the bill. See *RNCSE* 2000 Sep/Oct; 20 [5]: 5–6, 6–7, 7–8.) Dustin McDaniel, the Democratic candidate for attorney general, said, "What is established as generally accepted science should be taught. I'd think the scientific and the education communities would be exactly who[m] we would trust to do that," adding, "It's up to our churches and our families to explain exactly how the scientific parts of the universe are created by God." His Republican opponent, Gunner DeLay, told the newspaper that he wrote a paper in law school arguing for a First Amendment right for a teacher to teach creation science; "The old creation science is the new 'intelligent design'. And yes, I think it's scientifically valid," DeLay said. In the November 7, 2006, general election, Beebe, Halter, and McDaniel handily won; so did Martin.

California: Bill Bodell, the Republican candidate for Congressional District 29, denounced the teaching of evolution during a public forum on October 13, 2006, according to a report on the World Socialist Web Site (<http://www.wsws.org/articles/2006/oct2006/cali-o20.shtml>); there was no mention of the views of the other candidates. In the November 7, 2006, general election, Bodell lost to incumbent Democrat Adam Schiff by a large margin.

Colorado: The views of Janet Rowland, the Republican candidate for lieutenant governor, were under scrutiny, owing to her responses to a 2004 questionnaire circulated by a conservative Christian newspaper, according to the *Rocky Mountain News* (2006 Aug 16). The newspaper asked, "Do you believe that creationism should be taught in our schools along with the theory of evolution or just one? [*sic*]" and Rowland replied, "Either both or neither. All religions are welcomed in the schools except Christianity. This is wrong." Since 2002, lieutenant governors in Colorado are no longer elected separately, so when Republican gubernatorial candidate Bob Beauprez lost in the November 7, 2006, general election, Rowland thereby lost to her Democratic opponent, Barbara O'Brien.

Illinois: David McSweeney, running as a Republican in Congressional District 6, was reported by the *Chicago Tribune* (2006 Oct 25) to favor "the teaching of 'intelligent design' in public schools"; in the November 7, 2006, general election, he lost to incumbent Democrat Melissa Bean, who won 51% of the vote to his 44%.

Republican Peter Roskam and Democrat Tammy Duckworth, vying in Congressional District 8, took diverging views on teaching "intelligent design" in the public schools, according to the Arlington Heights, Illinois, *Daily Herald* (2006 Oct 23): "Roskam didn't say whether he supported such teachings in schools. 'It's a local curriculum decision that every community should be able to wrestle with,' he said. 'It's exactly the type of thing the federal government shouldn't get involved in.' Duckworth objects to teaching 'intelligent design' in science classes. 'It is not a science,' she said. 'If you have it as part of a history of religion class — I don't have a problem.'" In the November 7, 2006, general election, Roskam prevailed, with 51% of the vote.

Iowa: The Republican candidate for lieutenant governor, Bob Vander Plaats, said that he supported teaching "intelligent design" alongside evolution in public school science classes, reported the Ames *Tribune* (2006 Oct 12). "If we are going to teach evolution, there is another viewpoint and one that holds pretty good too (evolution) in regards to creation," Vander Plaats said. "I think that is something that I would want to visit further along with [Republican gubernatorial candidate] Jim Nussle in regards to 'Where are you at on that?' But my viewpoint is I would like to give both of these (time in the classroom)." He added, "I think from an educator point of view, I want to give the theories that have creditability weight in the classroom ... There are some credible evidences on both sides, I think from an educator point of view as well as a full discourse to the students of 'Here's how people believe the world came to be.'" The *Des Moines Register* (2006 Oct 22) cited Vander Plaats's remark as a "red flag" in its editorial endorsement of the Democratic ticket. Nussle, for his part, distanced himself from Vander Plaats's position, saying in a statement, "While I believe and I have taught my children that we are all God's creations, I do not believe 'intelligent design' should be taught in our public schools" (*Ames Tribune*, 2006 Oct 26). Democratic gubernatorial candidate Chet Culver was quoted in the same article as saying, "I think that we need to base what we teach kids in school on science ... I don't think we need to be teaching intelligent design in the public schools. I think we have to have a separation between church and state." In the November 7, 2006, general election, Culver and the Democratic candidate for lieutenant governor, Patty Judge, defeated Nussle and Vander Plaats by 54% to 44%.

Kansas: Evolution education was important in the races for the state board of education in Kansas (see below), but it also emerged as relevant to the gubernatorial race. During her campaign, incumbent governor Kathleen Sebelius, a Democrat, promised to press for a constitutional amendment to change the state board of education to a purely advisory body, citing in particular the controversy over the place of evolution in the state science standards. Suggesting that the controversy frustrates the state's attempts to attract the bioscience industry, she told the *Topeka Capital-Journal* (2006 Oct 11), "It doesn't give a whole lot of confidence in coming to Kansas." Her Republican opponent, Jim Barnett, reportedly supported the board's adoption of the anti-evolution version of the standards, commenting, "In a free society, it should be perfectly acceptable to question what is taught and to allow for differences of opinion." The *Wichita Eagle*'s blog (2006 Oct 21), subsequently reported Barnett as saying "I believe in evolution" and affirming that he has no problem reconciling evolution with his religious faith. In the November 7, 2006, general election, Sebelius defeated Barnett by 58% to 41%.

Maine: The Republican candidate for governor of Maine, Chandler Woodcock, was widely reported as endorsing the teaching of creationism in the public schools. In a profile of Woodcock, the *Portsmouth Herald* (2006 Oct 23) wrote, "He said his beliefs would never inform his political agenda. He believes, for instance, in creationism — the literal interpretation of the Bible — but would not mandate that it be taught in schools. He would leave that decision up to individual school districts," and the *Bangor Daily News* (2006 Oct 23) similarly reported, "Woodcock believes creationism — and all other theories about the origins of human life — should be taught alongside evolution models and that decisions on curriculum should be up to each school system." He was alone among the gubernatorial candidates in his belief, however; the Waterville *Morning Sentinel* (2006 Oct 24) noted that at a public forum, "all candidates except Woodcock said they don't believe [creationism] should be taught in public school," adding that the incumbent governor, Democrat John Baldacci, "seemed incredulous at the question." In the November 7, 2006, general election, Baldacci prevailed with 38% of the vote in a four-way race; Woodcock was second, with 30% of the vote.

Michigan: Creationism became a burning issue in Michigan's gubernatorial race, after Republican candidate Dick DeVos told a questioner at a September 8, 2006, campaign stop that he supported teaching "intelligent design" alongside evolution in the public schools. The questioner, Eric B Fauman (a member of NCSE), recounted the exchange in a letter to the editor of the *Ann Arbor News* (2006 Sep 14), commenting, "At a time when our students' science literacy is already significantly below average ... teaching our children sectarian religious beliefs as science can only harm our state's ability to compete internationally." DeVos subsequently told the Associated Press (2006 Sep 20), "I would like to see the ideas of 'intelligent design' that many scientists are now suggesting is a very viable alternative theory ... That theory and others that would be considered credible would expose our students to more ideas, not less." The *Detroit Free Press* (2006 Sep 20) also quoted him as saying, "Local school boards should have the opportunity to offer evolution and 'intelligent' design in their curricul[a]." His Democratic opponent, incumbent Jennifer Granholm, opposes teaching "intelligent design" as science.

The reaction to DeVos's comments from the scientific and educational communities in Michigan was unsurprisingly negative. The president of the Michigan Science Teachers Association, Paul Drummond, told the *Free Press* that "intelligent design" is "not science," and the president of the Michigan state board of education, Kathleen Straus, described it as "religious theory." Speaking to the Livingston *Daily Press & Argus* (2006 Sep 21), Michigan State University professor Robert T Pennock, the president of Michigan Citizens for Science, posed the question, "How could Michigan students compete in the life sciences, so important to our economy, if DeVos has them learn pseudoscience?" And the state's newspapers were critical of DeVos as well, with the *Lansing State Journal* (2006 Sep 22) editorially commenting, "'intelligent design' is not science. It is an attempt to forge the trappings of scientific inquiry around a fundamental structure of beliefs. It has no business in any science classroom," and a columnist for the Midland *Morning Sun* (2006 Sep 22) opining that DeVos's position, though unsurprising, casts doubt on his "ability to properly engage science." In the November 7, 2006, general election, Granholm defeated DeVos by 56% to 42%.

Minnesota: The creationist views of Michelle Bachmann, the Republican candidate in Congressional District 6, were a frequent topic of discussion in the state's newspapers. In endorsing her Democratic opponent Patty Wetterling, for example, the St Paul *Pioneer Press* wrote (2006 Oct 27), "the YouTube generation has seen [Bachmann] proclaiming widespread scientific support for the 'intelligent design' concept of life's origins, equally widespread doubts about whether global warming is a reality, and saying that Terri Schiavo, the comatose Florida woman whose end-of-life treatment triggered federal intervention in 2005, was 'healthy' and 'not terminally ill.'" In the November 7, 2006, general election, Bachmann won with 50% of the vote.

New Jersey: According to the Trenton *Record* (2006 Oct 16), during a public forum on October 15, 2006, Scott Garrett, the Republican incumbent in Congressional District 5, said that he would leave it up to individual school districts whether to teach "intelligent design" or evolution; the view of his Democratic challenger Paul Aronsohn was not reported. In the November 7, 2006, general election, Garrett was re-elected with 55% of the vote.

Ohio: Evolution education was important in the races for the state board of education in Ohio (see below), but the result of Ohio's

gubernatorial election was also relevant, since eight seats on the board are filled by gubernatorial appointment. Responding to a question from the *Columbus Dispatch* (2006 Jul 23), Democrat Ted Strickland said, "Science ought to be taught in our classrooms. 'Intelligent design' should not be taught as science," while Republican Ken Blackwell said, "I believe in 'intelligent design', and I believe that it should be taught in schools as an elective," adding, "And I don't see it as having met the generally accepted criteria as a science." Strickland won in the November 7, 2006, election, with 60% of the vote.

Evolution education also surfaced during a public forum on October 27, 2006, with the candidates for Congressional District 13, Democrat Betty Sutton and Republican Craig Foltin. The Elyria, Ohio, *Chronicle-Telegram* (2006 Oct 28) reported, "When panelists asked the candidates if they supported 'intelligent design' being taught in public schools, Sutton replied with an abrupt 'No.' Foltin answered the question by mentioning No Child Left Behind, the teaching curriculum, school facilities and everything except for 'intelligent design'. When panelists asked Sutton to rebut Foltin's response, she replied: 'No rebuttal on the "intelligent design" comments.'" In the November 7, 2006, election, Sutton prevailed with 61% of the vote.

Oregon: Covering a televised debate between incumbent governor Ted Kulongoski, a Democrat, and his challenger Ron Saxton, a Republican, the Associated Press (2006 Oct 17) reported, "On a topic that hasn't been much of an issue in the race, the teaching of evolution in the state's public schools, Kulongoski said: 'People should teach evolution. It should be taught in all schools.' Saxton gave a more ambiguous answer: 'We need to let science be science, and let teachers teach the science they believe is there.' But in a follow-up question, Saxton said he thought evolution should be taught." There were no reports on whether the candidates were asked whether they believed that supposed alternatives to evolution should be taught, unfortunately. In the November 7, 2006, general election, Kulongoski retained his position, with 51% of the vote to Saxton's 43%.

Pennsylvania: Senator Rick Santorum of Pennsylvania, who as the chair of the Senate Republican Conference was considered the third most powerful Republican in the United States Senate, was defeated by his Democratic opponent Bob Casey Jr, who received 59% of the vote to Santorum's 41% in the November 7, 2006, general election. Santorum was perhaps the most influential political ally of the "intelligent design" movement, a connection on which Casey's campaign capitalized, United Press International (2006 Nov 7) reported: "Ads cited his intervention in the dispute about disconnecting Terri Schiavo's feeding tube and his attempt to amend the 'No Child Left Behind Act' to teach the controversy between evolution and intelligent design'." (See Glenn 'Branch and Eugenie C Scott, "The anti-evolution law that wasn't", *The American Biology Teacher* 2003; 65 [3]: 165–6.)

Santorum's views on "intelligent design" were also cited in the endorsement of Casey by the *York Daily Record* (2006 Oct 29) — one of the two daily newspapers serving Dover, Pennsylvania — which described him as "[t]oo involved in the losing side of the divisive Dover 'intelligent design' flap (remember, he was on the advisory board of the legal group that helped spawn that fiasco, praised the school board for 'taking a stand' on ID — then resigned from the legal group's board after the judge's decision)". Santorum also contributed a preface to *Darwin's Nemesis* (Downers Grove [IL]: InterVarsity Press, 2006), a collection of essays in honor of the godfather of the "intelligent design" movement, Phillip Johnson, in which he expressed gratitude to Johnson for help "in my efforts to inject a renewed and unbiased understanding of science and its practice into the curricula of our public schools."

Texas: The *Dallas Morning News* (2006 Oct 17) summarized the position of four of the five gubernatorial candidates on "intelligent design" and evolution in the schools. Democrat Chris Bell said that she opposes teaching "intelligent design" along with evolution: "Things we teach kids in science class should have a scientific basis. Based on everything I have seen and heard, I fail to recognize the scientific basis for 'intelligent design'." Independent Kinky Friedman (the musician and writer) said that he opposes teaching "intelligent design" and quipped, "there's nothing intelligent about it." Incumbent Republican Rick Perry supports teaching "intelligent design" along with evolution; according to a spokesperson, he believes that it is "a valid scientific theory" that "should be taught as well." Independent Carole Keeton Strayhorn said that she opposes teaching "intelligent design" in science classrooms, although she added, "There may be a place you want to do it — in religion studies." The view of the fifth candidate, Libertarian James Werner, was neither included in the article nor apparently otherwise reported. In any case, in the November 7, 2006, general election, Perry was re-elected with 39% of the vote to Bell's 30%, Strayhorn's 18%, Friedman's 13%, and Werner's 1%.

Washington: At a campaign stop in Redmond, Washington, in early August, Mike McGavick, the Republican challenging incumbent Democrat Maria Cantwell for her Senate seat, was asked, "Will you vote to support the teaching of 'intelligent design' in public schools?" According to a transcript posted at the blog of the Seattle weekly *The Stranger* (available online at <http://www.thestranger.com/blog/2006/08/mcgavick_defies_kans.php>), McGavick answered, in part, "My view is that's a matter for local legislatures and local school-boards to decide on curricula. What I do believe though is we should teach all theories. So I think any theory that has some validity behind it should be taught. I wouldn't give it the same weight in my own view as something like Darwinism, which I think has greater scientific weight behind it, but the idea that we teach different beliefs seems to me to be part of teaching education."

The Stranger (2006 Aug 10–16) subsequently reported, "McGavick's campaign contributors include a crew that's associated with the Discovery Institute. Discovery Institute board members Tom Alberg, Christopher Bayley, former US Senator Slade Gorton, and Michael Vaska have given a combined total of $7300 to McGavick. (Discovery Institute founder Bruce Chapman's wife also kicked in $250.)" (It is only fair, however, to note that of those five, only Chapman is a notable public supporter of "intelligent design".) Cantwell, who told *The Stranger* that she "believes that 'intelligent design' has no place in the science curriculum of our public schools," was re-elected in the November 7, 2006, general election, with 57% of the vote to McGavick's 40%.

State boards of education and departments of education

Hawai'i: Reporting on the candidates for the Hawai'i state board of education, the *Honolulu Weekly* (2006 Sep 9) used a questionnaire that asked, among other things, whether "intelligent design" ought to be taught in the public schools. Evidently not every candidate replied to the questionnaire, and not every respondent chose to address the "intelligent design" question, suggesting that the issue was not particularly important in the election. Of the respondents to the "intelligent design" question, Kris DeRego, Carolyn Martinez Golojuch, and Karen Knudsen all answered in the negative. Incumbent Paul Vierling answered, "Parents, families and community are the best teachers for any belief system," which seems to be closer to no than to yes. Henry W Hoeft Jr said that they "[s]hould be taught side-by-side with Darwin's Theory of Evolution and students can decide which view to accept," and Brian Kessler said, "Voters should decide by referendum." In the primary, DeRego placed second and Vierling placed third in a field of three candidates in District 6; Knudsen placed second, Kessler placed eleventh, Golojuch placed twelfth, and Hoeft placed sixteenth in a field of seventeen candidates for three at-large seats on the board. Then, in the general election on November 7, 2006, DeRego lost to John Penebacker, who received 75% of the vote to DeRego's 25%, and Knudsen placed second, with 21% of the vote, and thus won a seat.

Kansas: As the November 7, 2006, general election approached, evolution education continued to be a factor in campaigns across Kansas, even though the results of the August primary election practically guaranteed a reversal of the state board of education's November 2005 decision to adopt a set of state science standards that was rewritten, under the guidance of local "intelligent design" activists, to impugn the scientific standing of evolution. In the primary election, Sally Cauble, a supporter of evolution education, defeated anti-evolution incumbent Connie Morris for the Republican nomination in District 5, and Jana Shaver, a supporter of evolution education, defeated anti-evolution candidate Brad Patzer, son-in-law of anti-evolution incumbent Iris Van Meter, for the Republican nomination in District 9. Since Cauble and Shaver's Democratic opponents, Tim Cruz and Kent Runyan, also support evolution education, supporters of evolution education were expected to have a 6–4 majority on the board, no matter who prevailed in the November election. (See *RNCSE* 2006 May/Jun; 26 [3]: 12–16.)

As a columnist in the *Kansas City Star* (2006 Aug 21), observed, however, "There's still time for voters to make the board's new moderate majority stronger still. Board members Ken Willard of Hutchinson and John Bacon of Olathe survived their GOP primaries." Willard, a Republican representing District 7, was facing a challenge from Democrat Jack Wempe; Bacon, a Republican representing District 3, was facing a challenge from Democrat Don Weiss. Both Willard and Bacon were avid supporters of the anti-evolution version of the standards, a decision that continued to attract comment. For example, the *Kansas City Star* (2006 Oct 28), endorsing Weiss and Wempe, described Willard and Bacon as having excited "national ridicule for voting to criticize the theory of evolution in state science standards," while the *Johnson County Sun* (2006 Oct 12), endorsing Weiss, castigated Bacon and his allies for their "antics on evolution instruction," which were "an embarrassment for Kansas around the world."

In the November 7, 2006, general election, Bacon defeated Weiss by 55% to 45%, Willard defeated Wempe by 51% to 49%, Cauble defeated Cruz by 65% to 35%, and Shaver defeated Runyan by 55% to 45%. Despite the re-election of Bacon and Willard, the Associated Press (2006 Nov 8) observed, "Come January, moderates will be calling the shots and one of the first things they're expected to do is rework the science testing standards for students to once again make them more pro-evolution oriented." A later report from the Associated Press (2006 Nov 21), however, indicated that "board members and scientists who want to rewrite the standards also want to take at least several months to do it. They hope to reconvene a panel of educators whose evolution-friendly work fell by the wayside last year when the board's conservative majority decided to adopt language suggested by intelligent design supporters." Steve Case, co-chair of the panel, explained, "I don't want the board to do anything in haste in a reactionary sort of way. They need to do it right." In the event, however, on February 13, 2007, the Kansas board of education voted 6–4 to approve a set of state science standards in which evolution is treated in a scientifically appropriate and pedagogically responsible way; Cauble and Shaver, the two new members of the board, both voted for the restoration of evolution to the standards. (For the latest from Kansas, see "Updates", p 14–15.)

