NCSE

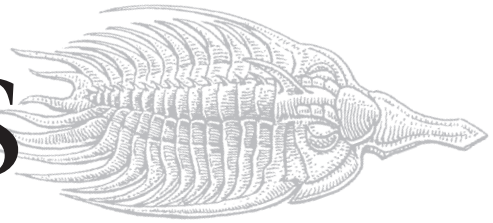
REPORTS OF THE NATIONAL CENTER FOR SCIENCE EDUCATION

DEFENDING THE TEACHING OF EVOLUTION IN THE PUBLIC SCHOOLS

Volume 30, Number 4 JUL-AUG, 2010

CONTINUES *NCSE REPORTS* & *CREATION/EVOLUTION*

CONTENTS



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VOLUME 30, NR 4, JUL-AUG 2010
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Cover: A 17th century engraving of a "harpy" by Mattäus Merian. Grafton EB. 1998. *1300 Real and Fanciful Animals from Seventeenth-Century Engravings.* Dover Pictorial Archive Series. Mineola (NY) Dover Publications.

"Where are the examples of one species turning into another?" This is one of the misguided criticisms of evolution because it rests on several misconceptions about the nature of evolutionary change. One of those misconceptions is about the nature of vestigial features.

It was always entertaining (and it may be again in the future) to watch performances by "creation evangelist" Kent Hovind as he offers to excise the coccyx of scientists who argue that this minimal expression of the typical vertebrate post-anal tail is a vestigial structure. Of course, evolutionary scientists (and anatomists) do not argue that this structure has *no* function — only that the current function is not the same as that performed in the ancestral organisms (or even by contemporary relatives that have retained the form and function of ancestral organisms).

Phil Senter addresses some common creationist arguments that claim that a lack of true vestigial structures is proof that evolution did not occur. What Phil has uncovered is clear evidence that creationist paradigms — based on their "baraminological" studies recognize vestigial structures (as they are properly defined and described in modern biology). So, if lack of vestigial structures invalidates evolution, it also invalidates creationist models that recognize these features as ways to include organisms in the same "baramin".

Our Executive Director, Eugenie C Scott was honored by the University of Missouri at Columbia which invited her to give the commencement address and to receive an honorary doctorate. She earned her PhD in physical anthropology there in 1974. In this issue, we carry transcripts of her remarks to graduates and their families both at the commencement itself and at a separate event held in commemoration of Scott's achievements and professional life.

BOOK REVIEWS

Our book reviews in this issue focus on books exploring paleontology and geology. Read about Chris Beard's hunt for the "dawn monkey" and think about whether he really has found the origin of all primates.

Then, travel the "fossil freeway" with Kirk Johnson and Ray Troll. If you loved dancing to the fossil record with Troll, you will love this retelling of a road trip through some of North America's most interesting and productive fossil sites. If you have been waiting for a replacement for Bob Hope and Bing Crosby's "road movies", this may be just the thing you are waiting for.

What about the "Cambrian Explosion"? Martin Brasier's *Darwin's Lost World* tell us that the emergence of complex animals was more like a slow fuse than a pyrotechnic display.

Donald Prothero reviews a new "coffee-table" type book on the history of life on earth: *Evolution: The Story of Life*. Despite a dew flaws, it contains valuable insights that works written for the general public rarely feature.

And ... don't miss Kevin Padian's review of Wellnhofer's definite book on *Archaeopteryx*. Wellnhofer is the world's leading expert on this most famous vertebrate fossil.

PEOPLE & PLACES

In his regular column on the people and places of evolution, Randy Moore provides a profile of J Frank Norris, the Baptist preacher who built his following from a small congregation in Forth Worth, Texas to become a powerful force against evolution. Norris liked power, politics, and did not shy away from actions that many would consider decided un-Christian (such as murder). He had an uncanny ability to attract more adherents than he alienated (and there was a significant tidal flow in both directions).

IN THE NEWS

School Districts in Australia have been struggling with sanctions for religious schools that are including creationist and "intelligent design" in the science curriculum. Similar issues arise in the UK.

Nebraska stands out as a state whose proposed science education standards do not contain any traces of creationist euphemisms and firmly endorse evolution.

RNCSE 30(4) was printed in July 2010

UPDATES

Georgia: The Georgia state superintendent of schools, Kathy Cox, announced that she was resigning as of June 30, 2010, in order to run the Education Delivery Institute, a new non-profit organization in Washington DC, according to the *Atlanta Journal-Constitution* (2010 May 17).The newspaper listed what it deemed to be the highs and lows of her tenure as superintendent. Among the lows:"Cox removed the word 'evolution' and several passages with related content from the new science curriculum in 2004 and referred to evolution as a politically charged buzzword. That sparked debate across the state and country, with many educators, scientists and even a former president [Jimmy Carter] attacking Cox. She ultimately backed down and restored the material."

Indiana: Just weeks after winning his bid to be the Republican candidate in the third congressional district of Indiana, Mark Souder — perhaps the most outspoken advocate for "intelligent design" in the House of Representatives — announced that instead of continuing to seek his ninth term in Congress, he was resigning — "after admitting to an affair with a female aide (Fox News 2010 May 18). In 2000, he was one of seven members of Congress to sponsor a Discovery Institute briefing held on Capitol Hill (see *RNCSE* 2000 Jan–Apr; 20 [1–2]: 6–7). In the same year, after receiving a letter from a group of scientists at Baylor protesting his sponsorship of the briefing and explaining that "intelligent design" is not science, he read a statement into the *Congressional Record* (2000 Jun 14: H4480–92), which stated in part

> I am appalled that any university seeking to discover truth, yet alone a university that is a Baptist Christian school, could make the kinds of statements that are contained in this letter. Is there [*sic*] position on teaching about materialistic science so weak that it cannot withstand scrutiny and debate?

He thanked "Phil[l]ip Johnson of the University of California at Berkeley[,] Robert * * * [*sic*; Barbara Forrest ascertained from Souder's office that it was Robert P George] of Princeton University, and others i[n] drafting this response."

In 2006, Souder arranged for a staff report from the House Government Reform Subcommittee on Criminal Justice, Drug Policy, and Human Resources — which he chaired — to endorse Richard Sternberg's claims of harassment and persecution for allowing the publication of a paper arguing for "intelligent design" in *Proceedings of the Biological Society of Washington* (see *RNCSE* 2008 Sep–Dec; 28 [5–6]: 36–8). In 2008, he appeared in the creationist propaganda film *Expelled*; when asked by the *Fort Wayne Journal Gazette* (2008 Dec 28) whether his film debut was the highlight of his year, he replied

> I personally believe that there is no issue more important to our society than intelligent design. I believe that if there wasn't a purpose in designing you — regardless of who[m] you view the designer as being — then, from my perspective, you can't be fallen from that design. If you can't be fallen from that design, there's no point to evangelism.

Kentucky, Calloway County: A group calling itself Citizens for Diverse Education was lobbying the Calloway County School Board to include "intelligent design" in the science curricula at Calloway County Middle School and Calloway County High School, according to the *Murray Ledger & Times* (2010 Apr 9). Brian Steward, a spokesperson for the group, told the board, "Our goal is to see that all theories are taught," and cited a state law still on the books (Kentucky Revised Statutes 158.177) which authorizes teachers to teach "the theory of creation as presented in the Bible" and to "read such passages in the Bible as are deemed necessary for instruction on the theory of creation." The superintendent of the school system explained that the curriculum is not decided by the school board but by a council at each school, relying on guidance from the Kentucky Department of Education. He noted that House Bill 397, the so-called Kentucky Science Education and Intellectual Freedom Act (which subsequently died in committee; see *RNCSE* 2010 May/Jun; 30 [3]: 4–9), would encourage teachers to promote "objective" analysis of evolution.

According to the *Ledger & Times,* Steward responded

> the problem he believes the schools have is they teach evolution as a fact. He said he didn't see where it would currently be illegal to teach intelligent design and has spoken with attorneys who back him up and would be willing to represent the school. He said the teachers don't even need to mention who the specific designer is, just that there was an intelligent designer.

The school board expressed a degree of sympathy for the proposal, but there seems to have been no further discussion of it at subsequent meetings, and NCSE was informed that the group never took it to the school councils. Calloway County is in southwestern Kentucky; it is home to about 35 000 people.

Louisiana: As the environmental disaster in the Gulf of Mexico was worsening, a columnist found it ironic that the state's politicians are now "seeking the brightest minds in science and engineering to help" when they "have built their careers by pandering to large anti-science constituencies in our state." Writing in the *Shreveport Times* (2010 Jun 19), Charles Kincade argued that such pandering "will condemn our students to instruction in junk science and dumb

down public school curricula. It already has brought our state national ridicule. And, most importantly, it will, unless changed, render us and future generations unable to deal with future challenges, which will increasingly be more scientific and technical in nature.

Kincade's targets were Louisiana's governor Bobby Jindal, who in 2008 supported and signed the Louisiana Science Education Act, which opened the door for creationism to be taught in the state's public schools, and Louisiana's junior senator, David Vitter, who in 2007 attempted to earmark $100 000 of federal funds to the Louisiana Family Forum — a religious right group with a long history of promoting creationism and attacking evolution — "to develop a plan to promote better science education." That plan would have involved a study of the Ouachita Parish School Board's anti-evolution policy, which was adopted with the LFF's support in 2006, and which subsequently provided the basis for the LSEA.

Quoting NCSE's Glenn Branch and Eugenie C Scott's "The latest face of creationism" (which appeared in the January 2009 issue of *Scientific American*) as warning that "scientific literacy will be indispensable for workers, consumers, and policymakers in a future dominated by medical, biotechnological, and environmental concerns", Kincade added,

> That future is now. The current Gulf disaster implicates all these concerns. And Jindal's educational policy handicaps future generations' ability to deal with inevitable future crises." He concluded, "unless the anti-science policies of Jindal, Vitter, *et al* are corrected, and soon, future generations will be unable to function in the modern world.

Missouri: When the Missouri legislative session ended on May 14, 2010, House Bill 1651 died, without ever having been assigned to a committee. The bill would have, if enacted, called on state and local education administrators to

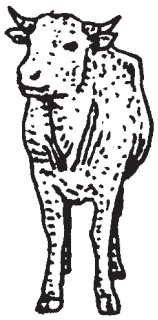
> endeavor to create an environment within public elementary and secondary schools that encourages students to explore scientific questions, learn about scientific evidence, develop critical thinking skills, and respond appropriately and respectfully to differences of opinion about controversial issues, including biological and chemical evolution ... [and to] endeavor to assist teachers to find more effective ways to present the science curriculum where it addresses scientific controversies. ... Toward this end teachers shall be permitted to help students understand, analyze, critique, and review in an objective manner the scientific strengths and scientific weaknesses of the theory of biological and hypotheses of chemical evolution. (For background, see *RNCSE* 2010 Jan–Apr; 30 [1–2]: 4–11.)

The chief sponsor of HB 1651 was Robert Wayne Cooper (R–District 155), joined by Doug Funderburk (R–District 12), Ed Emery (R–District 126), Cynthia Davis (R–District 19), Therese Sander (R–District 22), David Sater (R–District 68), Rick Stream (R–District 94), Jeff Grisamore (R–District 47), Jeanie Riddle (R–District 20), Rodney Schad (R–District 11), and Darrell Pollock (R–District 146). Cooper was the sponsor of a series of failed anti-evolution bills in the past in Missouri. In 2004, he introduced two bills, HB 911 and HB 1722, that called for equal time for "intelligent design" in Missouri's public schools. In 2006, he introduced HB 1266, which would have required that "If a theory or hypothesis of biological origins is taught, a critical analysis of such theory or hypothesis shall be taught in a substantive amount." In 2008, he introduced HB 2554, which is similar to 2010's HB 1651, and in 2009, he introduced HB 656, which is identical to HB 1651.