Michigan: Two incumbents on the state board of education in Michigan, Democrat Reginald Turner and Republican Eileen Weiser, faced no fewer than nine challengers, among them Republican Tom McMillin, a former mayor of Auburn Hills, Michigan, a former Oakland County commissioner, and president of the board of a charter school in Mount Clemens. According to the *Detroit News* (2006 Oct 6), McMillin said that evolution should be chal-

lenged as a "theory" in science classes: "Teachers should be given the latitude to question it." There were apparently no reports of the positions of the other candidates, although Turner was enthusiastic about the proper treatment of evolution in the new content expectations for science, which creationist legislators unsuccessfully attempted to derail recently (see *RNCSE* 2006 Jul/Aug; 26 [4]: 11–12). In the November 7, 2006, election, McMillin placed third in the crowded field, with 21% of the vote, while Turner retained his seat with 25% of the vote.

Nebraska: The headline on the front page of the *Omaha World-Herald* told the story: "Evolution question shadows state races" (2006 Oct 25). Three candidates for the Nebraska state board of education — Marilyn Carpenter, Alan Jacobsen, and Paula Pfister — "expressed a willingness to discuss how Nebraska's standards might include alernat[iv]e theories." Evolution education was in the news in Nebraska in 2002, when two members of the board unsuccessfully attempted to ensure that the newly drafted state science standards reflected the provisions of the so-called Santorum Amendment; they were subsequently defeated in the November 2002 election (see *RNCSE* 2002 Sep/Oct; 22 [5]: 14–15). Carpenter, Jacobsen, and Pfister were challenging three incumbent members of the board, Fred Meyer in District 6, Patricia Timm in District 5, and Kandy Imes in District 7, respectively, all of whom reportedly support the present standards. Carpenter favors teaching creationism alongside evolution, Jacobsen favors teaching "intelligent design" alongside evolution, and Pfister, denying that evolution is proven science, told the *World-Herald*, "If you're going to teach theories, you should teach all theories, not just evolution." Carpenter and Jacobsen were both reported as not having any plans to raise the issue, however. In the November 7, 2006, general election, Meyer defeated Carpenter by 53% to 47%, Timm defeated Jacobsen by 57% to 43%, and Imes defeated Pfister by 65% to 35%.

Ohio: In a closely watched race, Tom Sawyer handily defeated incumbent Deborah Owens-Fink for the District 7 seat on the Ohio state board of education. Evolution education was a key issue in the race; on the board, Owens-Fink consistently supported anti-evolution measures, including the "Critical Analysis of Evolution" model lesson plan, which was rescinded by the board in February 2006 (see *RNCSE* 2006 May/Jun; 26 [3]: 7–11), and dismissed the National Academy of Sciences as "a group of so-called scientists." Defending her stance to *The New York Times* (2006 Oct 26), she described the idea that there is a scientific consensus on evolution as "laughable."

Sawyer, in contrast, told the *Akron Beacon-Journal* (2006 Oct 23) that evolution is "grounded in numerous basic sciences and is itself a foundational life science. By contrast, creationism in its many forms is not science but theology." But the campaign was not solely about evolution, he subsequently explained to the *Beacon-Journal* (2006 Nov 8): the evolution debate "was a metaphor for the failure of some members of the state board of education to understand the larger issues facing education in Ohio. I mean funding, quality and governance."

Owens-Fink and Sawyer aired their views during a radio discussion entitled "Evolution's effect on voters," broadcast on October 26, 2006, by WCPN, and available online at <http://www.wcpn.org/soi/2006/1023.html> in MP3 format; also on the show were "intelligent design" sympathizer Chris Williams and Brown University cell biologist Kenneth Miller, then stumping for Sawyer and other pro-evolution-education state board of education candidates in Ohio. (A high point occurred when Williams claimed that evolution delayed the discovery of small interfering RNA, and Miller replied by remarking that Craig Mello, who won a Nobel Prize in 2006 for his work on RNA interference, was a student in the first biology class Miller taught.)

In the four-way race, Sawyer received 54% of the vote to Owens-Fink's 29%, David Kovacs's 12%, and John Jones's 9%, according to the Associated Press. The *Beacon-Journal* reports that Owens-Fink's campaign spent over $100 000, while Sawyer's spent about $50 000 — both "unusually large sums for a state school board race." Sawyer also enjoyed the support of the pro-science-education coalition Help Ohio Public Education, organized by Lawrence M Krauss and Patricia Princehouse at Case Western Reserve University and Steve Rissing at the Ohio State University.

Pro-science candidates prevailed elsewhere in Ohio. In District 4, incumbent GR "Sam" Schloemer handily defeated challenger John Hritz, described by the *Cleveland Plain Dealer* (2006 Oct 22) as "a conservative millionaire who wants to include alternatives to Darwinism in science class." In District 2, John Bender narrowly triumphed in a four-way race with 37% of the vote; his closest rival, Kathleen McGarvey, who won 35% of the vote, was described by the *Plain Dealer* as "sympathetic to teaching alternatives to evolution." And in District 8, Deborah L Cain defeated incumbent Jim Craig, who was criticized for ambivalence about the "critical analysis" effort (see *RNCSE* 2006 Jul/Aug; 26 [4]: 9–11).

In District 3, however, Susan Haverkos defeated incumbent Thomas Gunlock (who was appointed late in 2006 to complete a term). The *Cincinnati Enquirer* (2007 Jan 4) reported, "Haverkos emphasized support for teaching 'intelligent design' in 10th-grade science classes — an issue over which the 19-member board has clashed. ... During the campaign, she was quoted by a *Dayton Daily News* blog as saying, 'Did we come out of bubbling ooze or did we come out of something else? That question, to say it's been solved, is a stretch.'" Haverkos's campaign website reportedly contained anti-evolutionist rhetoric, including a citation of work on earthworm bioturbation by a graduate student at the University of Maine, Kelly Dorgan; Dorgan subsequently offered a public reply, saying, "Contrary to Ms Haverkos'[s] assertions, my work does *not* in any way challenge Darwin's theory of evolution ... Darwin's theory of evolution is an important component in my research, as it is in most aspects of

biology" (<http://www.marine.maine.edu/~jumars/Dorgan/ID.html>; see also Wesley R Elsberry's post at The Panda's Thumb blog: <http://www.pandasthumb.org/archives/2006/11/this_worm_has_t.html>). The citation of Dorgan's work was removed from Haverkos's website thereafter.

South Carolina: Karen Floyd, the Republican candidate for state superintendent of education, was widely reported to support teaching "intelligent design" in South Carolina's public schools. In a statement (available on-line at <http://scpie.org/FeatureArticle.asp?ArticleID=17>) posted on the website of South Carolina Parents Involved in Education — which supports such causes as abstinence education and retaining "under God" in the Pledge of Allegiance as well as what it terms "objective science education" — Floyd wrote:

> More and more scientists are publicly coming out in favor of an Intelligent Design Theory because that is what the evidence is telling them is true.
>
> Long gone are the days when God was excluded from scientific circles. If we ignore that reality, we will only limit our children's scientific knowledge.
>
> Clearly, the theory of the politically-correct minority has been allowed to dominate our classrooms to the point where not only is evolution being taught as a scientific truth, but the public address system cannot be used to say a prayer for the safety of athletes before a football game — this is wrong.

The Charleston *Post and Courier* reported (2006 Nov 3) that, "While Republican Karen Floyd is not the only candidate who thinks teaching alternatives to Darwin's theories would benefit students, she is the one who says it's appropriate to discuss 'intelligent design' in public school science classes." Her Democratic opponent, Jim Rex, disagreed, however, saying, "I believe our schools should be places that respect the spiritual and religious beliefs of the students and families of their communities. There is an appropriate place to do that, but the science classroom is not the place." The race was a squeaker. On election night, Rex won by a mere 455 votes; after considering and deciding against a legal challenge to the outcome, Floyd conceded defeat on November 21, 2006.

[*NCSE thanks Richard Katskee for information used in this article.*]

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Devolution and Dinosaurs: The Anti-Evolution Seminar in the European Parliament

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In January 2006, BBC News published an article entitled "Britons unconvinced on evolution", reporting that only 48% of those questioned accept the theory of evolution. About 17% chose "intelligent design" (ID), 22% opted for creationism, and the rest did not know (<http://newsvote.bbc.co.uk>). Several months later, an anti-evolution seminar was scheduled for members of the European Parliament (EP) in Brussels. The meeting took place on October 11, 2006, and was announced under the following title: "Teaching evolutionary theory in Europe. Is your child being indoctrinated in the classroom?"

The presentation was translated into four languages and publicized by the Catholic Kolbe Centre for the Study of Creation (see its press release "Evolutionary theory dismissed at European Parliament seminar"; available on-line via <http://www.kolbecenter.org>) and other creationist groups. Much of the tone of the seminar was conveyed by an anti-evolution letter written by a Polish member of the EP, Maciej Giertych (*Nature* 2006; 444: 265). In this letter, the author claimed that his arguments are entirely scientific and denied any religious motivation.

The series of three public lectures at the EP was introduced and moderated by Giertych, who was announced as "Population Geneticist, MA, Oxford University; PhD, University of Toronto". Giertych indeed holds a PhD in tree physiology; he is also an honorary member of the UK-based Catholic creationist organization Daylight Origins Society. At the meeting, Giertych explained his views on what he called the falsified hypothesis of macroevolution (the emergence of new body plans as documented in the fossil record). According to this EP member, genetics research provides no evidence of, but "only disproof" for, the concept of common ancestry of life. Moreover, Giertych questioned the value of teaching such "wrong theories" in public schools. His arguments were reinforced by the aerospace physiologist Joseph Mastropaolo, who came from the United States to Brussels; he claimed that the theory of evolution "consists merely of interpretational evidence" and that "the biological sciences offer no empirical proof of macroevolution, just insurmountable problems".

In response to my published statement that "evolution is a fact that has been explained by a modern theory" (dpa news service, 2006 Oct 30), Mastropaolo offered me a considerable amount of money for evidence for evolution that must be "scientific, objective, valid, reliable and calibrated" (*see* RNCSE *2005 Sep–Oct; 25 [5–6]: 33–4*). In a letter, Mastropaolo contended that "the entire universe is devolving, the

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exact opposite and excluder of evolution" … and that "evolution is anti-science, because it is based entirely on frauds and forgeries". He sent me his paper presented at the public EP hearing, entitled "Life devolves", and summarized the general conclusions of this seminar as follows: "All of the evidence proved evolution is non-existent, whereas the entire universe has always devolved." In his EP presentation, Mastropaolo revealed his religious conviction that "life … is dynamically engineered with vast disciplined originality" and referred to his papers published in the creationist literature. In one of these papers, Mastropaolo wrote that "the human muscle was meticulously nanoengineered by a designer of unimaginable intelligence using mathematics and creative power" ("The maximum-power stimulus theory for muscle", *Creation Research Society Quarterly* 2001; 37 [4]: 213–20).

At the EP meeting, the civil engineer Hans-Joachim Zillmer, a well-known anti-evolutionist in Germany, claimed that the fossil record does not provide evidence for the emergence of novel body plans (macroevolution). Zillmer, who was announced as an "expert for paleontology and evolution" and a "member of the New York Academy of Sciences", has not published a single paper in the international peer-reviewed literature. A young-earth catastrophist, Zillmer is the author of best-selling popular books with titles such as *Darwins Irrtum* (*Darwin's Mistake)* (Munich: Langen/Müller, 2006 [8th ed]) and *Die Evolutionslüge* (*The Evolution Lie*) (Munich: Langen/Müller 2005). These books, written in German and translated into several languages, are full of factual errors and unsupported claims. In *Darwins Irrtum,* Zillmer asserts that he has found human and dinosaur footprints in fossil-bearing sediments in a riverbed in Texas and concludes that these organisms lived together. Even most creationists have admitted long ago that these supposed "human prints" are fraudulent carvings or artifacts. However, in one respect Zillmer is right: between 1960 and 1966, humans and dinosaurs co-existed — in the animated television series *The Flintstones*.

In his sequel *Die Evolutionslüge*, Zillmer argues that marine trilobites, which he confuses with crustaceans, may have co-existed with humans in the Cambrian. Referring to the 5th edition of the book of the German "basic types" creationists Reinhard Junker and Siegfried Scherer (*Evolution — Ein Kritischer Lehrbuch* [*Evolution — A Critical Textbook*], Giessen [Germany]: Weyel, 2001; *see* RNCSE *2006 Jul/Aug; 26 [4]: 31–6 for discussion*), Zillmer claims that mutations are always harmful and cannot add information to the genome. In essence, he argues that evolutionary biologists, geoscientists, and the editors of leading scientific journals are incompetent ideologists: these dogmatic Darwinists *believe* in macroevolution — a modern fairy tale that is unsupported by any evidence. Zillmer and Mastropaolo assert that the scientific establishment actively prevents the publication of the truth — that evolution is a fiction. Zillmer is an advocate of the "young-earth catastrophe" view, which suggests that our planet was struck by a global catastrophe (deluge) about 6 000 years ago. Zillmer believes that either the God of the Bible (which he considers more likely) or an extraterrestrial intelligence (alien life forms) created all forms of life on earth. It should be noted that Zillmer is a member of the American Association for the Advancement of Science (AAAS). He uses this prestigious membership to promote his esoteric pseudoscience among the general public of Europe.

At the end of the meeting, the French Catholic creationist Guy Berthault informed the audience about the results of his empirical research programs concerning the deposition of sediments. According to Berthault, sediments "did not form slowly over millions of years", but "have been laid down within very short time periods". Hence, "fossils can not be dated by the strata that they are found in, nor the rocks dated by the type of fossils found in them."

The public anti-evolution seminar was co-organized by Dominique Tassot, the director of Centre d'Etude et de Prospectives sur la Science (CEP). This is an association of 700 French-speaking Catholic intellectuals that was founded in 1997 by the transformation of a pre-existing informal group. CEP members, who include some active researchers such as Berthault, do not accept macroevolution because it is in conflict with their specific reading of the Bible.

Giertych's bizarre letter to *Nature* was based on the religiously motivated lectures presented at his seminar. The meeting was part of a novel intelligently designed strategy to distribute and popularize anti-evolutionism in Europe. It is obvious that the reputation of the European Parliament was misused for this purpose. A few weeks later, the journal *Nature* published Giertych's letter on its Correspondence page. This provocative anti-Darwin letter sparked many angry reactions among the readers of this prestigious scientific journal (see *Nature* 2006; 444: 679–80).

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Turkish Creationist Movement Tours American College Campuses

Pat Shipman
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The first I heard of it was when I got an e-mail from a Turkish colleague, Cengiz Camci, in aerospace engineering, who had read an article of mine in *American Scientist* about the threat that "intelligent design" poses in the US. Cengiz told me that representatives from the Turkish Harun Yahya movement were coming to our campus (Penn State) to speak. He asked me to attend to support a small group of faculty and students who were opposed to the Harun Yahya sect

and wanted to counter their presentation with pertinent questions and rebuttals.

Cengiz succinctly called the upcoming event "a great example of totally useless 'intelligent design' propaganda." The talk, "The Collapse of Darwinism and the Fact of Creation", was given by Dr Oktar Babuna — an acknowledged student of Harun Yahya — with a very professional-looking presentation (see the websites <http://www.harunyahya.com/> or <http://www.harunyahyaimpact.com/biyografi.php>). Harun Yahya is claimed to be the pen name of a single man, Adnan Oktar or Adnan Hoca, to whom hundreds of books, articles, pamphlets, videos, and PowerPoint presentations are credited (*see* RNCSE *1999 Nov/Dec; 19 [6]: 15–17; 18–20, 25–9; 30–5*). Reportedly, Adnan Oktar was formerly a prisoner and inmate in a Turkish mental asylum, which he sees as a political imprisonment. The enormous output of Harun Yahya and the affiliated Science Research Foundation (known as BAV after its Turkish acronym) suggests that the name is used by a number of people in collaboration.

Harun Yahya espouses a strongly creationist view and is blatantly anti-Semitic, anti-Zionist, and anti-Freemasonry. Though Turkey's population is predominantly Muslim, the country has long been officially a secular state. Its excellent education system stands out among those of similar countries for the unusually high percentage of women who receive university educations. Harun Yahya is working hard to remove evolutionary theory from the education system and replace it with creationist doctrine. In 2006, hundreds of free copies of a very glossy text featuring numerous color photographs — entitled the *Atlas of Creation* — were sent to schools all over Turkey in an attempt to promote adoptions. The same book, in French translation, was sent to educators all over France early in 2007 (*see "Updates", p 14–15*).

In 2007, representatives of Harun Yahya have been contacting Muslim student associations in colleges, universities, and community centers offering to give presentations. In Pennsylvania alone, I was able to track recent talks by the same group, under identical or near-identical titles, at the University of Pittsburgh, Lehigh University, Villanova University, and Temple University. A similar talk was held at the University of Buffalo on January 29 and at Albany University on February 1, 2007.

I expected a slick and well-orchestrated presentation, and I was not disappointed. What did surprise me was the lack of advance publicity. As late as the day before the event, there was no posting on the Muslims Students' Association (MSA) website or on that of Dialog Forum, an interfaith group that cosponsored the presentation. I could not find an announcement of the event on any campus calendar, nor were there posters on campus. I was eventually able to confirm the identity of the sponsors by calling the registrar's office, which books campus rooms for events. On the day of the event, an announcement appeared on the MSA website. I sent e-mail notices to the departments of Earth Sciences, Anthropology, and Biology, and to the Life Sciences Consortium, in order to alert interested parties. My message apparently sparked a notice on the post-doctoral list-serve as well. The turnout was good for a bitterly cold Thursday night in January: about 50 people. I do not know how many were Muslims who normally attend MSA meetings and how many were attendees with scientific backgrounds.

Babuna is a neurosurgeon from Turkey educated both in Turkey and the United States. He and his colleague, Ali Sadun, were elegantly dressed in ties, white shirts, and pin-striped suits with handkerchiefs in their breast pockets. The PowerPoint presentation that Babuna gave was very professionally produced.

Babuna's triple threat

His talk naturally divided into three parts. The first section attempted to link evolutionary theory with evil and social injustice; the second presented calculations intended to show that the proteins and cells of living organisms were irreducibly complex and could not have arisen "by coincidence"; and the third attacked the fossil evidence that should support evolution as either absent or intentionally deceptive.

He began the first part by connecting Darwinism to the ruthless strategies of political figures such as Karl Marx, Adolf Hitler, Joseph Stalin, Leon Trotsky, and Friedrich Engels. He provided images of each political leader coupled with quotations in which *materialism* — that is, evolutionary theory — provided scientific justification for the murder or gross maltreatment of thousands. With each image, he solemnly intoned the numbers of people who had been murdered. (He did not, of course, mention the numbers of victims of any religious movement or inter-faith conflict.) He openly blamed Darwinism for terrorism and racism. He posed a strictly dichotomous choice to the audience: either you are for Darwinism and these evil deeds, or you believe that Allah created the world and all of the life-forms in it. "There is no other choice," he said repeatedly.

The second portion of his talk was billed as an objective examination of the evidence for the creationist or the Darwinist approaches. His evaluation was based on three questions: 1) How did the first cell originate? 2) What are the mechanisms of evolution? 3) Is there abundant fossil evidence showing evidence of evolution?