Nebraska: "Darwin's theory of evolution would continue as a cornerstone of science classes in Nebraska's public schools if proposed new state science standards are adopted this summer by the Nebraska Board of Education," according to a story in the *Omaha World-Herald* (2010 Jun 13). Moreover, there are apparently no efforts underway to lobby for the inclusion of creationism: "Three members of the Nebraska Board of Education say they're not aware of any effort by board members or the public to include intelligent design in Nebraska's new science standards."

The *World-Herald* editorially expressed its relief at the lack of any fuss over evolution, writing (2010 Jun 15):

> The board has included evolution in the curriculum as part of a commendably calm and responsible approach to modern science education. Indications are that the Nebraska standards, which are underpinned by the theory of evolution, will pass muster without the firestorm the same issue has raised in other states. That says a lot about the sound judgment of the elected board members and the common sense of Nebraskans in general.



Nebraska's previous state science standards, from 1998, received a grade of C for their treatment of evolution from both Lawrence S Lerner in his 2000 study for the Fordham Foundation and NCSE's Louise S Mead and Anton Mates in their 2009 study published in *Evolution: Education and Outreach*. Mead and Mates commented that the standards were "[w]eak on evolution," and also criticized them for including "creationist jargon" — in particular, using the word "theory" only with relation to biological evolution.

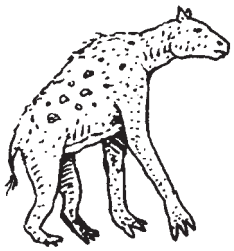
Woodland said that in the new standards, "We're treating evolution the way that we have it now. ...We expect the students to develop an understanding of biological evolution." Chuck Austerberry, a professor of biology at Creighton University and a member of the Nebraska Religious Coalition for Science Education, which supports the teaching of evolution in the public schools, reviewed the draft standards and regarded them as "appropriately neutral" on philosophical and theological matters. "We just want [students] to learn

the science," he said, "to learn it in a neutral, respectful environment."

South Carolina: Two anti-evolution bills, Senate Bill 873 and Senate Bill 875, died in committee when the South Carolina legislature adjourned on June 3, 2010. Both bills were introduced on May 21, 2009, and referred to the Senate Education Committee, where they apparently never received a hearing. Both bills were sponsored by Senator Michael Fair (R–District 6), who spearheaded a number of previous anti-evolution efforts in South Carolina. With respect to his 2003 attempt to establish a committee to "determine whether alternatives to evolution as the origin of species should be offered in schools," the *Greenville News* (2003 May 1), reported that Fair "said his intention is to show that Intelligent Design is a viable scientific alternative that should be taught in the public schools."

A version of the "academic freedom" anti-evolution bill, S 875 provided,

> Teachers must be permitted to help students understand, analyze, critique, and review in an objective manner the scientific strengths and weaknesses of existing scientific theories pertinent to the course. ... School governing authorities including, but not limited to, school and district superintendents, principals, and administrators, may not prohibit a teacher in a public school in this State from helping students understand, analyze, critique, and review in an objective manner the scientific strengths and weaknesses of existing scientific theories pertinent to the course.



Since 2004, thirty-two "academic freedom" anti-evolution bills have been introduced; all but one, Louisiana's SB 561/733, failed to pass.

S 873, however, was apparently unique. If enacted, it would have required the state board of education to "examine all curriculum in use in this State that purports to teach students about the origins of mankind to determine whether the curriculum maintains neutrality toward religion." The bill further provided, "Related to non-religion, the examination must include a review as to whether the curriculum contains a sense of affirmatively opposing or showing hostility to religion, thus preferring those who believe in no religion over those who hold religious beliefs." If the review revealed that a curriculum is not religiously neutral, then the bill would have required that "the offending curriculum must be revised or replaced as soon as practicable."

Texas: The Institute for Creation Research suffered a significant legal defeat in its lawsuit over the Texas Higher Education Coordination Board's 2008 decision to deny the ICR's request for a state certificate of authority to offer a master's degree in science education from its graduate school. A June 18, 2010, ruling in the United States District Court for the Western District of Texas found that "ICRGS [the Institute for Creation Research Graduate School] has not put forth evidence sufficient to raise a genuine issue of material fact with respect to any claim it brings. Thus, Defendants are entitled to summary judgment on the totality of ICRGS's claims against them in this lawsuit" (p 38).

The Institute for Creation Research moved its headquarters from California to Texas in 2007. When it applied for accreditation of its master's degree in science education, the state's scientific and educational leaders voiced their opposition. On April 24, 2008, the Texas Higher Education Coordination Board unanimously voted to deny the ICR's request. Subsequently, the ICR appealed the decision, while also taking its case to the court of public opinion with a series of press releases and advertisements in Texas newspapers.

The decision was in response to ICR's request for temporary state certification, enabling the ICR graduate school to operate while it sought accreditation. In California, the ICR graduate school was accredited by the Transnational Association of Christian Colleges and Schools, which requires candidate institutions to affirm a list of Biblical Foundations, including "the divine work of non-evolutionary creation including persons in God's image." TRACS is not recognized by the state of Texas, however, and after the ICR moved from Santee, California, to Dallas, Texas, the ICR expressed its intention to seek accreditation from the Southern Association of Colleges and Schools.

The ICR filed suit against THECB in 2009, accusing it and its members of imposing "an unconstitutional and prejudicial burden against ICRGS's academic freedom and religious liberties." The prolix style of the ICR's initial complaint — which the *Dallas Observer* (2009 Apr 20) quipped "reads kind of like stereo instructions" — was apparently continued in its subsequent documents; the court complained,

> It appears that although the Court has twice required Plaintiff to re-plead and set forth a short and plain statement of the relief requested, Plaintiff is entirely unable to file a complaint which is not overly verbose, disjointed, incoherent, maundering, and full of irrelevant information. (p 12)

In summary, the ICR claimed that THECB's actions violated its rights to free exercise, free speech, and equal protection, its rights to procedural and substantive due process, and its rights under the Texas Religious Freedom Restoration Act, as well as that "Standard 12" — the civil regulation on which THECB's decision was based (19 Texas Administrative Code sec. 7.4(14)) — was vague. The court found merit in none of these claims. With respect to the free exercise claim, for example, the court found that "the Board's decision was rationally related to a legitimate governmental interest, and there is no evidence the decision was motivated by animus toward any religious viewpoint" (p 24). Documents from the case are available on NCSE's website at <http://ncse.com/creationism/legal/institute-creation-research-graduate-school-v-paredes-et-al>.

Australia, New South Wales: A survey conducted by researchers at Macquarie University revealed that creationism is often presented in religious education classes in New South Wales. According to

The Australian (2010 Jun 25),"The survey found a group of scripture volunteers were distributing kits called 'Creation For Kids' containing colouring books, calendars and DVDs deriding evolution and claiming that the universe was only 6000 years old." Creationism was only part of the problem: the newspaper summarized,"Scripture teachers generally discouraged questioning, emphasised submission to authority and excluded different beliefs," and reported that Cathy Byrne, of the university's Centre for Research and Social Inclusion, believed that parents would be shocked to learn what goes on in some religious education classes.

Canada, Kamloops: The Kamloops Centre for Rational Thought filed a complaint with British Columbia's Ministry of Education over the teaching of creationism in the Kamloops Christian School, according to the Kamloops *Daily News* (2010 Mar 23). The Centre's director, Bill Ligertwood, argued,"It's like teaching alchemy in a science class"; he told *Kamloops This Week* (2010 Mar 23), "We think the Kamloops Christian School, according to the ministry's own website and the ministry's own policies, has no right to be teaching creationism in science classes." But the school's principal told the newspaper, "As long as we follow and meet the needs of the province, we're fine," and a spokesperson for the ministry explained that as long as the provincial curriculum is followed, the school is free to teach whatever it pleases. Kamloops is a city of about 92 000 in south central British Columbia**.**

Russia: A senior official of the Russian Orthodox Church called for the end to the "monopoly of Darwinism" in Russian schools during a recent talk in Moscow, according to Reuters (2010 Jun 9). "Darwin's theory remains a theory," Hilarion Alfeyev, the Metropolitan of Volokolamsk and a permanent member of the Holy Synod of the Patriarchate of Moscow, was quoted as saying. "This means it should be taught to children as one of several theories, but children should know of other theories too."

Alfeyev was addressing a group of officials from Russia's Ministry of Foreign Affairs, however, not education policymakers; Alfeyev is involved in a variety of ecumenical projects internationally and represents the Russian Orthodox Church in Brussels. According to Reuters, his talk was "dedicated to fighting 'fanatical secularism' of liberals hostile to religion, and called for dialogue with moderate secularists and cooperation with Catholics against common foes."

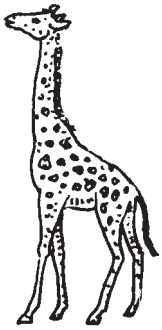
The veteran dissident Lyudmila Alexeyeva, a recipient of the European Parliament's 2009 Sakharov Prize for Freedom of Thought for her work with the civil rights group Memorial, described Alfeyev's call for the teaching of "other theories" as "a dangerous idea," vowing, "we will do all we can to stop it."According to Reuters,"She said it was unlikely religious teaching would replace Darwin in the national curriculum, but it could find its way into some schools with enough pressure from the Church."

Poll data about the acceptance of evolution in Russia are mixed: a 2005 poll reportedly found 26% of Russians accepting evolution and 49% accepting creationism, but a 2003 poll reported that 44% agreed with "Human beings are developed from earlier species of animals"), and a 2009 poll reported that 48% of Russians who "know something about Charles Darwin and his theory of evolution" agreed that there was sufficient evidence for the theory. (In comparison, only 41% of Americans agreed.)

As for what ought to be taught in the schools, it seems that Alfeyev's proposal might be popular. The same 2009 poll indicated that 53% of Russians agreed with "Evolutionary theories should be taught in science lessons in schools together with other possible perspectives, such as intelligent design and creationism," with 13% preferring that such perspectives be taught instead of evolution; only 10% agreed with "Evolutionary theories alone should be taught in science lessons in schools."

Yet despite the lead sentence in the Reuters story, it is unclear whether the Church is endorsing Alefeyev's call. According to Inga Levit, Uwe Hoßfeld, and Lennart Olsson, discussing "Creationism in the Russian educational landscape" in *Reports of the NCSE* (2007 Sep–Dec; 27 [5–6]: 13–7), the Russian Orthodox Church "has no officially declared position toward 'scientific creationism' ... [which] plays no significant role in official theological discourse, but unofficially remains a significant part of the Orthodox theological landscape."

Levit, Hoßfeld, and Olsson also reported that creationism in Russia is frequently visible as part of a sectarian project to impose Orthodox views in the public school system. Although Russian Orthodoxy is the dominant religion in Russia (with 63% of the population, according to a 2007 report), there is a significant Muslim minority (6%), as well as a sizable population of nonbelievers (16%), which might make it unfeasible for the Russian government to capitulate to sectarian proposals to change how evolution is taught.