To answer the first question, he gave some calculations to show the enormous complexity of living organisms, such as the number of amino acids that must be correctly assembled in a particular sequence to form a protein and the number of proteins produced by a single cell.

Pat Shipman is a paleoanthropologist who spent 20 years researching the early parts of human evolution by studying the fossil record. In 1990, she resigned her academic position to become a full-time writer to address an urgent need for science to be translated into language accessible to the public that would also convey the excitement and joy of scientific discovery. Two of her books have won major literary prizes in science. She is currently an Adjunct Professor of Anthropology at Pennsylvania State University and has a regular column on human evolution in American Scientist.

He asserted that a change in a single component rendered the whole (DNA or RNA molecule, or protein) ineffectual and nonfunctional.

"There is no trial and error mechanism in nature," he declared, "because if you change one single amino acid or one single protein, nothing functions any more." Such irreducible complexity could not have arisen by coincidence — "and evolution works by coincidence, Darwin tells us" — and must have been deliberately created, perfect and whole in a single, sudden step.

"You see, the whole theory of evolution collapses at the level of a single protein," he concluded.

Babuna chose the (human) eye as an example of an organ that could not possibly have been created by "coincidence". I found this choice fascinating, since a good deal of work has been done on the evolution of the eye. Among other studies, mathematical modeling has shown that a three-layered tissue — with light-sensitive tissue in the middle layer — can be easily transformed into a camera-type eye with a lens and retina by the action of natural selection.

Having declared the evolution of such irreducible complexity to be statistically impossible, Babuna moved to his second question concerning the mechanisms of evolution. He claimed there was not a single piece of evidence that natural selection had ever produced novelty, illustrating his point with a photograph of a cheetah chasing an antelope. "Natural selection may make the deer" — as he called it — "run faster to escape the cheetah, but it does not turn the deer into a horse. Natural selection produces no novelty, nothing new, no transformations into other species," Babuna said.

Babuna also argued that mutations, the second major mechanism proposed by evolutionary theory, were inevitably deleterious and usually resulted in death. Mutations are only harmful, he said: "Sixty years of genetic studies on fruitflies has yet to produce a single advantageous mutation." He also showed a video clip of Richard Dawkins being asked by an interviewer to name a mutation that had been shown to be clearly advantageous. Dawkins thought for some seconds without answering before the clip ended, a bit of clever editing that made this foremost evolutionary biologist look foolish.

The third segment of Babuna's talk concerned fossils. He cited the well-known quote from Charles Darwin regretting the lack of transitional forms, and declared that "there is not a single transitional fossil known." Fossils reveal the history of life, he conceded, but new forms appear suddenly and in their perfect, complex, and fully functional state, "which is very good evidence for creation, not evolution."

One tactic was to show photographs of various fossils which appeared to be identical to their modern form, such as dragonflies and horseshoe crabs. He presented these as evidence that evolution did not occur.

Babuna also attacked the practice of making reconstructions based on fossils as intentionally deceptive. He showed several images of the noted artist John Gurche making full-flesh sculptures of fossil hominins. "These are fakes," he said emphatically as the word FAKE was stamped across each image. "You can tell nothing about the ears, the lips, the hair, or the skin of a fossil from a few bits of skull. There is nothing here but the imagination of the artist." He repeated the demonstration several times, emphasizing the word FAKE.

To emphasize this point, he brought up the case of Ernst Haeckel, a renowned 19th-century biologist who was charged with drawing embryos of various species incorrectly to heighten their resemblance to human embryos. Babuna showed a quote from Haeckel saying that he had done nothing that other scientists did not do, implying that this was an admission of deliberately misleading the public. A more knowledgeable assessment of Haeckel's words would be that he felt he was justifiably generalizing from individual specimens and leaving out unimportant details to make his point clearer.

As a final strategy, Babuna cited various fossils that had at one time been claimed to be human ancestors that were then re-assessed. These including *Hesperopithecus* (a single pig tooth found in Kansas that was briefly thought to be a hominin tooth), the forged Piltdown skull, *Ramapithecus*, and *Zinjanthropus* (now called *Australopithecus boisei*). With each example, he would quote a scientist claiming the fossil was a human ancestor, and then the date of its revision, saying sarcastically, "Then they apologized" for the discredited claim.

In the case of several fossils (including *Zinjanthropus*), Babuna incorrectly implied that they are no longer considered to be hominins. In fact, *Zinjanthropus* or *Australopithecus boisei* and others are clearly hominins but are no longer thought to be *direct* ancestors of modern humans.

The audience responds

A very lively, sometimes heated question-and-answer session followed the presentation, and the questions were as far-ranging as Babuna's talk.

One member of the audience, George Chaplin, challenged Babuna "You say God created perfect and complete organisms," he argued. "If God created me, then I am perfect." A silence fell over the room as Babuna confronted this challenge.

"I didn't say perfect," Babuna replied. When the audience reminded him that he had used that very word repeatedly, Babuna said, "I didn't mean *perfect* perfect."

Asked what his definition of evolution was, Babuna replied "the definition of evolution is that living things come into being by coincidence." A biologist challenged this, saying it was not a suitable definition of evolution, nor was it one that was used by scholars in the field. "Since you don't define evolution in a way that any evolutionary biologist I know of defines evolution, your disproof of evolution isn't very convincing," she said.

When I cited *Archaeopteryx* as an excellent example of a transitional form, Babuna — who admitted he had never seen a fossil — disagreed. I told the audience about the teeth, wings, tail, brain, claws, tail, and sternum of *Archaeopteryx*, not to mention the many species of feathered dinosaurs now known from fossils. Babuna countered that there is a

UPDATES

Kansas: On February 13, 2007, the Kansas state board of education voted 6–4 to approve a set of state science education standards in which evolution is treated in a scientifically appropriate and pedagogically responsible way. These standards replace a set adopted in November 2005, in which evolution was systematically misrepresented as scientifically controversial. Those standards were the subject of intense criticism from scientific and educational organizations, including the National Academy of Sciences, the American Association for the Advancement of Science, and the National Science Teachers Association. Subsequently, the balance of power on the board changed, and supporters of the integrity of science education, who now enjoy a 6–4 majority on the board, quickly moved to restore evolution. Referring to the new standards, Jack Krebs of Kansas Citizens for Science told the Associated Press (2007 Feb 14), "Those standards represent mainstream scientific consensus about both what science is and what evolution is."

A different Associated Press story (2007 Feb 14) emphasized the role played by the two new members of the board, Sally Cauble and Jana Shaver, both Republicans. Both argued that the board should have deferred to the consensus of the committee of scientists and educators who wrote the original set of standards, which the board subsequently rewrote under the guidance of local "intelligent design" activists to impugn the scientific standard of evolution. "When you ask a committee to do something, and they do their time, and they give their knowledge, and you think they're worthy of that because you've asked them to serve on that committee, then you ought to let the process follow through," Cauble was quoted as saying. Similarly, Shaver said, "I looked at what the scientists and what people in the mainstream in the science community said about the standards and what they thought would be best for science education in Kansas."

The anti-evolution version of the standards was not in place long enough to be felt in the classrooms, or so the superintendent of the Wichita school system told the Associated Press: "We haven't changed our science books. We haven't changed our science curriculum ... I guess it's one of those things, if you wait long enough, this too shall pass." The February 13 vote was the board's fifth revision to the state science standards within eight years. But there is no guarantee that evolution's place in the standards is secure: the Associated Press's story observes, "State law will require the board to update the standards again by 2014, and elections before then could give conservatives a majority again." Nationally, NCSE's executive director Eugenie C Scott predicted, attempts to compromise evolution education without mentioning supposed alternatives such as "intelligent design" will recur: "'evidence against evolution' is the creationism *du jour*."

Mississippi: Mississippi's House Bill 625, introduced by Representative Mike Lott (R–District 104) on January 9, 2007, died in committee on January 30, 2007, which was the last day for committees to report bills originating in their house of the legislature. If enacted, HB 625 would have provided, "The school board of a school district may allow the teaching of creationism or 'intelligent design' in

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bird in South America with claws on its wings, which he suggested refuted all the evidence I had cited.

I also pointed out that his diagram of an eyeball was as "fake" as Haeckel's embryo diagrams or Gurche's hominin reconstructions. "Does an eyeball look like this?" I asked, pointing to his image. "I've dissected them and never seen those things like piano keys that you say are retinal cells. And what about that yellow stuff filling the eyeball? I've never seen that either, or those green arrows. This is as much a fake as the other illustrations you labeled fakes."

"No," Babuna answered. "This is just a diagram from a medical textbook."

A question of credibility

My friend Cengiz asked from the back of the room what had happened to the 80 000 blood samples and all the donated funds that had been raised in Turkey for Babuna's leukemia cure. When asked how that pertained to Babuna's talk, he replied, "It is relevant to his credibility."

Cengiz referred to a massive movement in Turkey started by Babuna and his family in 1999, when Babuna had been diagnosed with leukemia and needed a marrow transplant to save his life. According to Turkish newspaper reports, as many as 160 000 people, attracted by the promise of a large reward if they were suitable donors for Babuna, contributed blood and marrow samples. A great deal of money was also raised to test and process the samples, but both the funds and the samples remain unaccounted for. Turkish legal authorities are investigating.

Babuna has not been entirely open about this matter. In October of 1999, he told the Turkish newspaper he had cured himself of leukemia by prayer (*Turkish Daily News*, 1999 Oct 3; available on-line at <http://www.turkishdailynews.com.tr/archives.php?id=14352>.) However, Babuna does not mention in public that he also received treatment and transplants at the MD Anderson Cancer Center in Texas and later at the Seattle Cancer Care Alliance (<http://www.seattlecca.org/patientsandfamilies/international/OktarsStory.htm>).

Babuna promised after his cure to "go into politics" and it would seem that he has.

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the schools within the district. However, if the theory of evolution is required to be taught as part of the school district's science curriculum, in order to provide students with a comprehensive education in science, the school board also must include the teaching of creationism or 'intelligent design' in the science curriculum." A similar provision was part of 2005's House Bill 953, of which Lott was the chief sponsor; HB 953 died in committee on January 31, 2006.

New Mexico: At The Panda's Thumb blog, Dave Thomas reported that New Mexico's House Bill 506 was tabled by a vote of 8–4 in the House Education Committee on February 21, 2007 (<http://www.pandasthumb.org/archives/2007/02/2nd_creationism.html>). If enacted, HB 506 would have required the state department of education to adopt rules to "give teachers the right and freedom, when a theory of biological origins is taught, to objectively inform students of scientific information relevant to the strengths and weaknesses of that theory and protect teachers from reassignment, termination, discipline or other discrimination for doing so; and ... encourage students to critically analyze scientific information, give them the right and freedom to reach their own conclusions about biological origins and provide that no student shall be penalized in any way because the student subscribes to a particular position on biological origins."

Thomas reported, "only Mike Edenburn, at sponsor Dub Williams'[s] side, spoke in favor of the bill. Speaking against were several scientists and educators, myself included. After the comments, sponsor Dub Williams himself voted to table the bill, which was then tabled 8–4. (I was expecting the same 7–5 split as for the bill on teaching Bible as History, HB 498, which was tabled just before the HB 506 discussion.)" Williams also sponsored House Joint Memorial 14, which in effect would have asked, rather than required, the state department education to comply with the recommendations of HB 506; HJM 14 was tabled by a 7–4 vote in the House Judiciary Committee on January 29, 2007. Still remaining active are the Senate counterparts of HB 506 and HJM 14, SB 371 and SJM 9.

Tennessee: Senate Resolution 17, introduced in the Tennessee state senate on February 21, 2007, by Raymond Finney (R–District 8), would, if enacted, "request the commissioner of education to provide answers to questions concerning creationism and public school curriculum in Tennessee," beginning with, "Is the Universe and all that is within it, including human beings, created through purposeful, intelligent design by a Supreme Being, that is a Creator?" If the answer is yes, then SJR 17 poses the further question, "Since the Universe, including human beings, is created by a Supreme Being (a Creator), why is creationism not taught in Tennessee public schools?" If the commissioner declines to answer on the grounds that it is impossible to prove or disprove any answer, then SJR 17 poses the further question, "Since it cannot be determined whether the Universe, including human beings, is created by a Supreme Being (a Creator), why is creationism not taught as an alternative concept, explanation, or theory, along with the theory of evolution in Tennessee public schools?" And if the answer is no, then SJR 17 poses no further questions, remaining content to express admiration of the commissioner "for being able to decide conclusively a question that has long perplexed and occupied the attention of scientists, philosophers, theologians, educators, and others."

The on-line news source NashvillePost.com (2007 Feb 26) speculated, "This move by Finney, while not likely to receive the same level of interest as the Scopes case, may well have its roots in the same reasoning that encouraged the Rhea County leaders to spark the debate: a desire for attention. The resolution needs only to be passed by the Republican-controlled Senate in order to force Tennessee's Department of Education to answer on the record. A joint resolution would have to pass the Democrat[ic]-controlled House of Representatives, where it would likely find itself relegated to a black hole committee and not see the light of day. By circumventing ... the House, Senate Republicans would then be forcing a Bredesen cabinet member to weigh in on the creationism argument, right before next year's legislative session when both parties would be seeking to add to their numbers in the 2008 elections." (Philip Bredesen, a Democrat, is the current governor of Tennessee.)

France: Thousands of copies of *The Atlas of Creation*, by the Turkish creationist known as Harun Yahya, were recently sent to French schools, colleges, and universities, according to *Le Figaro* (2007 Feb 2). The newspaper reported that the "richly illustrated" 770-page book purports to show "the secret links between Darwinism and bloody ideologies like fascism and communism." It also contains a photograph of the September 11, 2001, attacks on the World Trade Center, with a "stupefying legend" blaming terrorism on "Darwinism" and calling it the "only ideology that valorizes, and therefore encourages, conflict."

The French minister of education, Gilles de Robien, responded quickly, the report said, directing academic administrators not to distribute the book, which "has no correspondence with" the French national curriculum. French biologist Hervé Le Guyader, professor at the University of Paris VI, carried out a preliminary analysis of the book for the education minister, reported *Le Monde* (2007 Feb 3). Le Guyader called the book "much more dangerous than previous creationist initiatives," noting that the book's lavish production "could convince someone who didn't know any biology." But, he added, its scientific content was "appallingly poor".

The French education ministry was quoted in a story from Agence France Presse (2007 Feb 2) as saying, "We believe that there are lots of resources behind this campaign and the mass distribution, but [we] are not alarmed as the book has not reached the classrooms or documentation centers." The mass distribution of unsolicited creationist literature in France is reminiscent of recent incidents in the United Kingdom and New Zealand, where Christian creationist organizations sent packets of anti-evolution material, including DVDs, to government schools.

[RNCSE *readers can visit the NCSE website <http://www.ncseweb.org> for links from these stories to original sources and follow-up analysis.*]

Time to Accumulate Chloride Ions in the World's Oceans

Creationism's Young Earth Not Supported

INTRODUCTION

Some "creation scientists" claim that the earth is only about 6000 years old, but this assertion is not based on science. They also object to using radiometric isotopic age-dating methods to determine the age of the earth, which calculate ages of about 4.54 billion years (Newman 1997). It is easy to counter these arguments, of course, if the earth can be shown to be billions of years old by some other method in addition to the isotopic age dating. One such method used early in the study of the age of the earth was based on observing the rate at which the world's rivers brought in dissolved sodium ions (Na^+) and then calculating how long it would take to make the world's oceans as salty as they are now, based on this rate of accumulation. In 1899, John Jolly estimated this time to be about 100 million years (Birkeland and Larson 1989). But then researchers realized that this estimate had a number of problems. The rate at which Na^+ ions were transported to the world's oceans was probably not constant, and many of the Na^+ ions came from recycled salt. Furthermore, the ocean waters probably reached a certain limit of Na^+ ion content but no more because many of these Na^+ ions were incorporated in clay and other minerals and thus removed from the ocean water. Therefore, the earth was *older* than 100 million years, but how much older could not be determined, so this method of estimating the age of the earth was abandoned. However, if the chloride ion (Cl^-) content in sea water is used instead of the Na^+ ion and if the origin of the Cl^- ions can be determined, then an estimate of the time that it takes to make all salt, both in the oceans and on the continents, can be calculated.

SOURCES OF SALTS AND THE CHLORIDE ION

It has been generally assumed that the Cl^- ion in salts in the oceans results from the weathering of igneous rocks, which produces dissolved ions that are transported to lakes or to the oceans. For example, each year four rivers surrounding the Great Salt Lake in Utah bring in about 2.9 million acre–feet of rain water which carries about 8.82 x 10^9 kilograms of dissolved salts to the lake. Each year all this water evaporates in the summer, so these salts are added to the lake beds (UGS nd).

Although some Cl^- ions in the salts in the Great Salt Lake could be newly derived from the weathering of igneous rocks in adjacent mountains, it is likely that much of the Cl^- ion content came from recycled salt (NaCl) released during the erosion of marine sandstones of Paleozoic, Mesozoic, or Cenozoic age in the surrounding area. Furthermore, in various places around the world, there are local thick layers of salt (some more than 1 kilometer thick) that are interlayered with the marine sandstones. Salt in all of these places must have been in the oceans at one time but is now on the continents. Therefore, when we calculate the amount of salt in the oceans as a basis for estimating the age of the earth, we have to include these ions as a part of the salt "in the oceans" because they were originally located there. On that basis, a source for the Cl^- ions in this salt must also be accounted for in addition to the *present* Cl^- ions in the oceans.

That ultimate source for the Cl^- ions in the present oceans, marine sediments on the continents, and thick salt beds could be from the older Precambrian rocks that underlie the Paleozoic, Mesozoic, and Cenozoic sedimentary rocks. The structure of the underlying Precambrian igneous and metamorphic rocks reveals evidence of extensive erosion of former continental mountains that once projected with high elevations above sea level, just like the elevations of the present mountains. These mountains would have had deep roots. That is, the relatively low densities of the rocks in the mountains would have caused them to float like icebergs atop the underlying denser mantle with most of their volume below sea level, extending to deep roots. Through a long period of geologic time and after periods of isostatic uplift, these mountains were eroded down to their roots and planed off so the Paleozoic, Mesozoic, and Cenozoic rocks were deposited on top of them. The average total thicknesses of these ancient Precambrian eroded masses must have been at least 20 to 30 kilometers because only at such thicknesses (depths) and high temperatures as occur there can

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– More Than 3.6 Billion Years

Lorence G Collins, California State University, Northridge

the kinds and compositions of minerals in these exposed rocks be formed (Winter 2001).

Amount of chloride obtained from Precambrian rocks

If 25 kilometers (km) is chosen as the average thickness (most measures fall between 20 and 30 km) for the depth of erosion for a volume of Precambrian igneous and metamorphic rocks in the area occupied by the continents, and if the average density of these rocks is 2.9 grams/cubic centimeter (g/cc), and if these rocks contain 130 parts per million (ppm) Cl^- (Table 1), the amount of Cl^- in this volume is 3.4974×10^{20} g. But the amount of Cl^- in the world's oceans is 2.6715×10^{22} g (see Table 3 for details of these calculations).

Table 1
Comparison of the abundance in parts per million of the eight most common elements in the earth's crust to the abundance of the element chlorine (Klein and Hurlbut 1977).

Element	Symbol	Abundance (ppm)
Oxygen	O	466 000
Silicon	Si	277 200
Aluminum	Al	81 300
Iron	Fe	50 000
Calcium	Ca	36 300
Sodium	Na	28 300
Potassium	K	25 900
Magnesium	Mg	20 900
Chlorine	Cl	130

Therefore, the amount of Cl^- in the world's oceans is about 19 times more than can be produced from a 25-km–thick tablet of continental crustal rocks. In fact, the thickness of original rock necessary to produce the amount of Cl^- presently in the oceans would have to have been 475 km, which is a depth many times greater than would ever be possible to erode. Furthermore, even greater thicknesses would be needed to account for the additional amount of Cl^- in salt in the marine sandstones and in the pure salt layers that lie on top of the Precambrian rocks. Therefore, erosion of continental rocks is far from being an adequate source for the large quantity of Cl^- ions in the world's oceans. In comparison, the amount of Na^+ in a 25-km–thick mass of continental rocks is many times more than adequate, since it makes up 2.83% of the earth's crust (Table 1). Obviously, this amount of Cl^- in the oceans requires another Cl^- ion source besides Precambrian igneous and metamorphic crustal rocks.

Mantle processes

The scientific explanation for the origin of the earth is that it accreted from planetesimals that collided and melted. Relatively heavy iron and nickel sank to the core of the earth, and the lighter elements, consisting mostly of oxygen and silicon, but including lesser amounts of six other metallic elements and even smaller amounts of Cl^- (Table 1), floated up and crystallized as silicate minerals in the outer mantle (Winter 2001). The abundant large O^{2-} ions (1.40 Å; 1Å = 10^{-8} cm) and tiny Si^{4+} ions (0.42 Å) occur in silicate lattices in which four O^{2-} ions surround one Si^{4+} in tetrahedral arrangements, and the other metallic ions fill the interstices outside the tetrahedra to obtain electrical balance. On the other hand, the Cl^- ion with its large (1.81 Å) size (Table 2) does not fit into the lattices and is relatively unstable deep in the mantle at the high pressures that occur there. Consequently, when the outer mantle was first formed, most of the estimated primordial 2.2×10^{25} g Cl^- was concentrated in the outermost parts of the mantle (Graedel and Keene 1996). Moreover, throughout this period, the Cl^- ions, because of their large sizes, continued to be squeezed out of dense silicate minerals in the mantle and migrated upward as a highly volatile gas, hydrogen chloride (HCl). At the earth's surface much of this HCl was expelled during volcanic eruptions. Today, we estimate that 7.8×10^{12} g HCl are expelled annually into the atmosphere by volcanic eruptions (Mattox nd; Cadle 1980), and of this amount, the Cl^- ion is 7.5863×10^{12} g. Therefore, volcanoes contribute large quantities of Cl^- ions that are scattered throughout the world in acid deposition. This is another way that Cl^- ions can become a part of the salts in the Great Salt Lake or be accumulated in the oceans.

Table 2
Comparison of the relative sizes (radii) of ions in angstroms.

Ion	Size
Si^{4+}	0.42 Å
Al^{3+}	0.51 Å
Mg^{2+}	0.66 Å
Fe^{2+}	0.74 Å
Na^{+}	0.97 Å
Ca^{2+}	0.99 Å
K^{+}	1.33 Å
O^{2-}	1.40 Å
Cl^{-}	1.81 Å

TABLE 3 *Calculations for determining the abundance of Cl^- ions in Precambrian crustal rocks in comparison to the abundance of Cl^- ions in the world's oceans.*

Abundance of Cl^- ions in Precambrian rocks:

Volume of Precambrian rocks (thickness x area of continents):
(25 km; 2.5×10^6 cm) x (1.4843×10^{18} cm^2) (Enchanted Learning nd) = 9.2769×10^{23} cc.

Mass of rock in this volume: (density x volume):
2.9 g/cc x 9.2769×10^{23} cc = 2.6903×10^{24} g.

Amount of Cl^- in this mass:
0.00013 (relative abundance of Cl^-; Table 1) x 2.6903×10^{24} g = **3.4974×10^{20} g Cl^-.**

Abundance of Cl^- ions in the world's oceans:

Mass of Cl^- ions per cc of sea water: mass of salts/cc
(0.03528 g/cc) x Cl^- % (0.553) = 0.0195 g Cl^-/cc (UCAR 2002).

Mass of Cl^- ions in the world's oceans:
0.0195 g Cl^-/cc x 1.37×10^{24} cc (volume of the world's oceans; Duxbury 2000) = **2.6715×10^{22} g Cl^-.**

TOTAL TIME TO MAKE ALL CHLORIDE IONS

Because the annual amount of Cl^- ions that is expelled into the atmosphere is known (7.5863×10^{12} g), this value can be used to calculate the time for Cl^- ions to have accumulated in the world's oceans through volcanic eruptions. Dividing 2.6715×10^{22} g by 7.5863×10^{12} g gives the number of years to be about 3.5 billion years. However, the amount of Cl^- ions in the world's oceans (2.6715×10^{22} g) also includes the 3.4974×10^{20} g of Cl^- ions that were eroded from the 25-km–thick Precambrian tablet (Table 3). This contribution of Cl^- ions from this tablet would subtract from the 3.5 billion years. The proportion of Cl^- ions contributed from the continental rocks is only 1/9th of the total in the world's oceans and subtracts only 0.046 billion years. So we now have a rough estimate of 3.316 billion years.

TABLE 4 *Calculations for obtaining the time to form the Cl^- ions in rock salt (NaCl) in continental rocks.*

Volume of sedimentary rocks:
0.66 x 1.4843×10^{18} cm^2 (continental area) x 1.8×10^5 cm (thickness) = 1.7633×10^{23} cc.

Volume of NaCl in sedimentary rocks:
0.01 x 1.7633×10^{23} cc = 1.7633×10^{21} cc.

Mass of NaCl (density x volume):
2.16 g/cc x 1.7633×10^{21} cc = 3.8087×10^{21} g.

Mass of Cl^- ions in NaCl:
0.6065 (percent Cl^-) x 3.8087×10^{21} g (mass of NaCl) = 2.31×10^{21} g Cl^-.

Added time for first Cl^- ions in NaCl:
2.31×10^{21} g of Cl^- ÷ 7.5863×10^{12} g/year = **0.3045 billion years.**

However, there are other factors to be considered in determining the amount of time needed to deposit all the salt present on the earth. For example, although more than 2.6715×10^{22} g of Cl^- have been released into the oceans, the above calculations have not taken into account the evaporite rock salt (NaCl) deposits on the continents, which must have formed from deposition of Cl^- ions in former ancient isolated marine seas that evaporated. No one has estimated their volumes, but from the abundance of various sedimentary rocks, the approximate volumes can be deduced. The sedimentary rocks on the continents consist of mostly shales, sandstones, and limestones (greater than 95% and perhaps as much as 99%) (Blatt 1982). The remaining rock types (1–5%) are phosphorites, coal and other organic deposits, banded iron formations, volcanoclastic rocks (ash beds), chert, gypsum, and rock salt. On that basis, a reasonable estimate for the volume of rock salt is about 1% of the volume of sedimentary rocks.

Of the continental surface area, 66% is covered by sedimentary rocks, and the average thickness of all these sedimentary rocks is 1.8×10^5 cm (Blatt 1982). Therefore, the average volume of sedimentary rocks is 1.7633×10^{23} cc, and 1% of this is 1.7633×10^{21} cc. On the basis that NaCl has a density of 2.16 g/cc, the mass of the Cl^- ions in this volume is 2.31×10^{21} g. This additional amount of Cl^- ions must be provided by Cl^- ions coming up from the mantle, and the amount of additional time required to produce that amount is 0.3045 billion years (see Table 4 for these calculations). Although there are more Cl^- ions on the continents in the troposphere, glaciers and ice masses, soil, ground water, fresh water lakes and rivers, and other sources (Graedel and Keene 1996), these amounts are so small that accounting for them does not change the time except in the fourth decimal point. Nevertheless, adding 0.3045 to 3.316 suggests that the time for all Cl^- ions to have accumulated on the earth in the oceans and in evaporite deposits is about 3.6 billion years.

OTHER FACTORS INCREASING THE TIME FOR ACCUMULATION OF CHLORIDE IONS

Some Cl^- in the world's oceans has been recycled into and then out of the crust because of plate tectonics. Therefore, the Cl^- in the world's oceans now does not include just the Cl^- ions that migrated into the oceans since the earth was formed. Since the Jurassic Period or as far back as the Precambrian, some Cl^- ions in the oceans have been carried down with sea water into the mantle by the subduction of basaltic oceanic plates. Both the water and the soluble Cl^- ions are released from the slabs and rise through the crust. The water facilitates the melting of the crustal rocks above the subducting slab to create magmas, and such magmas were injected into the Precambrian crust as well as into overlying Paleozoic, Mesozoic, and Cenozoic sedimentary rocks (Collins 1999). The solidified magmas might be expected to trap the Cl^- ions and prevent their use for estimating times of formation, but the large size (1.81 Å) of the Cl^- ion allows only a little to be trapped. Consequently, the igneous rocks contain Cl^- only in parts per million. For example, the standard biotite granite G-2 contains 70 ppm Cl^- (USGS 1995). Taking into account the amount of Cl^- ions stored in the continental igneous rocks that have not been eroded away to their roots, as well as those that have, can affect the estimated time for Cl^- ions to accumulate in

Continued on page 23

Knowing the Age of the Earth: The Geological Sciences Speak Out

Geological Society of America (2001)

The Geological Society of America recognizes that the evolution of life stands as one of the central concepts of modern science. Research in numerous fields of science during the past two centuries has produced an increasingly detailed picture of how life has evolved on earth.

The rock record is a treasure trove of fossils, and by 1841, eighteen years before Charles Darwin published *On the Origin of Species*, geologists had not only assembled much of the geologic time scale from physical relationships among bodies of rock, but they had also recognized that fossils document profound changes in life throughout earth's history. Darwin showed that biological evolution provides an explanation for these changes. Since the time of Darwin, geologists have continued to uncover details of life's history, and biologists have continued to elucidate the process of evolution. Thus, our understanding of life's evolution has expanded through diverse kinds of research, much of it in fields unknown to Darwin such as genetics, biochemistry, and micropaleontology. In short, the concept of organic evolution has not only withstood the test of time — the ultimate test of any scientific construct — but it has been greatly enriched.

In recent years, certain individuals motivated by religious views have mounted an attack on evolution. This group favors what it calls "creation science", which is not really science at all because it invokes supernatural phenomena. Science, in contrast, is based on observations of the natural world. All beliefs that entail supernatural creation, including the idea known as "intelligent design", fall within the domain of religion rather than science. For this reason, they must be excluded from science courses in our public schools.

This separation of domains does not mean that science and religion are fundamentally incompatible. Many scientists who conduct research on the evolution of life are religious, and many major religions formally accept the importance of biological evolution.

Misinterpreting the Bible's creation narratives as scientific statements, many creationists go so far as to attack the validity of geologic time — time that extends back billions of years. "Deep time" is the foundation of modern geology. It was actually well established, though not quantified, by geologists decades before Darwin published his ideas or most scientists came to accept evolution as the explanation for the history of life. Furthermore, thousands of geologists employing many new modes of research refined the geologic time scale during the twentieth century. Near the start of that century, the discovery of naturally occurring radioactive substances provided clocks for measuring actual ages for segments of the geologic record. Today, some billion–year-old rocks can be dated with a precision of less than a tenth of one percent. Moreover, modern geologists can identify particular environments where sediments that are now rocks accumulated hundreds of millions of years ago: margins of ancient oceans where tides rose and fell, for example, and valley floors across which rivers meandered back and forth, and ancient reefs that grew to thicknesses of hundreds of meters but were built by organisms that could not have grown faster than a few millimeters a year. By studying the fossil record that forms part of this rich archive of earth's history, paleontologists continue to uncover details of the long and complex history of life.

Acceptance of deep time is not confined to academic science. If commercial geologists could find more fossil fuel by interpreting the rock record as having resulted from a single flood or otherwise encompassing no more than a few thousand years, they would surely accept this unconventional view, but they do not. In fact, these profit-oriented geologists have joined with academic researchers in refining the standard geologic time scale and bringing to light the details of deep earth history.

Modern studies of the evolution of earth and its life are not only aiding us in the search for natural resources, but also helping us to understand how the earth-life system functions. Annual layers of ice in the Greenland glacier, for example, range back more than a hundred thousand years. These ice records warn that earth's climate may change with devastating speed in the future. The geologic record also reveals how various forms of life have responded to past environmental change, sometimes migrating, sometimes evolving, and sometimes becoming extinct. In the present world, bacteria are now evolving rapidly in ways that render antibiotics ineffective; to respond to bacterial evolution, we must understand evolution in general.

The immensity of geologic time and the evolutionary origin of species are concepts that pervade modern geology and biology. These concepts must therefore be central themes of science courses in public schools; creationist ideas have no place in these courses because they are based on religion rather than science. Without knowledge of deep time and the evolution of life, students will not understand where they and their world have come from, and they will lack valuable insight for making decisions about the future of their species and its environment.

American Geophysical Union (1999)

Earth History and the Evolution of Life Must Be Taught: Creationism Is Not Science

Adopted by Council December 1981
Re-affirmed May 1990, May 1994, May 1994;
expanded and re-affirmed December 1999

The American Geophysical Union affirms the central importance of scientific theories of earth history and organic evolution in science education. An educated citizenry must understand these theories in order to comprehend the dynamic world in which we live and nature's complex balance that sustains us.

Science employs a logical and empirical methodology to understand the natural world. Scientific research entails observation of natural phenomena, formulation of hypotheses as tentative, testable statements to explain these phenomena, and experiments or observations to test these hypotheses. Scientific theories, like evolution and relativity and plate tectonics, are hypotheses that have survived extensive testing and repeated verification. Scientific theories are therefore the best-substantiated statements that scientists can make to explain the organization and operation of the natural world. Thus, a scientific theory is not equal to a belief, a hunch, or an untested hypothesis. Our understanding of earth's development over its 4.5-billion–year history and of life's gradual evolution has achieved the status of scientific theory. "Creation science" is based on faith and is not supported by scientific observations of the natural world. Creationism is not science and does not have a legitimate place in any science curriculum.

AGU opposes all efforts to require or promote teaching creationism or any other religious tenets as science. AGU supports the National Science Education Standards, which incorporate well-established scientific theories including the origin of the universe, the age of earth, and the evolution of life.

These statements and others by professional societies in support of teaching evolution can be found in NCSE's *Voices for Evolution*, also available on-line at <http://www.ncseweb.org/article.asp?category=2>.

Rock of ages; ages of rock

With the focus of "intelligent design" firmly on biochemistry, information theory, and the origin of life, it is sometimes difficult to remember that there are people who think that isotopic age determination is unreliable, that the Grand Canyon was formed virtually overnight, that strata are dated by fossils and fossils by strata, that the earth is less than 10 000 years old, and, in general, that modern geology is all wrong. To discover or rediscover the delights of geology — and, perhaps, to equip yourself for whatever the latest creationist misinformation about geology will be — check out the following books, all of which are now available through the NCSE website: <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.

For the general reader

Pioneers of Geology: Discovering Earth's Secrets
by Margaret W Carruthers and Susan Clinton
Suitable for budding geologists in fifth through ninth grades, *Pioneers of Geology* engagingly presents the history of geology by concentrating on the life and works of six important geologists: James Hutton, Charles Lyell, GK Gilbert, Alfred Wegener, Harry Hess, and Gene Shoemaker (who not only discovered the comet Shoemaker–Levy 9, but also is widely considered the father of planetary geology). With black-and-white illustrations and photographs; a geological time scale and a diagram of the age and structure of the earth appear in appendices, along with a helpful glossary and a bibliography including references to internet resources.

Annals of the Former World
by John A McPhee
Assembled together in *Annals of the Former World* are no fewer than four of John McPhee's acclaimed popular books about North American geology — *Basin and Range*, *In Suspect Terrain*, *Rising from the Plains*, *Assembling California* — as well as the previously unpublished *Crossing the Craton*. Writing in *The New York Review of Books*, Stephen Jay Gould praised McPhee's "ability to capture the essence of a complex issue ... in a well-turned phrase." McPhee, a staff writer for *The New Yorker* since 1965, won the 1999 Pulitzer Prize for Nonfiction for *Annals of the Former World*.

The Mysteries of Terra Firma: Exploring the Age and Evolution of the World
by James Lawrence Powell
In *The Mysteries of Terra Firma*, Powell — the author of *Night Comes to the Cretaceous* and *Grand Canyon: Solving Earth's Grandest Puzzle*, as well as the former president and director of the Los Angeles County Museum of Natural History — describes the development of our understanding of the history of the earth by focusing on three themes: Time, Drift, and Chance. For a lucid explanation of the dating techniques used to establish the age of the earth, the revolution wrought by Wegener's theory of continental drift, and the role played by chance asteroid impacts in the history of the earth, look no further. "An accessible, lively account of the biggest questions in earth history," writes the reviewer for *Booklist*.

Earthsteps: A Rock's Journey Through Time
by Diane Nelson Spickert, illustrated by Marianne D Wallace
Is the 250-million-year career of a rock a suitable subject for a picture book aimed at kindergartners through third-graders? Yes! Writes the reviewer for *The Children's Bookwatch*, "Marianne Wallace's artwork is nothing short of spectacular. Diane Spickert's narrative text is absolutely faithful to the geology and paleontology of the Earth's record as recorded by fossils. *Earthsteps* is a 'must' for personal, school and community library children's science books and non-fiction picturebook collections." Complemented with a geological time scale (from the Permian to the Holocene) and a glossary of geological terms.

When and where

Ancient Earth, Ancient Skies: The Age of Earth and Its Cosmic Surroundings
by G Brent Dalrymple
Whereas Dalrymple's *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 scien-

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

tists 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."

The Chronologers' Quest: The Search for the Age of the Earth
by Patrick Wyse Jackson
In *The Chronologers' Quest*, Patrick Wyse Jackson recounts the fascinating story of attempts to ascertain the age of the earth, starting with prescientific mythology and sacred chronology, continuing through the rise of scientific geology in the seventeenth, eighteenth, and nineteenth centuries, and culminating with the advent of radioisotope dating methods, which show that the earth is about 4.5 billion years old. The reviewer for *Sky and Telescope* comments, "Jackson lays out the information clearly and chronologically, making it an excellent resource for researchers"; a useful annotated bibliography is included. Jackson is a lecturer in geology and curator of the Geological Museum in Trinity College, Dublin.

Atlas of the Prehistoric World
by Douglas Palmer
As its title suggests, *Atlas of the Prehistoric World* contains a collection of dazzlingly detailed paleogeographic maps, tracking shifts in land masses and climates from the Vendian Period to the present. In addition, Douglas Palmer, who teaches Earth and Natural Sciences at Cambridge University, narrates the story of life's evolution over the course of the last four billion years and provides a sparkling history of and guide to earth science. Accompanied by over 250 full-color photographs and illustrations, *Atlas of the Prehistoric World* is a wonderful reference for the student, the teacher, and the enthusiast alike.

The Map that Changed the World
by Simon Winchester
In *The Map that Changed the World*, Simon Winchester tells the practically Dickensian story of William Smith and his struggle to create what was arguably the first true geological map. Winchester writes, "Geology, it seems almost redundant to say, underlies and underpins everything: the site of every city, every gold mine, every field, every island is determined purely by geology — and humanity's condition is more directly influenced by geology than by any other aspect of the natural world. But until William Smith we could only surmise what that geology was, and what it would and could be elsewhere. We had no map."