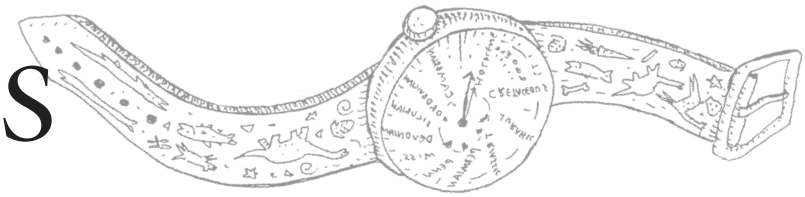


United Kingdom: Evolution disappeared again from a proposed revision of the primary school curriculum in the United Kingdom, prompting renewed calls for its reinstatement. According to the *Telegraph* (2010 Jun 19):

> Two years ago a survey found that one in three teachers believed creationism is just as valid as evolution ... In response, campaigners lobbied Labour ministers to include explicit teaching of evolution for all ages in the Children, Schools and Families Bill but it fell by the wayside as the law was rushed through just before the election. Labour had also accepted the recommendation by Sir Jim Rose, in his review of the primary curriculum, that young pupils should be taught evolutionary theory. But his plan, which would have come into effect in 2011, is not being carried out by the new Government.

In response to the disappearance of evolution from the primary

NEWS



Australia Moves Against Creationism in Science Classes

Michael Boswell

In Australia, fundamentalist schools are resisting pressure to remove creationism, or variants like "intelligent design", from science classes. This conflict arises because of the history and organization of Australian education. Since all school students receive certificates graded according to a syllabus or curriculum, all non-government schools must be accredited by state based education authorities. Each of Australia's six states and two territories form independent school districts. Most schools are run and funded by the states. Some schools are run by community groups (mainly churches) and are financially subsidized by the federal government. In each state and at the federal level, a politician becomes the minister for education and then appoints key personnel who advise on policy.

After John Howard's Liberal-National coalition won Parliament in 1996, the number of non-government schools exploded under his *laissez-faire* federal government. Before then, only new schools that did not geographically compete with established schools attracted funding, but the Howard government removed these restrictions. Some fundamentalist churches took advantage of this removal, using the classic "two models" approach — teaching creationism alongside evolutionary biology — to satisfy the curriculum requirements, while still promoting religious doctrine as science. In 2005, this approach was endorsed by Brendan Nelson, then the federal Minister for Education. As these students progressed to higher education, science educators complained about the increasing number entering university with strong creationist views.

In November 2007, the federal government changed. The new education minister, then Deputy Prime Minister Julia Gillard, appointed Professor Barry McGaw to lead the drafting of the new compulsory national curriculum. A former science teacher, Professor McGaw insists firmly that creationism does not belong in science classes.

In June 2009, an "Official Notice" was issued by Australia's

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school curriculum, the British Humanist Association sent a letter dated June 17, 2010, to the Secretary of State for Children, Schools, and Families (available online at <http://www.humanism.org.uk/_uploads/documents/1LettertoGoveonEvolutioninCurriculumFINAL.pdf>), urging him "to protect and promote science in the school curriculum, with the specific inclusion of the teaching of evolution in the primary curriculum." The letter was signed by a number of distinguished British scientists, including Richard Dawkins, Steve Jones, Harold Kroto, Paul Nurse, and Michael Reiss. The *Telegraph* reported, "The Department for Education said it would respond fully to the demands made in the letter but added that it would also review the curriculum for primary school pupils." (For background, see *RNCSE* 2009 Sep/Oct; 29 [5]: 8–13; 2010 Jan–Apr; 30 [1–2]: 4–11.)

United Kingdom, Northern Ireland: The Ulster Museum is receiving pressure to include exhibits on creationism from Nelson McCausland, the Minister for Culture, Arts, and Leisure in the Northern Ireland Executive, according to the *Guardian* (2010 May 26), which reported, McCausland defended a letter he wrote to the trustees calling for anti-evolution exhibitions at the museum. He claimed that around one third of Northern Ireland's population believed either in intelligent design or the creationist view that the universe was created about 6 000 years ago.

Richard Dawkins was quoted as replying, "If the museum was to go down that road then perhaps they should bring in the stork theory of where babies come from. Or perhaps the museum should introduce the flat earth theory." Mark Taylor, director of the Museums Association, told the *Belfast Telegraph* (2010 May 26), "I have been working in museums over 20 years and I can't recall in the UK an example of such blatant political interference," referring also to McCausland's desire for the museum to emphasize the role of the Ulster Scots and the Orange Order in the history of Northern Ireland. Previous anti-evolution efforts in Northern Ireland include a campaign to include a creationist account of the formation of the Giant's Causeway in the associated visitor center (see *RNCSE* 2008 Jan/Feb; 28 [1]: 20–2) and a request for the council of the Belfast suburb of Lisburn to send letters to secondary schools encouraging them to teach alternative theories to evolution (see *RNCSE* 2007 Sep–Dec; 27 [5–6]: 20–5)

largest education authority, the New South Wales "Board of Studies". It reminded science "teachers that Creationism and Intelligent Design are not part of the Board's Science syllabuses" (<http://news.boardofstudies.nsw.edu.au/index.cfm/2009/6/3/Official-Notice—Advice-to-Teachers-of-Science>). It places the onus on teachers to ensure that students know that creationism is not a scientific theory, is not evidence based, and it not part of any assessment of scientific knowledge in New South Wales.

The Australian Association of Christian Schools protested the official notice in a letter date 29 October, 2009 (<http://www.aacs.net.au/imagesDB/news/Letter-PresidentBOSreOfficialNotice-Science151009final1.pdf>). The Association asked the Board of Studies to

> withdraw the offending and dishonest Notice that [creationism and its variants] are "not scientific, not evidence based". The statement is simply indefensible and misrepresents science, logic and truth.

The letter continued:

> The very existence of the two paradigms that are the main focus of this Notice (i.e. Creationism and Intelligent Design) is the product of a body of evidence that invites a response. While accepting that these paradigms may not fully satisfy the demanding criteria of a fully developed scientific theory, there is, without doubt, a substantial body of evidence that constitutes grounds for plausible, if controversial, propositions to be put forward and considered. This is as true of the paradigm of Evolution by chance as it is of Creationism or Intelligent Design.

The letter concluded:

> This Notice is primarily about the politics of competing ideologies in science education and, in our view, seriously compromises the statutory independence of the Board of Studies. We are already aware of at least one of our member schools being called to account against the measure of this Notice as an apparent condition of its continued registration and accreditation. We therefore call on the Board to:
>
> - withdraw the Notice;
> - refrain from taking any action against faith-based schools based upon the Notice;
> - enter into serious consultation with representatives of faith-based schools to address any specific concerns that the Board might have in respect of the teaching of the science syllabus in general, and evolution and related theories in particular, in NSW schools.

The NSW Board of Studies has not yet responded to this letter.

In the neighboring state of South Australia — the nation's fifth largest school district — the "Non-Government Schools Registration Board" approved its revised *Policies* on 8 December 2009. One revision was the exclusion of creationism from any science class in any school (<http://www.ngss.sa.edu.au/files/links/POLICIES_of_the_NGSRB_8_12.pdf>). The forced removal of a creationist poster from a school sparked press attention during this year's March state election. In early May, the Board informed Christian Schools Australia that no action would be taken against schools teaching creationism or "intelligent design" until the new policy was reviewed (<http://csa.edu.au/briefings/118sa/271-sa-science-policy-on-hold>).

Commenting on the South Australian situation, Creation Ministries International told of its frustration in having creationism taught (<http://creation.com/australian-christian-schools-in-creationism-row>), adding a third Australian state to the list of those opposing what CMI called "teaching the evidence for evolution fully and fairly" — which, of course, includes giving "creation evidences a fair hearing". CMI continued:

> In the state of Victoria, while no such formal restriction [against the teaching of creationism] has yet been issued, it has long been an open secret among Christian schools that school inspectors are applying informal pressure to individual schools on the subject of creation, hinting about how their registration might be under threat if they teach it.

At issue, according to CMI, is that students who attend schools from which registration is withdrawn could be considered truant. These students would have to attend schools with approved curricula, and this could result in the closure of the unregistered schools.

One wonders what will happen in South Australia? Will New South Wales bow to the same pressure as South Australia? Will Victoria apply more than informal pressure to noncompliant schools? What is happening in the other states and territories? Will the adoption the new national curriculum prevent the teaching of creationism in science classes? How will the forthcoming federal or New South Wales elections affect the exclusion of creationism? To quote Bob Dylan "The answers, my friends, are blowing in the wind".

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NCSE NEWS

News from the Membership *Glenn Branch*

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

Brian Alters and **Lorne Trottier**, both members of NCSE's board of directors, both gave talks in McGill University's Mini-Science lecture series, an educational outreach program designed to offer the public an insider's view of science. The theme was Pseudoscience: From Quirks to Quacks, and accordingly Alters spoke (on May 5, 2010) on "Creationism, evolution, and God," while Trottier spoke (on May 19, 2010) on "Are cell phones and WiFi harmful to your health?" Alters holds the Tomlinson Chair in Science Education at McGill, and Trottier is a Governor Emeritus of McGill as well as the co-founder of Matrox, a privately held group of companies that is internationally known for its innovative computer graphics, video, and imaging products.

"Was the Darwin/Wedgwood dynasty adversely affected by consanguinity?" That was the question addressed by **Tim M Berra**, Gonzalo Alvarez, and Francisco C Ceballos in their recent article published in *BioScience* 2010; 60 (5): 376–83. In the abstract, the authors explain,

> Charles Darwin, who was married to his first cousin, Emma Wedgwood, was one of the first experimentalists to demonstrate the adverse effects of inbreeding and to question the consequences of consanguineous mating. He documented the phenomenon of inbreeding depression for numerous plant species, and this caused him to worry about the health of his own children, who were often ill. To determine whether Darwin's fears were justified, we constructed a pedigree of the Darwin/Wedgwood dynasty from the large quantity of genealogical information published on these families. ... Our findings suggest that the high childhood mortality experienced by the Darwin progeny (3 of his 10 children died at age 10 or younger) might be a result of increased homozygosity of deleterious recessive alleles produced by the consanguineous marriages within the Darwin/Wedgwood dynasty.

The paper was widely discussed in the media, including a report in *The New York Times* (2010 May 3). Berra is Professor Emeritus of Evolution, Ecology, and Organismal Biology at the Ohio State University, Mansfield, and the author of *Charles Darwin: The Concise Story of an Extraordinary Man* (Baltimore: Johns Hopkins University Press, 2009; reviewed in *RNCSE* 2010 Jan–Apr; 30 [1–2]: 37–8) as well as *Evolution and the Myth of Creationism* (Stanford [CA]: Stanford University Press, 1990).

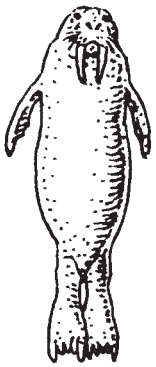
"How Not to Attack Intelligent Design Creationism: Philosophical Misconceptions About Methodological Naturalism," by Maarten Boudry, **Stefaan Blancke**, and **Johan Braeckman**, was published in *Foundations of Science* (2010) 15: 227–44. The abstract:

> In recent controversies about Intelligent Design Creationism (IDC), the principle of *methodological naturalism* (MN) has played an important role. In this paper, an often neglected distinction is made between two different conceptions of MN, each with its respective rationale and with a different view on the proper role of MN in science. According to one popular conception, MN is a self-imposed or intrinsic limitation of science, which means that science is simply not equipped to deal with claims of the supernatural (Intrinsic MN or IMN). Alternatively, we will defend MN as a provisory and empirically grounded attitude of scientists, which is justified in virtue of the consistent success of naturalistic explanations and the lack of success of supernatural explanations in the history of science (Provisory MN or PMN). Science *does* have a bearing on supernatural hypotheses, and its verdict is uniformly negative.
>
> We will discuss five arguments that have been proposed in support of IMN: the argument from the definition of science, the argument from lawful regularity, the science stopper argument, the argument from procedural necessity, and the testability argument. We conclude that IMN, because of its philosophical flaws, proves to be an ill-advised strategy to counter the claims of IDC. Evolutionary scientists are on firmer ground if they discard supernatural explanations on purely evidential grounds, instead of ruling them out by philosophical fiat.