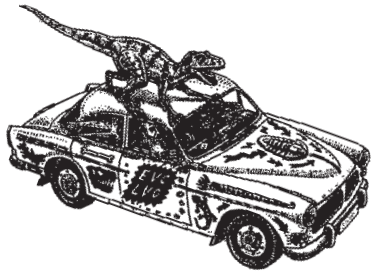
Geology and its history

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.

Great Geological Controversies
by Antony Hallam
From the publisher: "a widely acclaimed account of the most celebrated controversies in the history of geology — a book that covers many of the most important ideas that have emerged since the birth of the science. Among the great debates described here are those involving catastrophe theory, uniformitarianism, the discovery of the Ice Age, speculation concerning the age of the earth, and the advent of new ideas on plate tectonics and continental drift. In presenting these key topics, the author opens the fascinating history of geology to a wide audience. Frequently citing original sources, the author gives readers a sense of the colorful and at times immensely entertaining language of scientific discourse."

Plate Tectonics: An Insider's History of the Modern Theory of the Earth
edited by Naomi Oreskes
In *The Rejection of Continental Drift: Theory and Method in American Earth Science*, Naomi Oreskes traced the reception of continental drift in American geology from its initial rejection to its eventual acceptance. Now, in *Plate Tectonics*, she compiled the definitive history of the theory, told by the very scientists who developed and assembled evidence for it. Sections include The Historical Background, The Early Work: From Paleomagnetism to Sea Floor Spreading, Heat Flow and Seismology, The Plate Models, From the Oceans to the Continents, and Continents Really Do Move. Oreskes is Associate Professor of History at the University of California, San Diego.

Bursting the Limits of Time
by Martin JS Rudwick
From the publisher: "Highlighting a discovery that radically altered existing perceptions of a human's place in the universe as much as the theories of Copernicus, Darwin, and Freud did, *Bursting the Limits of Time* is a herculean effort by one of the world's foremost experts on the history of geology and paleontology to sketch this historicization of the natural world in the age of revolution. Addressing this intellectual revolution for the first time, Rudwick examines the ideas and practices of earth scientists throughout the Western world to show how the story of what we now call 'deep time' was pieced together."



NCSE on the Road

A Calendar of Special Events, Presentations, and Lectures

Date	June 17, 2007
City	Cancun, Mexico
Presenter	Eugenie C Scott
Title	Communicating Science without the Jargon
Event	First Pan American Congress in Developmental Biology
Time	1:30 PM
Location	Gran Hotel Melia Cancun
Contact	Ida Chow, ichow@sbdonline.org

Date	September 27, 2007
City	Amherst MA
Presenter	Eugenie C Scott
Title	Creation and Evolution: A Historical Perspective
Event	Hampshire College Science and Religion lecture series
Time	TBA
Location	Hampshire College
Contact	Salman Hameed, shameed@hampshire.edu

Date	October 27, 2007
City	Long Beach CA
Presenter	Eugenie C Scott
Title	Surmounting the Roadblocks to Teaching Evolution
Event	2007 California Science Education Conference
Time	9:30 AM
Location	Long Beach Convention Center, Room 104C
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

Name	Glenn Branch
Title	NCSE Deputy Director
Contact	branch@ncseweb.org

Name	Nicholas J Matzke
Title	NCSE Public Information Project Director
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Name	Susan Spath
Title	NCSE Public Information Project Director
Contact	spath@ncseweb.org

Name	Peter MJ Hess
Title	NCSE Faith Project Director
Contact	hess@ncseweb.org

Name	Louise S Mead
Title	NCSE Education Project Director
Contact	mead@ncseweb.org

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

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Continued from page 18

the world's oceans by only an insignificant time. On the other hand, the time for recycling would affect the age estimate because only the Cl^- ions in the world's oceans are used in the calculations and not the time while some are being recycled. The recycling would have been slow because the oceanic plates move only 1–10 cm per year (Huang 2001) and because the widths of the plates that were subducted can be more than 9000 km (Birkeland and Larson 1989). The times involved when many Cl^- ions were being recycled during all subduction periods (including those in the Precambrian) are not included in the 3.6-billion–year age, and, therefore, an additional unknown period of time should be added to the 3.6 billion years. For example, if the average motion of the oceanic plates since the Pacific Ocean first split apart in the mid-ocean in the Jurassic Period is 5 cm per year and if the plates have moved 9000 km to the present time, the time for these movements is 0.18 billion years. This would make the total age of the Cl^- ions in the ocean about 3.78 billion years. Add similar times to this age for movements of crustal plates during older (Precambrian) subduction periods, and ages in excess of 4 billion years could be possible.

At any rate, the calculated 3.6 billion years for the minimum age of the earth is far greater that the often-quoted creationists' age of 6000–10 000 years. The time required for Cl^- ions to accumulate in the world's oceans and on the continent of 3.6 or more billion years is plausible and agrees with radiometric dates for Precambrian rocks. Some rocks have been dated as being 3.7 to 3.8 billion years old, and the oldest rock found near Great Slave Lake in Canada has been dated as being 4.03 billion years old. Furthermore, detrital zircon crystals in Precambrian metasedimentary rock in Australia are dated to be 4.3–4.4 billion years old (Newman 1997).

Why chloride ions accumulate

In order to use the abundance of Cl^- ions in the world's oceans as a means of calculating the age of the earth, these ions must have special properties that allow them to accumulate gradually. When the abundance of Na^+ (28 300 ppm) is compared to that of Cl^- (130 ppm) in crustal rocks (Table 1), the relatively smaller amount of Na^+ (30.8%) compared to the amount of Cl^- (55.3%) in sea water (Table 5) is far out of proportion and in a reverse relationship to what we would expect (UCAR 2002). That is, the extremely scarce Cl^- ion in Precambrian rocks has accumulated in the oceans and is the dominant ion, instead of the much more abundant Na^+ ion. Without knowing that huge amounts of Cl^- ions came up from the mantle below the Precambrian rocks, this reversal seems enigmatic. Why do the Cl^- ions accumulate to such a greater extent than Na^+ ions?

In contrast to the Cl^- ion, the other soluble elements (as ions) in sea water, such as sodium (Na), magnesium (Mg), sulfur (S), calcium (Ca), and potassium (K), do not accumulate to the extent that Cl^- ions do because they either become subtracted by sea animals to form their carbonate shells and skeletons (that later compose limestones) or are incorporated in the crystal structures of clay or other minerals. Both Na^+ and Cl^- ions, however, are particularly soluble in water because water is an asymmetric molecule in which one end has a positive charge and the other a negative charge. Because of the polar nature of water, many water molecules orient their positive ends to surround the negative Cl^- ions, and many other water molecules orient their negative ends to surround the positive Na^+ ions. Because the Na^+ ion is relatively tiny (a sphere whose radius is 0.97 Å), fewer polar water molecules can surround it in comparison to the Cl^- ion whose sphere has a radius of 1.81 Å and whose greater surface area allows many more polar water molecules to surround it. This relationship between water and a Cl^- ion causes it to be extremely soluble … and more soluble than the Na^+ ion.

Table 5

Percent of each element occurring as ions in sea water (UCAR 2002).

Element	Percent of All Dissolved Ions
Cl	55.3
Na	30.8
Mg	3.7
S	2.6
Ca	1.2
K	1.1

The high solubility of the Cl^- ion, the lack of incorporation of Cl^- ions by sea animals, and the large (1.81 Å) size of the Cl^- ion which prevents it from being incorporated into other minerals ensure that the Cl^- ions remain in solution and accumulate in the oceans unless the water containing them is evaporated. On the basis of these characteristics, the thick salt (NaCl) beds (some more than 1 kilometer thick) that occur, for example, in China, Great Britain, United States, the former USSR, Germany, Canada, and Mexico, and which are interlayered with the supposed "Noachian Flood" deposits, provide strong evidence that all sedimentary rocks in the geologic column cannot have been deposited during the alleged global Flood lasting one year. The reason is that the geologic column must contain arid periods that allowed isolated salty seas to evaporate and precipitate their Na^+ and Cl^- ions (and other salts) into these thick salt beds. That cannot happen while water in the Noachian Flood is supposedly covering the whole earth. Furthermore, these salt beds are interlayered with other evaporite deposits, such as gypsum beds, chemically precipitated calcium carbonate (limestone), and other salts that are deposited sequentially in the proper order according to their ions' saturation points as water evaporates, and then these ions begin to precipitate (Birkeland and Larson 1989). Moreover, these salt beds are also interlayered with red beds (former muds) that contain oxidized iron (which indicates exposure to oxygen in the atmosphere), and these red beds have mud cracks that are characteristic of drying conditions in deserts. If creation scientists were to claim that the salt beds were formed during the Noachian Flood from the eruption of hot hydrothermal salt solutions from the mantle, this hypothesis would not make any scientific sense. Any erupting hot water salt solutions would have mixed with the Flood waters, and their Cl^- ions, which are very soluble, would have been disseminated and diluted in the water, preventing precipitation.

Validity of calculations

The value of 3.6 to 4 billion years for the time of the accumulation of Cl^- ions in the world's oceans is based on the present annual rate at which HCl is erupted from volcanoes. Obviously, this rate has not been constant through time. The amount of emerging

HCl in volcanoes is a function of several variables including the number of volcanoes at a given time, frequency of eruption during a year, activity of volcanoes through long periods of time (including periods of dormancy), and the rate at which HCl moves up from the mantle to be expelled by the volcanoes. Volcanoes erupt from mid-ocean spreading centers as well as on continents above subducting plates, so emergence of HCl from the mantle can be expected throughout most of geologic history. However, plate tectonics has been intermittent through time. During the Precambrian Era, rafted continental plates have collided, and plate movements have stopped for a while. But the earth is a restless planet, and the continents split apart again, and these back-and-forth rafted movements of continents are repeated over and over. When the plates are not moving, few volcanoes erupt, so the release of HCl could be at a much slower rate. Slow rates would *increase* the time it takes for Cl^- ions to accumulate in the world's oceans; fast rates would shorten the time. The slow rates, particularly early in the earth's history, could make the value for the first appearance of the Cl^- ions to be more than 3.6 billion years. In any case, the 3.6-billion–year value (or as much as 4 billion years if recycling during subduction is included) is an approximation of the time for the accumulation of all the Cl^- ions in the world's oceans. Whatever the real value is, it is certainly not in *thousands* of years but *billions* of years.

Conclusions

The instability of the Cl^- ions in the mantle because of their large (1.81 Å) size (which causes them to rise toward the earth's surface) and the relative inability for the rising Cl^- ions to precipitate abundantly in granitic crustal rocks (only 130 parts per million) explain why the Cl^- ions are mostly expelled during volcanic eruptions in escaping HCl gas and then accumulate in the world's oceans. This process would have taken at least 3.6 billion years, indicating that the world's *oceans* are billions of years old and that the earth itself must be older. Therefore, the Cl^- ions in the oceans could not have been deposited in 6000 years or during the Noachian Flood without a suspension of natural laws and processes. Thus the only way to produce these concentrations of salt in the world's oceans during these short periods of time is to invoke a miracle. Of course, there is no argument against a miracle, but neither does a miracle provide any scientific evidence.

Biblical stories, such as that of the Noachian Flood, were written to make a theological point without regard for science. As Pope John Paul II has pointed out, the Bible is not intended to be a science text, and science is not in conflict with the biblical message (John Paul II 1996). The Hebrew story-telling style of writing that described the Noachian Flood is quite acceptable and valid for the audience which was addressed by the author of Genesis. Who at that time would have the knowledge to understand a scientific explanation? What is important is that the theological messages that are presented in Genesis can be just as meaningful for the biblical people, who were not trained in science, as they can be for any scientist living today.

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Some copies of the July/August 2006 issue of *Reports of the NCSE*, volume 26, number 4 — with the mudskipper on the cover — were miscollated by the printer. Please check your copy to make sure that all 48 pages appear in order and with no repetitions. If you have a faulty copy, let NCSE know, ideally by e-mailing oops@ncseweb.org with your name and address, and we will send you a replacement copy straightaway.

Evolution: Dollars and Sense – A View Beyond the Gas Station

Myopic Views about Gas and Oil Resources

Paul Caton

Evolution supporters neglect an important argument against creationism in their case for teaching evolution: specifically, the economic effects that knowledge about evolution has on world energy requirements. Too often, when filling our cars with gas and oil, we do not think beyond the gas station. We do not consider the facts that these fluids were initially pumped from ancient porous sediments and that to locate them required direct or indirect analysis techniques involving knowledge about life's evolution.

I thought about this myopic viewpoint on hydrocarbon sources when going down the Grand Canyon during the 2002 NCSE boat trip. Within this awesome 350 km (220-mile) "gash" in the earth's surface is what the young-earth creationist Steve Austin of the Institute for Creation Research (ICR), regards to be an impressive section of Paleozoic "Flood" rocks (Austin and others 1994). By looking at sediment exposures within the canyon walls and thinking about subsurface rocks beneath layer exposures for miles around, one can become impressed with Austin's views that God's Flood rocks were deposited worldwide.

At kilometer 18.2 (mile 11.4) along the Colorado River, the lower-Permian Esplanade Sandstone appears 300 m below the surface. However, 1000 km (600 miles) to the east at Levelland, Texas, this sandstone formation changes considerably; in these regions it is called the Abo formation. In January 2000, Seneca Resources Corporation announced production of 215 barrels of oil per day from wells in the Abo, but at a depth of about 2100 m. This means that the "Flood" had to have deposited an additional 1800 m of debris in Texas above that at the Grand Canyon's site in Arizona. But the problem is that ground level at the Grand Canyon is 2014 m above sea level (<http://www.wunderground.com/cgi-bin/findweather/getForecast?query=grand+canyon>), compared to only 1002 m at Levelland (<http://www.wunderground.com/US/TX/Levelland.html?extendedsun=sunon>). So Austin and his colleagues have to explain how the Flood could deposit an additional 1800 m of debris above a continuous geologic stratum and still have the surface above this extra debris be more than 1000 m *below* that over the same stratum at the Grand Canyon.

For young-earth creationists committed to "Flood geology", these deposits were laid down within 390 days about 2500 BCE; geologic time is scrunched between Bible pages. Consequently, creationists ignore processes requiring the integration of *all* energy exchanges and laws of physics for the time when sediments were deposited. They only look at the geometric configurations of the rocks in front of them. This is why Austin and his young-earth creationist peers have a myopic view of sediments within the Arizona Grand Canyon walls as being descriptive of a biblical flood sequence while ignoring what happened in Texas to the east, or anywhere else for that matter.

A LACK OF CONTEXT

From today's explorationist viewpoint, these young-earth creationists do not have a paleoenvironment deposition-trend model to encourage them to look for oil in Texas where, during the Permian, energy interactions between the sea, the earth's surface, and the biosphere were quite different than those in Arizona's Grand Canyon area; this is clearly evident by comparing the paleohistory retained in the Texas Abo sediments and fossils. These sediments and fossils also unify the Abo formation with other prolific, oil-bearing, Permian reefs that also trend about the western and northern regions of west Texas and southeastern New Mexico in this so-called Permian Basin. The succession and development of these well-known Permian Basin Paleozoic reefs and surrounding sediments are defined by surface exposures, 40 000 exploration wells, and 200 000 development wells. These formations have appearances and dimensions similar to modern barrier reefs as described by Peter Scholle on his website (<http://geoinfo.nmt.edu/staff/scholle/guadalupe.html>).

In practice, when exploring, drilling, and developing Permian Basin or other Paleozoic era oil reservoirs about the world, young-earth creationist geologists

Paul Caton received his BS in Geology from the University of Alaska at Fairbanks (1960) and a PhD in Geophysics from Tulsa University (1973) with a focus on reservoir hydrology. His principal geothermal- and oil-industrial role for 35 years was field exploration, development, production, and research using surface and borehole seismics, and electrical, gravity, magnetic and nuclear fields. Later, he consulted for several geophysical and oil companies, and taught physics, chemistry, and astronomy at colleges and universities until retiring in 1996.

must accept and work within evolutionary frameworks, while they seek means to force their Flood beliefs to "fit" their observations.

Even though it appears that there are young-earth creationist geologists who successfully find oil, and that their successes have nothing to do with evolution, this is a deceptive simplification of a more complex situation. YEC petroleum explorers agree on using the same fossils and geological strata that evolutionists use to find oil. In essence these are *geometrical perspectives* for finding oil — just draw lines along peaks and troughs on seismic sections and at breaks indicative of faults, then plot contour horizons between seismic sections, and name horizons according to what are thought to be known fossil distributions in other wells, and finally "spot" your well-site. However, the final step is to let somebody like Paul Caton, who has the scientific (that is, evolution-based) knowledge and experience, make your final, multi-million–dollar borehole decision to complete the well … or else abandon the hole, because "Flood geology" cannot consummate the deal.

To "abandon the hole" means a disaster of wasted time, money, and resources, and that is why my position was *not* envied within the oil industry, however vital it was for making the final decision. For the relatively few in this role to succeed, we must be familiar with the surface and subsurface geology, know source-rock/hydrocarbon-migration possibilities, and have all prospect geophysical data available. So that our final borehole decision is justified, we must also know about the fossils collected, the formation and fluid measurements made, and the drilling history; in other words, we also have to know physics, chemistry, geology, paleontology, *and* evolution to be successful.

We cannot be so myopic as to make an "abandon" decision based solely on conditions about the borehole wall — it would be as foolish as describing sedimentary processes about the world by just looking at the Grand Canyon's walls. Instead, any justification for abandonment might include telling geologists that they picked the wrong seismic sections because of incorrect processing or interpretations, or that they need to review their paleogeology and thoughts about fluid migrations in time and space from source- to reservoir-rocks throughout the area. Using this multidisciplinary scientific approach, I made decisions to abandon about twenty "wildcats" during the 1980s, only three of which ultimately proved productive. The low percentage of productive wildcat wells demonstrates the superiority of this integrated scientific approach over just "eyeballing" the index fossils or sediments.

Evolutionist exploration concepts beyond the gas station

Gas and oil deposits are found directly in strata using index fossils with known ages that were deposited along ancient shorelines or within shallow sea environments where conversions to hydrocarbons of decayed phytoplankton deposits have taken place over millions of years to mature finally into fluids with multimillion dollar values. From this perspective, the scientific process is deployed, and all scientific aspects are integrated to find hydrocarbon reservoirs without invoking any miracles. The economic success of this approach has demonstrated that wildcat wells are best discovered (or positioned) by considering animal and plant species as they change in ancient environments in space with time: understanding evolution helps to predict the presence of oil. Integrated within these "spotting" decisions is knowledge about later dynamic earth processes involving pressure and temperature changes that modified and faulted the formations containing these fossils and confined fluids.

The most difficult drilling-target assignment problems confronting evolutionists are data acquisition limits in geologic time over spatial regions. We just cannot sample every point, even though 3-D seismics and improved computer power have greatly improved our ability to locate buried folds, post-depositional faults, facies pinch-outs, reefs, and salt diapirs. Consequently, information from a variety of geological and geophysical sources is integrated and extended beyond anticipated reservoir dimensions — a form of *prediction* of where petroleum ought to be that serves as a real-world test of the method.

Geologic and geophysical information is also applied to get "the big picture" about resource-rich regions in relation to deposition basins that developed after Precambrian times. These "big pictures" benefited from an improved understanding of plate-tectonic processes that helped to refine our knowledge about ancient landmass and sea distributions about the globe from the Paleozoic through the present by integrating regional fossil, gravity, magnetic, and satellite data. We can also use data from current, global earthquake distributions, heat flow and crustal-strain measurements — along with vastly improved isotope decay-rate measurements — to make predictive models about the physical processes and their effects as seen in ancient rocks.

Creationist perspectives about exploring beyond the gas station

Creationists' perspectives about the origins and/or occurrences of gas and oil within rocks *first* must fit into their religious beliefs about the age of the earth. However, creationist groups are not united in these beliefs (see Scott 1997). Creationists include the young-earth creationists who believe that the earth can be no more than 6000–10 000 years old and that the Noachian Flood was a historical, planet-wide event. Others, such as many old-earth creationists, accept an older earth (for some as old as 4.5 billion years) and may or may not believe that the Flood with its associated catastrophic events is responsible for all the earth's geological features.

For those who view the Flood as an actual historical event, massive quantities of water moved across the earth some 4500 years ago (about 2500 BCE) producing significant alterations of the earth's surface. As the waters receded over the course of several months, the sediments eroded by water currents were "dumped" as thick sedimentary piles where some hydrocarbons accumulated, for example as the 10-km–thick section in southern Texas towards the Gulf of Mexico. I will refer to those creationists who attribute the geologic features of the earth to be due

to the effects of this Flood as "Flood creationists" — regardless of whether they are young-earth or old-earth creationists.

In their article about the 10-km–thick Texas sediment section, the Flood creationists Carl R Froede and John K Reed state, "The Biblical approach to understanding Earth's short history requires that the physical evidence (i.e., the rock record) fit within the context and constraints of Scripture" (Froede and Reed 1999). From this perspective, they regard *all* Paleozoic, Mesozoic, and Cenozoic sediments containing gas and oil to have been eroded at about 2500 BCE and then deposited during the latter part of the year-long Flood period — a feat that would require that nearly 30 meters of sediment were deposited per day. This is a bunch! However, the important point about their statement is that they recognize that these 10 km of sediments have to be "fit" within their scriptural time constraints.

While they try to reconcile the biblical time frame and the required sedimentation rates in the Gulf of Mexico, Froede and Reed call for some sort of geological physics that "… infers the energy required for materials to be eroded, transported, and deposited, and compares those relative levels to Scripture." Their objective is to "… jettison the evolutionary baggage that permeates …" the global uniformitarian stratigraphic column that is used by other Flood -creationists, including Steve Austin of the ICR. Froede and Reed must attribute tremendous floodwater energies to directing sediments towards the Gulf of Mexico, but they admit that they have a problem explaining how these high-energy activities allowed what appears to be deposition of ancient carbonates (which precipitated and grew) and finer clastic deposits of these ancient reefs, both of which would not have been possible in the face of these powerful forces.

We can appreciate that Froede and Reed admit that their fellow Flood creationists "… use traditional evolution-based methods (i.e., biostratigraphy) to define time," and therefore that such methods would be essential in their oil exploration approaches. However, their approach to reconciling stratigraphy and Scripture still does not prescribe any specific means to explore for oil — something that evolutionary models *do* support. One major problem, of course, is that their inferred temporal- and spatial-energy levels are *not defined* in the Bible. These Flood creationists will have to invoke new, accelerated physical processes within selected spatial areas at specific times during their Flood year at about 2500 BCE — certainly not enough time to produce large reefs, yet such ancient reefs are some of the most prolific oil reservoirs sought about the world.

Ignoring science

Froede and Reed are not the only Flood creationists to ignore well-known laws of physics involved with the development of sedimentary processes and structures in order to promote a high-velocity Flood. Such omissions — which have significant implications for oil exploration — are common in Flood creationist arguments. Petroleum geologists look for primary, oil-bearing structures, which are often found in seismic sections that include the buried reefs, ancient sand sections associated with seashores that have transgressed and receded numerous times, and ancient, meandering river valleys near seas. All of these are the result of long-term physical, chemical, and biotic interactions. They also search for secondary oil-traps that include buried faults that occurred after the initial formation in response to offshore sediment instabilities, uplifted sediments about salt diapirs, and structure faults and folds that formed in response to plate tectonic stresses and strains at some later time.

Extensive, detailed geologic features that are seen in well-log and rock-core sections prove confusing to uninitiated Flood creationists because they do not anticipate seeing the numerous delicate structures preserved in what they must conclude were violent, turbid Flood times. Depending on the completeness of the geologic column penetrated in a particular location, well-logs may reveal oscillatory shallow sea sediments overlying ancient onshore sediments with coal layers, beneath which are the objective, more ancient porous shallow-marine targets. When well-logs are correlated between wells in production reservoirs about ancient shallow marine deltas, barrier islands, or reefs, then it is easy to see the complex changes caused by a migrating seashore environment — just as are seen today along any seashore beach. Indeed, cores from wells typically contain detailed information about sediment changes along these ancient shorelines. How Flood creationists can ignore or rationalize the physics involved with such detailed, borehole data as being less than 4500 years old is not clear to me, but they *must* ignore it to persist in their commitment to the biblical Flood narrative.

These examples show how Flood creationists often promote their geologic "expertise". First, they must omit data and observations that are inconsistent with a young earth, and second, they must ignore and/or manipulate the laws of physics in all their aspects. Consequently, Flood creationists preach creationism at home and church, but practice evolution at work; to do otherwise would be to become a costly failure. The bottom line for Flood creationists' perspectives about "spotting" gas and oil well drilling-targets is that they must apply or rely on evolutionist concepts and standard applications of the laws of physics when in the hole, or else make costly errors.

A challenge for Flood creationists: Put your money where your mouth is

If the Flood creationists are correct about the physical processes and times required to produce petroleum according to a literal biblical framework, then they should demonstrate their confidence in their "science" by investing their own money to explore for and to drill oil wells into wildcat geologic targets identified solely on the basis of their models. Then they should develop productive reservoirs about these targets — a single well in the middle of nowhere is not an economic producer and would not establish the success of Flood geology.

They need to explain how the Phanerozoic sediments and different fossil species were suspended in the Flood's waters and then selectively deposited dur-

ing later Flood days as different density lithologic units within various sedimentary structures along with the lower-density hydrocarbon fluids. Then without requiring miracles in their physics, these creationists need to give the physical processes by which these formations were selectively hardened without "frying the oils" so that they do not experience the borehole "kicks" that tend to kill neophytes.

When going downhole and then pressure testing, all physics and biological processes for rock and fluid identifications for the potential oil reservoirs are to be consistent with the physics that allowed Noah and his Ark occupants to live and float about on the Flood's waters. Just as is common practice within conventional oil companies, all geological, geophysical, paleontological, and petrophysical measurements are to be integrated, including regional geology, surface gravity and magnetic data, seismics, the conventional suite of well-logs, and pressure/flow test data. If data are "lost" or missing from the test hole, other data are expected to be integrated, including check-shot, vertical-seismic, and borehole-gravity surveys — another standard industry practice. However, *only Flood creationist concepts are to be used to integrate universal physics and fossil measurements* — no evolutionist ideas, equations, or procedures are permitted.

One challenge might be that three wildcat wells are to be successfully completed in the following structures: a Devonian reef in Canada, Mesozoic growth-fault sediments, and Tertiary sediments about a salt diapir. Following successful flow-tests in each of the three different wildcats, then reservoirs are to be developed with offset wells — again, by only using Flood creationist concepts about fossils, geologic strata, reservoirs, and fluid-type and flow distributions.

The project should hire consultants affiliated with the Institute for Creation Research (ICR). Steven Austin, Chairman of the ICR's Master's Geology Program, emphasizes Flood geology in his field programs and petroleum geology course (<http://www.icr.edu/geology/index.html>); consequently, he might be made company director. Evaluating the geophysical evidence might be John Baumgardner who could use his Flood model algorithm talents to estimate potential oil reserves and flow parameters as targeted reservoirs are drilled — again, standard practice in this sort of fieldwork. Other ICR staff members will need to assist Austin and Baumgardner with the Flood creationist geologic, geophysical, and reservoir developments that will be needed when resolving petrogenesis and flow problems in the three different regions that were formed about 2500 BCE and within nearly 390 days.

For these drilling assignments and reservoir developments, I am certain that Baumgardner will improve his Flood velocity model (Baumgardner and Barnette 1994). In different parts of the earth and without disturbing Ark occupants, the alleged floodwaters somehow had to speed up suddenly and just as quickly slow down so that they allowed high-velocity, saturated sand beds to be intermixed with layers of low-velocity fine-particle deposits, such as clay laminates and layers of precipitates; then, somehow, deeply buried evaporites also got mixed into the real-earth sediment sequences that are seen today. In part, these layer-deposit/velocity relationships will depend on local, single alleged floodwater viscosities, salinities, and solubilities. In some cases, these Baumgardner models will be needed to determine whether hydrocarbons were associated with original deposition, or whether they later migrated into each reservoir after the creationists' single, alleged Flood. Development of Baumgardner's algorithms for field applications of Flood velocity analyses will also assist Flood creationists to determine whether fossil distribution analyses are useful tools for finding oil and gas reservoirs, and when estimating extents of reservoirs.

By being restricted to the 390-day Flood creationist concepts, the ICR geologists will need to explain how the Flood's waters, expelled from sediments at decelerating Darcy flow rates, retained hydrocarbons in certain reservoir regions. Light, low-density hydrocarbons should migrate upward through porous, unconfined and/or leaky aquifers prior to becoming hardened during the few remaining Flood days. This continual, upward leakage of oil flow due to vertical compaction suggests that most oil should be found in the highest Cenozoic sediments — but, of course, it is not found in such recent sediments. This might be Flood creationists' justification for oil's being missing in the Grand Canyon region, but it does not explain its presence in the Texas Permian Basin.

Because the Institute for Creation Research continues to explain oil chemistry as being derived from porphyrins associated with decayed remains of chlorophyll and blood (McQueen 1986), then these drilling tasks will be their opportunity to prove this point. However, there is a low-density problem to be resolved with decayed plant and animal remains compared to oil. Decayed plant and animal remains tend to bind with higher-density clay and sand particles that are then flushed *down* with water currents, whereas lighter-density oil tends to congeal and float *up* towards water-surfaces.

The prospects for this project are not good. Glenn Morton discusses on his website his frustrations about trying to hold on to Flood creationists' beliefs while interpreting conventional oil-industry seismics. He writes that he left young-earth creationism because "[n]othing that young-earth creationists taught me about geology turned out to be true" (Morton nd). Unfortunately, his experiences were the same as those that I encountered with new employees who were trained by Flood creationists while I worked in Louisiana in 1987. They were unprepared to accept the repeated, detailed fossil and sand-shale sequences of transgressive/regressive seas. Apparently, these people only attended descriptive geology courses; somehow, they missed the essential, dynamic physics models that are needed to interpret the phenomena seen in seismic sections and well-logs that are routinely analyzed in oil exploration. As evolutionists are well aware, physical models about the ancient environments in which rocks and fluids were emplaced and then later modified through time and space are just as important to know as what the rocks and fluids look like today. Without such knowledge, our challenge to the Flood creationists is bound to come to naught.

Finding potential oil reservoir sources on the internet

It is fun finding potential oil reservoir sources on the internet — provided we accept the evolution of life in response to changing physical environments throughout earth's history of plate tectonic movements over millions of years. In general, oil tends to accumulate in ancient, shallow sea sediments or near shorelines, and within warm mid-latitude regions where phytoplankton were prolific. Later, deposits of these dead phytoplankton and the organisms that fed on them were slowly converted to hydrocarbons while being covered with impermeable, fine-grained sediments or precipitates that prevented the lighter hydrocarbons from flowing beyond the porous reservoirs. Provided that an "oil-pool" remained confined throughout geologic periods and was not subjected to temperatures in excess of 120° C at approximately 2–7 km depths, the result is exploitable oil.

Oil exploration can begin by choosing a present-day location for a proposed well-site. Then go backwards in time by rotating continents to see if ancient, deeper sediments beneath the selected site have potential source rocks for oil, where we might drill for oil. The program that I suggest using to find oil is the Paleomap Project by CR Scotese (<http://www.scotese.com/pzanim.htm>). For this demonstration, I will use one task assigned to the Flood creationists, although we will do the inverse job: find *the origin for* a Devonian reef with which I was involved during the 1960s, located about 200 km northwest of Edmonton, Alberta.

To "drill down" to the Devonian reef from the northwestern Edmonton, Alberta, location, I suggest using Scotese's Paleomaps because these have color-coded regions: blue is for deep ocean areas, and light blue represents continental shelves, oceanic plateaus, and inland seas; tans represent land masses; and reds are mountains. Place a pencil dot on the recent map, just east of the Canadian Rockies, at the Edmonton latitude, on the tan landmass, and then follow this point as the North American plate moves around backwards in time to the assembly of Pangaea, and so on till we get back to the Devonian. Always watch as tan areas, which indicate erosion, show up, when light-blue seas overlie the reference point, and notice as the dark brown Rockies began to rise in the Cretaceous; continue backwards to the Devonian where the starting point should be on a continental edge near the ocean or in a sea. Also, notice what happens around the rest of the world as other plate boundaries, inland seas, and mountain ranges form.

Backing through time to the Oligocene (30 mya), the selected well-site location in Canada remained just east of the Rockies as an erosional area but was covered by some sediments eroded from the Rockies as North America was moving away from northeast Africa. By the Cretaceous (90 mya), inland sea sediments covered the region that extended along the eastern Rockies from the Gulf of Mexico to the Arctic Ocean; the US had moved beyond north Africa. Backing further into the Triassic (240 mya), as Pangaea broke up, the Rockies began forming as the Pacific plate underthrust western North America, while the Canadian site remained on essentially eroding featureless land; the US east coast was still attached to north Africa.

By Carboniferous times (320 mya), the Canadian site was near the equator and possibly near a small sea; Pangaea had not been completely assembled. Shallow seas overlay the area during Devonian times (360 mya) when most of the nearly formed Pangaean continental mass was in the southern hemisphere. The Canadian site location was either on the equatorial, ocean-shelf edge or an inland sea of a smaller continent that had been formerly isolated from the southern landmass moving northward. This was an ideal location for Devonian reef developments near the equator, just as is the case for modern Australian reefs.

Alternatively, Flood creationist diagrams generated by the hypothetical Noachian Flood circulation patterns created by Baumgardner demonstrate the futility of searching for potential oil reservoirs created during the Flood (Baumgardner and Barnette 1994). Baumgardner's high-velocity Flood-maps suggest that sediments would be dispersed *everywhere* about Pangaea; consequently, if one attempts to use his Flood distributions, it is impossible to anticipate the regional, source-rock depositional environment for the selected Canadian, Devonian-reef position — something that standard models, like the Paleomap program, can do quite easily. Worse though, there still is not a Flood creationist Devonian map from which we can move forward in time, and then predict where other present-day surface sites can be used to find oil. The only way to do this, of course, is to rely on applying modern scientific models that incorporate physics, chemistry, geology, paleontology, and evolution to the problem of petroleum exploration.

Baumgardner's Flood maps would have us drilling expensive holes randomly all over the earth's surface until we hit oil. Austin's analyses suggest that all we need to do is to just keep drilling expensive, deep holes beyond the Grand Canyon until oil is found in buried "mounds" or buried geometric features — ignoring the important information about the formation of geologic features that we can learn from understanding paleontology and physics.

Special Focus on Petroleum Resources in *Nature*

In 2003, *Nature* published a suite of useful technical articles concerning "Insight [into] hydrocarbon reservoirs" (426: 317–63). This is the shortest collection of recent essays that I have seen that can direct *RNCSE* readers to a better understanding of the issues.

In light of these articles about oil exploration/production concepts, it is clear that Flood creationists' hypotheses are impossible to support. Instead, the industry must rely on data acquisition, analysis, and interpretation concepts based on extensive spatial/temporal measurements that rely on well-known physical, chemical, and biological concepts within rock and fluid environments that span millions of years about a dynamic earth.

— Paul Caton

Conclusions

Even though we can describe likely locations for petroleum deposits based on a collection of appropriate geologic features, a *successful* oil exploration enterprise relies heavily on integrating knowledge from physics, chemistry, geology, paleontology, and evolution into a coherent framework that can help explorers evaluate the potential for oil-bearing deposits. To date, all of the "alternative" models must violate the laws of physics or contravene the known, tested natural processes that produce geologic features on earth in order to be consistent with biblical time lines. However, none of these provides petroleum exploration models with any ability to predict likely locations of productive and useful deposits. The proposed challenge — that Flood creationists should lay out an exploration plan that relies *only* on these biblical models and then test the model by drilling wells in the predicted locations — is guaranteed to show the bankruptcy of the "scientific" programs that rely solely on biblical authority. And bankruptcy would be the result for any energy company that was foolish enough to rely on these models instead of those based on modern scientific knowledge that depends on evolutionary concepts.

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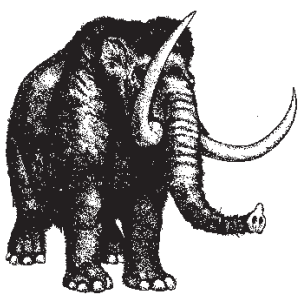

How Does the Sun Shine?

"Intelligent Design" in Astronomy

Joseph Lazio

"Intelligent design" (ID) has been discussed most frequently in the context of biological problems. Here I use a simple example drawn from astronomy to illustrate both the allure of and the difficulties with ID. Appropriately, we shall see that the 100th anniversary of Einstein's *annus mirabilis* plays a role in the eventual solution.

Consider a deceptively simple question from the perspective of an astronomer 100 years ago …

Joseph Lazio received his PhD in 1997 from Cornell University, for work based on observations of radio pulsars and the interstellar medium. He observes frequently with many of the premier radio telescopes including the Very Large Array, the Very Long Baseline Array, and the Green Bank Telescope, and leads searches to find natural radio emission from extrasolar planets. He is employed as a radio astronomer working in the District of Columbia; his main interest is in radio astronomy at low radio frequencies.

June 30, 1905

My dear A____,

I write with my continuing thoughts on a matter that causes me great distress. With many new telescopes and the powerful technique of spectroscopy, we are now able to split the light from stars into its constituent colors for study and even determine the composition of the stars. Yet, is it not embarrassing that we cannot answer a child's simple question, How does the sun shine?

From studies of landforms, our learned colleagues tell us that the earth must be quite ancient, at least 300 million years old and potentially much older, and it has been temperate enough during most of this time for liquid water to have been flowing on the surface. Clearly, the sun must have been shining at essentially its current intensity for at least this long as well.

Our difficulty is that the sun does not appear to have enough "fuel" to have been shining for so long. Consider a burning match. It releases a certain amount of light and heat as it burns. Careful measurements can be used to determine the amount of light and heat such a burning match generates. Using Kepler's Laws of Planetary Motion and Newton's Law of Universal Gravitation, we can determine the mass of the sun and consider how long it could burn, at its current rate of producing light and heat, were the sun like a burning match. I have performed the calculations myself and the result is quite sound: The sun could not have been burning for even 1 million years. This is clearly far too short for it to have been heating the earth.