Blancke is a doctoral researcher and Braeckman is a faculty member at the Department of Philosophy and Moral Sciences of Ghent University.

Geoffrey A Clark spoke on "Evolution, creation science, and the demon-haunted world" on April 15, 2010, at Sul Ross State University. His talk was the 16th HJ Cottle Lecture, named in honor of Harve James Cottle, a distinguished researcher, educator, and member of the department of biology at Sul Ross State University for several years in the 1920s who promoted student interactions with outstanding scientists of various fields. Clark is Regents' Professor in the Department of Anthropology at Arizona State University.

Pete Devine was given the 2009 Howard Bell Award, the highest honor from the Association for Environmental and Outdoor Education. The award was for his career contributions to the field in



Glenn Branch is NCSE's deputy director

California, including many conference presentations on teaching evolution and the invalidity of creationism. Devine is the Resident Naturalist at the Yosemite Conservancy.

Jerry Fodor and Massimo Piattelli-Palmarini's *What Darwin Got Wrong* (New York: Farrar, Strauss, and Giroux, 2010) was reviewed by NCSE Supporter **Douglas Futuyma**, Distinguished Professor in the Department of Ecology and Evolution at Stony Brook University, in *Science* (2010; 328: 692–3); by Ned Block and NCSE Supporter **Philip Kitcher**, the John Dewey Professor of Philosophy at Columbia University, in the March/April 2010 issue of *Boston Review* (available on-line at <http://www.bostonreview.net/BR35.2/block_kitcher.php>); and by NCSE Supporter **Richard Lewontin**, the Alexander Agassiz Professor of Zoology and Professor of Biology at Harvard University, for *The New York Review of Books* (2010; 67 [9]: 34–6). None of the reviews was enthusiastic.

Futuyma concluded,

> Because [Fodor and Piatelli-Palmarini] are prominent in their own fields, some readers may suppose that they are authorities on evolution who have written a profound and important book. They aren't, and it isn't.

Block and Kitcher wrote

> They do not have new data, new theory, close acquaintance with the everyday practice of evolutionary investigations, or any interest in supplying alternative explanations of evolutionary phenomena. Instead, they wield philosophical tools to locate a 'conceptual fault line' in contemporary Darwinism. Apparently unshaken by withering criticism of Fodor's earlier writings about evolutionary theory, they write with complete assurance, confident that their limited understanding of biology suffices for their critical purpose. The resulting argument is doubly flawed: it is biologically irrelevant and philosophically confused.

Lewontin wrote,

> While *What Darwin Got Wrong* may have been designed *pour épater les bourgeois* and to forcibly get the attention of evolutionists, when two accomplished intellectuals make the statement 'Darwin's theory of selection is *empty*,' they generate an anger that makes it almost impossible for biologists to give serious consideration to their argument.

A review of *What Darwin Got Wrong* and coverage of the various reviews appearing elsewhere will appear in a future issue of *RNCSE*.

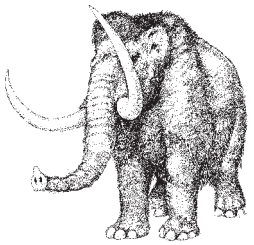
The ninth edition of **Scott F Gilbert**'s *Developmental Biology* (Sunderland [MA]: Sinauer Associates, 2010) was published. The publisher writes,

> During the past four years, the field of developmental biology has begun a new metamorphosis. The Ninth Edition of *Developmental Biology* mirrors this shift with a wholly revised text, over 600 new literature citations, and substantial reorganization of content. The introductory section has been streamlined. ...Another new feature is the addition of short part openers that address key concerns in developmental biology. These provide an introduction to the subsequent chapters, telling the reader what to expect and placing that information into a specific context. Each chapter ends with a guide to Web-based resources relevant to that chapter's content... . Some of the new material in this edition includes: mesenchymal and induced pluripotent stem cells; the transdifferentiation of pancreatic cells; new data on sea urchin micromere specification; the mechanisms whereby Sry and Wnt signaling determine mammalian sex; the memory of cell fate during amphibian limb regeneration; how bats got their wings and how dachshunds got their short legs.

Gilbert is the Howard A Schneiderman Professor of Biology at Swarthmore College.

Ursula Goodenough spoke on "Sex and evolution: What meiotic sex is good for, and what it has contributed to the evolution of our kind" at the Saint Louis Science Center on May 12, 2010 — and her talk was covered by the *St Louis Post-Dispatch* (2010 May 22).

> Her lecture amounted to an explanation of the nitty gritty of Darwinist thinking at the most basic, cellular level. It's the stuff Darwin knew but couldn't explain. Goodenough, 67, gives off the vibe of a very, very smart hippie. Dressed in a black sweater and a red, flowered skirt, and wearing a small, Indian purse decorated with a beaded elephant, Goodenough's long, gray hair kept interfering with the wireless microphone hooked to her ear. She sprinkled words such as 'cool' and 'dude' and phrases such as 'hangs out' and 'you're toast,' into lecture notes on eukaryotes, Chromalveolates and opisthokonts.



Interviewed by the newspaper, she discussed the state of evolution education: "All it takes is one or two parents complaining," she lamented, "and an overworked, underpaid teacher might fold. It's not their jobs to change the system, but the system has to change." A Supporter of NCSE, Goodenough is Professor of Biology at Washington University in St Louis.

Steven T Jackson of the University of Wyoming was accidentally omitted from the list of NCSE members elected as Fellows of the American Association for the Advancement of Science in 2009 (see *RNCSE* 2010 Jan–Apr; 30 [1–2]: 10–13); apologies and congratulations to him from NCSE. Jackson also recently edited and provided the introduction to a new edition of Alexander von Humboldt and Aimé Bonpland's *Essay on the Geography of Plants* (Chicago: University of Chicago Press, 2009). The publisher writes,

> Among the most cited writings in natural history, after the works of Darwin and Wallace, this work appears here for the first time in a complete English-language translation. Covering far

> more than its title implies, it represents the first articulation of an integrative 'science of the earth,' encompassing most of today's environmental sciences. The edition also includes a poster-sized color reproduction of the Mt Chimborazo tableau, an icon in the history of science and scientific graphics. Here, ecologist Stephen T Jackson introduces the treatise and explains its enduring significance two centuries after its publication. He also provides materials on the instruments used by Humboldt and biographical sketches of the persons mentioned in the Essay.

On the Cutting Edge, a resource for undergraduate geoscience teaching (<http://serc.carleton.edu/NAGTWorkshops/index.html>), was honored with the *Science* Prize for Online Resources in Education, and **Cathryn Manduca** and her colleagues were invited to contribute a piece to *Science* (2010; 327 [5969]: 1095–6) describing their efforts. They explained,

> In contrast to science, which makes progress at the level of the community and where individual work builds on all that has come before, teaching science has often been an individual enterprise. Typically, faculty create courses in isolation, without the benefit of knowledge of others' classroom experiences or research on how students learn. ... Building a culture of sharing and communal improvement in support of undergraduate geoscience teaching is the goal of the On the Cutting Edge professional development program.

Manduca is the executive director of the National Association of Geoscience Teachers and the director of the Science Education Resource Center at Carleton College.

NCSE Supporter **Bill Nye "The Science Guy"** was honored as the 2010 Humanist of the Year at the American Humanist Association's 69th Annual Conference, held June 3-6, 2010, in San Jose, California. "Nye has long been an advocate for public understanding of science and the environment," according to the Spring 2010 issue of the AHA's newsletter *Free Mind*, which added, "He is the author of five children's science books, holds three patents, and is the recipient of numerous honors and awards, including three Emmys."

Andrew J Petto, a member of NCSE's board of directors and the editor of *RNCSE*, and NCSE Supporter **James "The Amazing" Randi** both spoke in a seminar series on Special Topics in Biomedical Communication: Science and Pseudoscience, held on-line by the University of Science in Philadelphia during the summer of 2010. Randi's topic was "Did the enlightenment ever arrive?" and Petto's was "Denying science: It's the Umwelt, stupid!"

NCSE's **Joshua Rosenau** reviewed Elaine Howard Ecklund's *Science vs Religion: What Scientists Really Think* (New York: Oxford University Press, 2010) for the *Washington Post* (2010 May 30). He noted

> Americans are almost evenly divided between those who feel science conflicts with religion and those who don't. Both sides have scientific backers. Ecklund offers a fresh perspective on this debate ... Rather than offering another polemic, she builds on a detailed survey of almost 1700 scientists at elite American research universities — the most comprehensive such study to date.

He concludes, "For Ecklund, the bottom line is recognizing and tolerating religious diversity, honestly discussing science's scope and limits, and openly exploring the disputed borders between scientific skepticism and religious faith."

Lois Schadewald was interviewed about *Worlds of their Own* (Philadelphia: Xlibris, 2008), a posthumous collection of articles by her brother **Robert J Schadewald**, a former president of NCSE's board of directors, for Point of Inquiry, a podcast of the Center for Inquiry. The podcast's editor comments, "In this episode of Point of Inquiry, Robert M Price asks Lois to outline some of her brother's research in Flat Earth and Hollow Earth 'science' as well as to relate some stories of his association with important 'alternative science' figures like catastrophist Immanuel Velikovsky. Schadewald talks some about her brother's unique approach to dealing with promoters of pseudoscience, and what he gained from it. She discusses the timeline of Bob's research interests and how he eventually made his way to studying creationism." To hear the podcast, visit <http://www.pointofinquiry.org/lois_schadewald_the_schadewald_legacy_nemesis_of_pseudo_science/>. Lois Schadewald is Professor of Chemistry at Normandale Community College.

NCSE's executive director **Eugenie C Scott** received the Public Welfare Medal from the National Academy of Sciences in a ceremony on April 25, 2010, in Washington DC. According to a January 11, 2010, press release, "the medal is presented annually to honor extraordinary use of science for the public good"; Scott was chosen "for championing the teaching of evolution in the United States and for providing leadership to the National Center for Science Education." Accepting the medal, Scott said,

> That an organization comprised of the finest scientists in the nation would bestow this award on a small, underfunded, understaffed, nonprofit laboring to defend the teaching of evolution is both humbling and inspiring. On behalf of all the people who have worked at NCSE over the last 22 years to make it an effective organization, I thank you from the bottom of my heart. (See *RNCSE* 2010 May/Jun; 30 [3]: 19 for her remarks.)

Previous recipients include Neal Lane, Norman Borlaug, Maxine F Singer, C Everett Koop, and Carl Sagan. The National Academy of Sciences is a private, nonprofit institution that was established under a congressional charter signed by President Abraham Lincoln in 1863. It recognizes achievement in science by election to membership, and provides

"How Did You End up in this Job, Anyway?"

Eugenie C Scott

It is of course a wonderful thing to receive an honorary degree from the University of Missouri, an institution that many years ago I called home.