There is a second method by which the sun might be able to produce light and heat. Consider holding a rock above the earth. As we know, if dropped, the rock will be attracted toward the earth and fall toward it, in accord with Newton's Law of Universal Gravitation. Before it is dropped, it has a certain amount of gravitational potential energy, "gravitational" because it results from the mutual gravitational attraction between the earth and the rock and "potential energy" because it represents potential to do work. After the rock is dropped, and as it falls, its velocity increases, as the potential energy is converted into energy of motion. If this energy of motion can be converted to light and heat, it represents another potential means of powering the sun.

Consider constructing the sun from its individual constituents, had they started from an initial, quite dispersed state. Initially the first few parts of the sun are attracted to each other only quite weakly. As the sun grows in mass, though, subsequent additions of material acquire considerable velocity as they are attracted to the growing sun. By the time the sun reaches its present mass, a large amount of energy is available for liberation.

Unfortunately, even this apparently quite vast energy store is still insufficient. Again, I have performed the calculations myself, and I find that I must agree with those who find an age of no more than about 30 million years.

How are we to explain this conundrum? After much thought, I write to ask your opinion of the following. We read in Exodus, Chapter 3, "the bush burned with fire, and the bush was not consumed." Is this description not identical to what we see today? A burning object that should have long since been consumed by its fire, yet it continues to burn. Having exhausted natural causes for the sun's brightness, should we not consider supernatural causes? If so, perhaps we shall conclude that, while subtle, the heavens truly do proclaim the greatness of God.

I shall quite anxiously await your thoughts on this matter.

Yours truly,

E_____

Unbeknownst to our puzzled astronomer, the answer to his conundrum was being published as he wrote his letter to his friend, though it would take another 15 years for the solution to be realized. Albert Einstein had been considering what would appear to be a completely unrelated problem: How do electric and magnetic fields appear to different observers in motion relative to each other? In 1905, he published a paper entitled "On the electrodynamics of moving bodies" in which he laid out what is now known as the special theory of relativity. One of the predictions of this theory is that $E = mc^2$, or that all mass has an energy ("rest energy") associated with it.

As is the case with any successful theory, the special theory of relativity has been probed quite stringently in a number of different tests. It has passed all tests to date with flying colors, and the $E = mc^2$ prediction was illustrated quite dramatically at the end of World War II in the cities of Hiroshima and Nagasaki and during the Cold War.

Today we understand that the sun shines because hydrogen in its core fuses to form helium. One helium atom has a mass of 6.698×10^{-24} g while four hydrogen atoms have a mass of 6.694×10^{-24} g. This difference of 0.004×10^{-24} g may not seem significant, but the sun has a considerable amount of hydrogen. It is a simple calculation to show that the sun has a sufficient supply of hydrogen to shine or radiate energy at its current rate for many billions of years, in fact for much longer than the age of the earth.

We can identify a serious flaw in our astronomer's logic, one that also informs ID arguments. Having exhausted all *known* natural causes for the explanation of the sun's longevity, our astronomer turned to supernatural causes. He failed to consider *unknown* natural causes. Indeed, this example illustrates the caution one must apply in exclud-

Will the Real ID Please Stand Up?

Duane Jeffery, Brigham Young University

The Salt Lake Theological Seminary, in Salt Lake City, Utah, is a multi-denominational Protestant seminary billing itself as "the only graduate theological seminary in the Intermountain West." On June 17, 2006, it hosted a full-day symposium entitled "Will the Real 'Intelligent Design' Please Stand Up?"

The program included four speakers and a closing panel discussion engaging the speakers with one another and the audience. Speakers included Jason Glotz, an adjunct professor of philosophy at Westminster College in Salt Lake City; James Keener, Distinguished Professor of Mathematics at the University of Utah and a member of the Board of Directors of the Salt Lake Theological Seminary; Clifton Sanders, Dean of the School of Science, Mathematics, and Engineering at Salt Lake Community College and adjunct instructor in philosophical theology at the Salt Lake Theological Seminary; and Brent Slife, Professor of Psychology at Brigham Young University and an evangelical Christian.

Brent Slife opened the program and was the only speaker to provide a formal paper. His was also the most thoroughly developed analysis, so my review of his presentation sets the stage for those that followed. (Copies of his paper are available on request from brent_slife@byu.edu.)

Noting that it has been recognized by one rating service as "one of the 100 most important books of the 20th century," Slife chose to center his remarks on Michael Behe's *Darwin's Black Box.* He observed that when he began study of "intelligent design" (ID) literature, he assumed, as a believing Christian, that he would "necessarily favor" ID. But once he "actually read and began to examine the arguments and evidence, I realized how debatable and perhaps even wrong-headed they were, even for a Christian."

Slife's objections stem from both his psychological training and his religious commitments. While Behe develops two main sub-arguments (how ID is detected, and how it is explained), Slife chose to focus only on the latter. He accepted Behe's separation of the question of the origin of a given complex entity from that of its present daily operation. He recognized Behe as arguing that ID was involved only in the origin of complex structures; the operation thereafter is all just standard laws of nature.

Slife believes, however, that this leads Behe to an inconsistency. On the one hand, Behe seems to want to stay within the naturalistic con-

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ing unknown natural causes. Although the special theory of relativity was published in 1905, it would take another 15 years for sufficient additional data to accumulate to show that the conversion of mass to energy is the source of the sun's power. In 1920 Arthur Eddington was able to put all of the pieces of the puzzle together (in "The internal constitution of the stars," his presidential address to the British Association for the Advancement of Science).

Interestingly, this conundrum of the sun's longevity was itself used to challenge Darwin's theory of evolution. While they did not invoke supernatural causes, many physicists (including the notable Lord Kelvin), unable to explain the sun's longevity, argued that estimates of the ages of geological formations, and by extension, the theory of evolution, could not be correct.

Of course, this example also illustrates another well-known difficulty with ID. If we suppose that the lack of an *agreed-upon* natural explanation for an observation constitutes proof of an *extra*natural cause, then when a natural explanation is developed, one would have had to conclude that the "intelligent agent" was somehow diminished.

By the same token, the answer to this conundrum illustrates the general connectedness of scientific inquiry. Considering how moving magnets behave leads to an explanation of how the sun shines which leads to support for a large age of the earth and the theory of evolution. In contrast, ID proponents often invoke "irreducible complexity", but it is not clear how the finding of "irreducible complexity" can lead to understanding in other fields of science.

ID is usually applied to biology, but this example shows how advocates might see "evidence" for the existence of a designer in fields outside of biology. The strength of scientific inquiry lies in its integrity and its ability to connect what may otherwise appear to be unrelated observations about the world around us into an explanation that tells us more about the universe than we knew before.

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fines of science, with physical laws governing all of nature, including the nature of human beings. Otherwise, Behe is doing something other than science. On the other hand, Behe also claims, "intelligent designs of cilia and human-created proteins were not themselves controlled or caused 'by the laws of nature'." Otherwise, the design would be the outcome of "chance and necessity," and thus not intelligent.

The inconsistency, as Slife sees it, is that Behe wants to stay within science and naturalism but also realizes that the usual rules of science cannot explain the kind of "prime movement" or "originary purpose" that is necessitated by a truly intelligent designer, divine or human. Slife argued that science has a "dirty little secret" when it comes to religion — its commitment to naturalism, which he believes is an unproved and too-often-unacknowledged assumption. Readers of *RNCSE* may be rather surprised by this latter assertion. However, to Slife the "methodological naturalism" in science is equivalent to what is more commonly regarded as *metaphysical* naturalism. Slife would contend that even "methodological naturalism" assumes a world in which God is not active.

This drastically limits science, he believes, and Behe's buying into science for his arguments imposes those same limitations on him as well. Slife is concerned that science has come to occupy in our society an image of dispassionate and totally objective analysis, and that too many Christians, in their efforts for a respectable theology, have sold out to Deism. In Deism, he asserted, God was once operative but no longer is, and he sees Behe's arguments in precisely that same vein. In Slife's view, this Deism requires that God follow all the natural laws and thus is currently irrelevant.

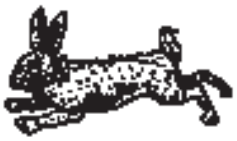
A theistic God must be an active God, he said: "a lawful God is not a Christian God." The notion that God merely upholds natural laws does not allow God to be "active" in any meaningful theistic sense because God's upholding of the laws means that He cannot act otherwise than the laws. Because this ability to "act otherwise" is the basis of any freedom of action, a deistic God enjoys no such freedom. Moreover, God cannot minister to His children uniquely or modify his actions in the light of changing circumstances because the laws of nature are the same for everyone, regardless of their situations.

So, concluded Slife, "Should Christians support the 'intelligent design' movement? I think you can see how I would have to answer in the negative." Slife asserted that he and other Christian scholars have outlined a better alternative to science/religion problems in a special issue of the *Journal of Psychology and Theology* (2006 Fall; 34 [3]).

James Keener followed Slife in the symposium line-up, and approached the issue from the standpoint of a mathematician specializing in biological issues. His presentation employed a number of comparisons which in essence explored the first of Slife's concerns from Behe: how does one detect "intelligent design"? Keener compared Stonehenge with a pile of scattered rocks, the stone pillars of Bryce Canyon with Old World obelisks, Mt Rushmore with New Hampshire's (now defunct) Old Man of the Mountain, spiral galaxies with crop circles. He emphasized that "design" carries with it no moral imperatives whatever: designs can be good, bad, or neutral. Following Dembski's tripartite explanatory filter, a designed entity or feature must be a) a necessary outcome from natural law; b) a product of chance; or c) given that the first two options fail, a product of "intelligent design".

He then explored various issues for which he sees inadequate explanations from current science: the origin of biological codes and information, the fine tuning of various (cosmological "constants"), the properties of specific chemical elements, and even the well-hyped bacterial flagellum. There are, of course, extensive discussions of these in modern scientific literature, but Keener focused on the shortcomings in ID explanations of these issues. Even at its best, ID cannot identify the proposed designer or say anything substantive about the designer's personality, intents, or motives. It cannot determine the timing of design events in our cosmos or on our planet; it cannot argue either for or against the concept of common descent which lies at the heart of evolution; it can say nothing at all about the quality, good or bad, of a given proposed design. It is, then, theologically vacuous.

So why is ID so popular, he asked? It clearly is not winning in the courts, but it *is* appealing to the general public, to which it sounds like a respectable alternative to the blind mechanisms of science. And that is precisely why he feels it has had no success with the scientific establishment: it is not mechanistic and it is not science; it makes no testable predictions, for instance. But Keener pointed out that there are a number of concepts in standard science that do not meet those criteria either. Ultimately, Keener concluded, there is no acceptable way to detect design; he sees no way to bring mathematical rigor to the questions it poses. Any claims for design thus remain necessarily subjective, non-scientific, and therefore unpersuasive.



Clifton Sanders, the next speaker, began with a brief report of a recent ID conference ("ID Under Fire") at Biola University (*see* RNCSE *2006 May/Jun 26 [3]: 4–6, 7*). He focused mostly on sociological developments well-known to *RNCSE* readers and noted with favor that ID is "generating discussion," noting that Phillip Johnson "measures his success by the discussion he generates." Sanders believes that the ID discussion has forced science to be more circumspect and self-aware about descriptions of scientific method in textbooks and other writings. He touched briefly on "inspiration" in such scientific anecdotes as Kekulé's benzene structure and Maxwell's equations. With regard to whether ID can produce any real science, he offered a comment attributed to Jonathan Wells at the Biola conference, that "in a couple of months ... some cancer research may give insights" that Darwinism would not. But, concluded Sanders, "whether ID ever does become able to give a payoff, it generates discussion and that's good."

Jason Glotz, the concluding speaker, lamented that many of his intended points had already been

"Intelligent Design": A Lamb in Wolf's Clothing

Geoffrey Dobson
James Cook University

"Intelligent design" (ID) is a shrewd tactic by creationists to confuse the public about the strengths and limitations of science. ID supporters talk about "origins science" or the "first cause" of the universe, the "first cause" of nature and the "first cause" of life including the "first cause" of human beings. The universe and everything in it, they argue, are so complex that they must be products of a supernatural intelligent cause.

Let me lay my cards on the table. The advocates might be correct in positing a designer and that designer might be a God. However, this has little or nothing to do with science or the scientific process. Science, in contrast to religion, does not deal with "first causes" — a view fully recognized by great scientists such as Newton, Galileo, Kepler, Descartes, Darwin, Faraday, Maxwell, Einstein and *bona fide* scientists today. One of the features of science most misunderstood by the general public is that it does *not* answer questions on "first causes". Science cannot tell us the "cause" of gravity. Newton, who believed in God, taught that the force of gravity does not "cause" a planet to move around the sun, but is a measure of the forces involved in its motion. Newton explained "how" gravity obeyed his inverse-square law, but on the question of "why", he wrote in his *Principia* "I frame no hypotheses". Galileo, who also believed in God, wrote the following on the inability of science to deal with first causes: "To put aside hints and speak plainly, and dealing with science as a method of demonstration and reasoning capable of human pursuit, I hold that the more this partakes of perfection, the smaller the number of propositions it will promise to teach, and fewer yet will it conclusively prove." Today's Big Bang theory does not describe the "first cause" of the universe, but represents a whole class of cosmological theories of its growth and maturation that predict an extremely small hot early universe.

ID advocates particularly focus on Darwin and his theory of natural selection in evolution, saying that they are "skeptical" that natural selection can produce the complexity and diversity of life. Natural selection is a principle of change that works by selecting the successful and eliminating the unsuccessful inheritable variations in individuals of a species. In the majority of cases these inheritable changes are not adaptive, and thus not successful. The theory helps to explain the grand diversity of life and why 99.9% of all species that ever existed are now extinct. That is, it explains why, of the total 15–30 *billion* species of animals and plants believed to have existed over the past 3.5–3.8 billion years, only 15–30 *million* are around today. If there were an "intelligent design", a 0.1% success rate is an appalling record.

The ID advocates are lambs in wolves' clothing. They claim that ID should be taught in the science classroom as an alternative to the theory of natural selection. But their claims are religion masquerading as science: pretending that their "theory" has teeth, when it has none. However, they appear to have the ear of President Bush who told reporters recently that he believes that both ID and evolutionary theory should be taught "so people can understand what the debate is about. … Part of education is to expose people to different schools of thought. …You're asking me whether or not people ought to be exposed to different ideas, and the answer is yes."

A few weeks later Australia's Federal Minister of Education Brendan Nelson said he would be "quite concerned" if ID were to replace "teaching the origins of mankind in a scientific sense." On the other hand, if parents wanted their children to be taught ID, "I think that's fine," he told the National Press Club in Canberra. "As far as I'm concerned, students can be taught and

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covered. He did briefly trace the history of ID arguments from Paul in the New Testament through Thomas Aquinas. He felt that the usual arguments for complexity (for example, the vertebrate eye) were not valid. He described ID as an "impatient reaction to the culture wars" but an important advance over standard creationism since ID at least tries to give specifics in the argument for a designer. However, both viewpoints still use God-of-the-gaps arguments, he said, and ID has *not* demonstrated that it is capable of filling the gaps. And since ID cannot identify a designer, it is (also citing Behe) "theologically minimal" and therefore, said Glotz, "no big windfall for Christians".

The subsequent panel discussion and question/answer session mostly covered points made above. One possible new contribution came from Keener, who indicated that there seemed to be "32 different definitions" for what comprises a complex system; he personally cannot adequately define them (or "irreducible complexity") and so cannot identify any acceptable criteria for meaningful application of ID proposals. The sympo-

should be taught the basic science in terms of the evolution of man, but if schools also want to present students with 'intelligent design', I don't have any difficulty with that. It's about choice, reasonable choice." Nelson's statements are muddled and misleading. So, ID advocates have been famously successful in convincing political leaders that there is some "bite" to their position.

Contrary to what is presented by ID advocates, neither evolution nor natural selection *per se* is at center stage, but the scientific process about how ideas and knowledge are formed, transformed, and verified (or falsified). Confusing ID with science puts scientific education, knowledge, research, and applications at risk, replacing them with a faith-based "way of knowing". Religion's "top-down" approach of faith seeking understanding was suitably illustrated by the medieval theologian Saint Anselm when he wrote: "I do not seek to understand so that I may believe; but I believe so that I may understand". Providing answers to questions such as the existence of an "intelligent designer" (or God) is intractable in the world of science, because there is no empirical observable link between the divine and the physical, separate from the belief itself. The problem resides exclusively in the domain of faith. Natural science may be regarded as "proof without certainty" and religion as "certainty without proof".

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sium was entitled "Will the Real 'Intelligent Design' Please Stand Up?" The conclusion was that "generating discussion" is about as high as it can stand.

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BOOKREVIEWS

Creation as Science: A Testable Model Approach to End the Creation-Evolution Wars

by Hugh Ross
Colorado Springs (CO): NavPress, 2006. 291 pages

Reviewed by Timothy H Heaton, University of South Dakota

Those familiar with Hugh Ross and his Reasons to Believe (RTB) ministry will find many familiar themes in *Creation as Science*. Ross is an old-earth creationist with a background in astronomy who believes that science and the Bible tell the same history. Ross seeks to prove that the universe has been fine-tuned for human civilization by the biblical God and could not have come about by chance. The point of this book is to challenge others, creationists and non-creationists alike, to compare their models of earth history with his, using scientific data as a test.

The "fine-tuning" of the universe is a theme that runs through all Ross's books, but in *Creation as Science* he takes the concept to even greater extremes: "The Bible says that God works continuously throughout cosmic history to ensure that everything in the universe maintains the just-right conditions for support of human life" (p 72). According to Ross, some of God's purposes in creating the universe were to:

> Supply resources for the rapid development of civilization and technology and the achievement of global occupation.
>
> Provide humanity with the best possible viewing conditions for discovering, through a careful examination of the cosmos, His existence and attributes.
>
> Set up the optimal physical theater — including an optimal human life span — for conquering sin and the evil it produces. (p 68)

God's mechanisms for achieving his purposes, according to Ross's model, involve a puzzling blend of naturalistic and supernatural processes. For example, Ross believes that God initiated the Big Bang under a precise set of conditions so that, over 13 billion years later, a planet would form on which God could create humans and where they could survive. Ross never explains why God did not create the universe and the earth in the same sudden and miraculous way that he created humans. Here is an example from the fossil record:

> … the Creator worked efficiently and effectively to prepare a home for humanity. A huge array of highly diverse, complex plants and animals living in optimized ecological relationships and densely packing the earth for more than a half billion years perfectly suits what humanity needs. These life systems loaded earth's crust with sufficient fossil fuels and other biodeposits to catapult the human race toward technologically advanced civilization. (p 140)

Here we see Ross's astounding double standard. When it comes to astronomy and geology, Ross believes in an old universe, so he seeks reasons why God needed so much time. But when it comes to biology, Ross invokes a miracle at every turn:

> From a biblical perspective, one reason so many apparent transitions appear in the fossil record for whales and horses is that Creation had a particular

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> time, place, and purpose for each one in the ecosystem. Because these kinds of species go extinct so rapidly, the fossil record shows frequent replacements, or "transitions," for them. It seems God frequently created new species to replace those that went extinct. … The biblical creation accounts describe God as continually involved and active in creating new species until he created human beings. (p 143–4)

The irony is this: the direct formation of fossil fuels would require far less creative effort than creating thousands of new species over millions of years. In a similar manner, Ross proposes that God compensated for changes in solar luminosity (apparently outside divine control) with a host of geological and biological miracles on earth and then concludes: "The number of just-right outcomes converging at the just-right times to compensate for the decreasing brightness of the youthful sun seriously strains naturalistic models" (p 132–3).

In astronomy, events follow natural laws, while in biology, every detail is due to a deliberate act by the Creator. If male nipples and human sex drive need special explanations, as Ross suggests (p 160, 170), and so does every individual species that ever lived, then why not the billions of galaxies and the many types of stars that played no role in earth's formation? Why would a powerful God choose to create every individual species by a special act but leave the formation of a solar system (a much simpler structure) to gravity and eons of time? While Ross proposes types, frequencies, and economy for God's miracles (p 70–2), his choice of when to invoke these miracles seems arbitrary. It is difficult to understand what proof and attributes Ross expects us to find for God in such a capricious universe.

Ross's double standard starts to make sense in light of the twofold purpose of *Creation as Science*. First Ross offers his own reconciliation between science and religion, which he calls the RTB creation model. "This book outlines a model that strives to uphold both scientific and biblical integrity as it attempts to reconcile the goals of the scientific community with the goals of the Christian community" (p 52). Second, Ross invites creationists and evolutionists to engage him in testing competing models to see which one is right. Ross proposes his test with confidence and appeals to humility on the part of the other players "in assigning credit where it is due" (p 202). So what is this game, and why does Ross think he can win?

As I see it, Ross consciously attempts to align himself with what he regards as the strongest positions of scientists and creationists. In particular: 1) Wherever Ross feels that scientists have thoroughly established a conclusion, he accepts that conclusion. Examples include the Big Bang model for the origin of the universe, radiometric dating, and the history of life on earth as documented in the fossil record. Then he uses this scientific evidence to criticize the young-earth creationists for their unscientific views, and he makes predictions for where future research will lead in these areas as a further test of his model. It should be noted, however, that Ross does not apply scientific conclusions uniformly. Due to his training in astronomy and the quantitative elegance of models in physics, he accepts historical conclusions in these areas more readily than in scientific disciplines such as biology and archaeology. For example, Ross does not regard morphologic and genetic similarities between species as proof of common ancestry, but as "shared designs" in progressive creation by God (p 80).

2) Where there are gaps in scientific knowledge, Ross invokes the biblical God. This aligns him with both the young-earth creationists and "intelligent design" advocates. Examples include the initiation of the Big Bang, the origin of life on earth, major gaps in the fossil record, and the peculiar intelligence of humans. Here Ross criticizes mainstream scientists for having weak explanations, whereas the powerful biblical God can fill these gaps with ease. He predicts that future research will continue to have trouble filling these gaps, and that this will be a confirmation of his model. Ross defends the "God-of-the-gaps" concept, saying "if the gap becomes wider and more problematic from a naturalistic stance as scientists learn more, then a supernatural explanation seems in order" (p 34–5).

3) Ross seeks out biblical verses that appear to support his view. For example, he argues that "thousands of years previous to any scientific speculation or research into big bang cosmology, the Bible predicted all of the fundamental attributes of a big bang universe" (p 75). Most of Ross's citations are brief phrases from books like Isaiah and Psalms where the context is either mysterious or constantly shifting. Ross's mental gymnastics become even more pronounced where the narratives of Genesis conflict with his views. He argues that the creation "days" of Genesis 1 are "six creation epochs" during which most fossils were formed and that God's "'day of rest' is ongoing in the context of this universe" (p 72), thus advocating the Day–Age theory. Ross accepts that the Flood of Noah killed all humans and their associated "soulish animals" outside the ark but not that the flood was global: "In fact, careful analysis of the relevant biblical texts shows that Noah's Flood was geographically limited" and "because of its relatively brief duration, would not have left any significant geological or archaeological evidence" (p 79, 224). These interpretations put Ross completely at odds with the young-earth creationists, but he never suggests that Bible scholarship should decide the issues.

4) Ross frequently cites evidence that the emergence of humans is so unlikely that it requires a God: "According to recent studies, for the universe to produce the kinds of galaxies, stars, planets, and chemical elements essential for physical life, the cosmic mass density must be fine-tuned to at least one part in 10^{60}. The cosmic dark energy … must be fine-tuned to at least one part in 10^{120} [and] even if the universe contains as many planets as it does stars, the possibility for the existence of just one planet or moon with the required conditions for advanced life falls below 1 in 10^{282}" (p 94, 97; footnotes indicate that these studies were conducted by Ross himself).

The book is filled with these sorts of statements. It appears from the footnotes (and from his other books) that Ross spends a lot of time scanning the scientific literature for any suggestion that conditions for life represent an unlikelihood and then accepts these claims as the final word on the subject. He enjoys reducing these probabilities to numbers and then multiplying them together to derive astronomical improbabilities for life appearing on its own — all to prove that the biblical God had to be involved. This line of reasoning is common to creationists, but Ross takes it to a whole new level.

Ross's attempt to find as many cases of "fine-tuning" as possible has led him into serious errors outside his

specialty of astronomy. For example, in trying to explain the need for ice ages, he claims that "large, fast-moving glaciers predominant during ice ages contributed to the formation of many of earth's richest ore deposits" (p 173). Actually, glacial ice is exceptionally poor at sorting minerals by density and thus does not concentrate valuable minerals into ore deposits. Another of Ross's claims involves weather phenomena:

> If earth's rotation rate slowed to 26 hours per day, no hurricanes or tornados would ever occur. … [Earlier in earth history] 21-hour days spawned enormously more destructive hurricanes and tornados. Placing humanity on earth when the rotation rate had slowed to 24 hours meant that the Creator timed the human era to correspond with the ideal hurricane and tornado era in geologic history — another piece of evidence that the timing of humanity's advent was planned rather than accidental. (p 171)

Earth's rotation is not the main driving force for these storms — solar radiation is. If solar luminosity increased during the history of terrestrial life, as Ross contends, then intensity of storms could have increased. Slowing of earth's rotation would tend to reduce wind speeds, but hurricanes and tornados would not cease if the rotation slowed to 26 hours per day. Since primitive trees and land animals survived during 21-hour days, then there is no reason to doubt that humans could have also. Many other examples of Ross's dubious science could be cited.

Ross devotes 25 pages at the end of the book to proposing, in tabular form, 89 "predictive tests" that should help settle the creationism/evolution debate: 22 for "simple sciences" (mostly astronomy), 52 for "complex sciences" (mostly biology), and 15 for "theology/philosophy". For each of the 89 "tests" he includes a prediction for the RTB Model as well as for three of its rivals: Naturalism, Young-Earth Creationism, and Theistic Evolution. Here is one typical example from each category:

Predictive Test 6 under Simple Sciences

RTB Model and Theistic Evolution:
> Evidences [*sic*] for an actual beginning of space and time will grow stronger and more numerous. These evidences [*sic*] will continue to place the beginning of space and time at about 14 billion years ago.

Naturalism:
> Evidences for an actual beginning of space and time will become weaker and less numerous.

Young-Earth:
> New discoveries will prove that the beginning of space and time took place less than about 10 000 years ago.

Predictive Test 37 under Complex Sciences

RTB Model:
> Continuing DNA analysis increasingly will establish that humans could not have naturally descended from previously existing hominins or primates.

Naturalism:
> Continuing DNA analysis increasingly will establish that humans did naturally descend from previously existing hominins or primates.

Young-Earth:
> Continuing DNA analysis increasingly will establish that Neanderthals, archaic *Homo sapiens*, and *Homo erectus* are fully human.

Theistic Evolution:
> No majority position yet developed.

Predictive Test 9 under Theology/Philosophy

RTB Model and Young-Earth:
> As philosophers continue to research the nature of birds and mammals, they will find increasing philosophical evidence that they possess many features that could not possibly be derived or inherited from lower animals.

Naturalism and Theistic Evolution:
> As philosophers continue to research the nature of birds and mammals, they will discover increasing philosophical evidence that they possess no features that could not possibly be derived or inherited from lower animals.

I believe that the above predictions illustrate why Ross believes he can win using this strategy. In the realm of astronomy, he knows where the science is headed, and he has done his best to align his model with that science while distancing competing models from it. In the areas of biology, theology, and philosophy, he has made predictions that are so subjective that he can continue to filter the evidence selectively and cite the opinions of authorities that agree with him. He has already dismissed evidence for evolution in favor of numerous *ad hoc* miracles, so there is no reason to suspect that he will be objective with future discoveries.

While this strategy will undoubtedly strengthen Ross's own faith, it is unlikely to have any impact on those of other perspectives. Philosophical naturalists and theistic evolutionists will continue to find Ross's model biased, arbitrary, and only consistent with selective evidence. Young-earth creationists will continue to insist that Ross is out of harmony with the Bible, which is their primary authority. Even if some of Ross's "predictive tests" fall in his favor, this is unlikely to sway others because his model is internally inconsistent and deliberately constructed to accommodate the data he hopes will vindicate it.

Creation as Science does not live up to its title. While Ross proposes a scientific-style test to resolve a long-standing controversy, in reality it represents an entrenchment on the part of its author into an incoherent model with little hope for widespread appeal.

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Who was Adam? A Creation Model Approach to the Origin of Man

by Fazale Rana with Hugh Ross
Colorado Springs (CO): NavPress, 2005. 299 pages.

Reviewed by Jeffrey K McKee, The Ohio State University

Among the creationist books that adorn my shelves, *Who was Adam?* is noteworthy for its fine style and rare candor. Even the introductory section recounting scientific knowledge of human evolution is remarkably well-written, yet nuanced

enough to allow a modicum of doubt. And although the authors are irritatingly repetitive as they pound their point home, one can sense their genuine enthusiasm for the subject and their fervent belief in their conclusions. Well-written, however, is not the same as logically sound.

The book revolves around what the authors call the "RTB model." They repeat this term so many times that one easily forgets that RTB means "Reasons To Believe," a Christian apologetics organization of which the authors are president and vice-president. But throughout the book one gets the impression that it could also stand for "Return to Bible," as the authors often do. To wit, "But that's what the Bible says happened" (p 111).

In a sense this is quite refreshing. They do not try to cloak their creationism with the scientific-sounding, yet meaningless, trappings of "intelligent design". They proudly state what others try to hide — that their "science" is strictly guided by the ultimate truths in scripture. Never mind that historical geologists tried to do the same thing until the 1830s, when an embarrassment of riches in fossil discoveries brought an end to William Paley's approach of natural theology, or what we like to call "Paley-ontology".

In reality, Rana and Ross are trying to shoehorn science into the Bible, and vice versa. On the positive side they give science the nod when it comes to the age of the earth. They disagree with the "self-described biblical literalists" (p 24) in favor of "other theologically credible interpretations of Genesis 1" (p 42). That breath of fresh air quickly gives way to the familiarly foul stench of standard creationist arguments, blown by the harsh winds of supposedly "testable" creationism.

For purposes of this review I will focus on my own field of paleoanthropology and dissect the authors' diatribe on human evolution. Most of their approach is to disparage the "notoriously" incomplete fossil record. They are not as harsh on my colleagues and me: "Paleoanthropologists are dedicated and talented scientists who must not be disparaged because their discipline lacks robust data" (p 152). Gosh, thanks, guys. Nevertheless, they use the same fossil record to test the RTB creation model, and *amazingly* … all of the data fit.

Among the RTB model's predictions are that humanity can be traced back to one woman (Eve) and one man (Noah), with the former having arisen in the Garden of Eden. This fits well with the genetic data that trace human origins to a "mitochondrial Eve" and with the "Out of Africa" hypothesis held in many corners of paleoanthropology. How *do* they get around the fossil and genetic evidence that point to African origins of *Homo sapiens*, while acknowledging that most scholars place the Garden of Eden in Mesopotamia? They argue that the boundaries of Mesopotamia may have extended into northern and eastern Africa, particularly Ethiopia — where there are some early *Homo sapiens* fossils. How convenient!

The authors argue that all other hominin fossil species, such as the Neanderthals or *Homo erectus*, were not created in God's image because they did not behave as we do. Illustrating a pattern of denial that pervades the whole book, Rana and Ross go to great lengths to distinguish the Neanderthals' tool kit as being very unsophisticated and to deny the existence of intentional burials. Being such primitive brutes, Neanderthals "behaved more like animals than like humans" (p 196). It is true that subsequent peoples had more sophisticated stone tools and art. But by logical extension of the Rana/Ross argument, early *Homo sapiens* also must not have been made in God's image — they lacked agriculture and permanent shelters, let along MP3 players and nuclear weapons, so they also did not behave like modern humans.

Among the most egregious errors in the book is an argument dealing with the evolution of human brain size. I am not sure whether the authors did not understand statistics or were knowingly deceptive. Nevertheless, they boldly state: "For each hominid species, brain size remains relatively constant through the time it existed" (p 164). They refer to a tidy graph of the *average* relative brain size for four groups to show the "general pattern of discontinuous leaps." This is curious, because in the same paragraph they document a substantial range of brain sizes within each group, and ignore the fact that later *Homo erectus* had a larger brain size than early *H erectus*. Even more perplexing is that they lump three or four different species, with successively greater brain sizes, into *Australopithecus*, giving one low average brain size over a 3.5–million-year period. My suspicions in this case go with intentional deception.

There are many other gems of illogic, such as an entire chapter devoted to how humans arose at the perfect moment of geological time in terms of the sun's brightness, length of earth days, best solar eclipses, fewest earthquakes, optimal climate, and more. It is enough to tax the credulity of even the most ardent creationists, and give them reason *not* to believe.

In short, *Who was Adam?* constitutes a classic case study in the differences between rationality and rationalization. It becomes abundantly clear that rationalizing preconceived ideas is no match for rational science through the testing of legitimate hypotheses.

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Earth: An Intimate History

by Richard Fortey
New York:
Knopf, 2004 (hardbound);
Vintage, 2005 (paperback).
429 pages

Reviewed by Neil Wells, Kent State University

Lately it has seemed like a golden age for popular books that tackle complex geological subjects. The trail blazed by John McPhee and Simon Winchester has recently been well trod by Mark Bowen (*Thin Ice*), Andrew Knoll (*Life on a Young Planet*), and Simon Lamb (*Devil In The Mountain*). Among the successes we must also include Richard Fortey, a paleontologist at the Natural History Museum in London, who has already written several great books (for example, *Life* and *Trilobite*), and who has most recently offered us *Earth: An Intimate History.*

In this book, Fortey focuses on physical geology, particularly plate tectonics, especially in terms of how we think about the earth and how geology has influenced history and culture. In short, he is biting off a huge subject. So far, this is not much

different from the goal of any introductory physical geology text, although *Earth* is in no way a textbook. The glory of geology is its grand ideas, its wealth of details, and its many interconnections (think of Arthur Holmes's *Principles of Physical Geology*). However, students can easily be overwhelmed. Perhaps to avoid this, instead of trying to repeat Holmes's encyclopedic treatment, Fortey offers a series of small, intimate, selective portraits of specific features, outcrops, and concepts to represent the larger panorama. Thus in the first chapter, the reader is drawn into geology, interpretation of the past, and impermanence by details of volcanism around Naples, including the concept of vertical crustal instability as shown by Lyell's columns at Serapis. Fortey then shifts from vertical movements to horizontal movements (the Hawaiian volcanic chain), and thence to considering whole oceans and continents. He next discusses details of the Alps, as a stand-in for collisional mountain ranges in general, and chases that down with specifics about the geology of Newfoundland and Scotland. Subsequent chapters cover elements, minerals, igneous rocks, faults, and the Precambrian, and Fortey finishes by wrapping everything up in the sort of grand aerial field trip around the world that one would take if one had Santa's sleigh for an afternoon.

I think that this book should please everyone, from seasoned geologists through neophyte geology students to the lay public. All readers should enjoy Fortey's elegant writing and his love for his subject. As examples of what to expect, he describes some metamorphic minerals as "betraying another phase in their long continued ill-usage," and he explains granite magmas as the inevitable sweat of earth movements. One of my favorites was, "Even today, there are hardened 'field men' — working geologists on the rough end of a hammer — who feel that the laboratory- or computer-based scientist is something of a softie, a spinner of hypotheses away from the coalface of real observations." He describes geological time as "vaster than empires, and more slow". In short, the man knows how to turn a phrase and spin a metaphor.

In fact, some parts of this book were quite reminiscent of John McPhee's writings, and the chapter on elements and minerals could have fit right into James Burke's *Connections*. However, it is not derivative, and Fortey keeps things fresh and interesting, even for the seasoned geologist, by digging up many fascinating nuggets of information, such as how the history of the dollar traces back to some Czech silver mines, how Kalgoorlie had a second gold rush when the residents discovered that they had inadvertently paved their streets with rich gold ore, and Lawrence Morley's run of bad luck with short-sighted reviewers that caused him to lose out to Vine and Matthews in publishing on ocean-floor spreading.

However, readers with different levels of background knowledge will likely see this book very differently. The seasoned geologist may not learn much of consequence about the almost iconic features covered in this book, such as the Grand Canyon, the Insubric Line, the Moine Thrust, the San Andreas Fault, the East African Rift Valley, Vesuvius, and Hawai'i. Nonetheless, the many delightful nuggets, abundant wonderful quotations from the old geological literature, and enlightening glosses on old controversies still make it a worthwhile and enjoyable read. Students will find the book very educational: the advantage of drawing just a few intimate portraits is that more details can be provided, at a more leisurely pace. They will no doubt be left wishing that their introductory professors had explained the big ideas and their context as clearly as Fortey does, and they should feel more intimately connected to places and ideas that they heard of all too briefly in class. (Nonetheless, the book is far too personal and idiosyncratic to substitute for an introductory textbook.)

I am least sure how a lay reader will respond to this book. I could see geological novices being charmed by the prose and the personalization of the subject, but I could also see some being frustrated by the indirect approach, the terminology, and the lack of enough good diagrams to illustrate complex concepts. (He includes some lovely photos and sketches, but the standard textbook model would have served him better here and there.) I do not think novices will get all that they might out of this book, but it should be an enjoyable read nonetheless.

There are a few minor errors. Carson City is still Nevada's capital and is more than a "ramshackle collection of wooden buildings scattered over a hillside". The presence of almandine is not indicative of a pressure of 200 gigapascals (which is more than half the pressure at the earth's core).

My favorite chapters were the ones on the Alps and Newfoundland (the latter has inspired me to try to start my next introductory geology class with the story told by Newfoundland), but I would expect others to make different choices.

Hymn of Praise to the Intelligent Designer

Philip Appleman

O Clever Designer, I want you to know
I believe in you — but as a favor,
Explain to me, please, all these mysteries
So my faith doesn't flicker or waver.

Your intelligent windpipe will keep me alive,
And I'm grateful — but, hey, were you joking
When you hooked the thing up to my swallowing tube
So I'm always in danger of choking?

O Intelligent One, whose great wisdom designed
All these intricate knee joints and hips,
This journey through like would have been very nice
If they'd lasted the whole bloomin' trip!

O Brainy Designer, I'm glad that your cunning
Urethra affords me relief.
By why did you wrap a big prostate around it
To give me such misery and grief?

I'm OK with my abdomen — belly and guts,
And most everything you put in it —
But why did you stick an appendix in there
That could rupture and kill me this minute?

Now don't get me wrong, you're a brilliant Designer.
But somehow, just every so often,
I fear that your nifty Intelligence will
Design me right into a coffin!

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