I'm extremely grateful to all of the people who supported my candidacy for this high honor, particularly Frank Schmidt.

At the NCSE, we focus on two subjects: the nature of science and evolution. The US stands out among developed (and even some underdeveloped) nations with a high rate of rejection of the idea that living things have had common ancestors, and that the earth and universe are ancient and have changed over time. Only about half of Americans accept the idea that evolution has occurred, whereas the percentage of scientists who accept this is over 95%. Scientists vigorously debate details about how evolution occurred, not whether. Nonetheless, there has for over fifty years been a growing movement to try to persuade our fellow citizens that what is routinely taught at the university level in astronomy, geology, biology, and anthropology is without a scientific foundation.

The question I am most frequently asked is "Why do we have this problem (of creationism) here in the US and they don't have it elsewhere?" The second most frequently asked question is "if humans evolved from apes, why are there still apes?" The third question — after someone gets to know me — is "How did you end up in this job, anyway?"

For my remarks tonight, I thought I would talk about that third question and tell you a little bit about how I got into this rather peculiar line of work of mine. It starts here, after all, because it was at the University of Missouri that I first was introduced to something called "creation science." One day, in 1971, my professor, Jim Gavan, handed me a stack of small, brightly colored, slick paper pamphlets from the Institute for Creation Research. "Here," he said, "Take a look at these. It's called 'creation science'."

Wow. Here I was studying to be a scientist, and here were people calling themselves scientists, but we sure weren't seeing the world the same way. Creationists claimed to be looking at the same data as mainstream scientists, but were concluding that all living things had appeared in their present form, at one time, a few thousand years ago. I and the rest of science was concluding that living things had branched off from common ancestors over scarcely imaginable stretches of time.

They were concluding that the entire planet had been covered by water, and that all the present-day geological features of earth had been determined by this flood and its aftermath. I couldn't see any evidence for this at all, and much evidence against it. Why were we coming up with such different conclusions? The data sometimes were the same (although I found many errors in creationist literature), but the biggest differences were in philosophy of science and the approach to problem solving.

I began collecting creation science literature as an interesting problem in the philosophy of science — and because of course it was just inherently interesting. Due to the pressures of graduate school and later my first teaching job at the University of Kentucky, I wasn't able to pursue it especially deeply, but students would occasionally bring up the topic. I would tell them that even if proponents of creation science claimed they were doing science, one cannot claim that one is doing science if one is doing something very different from what scientists are doing. Creation science was a good foil to use to teach students about the nature of science. Nowadays, "intelligent design" — a more recent form of creation science — can be used in the same way.

What makes science scientific?

As executive director of the National Center for Science Education, I regularly encounter the public's misunderstanding of the most basic elements of science. I deal with people who nod in agreement with a typical creationist statement that "neither evolution nor creationism is scientific because no one was there to observe it." I deal with a public that agrees with creation scientists stating that "evolution isn't scientific because evolutionists are always changing their minds," and perhaps most disappointing, with people who contend, "well, if science is a search for truth, why can't we just tell students 'God did it' in science class?" All of these are misunderstandings of what science is all about, which gets us into the question of what is science, and of course the fundamental question of what do you teach in a high school science class.

Of course, philosophers of science vigorously debate the definition of science, but at the level that the public understands these issues, their concerns are more like debating the number of angels that can dance on the

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Eugenie C Scott is NCSE's executive director.

science, technology, and health policy advice to the federal government and other organizations.

NCSE's executive director **Eugenie C Scott** received an honorary degree from the University of Missouri, Columbia on May 15, 2010, and an honorary degree from Colorado College on May 17, 2010, both in recognition of her achievements in defending the teaching of evolution in the public schools. The honorary degrees were her seventh and eighth: she received honorary Doctor of Science degrees from McGill University in 2003, the Ohio State University in 2005, Mount Holyoke College and the University of Wisconsin, Milwaukee, in 2006; Rutgers University in 2007; and the University of New Mexico in 2008. The degree from the University of Missouri was especially meaningful for Scott, since she earned her PhD in physical anthropology there, with a dissertation on dental evolution in pre-Columbian Peru. She previously received the university's distinguished alumni award in 1993. (See sidebar, p 16, for a transcript of her commencement address, and p 12 for a tran-

head of a pin. Doubtless to the frustration of my colleagues in the philosophy of science, my job requires me to simplify — probably beyond what they consider acceptable. But in doing so, I can make a little progress in helping the public to understand why science works, and also why the various creationisms aren't science. Maybe down the road the nonscientists I encounter can tackle falsification and the demarcation problem; right now, I'd be happy if they understood two basic rules of science that I believe the majority of scientists would agree upon:

> Science requires *testing* of explanations against the empirical world, and requires explanation through only *natural* causes.

The reason for the restriction of science to natural causes is related to the importance of testing in science. We can only test an idea if we can hold constant some of the variables under consideration. If God is omnipotent, He is unconstrained, and His actions cannot be held constant. As such, any experiment that postulates God as an actor could have any possible outcome. Therefore there is no way to scientifically test explanations that involve God or any other supernatural force. We are stuck with using only natural causes in science, because those are the only ones we can test. If we ever invent a theometer, maybe then we will be able to test hypotheses involving God.

And that is why creationism isn't scientific, despite the claims of its proponents. It ultimately invokes the direct hand of God to specially create, whether Adam and Eve, or the bacterial flagellum, and whether true or not, invoking God cannot be deemed science. Furthermore, in my study of creationism, it became clear that the way they carried out their "science" was fundamentally flawed. Starting with a conclusion (God specially created) and looking for evidence to confirm it, is not doing science. And confusing students about what is science and what is outside of science is educational malpractice.

Science in society

My interest in creationism changed from a casual concern about philosophy of science the year after I left Missouri. In October 1975, Jim Gavan unwisely accepted an invitation to debate the ICR's Duane Gish. Gish had skillfully-honed debate skills that were highly effective in persuading the public that evolution was shaky science, and that folks should really consider his "scientific alternative". I and some of my Kentucky students drove from Lexington to Missouri to attend the debate, and it was an eye-opener.

I counted thirteen buses from local church groups parked outside the huge auditorium, and after seeing the enthusiasm with which the audience received Gish and his message, the cold water of the social and political reality of this movement hit me for the first time. It was no longer just an academic exercise. People were taking this pseudoscience *very* seriously.

The late Jim Gavan was an excellent scientist, a former president of the American Association of Physical Anthropology, a smart and articulate man well-grounded in philosophy of science. He had done his homework: he had studied creationist literature for several months, and came as prepared as anyone could be expected to be. Clearly, his scientific arguments were superior, but judged from the perspective of who won the hearts and minds of the people, the folksy, jocular Gish mopped him up.

So I realized that there was a heck of a lot more in this creationism and evolution business than just the academic issues. I went back to Lexington and my job of teaching evolution to college students with a new appreciation of a growing movement that had as its goal the undermining of my professional discipline, to say nothing of the scientific point of view. But still — there were papers to publish, and a high teaching load, and I was still learning my job, so I didn't take an active role in the controversy quite yet.

My true baptism into realizing the depth and extent of the social and political importance of the creation science movement came in 1980 in Lexington, Kentucky, when the "Citizens for Balanced Teaching of Origins" approached the Lexington school board to request that creation science be introduced into the curriculum. Because I had collected creationist literature over the years, I became a focal point for the opposition to this effort. I learned a lot: lessons I have applied in my current job. Scientists of course are major stakeholders in this controversy, but we are not alone, nor do we succeed alone.

Teachers are concerned about maintaining professional standards, and parents want their children to get a decent science education. People who care about church and state separation are very concerned about the teaching of creationism in science class. But stakeholders often not recognized are members of the mainstream clergy, who do not want someone else's religion (biblical literalism) taught Monday through Friday and then have to straighten out their congregants on the weekend. In my experience, evolution is more likely to be taught in Catholic schools than in public ones.

In Lexington, we formed a coalition of scientists, teachers, civil libertarians, parents, and clergy, and after over a year of controversy, we persuaded the Lexington Board of Education to reject the proposal to bring creation science into the curriculum — by a scant 3–2 margin. The fact that the mainstream clergy stood up and announced that

script of her address at a banquet held by the university's president for the honorees, their sponsors, and selected guest.)

NCSE congratulates **Tim White** on his inclusion in *Time* magazine's list of "the people who most affect our world" for 2010. White was honored for his work in paleoanthropology, particularly the recently described "Ardi" — *Ardipithecus ramidus*. **Sean B Carroll** wrote, "'Ardi', a 4-ft female, transforms our picture of our early ancestors. Ardi was at home in trees, but she also walked upright. A woodland dweller, she refutes the belief that modern posture was an adaptation to living on the savanna. Gaps in human history remain, but White has filled a big one." A Supporter of NCSE, White is Professor of Integrative Biology at the University of California, Berkeley.

Michael Zimmerman's article "Combating the fifth wave of creationism: Religious leaders and scientists working together" was published in *Theology and Science* (2010; 8 [2]: 211–22). The abstract:

> The creationist movement in America is entering its fifth

they thought evolution should be taught in school, and that they preferred to teach creation their own way, thank you very much, swung the community and thus the elected school board members to our side.

What happened in Lexington has happened in community after community across the US, and — I'm happy to say — when my staff and I can get input into the situation, the evolution side more often than not prevails. But the creationism controversy is not a problem that will be solved merely by throwing science at it. Of course, creationists — whether traditional creation science proponents or "intelligent design" proponents — contend that their views are supported by science and thus should be taught in science class, a point that has often been, and continually needs to be, refuted.

But it's not fair

Scientists are the best equipped to make the point. Showing that evolution is solid science, and that creationism is unscientific is necessary — but insufficient. Ironically, the most effective argument creationists have used over the years is not a scientific one at all, but the "fairness" argument: that it is only "fair" to "teach both" — as if there were only two choices. Of course, even within Christianity there are a half dozen varieties of creationism, and if we add other world religions — much less Native American and other tribal society versions of creation — we quickly escalate into the thousands. "Both" indeed.

Yet fairness is an important part of American culture, and appeals to fairness and democracy have a resonance beyond the appropriateness of their application to science. Science is not a democratic process; it's a meritocracy. We keep the ideas that work, and discard the ideas that don't. If I'm speaking to a group of biologists I'll sometimes joke, "How many of you would vote in Lamarckism over natural selection?" and almost all the hands go up! But however much nicer it would be for the diversity of life to be caused by Lamarckian processes allowing for the inheritance of acquired characteristics, rather than the painful, wasteful, and brutal process of natural selection, we have to go with how the world works, rather than how we'd like it to work.

In Missouri, you have had legislation introduced over the years which attempts to capitalize on this American enthusiasm for fairness to both sides. Bills once stressed giving equal time to creation science, and more recently, to "intelligent design". Within the last decade, the focus has shifted to bills that direct teachers to "critically analyze" (read: criticize) evolution, or to teach the "strengths and weaknesses" of evolution. We call this the "evidence against evolution" strategy, and it arose from a dissent from a Supreme Court decision that I won't bother you with here. But the purpose of these bills in Missouri and elsewhere is to encourage teachers to cast doubt on the validity of evolution, and to introduce creationism through the back door.

And ultimately, what we are talking about with the creationism/evolution controversy is "what do you teach in a high school science class?" And clearly, what you should teach, sensibly enough, is science. Not something outside of science, like a religious idea, no matter how popular it is.

Of course, it's impossible to teach all of science. What a high school teacher does is take the consensus view of science and choose from the topics that are most important for a beginning learner. The skill of a pre-college teacher is figuring out how to break down these topics into a sequence of learning so that a young person can build an understanding of the science that would allow additional study.

What the creationists want is for us to abandon the consensus view of science and introduce materials into the curriculum which are not only outside of the consensus, but not even science at all. Ironically, although anti-evolutionists are quick to accuse opponents of unfairness, theirs is ultimately the most unfair position. It miseducates students and handicaps them for further understanding of science.

Those of us concerned about public science literacy should indeed be concerned about the attacks upon evolution, because fundamentally such attacks are attacks on science itself. And if the United States loses its scientific superiority, it can hardly expect to maintain its international superiority in agriculture, medicine, energy, or any of the many other areas which science informs.

I also would hope you would be concerned that many young people are not learning one of the most profound discoveries in human history: the genetic connection between human beings and all other living things on the planet. And the more that evolution teaches us about the connections among all living creatures, from the simplest single-celled organism to creatures capable of leaving the planet itself, the more we will understand how very precious life is, and hopefully, we will apply these lessons to preserving and enhancing our lives and those of the organisms with which we share our planet.

Evolution is an important scientific idea. It's too bad so many students are not being allowed to learn it in our public schools.

[Delivered at the University of Missouri, Columbia, on May 15, 2010.]

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wave. Beyond the first wave, which may largely be characterized as opponents to evolution ignoring the subject with the hope that it would simply go away, the next three creationist waves (prohibiting the teaching of human evolution; requiring the teaching of "creation science"; requiring the teaching of "intelligent design") were all defeated because courts regularly ruled the legislative actions taken to promote each wave unconstitutional. While the fifth wave, a call for the "weaknesses" of evolution to be taught, shares many of the same motives with earlier waves, the major difference is that legislation is being crafted in a manner that makes it likely the courts will not be able to intercede. Thus, if a robust view of religion and a healthy understanding of science are to be promoted, combating this new wave of creationism will require different strategies than have previously been in place. One such strategy is for religious leaders and scientists to join

Use Sunscreen, and Use Your Brains

Eugenie C Scott, NCSE's executive director

Graduates, parents, distinguished faculty and guests ... but especially graduates, because a graduation should be all about you.

The traditional ritual of a commencement speech is to give graduates advice: how to live your lives, what sort of people you should be, how you can build a better America, and so on. Of course, this is the height of presumption, since you have only just met me, and have no reason to conclude that my judgment would be any better than the judgments of your parents, your roommates, your Facebook friends, or some random person off the street. But a graduation is a ritual, and we anthropologists understand ritual, so I'm going to do it anyway.

So what can I tell you in five minutes? I did what anyone would do: I went to my Facebook friends.

My status earlier this week was "Trying to think of something sensible to say to the graduates of Mizzou later this week." Suggestions from my friends included, "Throwing in a few appropriate Sartre quotes is a good way to grab a young, up-and-coming crowd."

Well, okay, young, up-and-coming crowd, how about:

> All human actions are equivalent ... and ... all are on principle doomed to failure.

Well, that's sure a cheery thought on your graduation day, as you go forth to begin your new lives.

Another suggestion, however, was more useful. "Wear sunscreen."

This, of course, is from perhaps the most famous commencement address. If you Google "Vonnegut" and "wear sunscreen," you will see over 20 000 hits. On YouTube alone, there are well over 1000 video versions and satires, including versions in English, Arabic, Portuguese, Swedish, German, and probably many other languages I missed. One features Yoda from Star Wars.

But this most famous commencement address was never given, and wasn't even written by Kurt Vonnegut. The author Vonnegut's name somehow got attached to a fantasy commencement speech written by Chicago Tribune journalist Mary Schmich, which took on a life of its own. In addition to the admonition to wear sunscreen, the essay had lots of other good advice, like:

> Do one thing every day that scares you.

And highly relevant for today:

> Get to know your parents. You never know when they'll be gone for good.

And similarly:

> Be nice to your siblings. They're your best link to your past and the people most likely to stick with you in the future.

So, "wear sunscreen" is good advice — go read the essay sometime.

Another of my Facebook friends had a suggestion that really resonated with me: Trust your brain. Now you're talking.

As you heard, I'm a scientist, and I believe strongly that reason, facts, and empirical evidence are essential for making not just scientific decisions, but other decisions as well. How can I encourage you to trust your brain? Well, as I was writing this talk, I read an article in the *San Francisco Chronicle* by a reporter who attended a psychic fair. He wrote:

> A whole wonderful building full of miracles. Major credit cards accepted.

The reporter went on to describe these miracles, to wit:

> It could be a magic bracelet (results not guaranteed), or a magic stick (your results may vary), or a magic meditation magnet (no refunds).

And indeed, there were people attending the fair who seemed not to be using their brains very much. One purveyor would, for $100, converse with a customer's dead relatives. As the reporter commented, "her conversation seemed to be a trifle one-sided."

Trust your brain. It's useful not just for surviving four years of university, but for deciding lots of things that are important. Like what brand of sunscreen to select, or what policies our elected representatives should follow, or whose fault the Deepwater Horizon oil spill is, as well as whether to believe someone can channel your dead relatives.

Trust your brain. Ask questions when people make claims that sound fishy to you — and perhaps even more importantly, when you agree with them.

Use sunscreen, and use your brains.

Granted, there are times when maybe your brain isn't the most important part of you. I recently read an analysis of love that explained:

> sight, smells, [and] touch [stimulate] the thalamus, which in turn stimulates ... increased heart rate and blood pressure, rapid breathing and flushed skin .... [T]he ventral tegmental area and the nucleus accumbens c both rich in dopamine receptors — become quite active ...A network of mutual interactions among the amygdala, the insula, and various parts of the prefrontal cortex integrates bodily perceptions and cognitive appraisal.

Okay. Knowing the neurological wiring that accompanies making love is very interesting, but I'm not sure that it really improves on the experience itself. So use your brains, but use your heart, too. You'll be a better functioning organism if you use both. The real trick in this world of ours is realizing that there are times when you need to set aside your gut and your heart and trust your brain — because it's going to give you a better answer.

And that is my presumptuous advice to you on this most happy day of your graduation, which I am highly honored to share.

Congratulations — and the best of luck to you!

[Delivered as the commencement address to the graduating class at the University of Missouri, Columbia, on May 15, 2010.]

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forces and demonstrate to the public that those promoting conflict are in the minority and doing damage to both religion and science.

In the article, Zimmerman explained the purpose and recounted the successes of the Clergy Letter Project, of which he is the founder (see <http://www. theclergyletter project.org/>). A recipient of NCSE's Friend of Darwin Award, Zimmerman is Professor of Biology at Butler University; he recently began a regular blog at the Huffington Post (<http://www.huffingtonpost.com/michael-zimmerman>). In the same issue of *Theology and Science* are Chris Doran's "Intelligent design: It's just too good to be true" (233–7) and Adam Pryor's review of Michael Dowd's *Thank God for Evolution* (241–3).

Yves Barbero dies

Eugenie C Scott

Yves Regis François Barbero, a long-time member of the National Center for Science Education, died from complications of diabetes and heart disease on December 8, 2009, in San Francisco, California, a city that became his home after he moved there from New York in 1976.

Yves was born in Toulouse, France, in 1944, but his American father, Joseph Barbero, and his French mother, Monique Lacassagne Oliveri, moved to Brooklyn, New York, when Yves was eight years old. He attended school in Brooklyn, graduating from Brooklyn Technical High School in 1962, after which he served in the army. He was stationed in Frankfurt, Germany. After his military service, he returned to New York in August 1965, where he attended City College, mostly at night. One of the jobs he most enjoyed was working as a reporter for the *Bangor Daily News*, in Bangor, Maine, in the Skohegan bureau, from 1972 to 1974. A search for his name in Google News archives shows a number of well-written articles, and even some unusual and/or amusing assignments — such as spending a night in jail as a reporter, riding at night with police in a police car, and seeing what could be purchased for a nickel. He also tackled controversial topics, writing about two Maine women who had to travel to New York for abortions, commenting on the similarity of atheist and fundamentalist tracts, and investigating conditions at a naval prison in Maine.

An article in the *Bangor Daily News* dated May 27, 1974, notes that their former reporter Yves Barbero, now living in New York, was about to publish his first novel. Under the pen name of Yves Regis François, Doubleday was to publish *The CTZ Paradigm*. The novel, "written while he lived in Skowhegan, is an adventure, science fiction story concerning a war between planets in the twenty-sixth century."

After moving to San Francisco, he worked in the elevator construction trade. Yves was a solid union man, and a proud member of the International Union of Elevator Constructors Local 8. After he was physically no longer able to work in the construction trade (he had diabetes and other health problems), Yves began a business as a computer consultant and website designer. He used his computer skills to design and maintain websites for a number of unions and community associations, including the Bay Area Skeptics and the National Center for Science Education.

From 1989-90 he worked as a computer technician at the California Academy of Sciences. His former boss, biologist Daphne Fautin, now at the University of Kansas, said, "he was very crucial to getting the office of the Director of Research at CAS automated when I was director — it was the very early days of computerization and he knew how to do it."

Yves was very generous with his advice and assistance to NCSE, especially when the organization was just getting started. He was our *pro bono* computer advisor, recommending hardware and software to help us to work more effectively. I fondly remember when, back in the 1990s, he recommended a backup system for NCSE's computers. After finding that we didn't have the $500 for the hardware, he sent out an e-mail to a list of friends requesting donations. Within a week, he had collected the money and we were on our way. He also designed NCSE's first webpage, a new experience for our small nonprofit in the mid-1990s. In recognition of his many services to NCSE, he was one of the first recipients of the Friend of Darwin award.

Although he did not graduate from college, he was always a voracious reader, devouring everything from fiction to philosophy. He truly was self-educated, and enjoyed discussing history, politics, science, and just about any other subject: his intellectual tastes and curiosity were wide-ranging indeed.

Yves had many close friends with whom he interacted on a daily, or nearly so, basis, including Tim Chiara, who co-rented his flat for many years, often worked with Yves in his computer business, and provided a great deal of logistic and other assistance when Yves needed it, and his neighbor Ged Gasperas, with whom he shared many a thought, many a book and many a movie. In his family, he is survived by his mother and his two sisters, Jo Ann Clark and Bettie Betancourt.

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Eugenie C Scott is NCSE's executive director.

Martin Gardner dies

The polymathic Martin Gardner died on May 22, 2010, at the age of 95, according to the obituary in *The New York Times* (2010 May 23). Born in Tulsa, Oklahoma, on October 21, 1914, Gardner studied philosophy at the University of Chicago, graduating in 1936. After working as a reporter and in public relations, he served in the US Naval Reserve from 1942 to 1946, and then launched a freelance writing career. In 1957, he began writing his "Mathematical Games" column for *Scientific American*, which ran until 1981. A prolific author, he wrote books not only on recreational mathematics but also on science and philosophy, literary topics (including his celebrated *The Annotated Alice*), and pseudoscience. In 1976, he was one of the founders of the Committee for the Scientific Investigation of Claims of the Paranormal (now the Committee for Skeptical Inquiry).

In a 1998 interview with *Skeptical Inquirer*'s Kendrick Frazier, Gardner said that as a high school student, "I actually doubted the theory of evolution, having been influenced by George McCready Price, a Seventh-day Adventist creationist. A course in geology convinced me that Price was a crackpot. However, his flood theory of fossils is ingenious enough so that one has to know some elementary geology in order to see where it is wrong. Perhaps this aroused my interest in debunking pseudoscience." Gardner's first book *In the Name of Science* (1952; reissued as *Fads and Fallacies in the Name of Science*, 1957) devoted a chapter to "Geology versus Genesis"; and he returned frequently to the topic, with his collection *Did Adam and Eve Have Navels?* (2001) even taking its title from a classic challenge to creationism.

Vestigial Structures Exist Even Within the Creationist Paradigm

Phil Senter

INTRODUCTION

A vestigial structure is a rudimentary biological structure that was not rudimentary in the ancestors of its bearer. Such a structure is interpreted by evolutionary biologists as a vestige of a homologous structure that was more fully functional and often larger in the ancestors of the organism in question. Biologists generally consider the existence of vestigial structures one of the main lines of evidence for evolution (Barton and others 2007; Hall and Hallgrimsson 2009). Creationist authors typically argue against the existence of vestigial structures to discredit the idea of evolution (Dewar 1957; Morris 1974; Glover 1988; Bergman and Howe 1990; Bergman 2000; Menton 2000; Sarfati 2002). However, here I show that vestigial structures exist even within the parameters of the creationist worldview, even though creationists go to great lengths to deny their existence and discredit their importance. Vestigial structures are entirely consistent with the creationist worldview and arguments that their absence refutes evolution should be discarded by creationists.

In this discussion, I will examine two predictions derived from the hypothesis that vestigial structures exist. The first prediction is that creationist arguments against the existence of vestigial structures can be refuted. The second prediction is that examples of vestigial structures can be identified even within the creationist paradigm; that is, that examples of vestigial structures can be identified in organisms for which both the putative ancestor and the putative descendant are recognized by creationists as part of the same "created kind" or baramin.

In creationist technical literature the term baramin refers to an organism that was created by God during the Creation Week that is recorded in the first chapter of Genesis, plus all of its descendants (Siegler 1978; Wood 2002, 2006). Creationists recognize that speciation occurs within baramins, so that a given baramin today includes several populations that mainstream biologists regard as separate species (Siegler 1978; Tyler 1997; Robinson and Cavanaugh 1998; Wood 2006). Among closely related species, morphological and/or genetic continuity and the ability to produce hybrid offspring are considered by creationists to demonstrate inclusion in the same baramin (Siegler 1978; Wood 2002, 2006). According to these criteria, most baramins correspond to families in the taxonomic hierarchies of mainstream biology (Robinson and Cavanaugh 1998; Wood 2000; 2006). For example, creationists consider the cat family (Felidae) a single baramin in which all the members — house cats, bobcats, tigers, lions, and so on — are descended from the ancestral cat population that God created during Creation Week (Robinson and Cavanaugh 1998).

REFUTATION OF ARGUMENTS AGAINST THE EXISTENCE OF VESTIGIAL STRUCTURES

By far the most popular creationist argument against the existence of vestigial structures is that many biological structures that were once considered useless are now known to have a function (Dewar 1957; Morris 1974; Bergman and Howe 1990; Bergman 2000; Menton 2000; Sarfati 2002). This argument is invalid, because it confuses vestigiality with uselessness. A rudimentary structure can have a recognizable function and still be considered vestigial if it is demonstrably a remnant of an ancestrally non-rudimentary structure (Isaak 2007). For example, if it is demonstrated that the rudimentary, spur-like hindlimbs of pythons are derived from non-rudimentary hindlimbs in the ancestors of pythons, then python spurs can be considered vestigial hindlimbs, despite the fact that they have a recognizable function: to spear opponents during dominance contests (Barker and others 1979). By the same token, the rudimentary wings of the cassowary can be considered vestigial if it is demonstrated that they are derived from non-rudimentary wings in cassowary ancestors, despite the fact that cassowaries use their rudimentary wings in threat displays (Davies 2002). While it is true that Darwin (1872) assumed that rudimentary structures are useless, modern biologists do not make this assumption and therefore do not employ uselessness as a criterion for recognizing a vestigial structure. Even so, vestigial structures can often be considered useless with respect to the usual function of their non-rudimentary counterparts. For example, python hindlimbs are useless as organs of locomotion, and cassowary wings are useless as organs of

continued on page 23

Phil Senter is a dinosaur paleontologist who teaches biology courses at Fayetteville State University in North Carolina.

Coming Soon: A New *RNCSE*

Andrew J Petto, RNCSE *Editor*

It is coming! We are pleased to announce a significant change in the format of the publication that NCSE distributes to its members. Beginning with volume 31 (the 2011 January/February issue), *Reports of the National Center for Science Education* will be available on line. All our articles, features, and book reviews will be available in their entirety only through the NCSE website (<http://ncse.com>).

Will I Still Receive *RNCSE* in the Mail?

Yes. There will still be 6 issues of *RNCSE* published each year, but we will be changing the format in several ways. You will continue to read about the work our our staff and members are doing to promote good science education that includes evolution as a fundamental explanation for the history and diversity of life. You will also see members-only features and other materials in the print version.

RNCSE will still feature original articles, features, news analysis, and book reviews, but our print version will contain brief summaries of these contributions. The full text of these items will appear on line. Each printed issue will provide a complete citation for the on-line material and a url to link directly to the items that interest you.

The printed version of *RNCSE* will be smaller (about 16 pages). The reduction in the size of the publication will be the result of shortening the original articles, book reviews, and features, which will appear only as brief summaries in the on-line version. What you will see in print will be a review of the main thrust of original contributions, including a recap of the authors' main points and with specific attention to the authors' conclusions.

How will I Get the On-Line Material?

The on-line articles, features, and book reviews will be available in two ways. You will be able to browse issues of *RNCSE* as you do today by connecting to the publications page of the NCSE website: <http://ncse.com>. This will present you with content organized into bimonthly issues as you see today on the NCSE website.

You will also be able to locate materials that interest you by using the URL that will appear with each summary in the new version of *RNCSE*. This will take you directly to the item that interests you without having to look through the contents of an entire issue to locate it.

When Will Articles be Available?

Beginning in January 2011, the materials that we will summarize in the print version of *RNCSE* will appear on line in the first month of the publication date. For example, the publication date of *RNCSE* volume 31, number 1, will be Jan/Feb 2011. The on-line material will be available in January, and the printed issue will be available in February. Readers may access the on-line material as soon as it is available; you do not need to wait for the issue to arrive in the mail. You may also subscribe to a publication alert that will tell you when new materials are available.

What if I Prefer to Have Articles on Paper?

You have two choices for receiving print versions of the content that we provide on line. First, you can connect directly to the materials that you want to print, download them to your own computer, and then print them to read right away ... or later.

Second, NCSE members are entitled to free document delivery services. You simply tell NCSE which articles you would like to see in print, and we will send you a copy of that article on paper. This service is available to all NCSE members — and only to NCSE members.

Why is NCSE Changing *RNCSE*?

NCSE made the decision to change *RNCSE* for several reasons. The first reason is that putting our content on line allows us to continue the evolution of NCSE publications that reached back to the earliest days of NCSE. We want to provide more content and more variety for our readers. This was the rationale for the original revision of the NCSE publications that combined the older *Creation/Evolution* journal and *NCSE Reports* into the *RNCSE* that you are reading now. The on-line environment allows us to continue to expand the contents both in the type of contributions that we offer you and in the supplemental materials that accompany them. This means more charts, graphs, and photos will be available than we can provide in print — and perhaps even some innovative formats that are impossible to print, such as videos.

Second, the new format will allow each reader to customize the "*RNCSE* experience" — choosing to read the contributions in each issue in the order that suits you, the reader, and only the items that interest you the most. We also plan to provide a searchable database of all the original material published in NCSE publications, so you can create your own collections of materials on a particular subject, such as "flood geology" or "intelligent design" models.

Finally, this change will allow NCSE to make a more efficient use of your financial contributions. Printing and mailing costs continue to increase, and the publication of *RNCSE* takes up an increasing proportion of our budget. At the same time, NCSE is called on more and more to provide advice, information, and support to citizens, teachers, students, lawyers, legislators, clergy, and the press whenever opposition to evolution education emerges in communities across the continent and around the world. This change in *RNCSE* will allow us to devote more of our resources to our primary mission of promoting good science education and evolution education everywhere because it will expand access to the original content of our publications even while lowering the costs of distributing this information.

Our goal is to serve you better with our new publication. Please welcome the new *RNCSE* in January 2011, and give us your feedback to help us to meet your needs for information on creationism/evolution issues in the future.

Spineless Wonders

They may not be as cute and cuddly as their vertebrate cousins, but the invertebrates, including perhaps 95% of all animal species and comprising over 30 phyla, are, in EO Wilson's phrase, "the little things that run the world" — and they have loomed correspondingly large in the history of life and in our scientific understanding of it. It's no surprise that some of the best popular writers on evolution, from Stephen Jay Gould to Richard Fortey, have devoted their talents to these spineless wonders. (And it's no obstacle for finding a readership for books on the evolution of the invertebrates that their fossilized remains are often of spectacular beauty!) Featured here are books introducing the extant and fossil invertebrates, discussing the earliest forms of life in the fossil record, and exploring the rise of the animals in the late Precambrian, Cambrian, and Ordovician. All of these books on the evolution of invertebrates are now available through the NCSE website: <http://ncse.com/store> — look in the "In the latest *RNCSE*" section. And remember, every purchase benefits NCSE!

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

Meet the invertebrates

An Introduction to the Invertebrates, second edition
by Janet Moore
A short but thorough guide to the invertebrate phyla, Moore's textbook emphasizes evolution throughout, with introductory chapters on "The process of evolution: Natural selection" and "The pattern of evolution: Molecular evidence" as well as a final chapter on "Invertebrate evolutionary history". The reviewer for the *Quarterly Review of Biology* commented, "Survival is a mark of success, as every biologist knows. The fact that this 'little book' has a second edition indicates that it has found a welcome place as an introductory guide to the invertebrates." Janet Moore is former Director of Studies in Biological Sciences at New Hall, Cambridge.

Fossil Invertebrates
by Paul D Taylor and David N Lewis
"Our aim in this book," the authors explain, "is to introduce examples of the more common fossil invertebrates from around the world, as well as some rarer but scientifically significant fossils. We have set out to highlight the appreciation of fossils as the remains of once living animals, not merely as oddly shaped stones." The reviewer for *Library Journal* comments, "The authors provide a comprehensive compendium of information regarding every aspect relating to invertebrate fossils: history, general descriptions, and specifics related to all types of shells and fossils discovered. Numerous plates augment the text and provide visual reference points for readers."

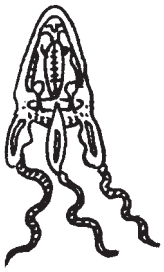
Early life

The Origin and Early Evolution of Life
by Tom Fenchel
"This book," Tom Fenchel explains, "is about the development of life from its origin and until multicellular plants, fungi, and animals arose — corresponding approximately to the time period from 4 to 0.6 billion years ago." The reviewer for *BioEssays* writes, "The classical, recurrent themes are treated in a clear and interesting style of writing. The scope of the book is broad enough to be useful to advanced undergraduate or graduate students as well as to any reader possessing a college scientific background." A glossary and suggestions for further reading are included.

Life on a Young Planet
by Andrew H Knoll
From the origin of life to the Cambrian explosion, Knoll draws not only on paleontology but also on the latest insights from molecular biology, ecology, and the earth sciences to produce a broad understanding of the emergence of biological diversity. Sean Carroll (the author of *Endless Forms Most Beautiful*) writes, "This is a truly great book. It is a remarkably readable synthesis of many diverse ideas selected from a breathtaking array of disciplines. The narrative is engaging and entertaining — a travelogue through time that incorporates amusing and informative anecdotes from Knoll's travels to many far-off places." Knoll is Fisher Professor of Natural History at Harvard University.

Cradle of Life: The Discovery of Earth's Earliest Fossils
by J William Schopf
"This book chronicles an amazing breakthrough in biologic and geologic science," J William Schopf explains, "the discovery of a vast, ancient, missing fossil record that extends life's roots to the most remote reaches of the geologic past. At long last, after a century of unrewarded search, the earliest 85% of the history of life on earth has been uncovered to forever change our understanding of how evolution works." Writes the reviewer for *Scientific American*, "Schopf ... has a good deal to say about scientists and the way science is done. It all makes for a book that bears out his assertion that 'science is enormously good fun!"

<http://www.ncse.com/store>



The rise of the animals

Darwin's Lost World: The Hidden History of Animal Life
by Martin Brasier
To the question of where Precambrian fossils were, Darwin lamented, "I can give no satisfactory answer." *Darwin's Lost World*, as the reviewer for *Library Journal* comments, thus provides "[a] rollicking account of [Brasier's] adventures seeking an answer to a question that vexed Charles Darwin." At once a travelogue, ranging from China, Mongolia, and Siberia to Oman, Newfoundland, and Scotland, and a review of what is now known about the emergence of complex multicellular life, *Darwin's Lost World* is a spirited introduction to the biota of the late Precambrian and early Cambrian. Brasier is Professor of Paleobiology at Oxford University. (*See review by Roy Plotnick beginning on p 30 in this issue.*)

The Rise of Animals: Evolution and Diversification of the Kingdom Animalia
by Mikhail A Fedonkin, James G Gehling, Kathleen Grey, Guy M Narbonne, and Patricia Vickers-Rich
"The main aim of this book is to highlight one part of the immense sweep of time called the Precambrian — the Proterozoic — and, in fact, only a part of that eon — the time when the first animals appeared — in a wide variety of places on earth," the authors explains. "The first animals will always be of profound interest to scientist and layperson alike." With a foreword by the late Arthur C Clarke. The reviewer for *Science* writes, "*The Rise of Animals* offers a much-needed avenue to communicate to the general public the past decade's exciting discoveries of Ediacaran fossils."

Burgess and Chengjiang

The Crucible of Creation: The Burgess Shale and the Rise of Animals
by Simon Conway Morris
"Located in the west of Canada, the Burgess Shale contains a unique collection of fossil remains, and has become an icon for those studying the history of life," writes the publisher. "This remarkable book takes us on a fresh journey back in time through the Burgess Shale and its astonishing collection of Cambrian creatures. Simon Conway Morris paints a vivid picture of the critical period which saw the diversification of all the major animal groups, and takes a controversial stance on current evolutionary theories." Conway Morris is Professor in the Department of Earth Sciences at Cambridge University.

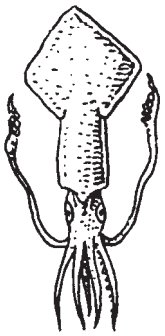
Wonderful Life: The Burgess Shale and the Nature of History
by Stephen Jay Gould
In *Wonderful Life*, Gould tells the story of the reinterpretation of the unusual fossils of the Burgess Shale: "a grand and wonderful story of the highest intellectual merit — with no one killed, no one even injured or scratched, but a new world revealed." Reviewing *Wonderful Life* for *Nature*, Richard Fortey wrote, "There is no question about the historical importance of the Burgess Shale, and Gould is right when he says that it deserves a place in the public consciousness along with big bangs and black holes .... A compelling story, told with characteristic verve."

The Cambrian Fossils of Chengjiang, China: The Flowering of Early Animal Life
by Hou Xian-Guang, Richard J Aldridge, Jan Bergström, David J Siveter, Derek J Siveter, and Feng Xiang-Hong
The first book in the English language on the Chengjiang biota, *The Cambrian Fossils of Chengjiang, China* succeeds in doing justice to both their scientific importance and — with scores of color plates — their wondrous beauty. Reviewing the book for *New Scientist*, Douglas Palmer writes, "Mainly intended for professional palaeontologists, this spotter's guide details the amazing fossils, 525 million years old, that have been shaking the tree of life for the past 10 years. Chengjiang's hundred species, from algae to chordates, challenge North America's Burgess Shale fauna for the quality and amount of new information they provide."

Trilobites and beyond

A Sea without Fish: Life in the Ordovician Sea of the Cincinnati Region
by Richard Arnold Davis with David L Meyer
From the publisher: "The Cincinnati area has yielded some of the world's most abundant and best-preserved fossils of invertebrate animals such as trilobites, bryozoans, brachiopods, molluscs, echinoderms, and graptolites. So famous are the Ordovician fossils and rocks of the Cincinnati region that geologists use the term 'Cincinnatian' for strata of the same age all over North America. This book synthesizes more than 150 years of research on this fossil treasure-trove, describing and illustrating the fossils, the life habits of the animals represented, their communities, and living relatives, as well as the nature of the rock strata in which they are found and the environmental conditions of the ancient sea."

Trilobite! Eyewitness to Evolution
by Richard Fortey
Reviewing *Trilobite!* for *RNCSE*, Kevin Padian wrote, "Fortey has a lot to teach about trilobite structure, diversity, and evolution, but his book is far less pedestrian and far more engaging than a more text-like treatment would have been. Rather, he has used trilobites as a vehicle to explain a great many aspects of evolution, geologic history, and how we know what we know about these ancient animals and the problems that they illuminate. Besides, his prose is genial and knowledgeable ... We in the field of evolution are lucky to have a great many fine writers, and Richard Fortey is one of the best."



NCSE on the Road

A Calendar of Special Events, Presentations, and Lectures

Date Sep 8, 2010
City Ft Wayne IN
Presenter Eugenie C Scott
Title Why the Fuss About Darwin and Evolution?
Time 7:00 PM
Location Indiana University/Purdue University
Contact Karen S Burtnett, burtnek@ipfw.edu

Date Oct 8, 2010
City Los Angeles CA
Event Council for Secular Humanism Conference
Presenter Eugenie C Scott
Title Science and Religion: Confrontation or Accommodation?
Time 2:00 PM
Location Millennium Biltmore Hotel
Contact Tom Flynn, tflynn@centerforinquiry.net

Date Oct 23 – 24, 2010
City Washington DC
Event USA Science & Engineering Festival Expo
Presenter NCSE Staff
Time 10:00 AM – 5:30 PM
Location National Mall
Contact USA Science and Engineering Festival, http://www.usasciencefestival.org/

Date Nov 26 – 28, 2010
City Sydney NWS Australia
Event The Amaz!ng Meeting
Presenter Eugenie C Scott
Time All Day
Location Sydney Masonic Centre
Contact The Amaz!ng Meeting Website: http://www.tamaustralia.org/

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continued from page 18

flight. This objection by creationists based on the functionality of these vestigial organs therefore arises from a misunderstanding of the concept of vestigiality.

Bergman (2000) argues that a definition of vestigiality based on reduction and not uselessness is meaningless, because biologists do not consider structures vestigial if they have been only slightly reduced. It is correct that biologists do not consider slightly reduced structures vestigial, but Bergman (2000) is incorrect to assume that any degree of reduction is used to label a structure vestigial. Structures are labeled vestigial, based on reduction in size, only if that reduction is extreme. For example, the shortened limbs of a dachshund are not considered vestigial limbs, but the miniscule spurs of a python are. This objection by Bergman (2000) is therefore based on a misunderstanding of the reduction criterion.

Bergman (2000) correctly states that the evolutionary history of an organ must be known to determine whether it is vestigial. He then argues against the validity of determinations of vestigiality by claiming that evolutionary histories are not known for most such organs and that their identification as vestigial is based on direct comparison with modern and not fossil examples. That claim shows two errors: first, evolutionary inference does not require direct observation of the history of all structures. Second, the evolutionary histories of vestigial skeletal structures are often well documented by fossil series. For example, in derived tyrannosauroid dinosaurs the third finger is reduced to a metacarpal splint with no phalanges (Lambe 1917), whereas early tyrannosauroids had a complete third finger; the fossil record therefore sufficiently documents the evolutionary history of the tyrannosauroid third finger to determine that in derived tyrannosauroids it is vestigial (Xu and others 2004). This objection by Bergman (2000) is based on the incorrect assumption that fossil series are not used to determine vestigiality.

The above objection by Bergman (2000) is invalid for a another reason. In evolutionary studies, a precursor to a rudimentary organ can be deduced by comparison with its non-rudimentary counterparts in close relatives. By the same token, within the creationist paradigm a rudimentary structure in one species must be considered vestigial if the homologous structure is non-rudimentary in other species within the same baramin. In such a case, even a creationist must concede that a rudimentary structure has evolved from a non-rudimentary homolog.

Darwin (1872) and others explain that a biological structure may become vestigial if members of the evolutionary lineage in question stop using it. Some creationists claim that this explanation is Lamarckian and therefore false (see Glover 1988; Berman and Howe 1990). The term Lamarckian refers to the now-discredited hypothesis, named after the pre-Darwinian biologist Jean Lamarck, that traits acquired by an organism during its lifetime are heritable. An example of a Lamarckian scenario is one in which an organism does not exercise a certain muscle, which then atrophies due to disuse, and the organism's offspring then inherit an atrophied version of that muscle. Lamarckian scenarios are unrealistic, as witness the fact that the children of amputees are born with their limbs intact. But the creationists' objection that the disuse explanation of vestigiality is Lamarckian is based on a misinterpretation of the evolutionary scenario described by Darwin and others, which is in fact not Lamarckian. The misinterpretation is understandable, because the evolutionary scenario in question is often described with poor wording, as in the first sentence of this paragraph. This scenario could be better worded thus: if members of an evolutionary lineage cease to use a given organ, then the survival of the lineage will not be compromised if one of its members is born with a heritable mutation that results in the reduction of that organ to a rudimentary state; the descendants of that individual will possess a vestigial organ. This is not a Lamarckian scenario, and the objection that it is one is therefore false. Neither Darwin (1872) nor any modern evolutionary biologist makes the Lamarckian claim that atrophy of an organ due to disuse (for example, withering of a muscle that an individual does not exercise) is heritable.

Examples of vestigial structures

Clearly, the creationist arguments against the existence of vestigial structures are based on misunderstandings and incorrect assumptions. Even so, these examples of vestigial structures do not necessarily demonstrate that vestigial structures exist within the creationist paradigm, because they relate to taxa that creationist authors have not identified as belonging to a single baramin. Baraminologists (creationist researchers who seek to determine which extant taxa belong to which baramins) have not placed pythons in the same baramin as any fully legged animal, and they have not yet studied cassowaries or tyrannosauroids.

However, examples of vestigial structures do exist within baramins that have been studied by and are recognized by baraminologists. The fossil horse series offers some examples. Creationists once considered fossil members of Equidae (the horse family) to have been created separately from modern horses (Cousins 1971; Gish 1973). However, recent baraminological studies confirm that there is too much morphological continuity between the various fossil and extant members of Equidae to support that interpretation (Garner 1998; Cavanaugh and others 2003; Wood 2005). Today's creationists therefore consider the fossil horse series a real example of evolution within a single baramin (Garner 1998; Cavanaugh and others 2003; Wood 2005). The fossil record reveals that in the earliest equids each forelimb had four digits, each hindlimb had three digits, the shaft of the ulna extended the full length of the forearm, and the shaft of the fibula extended the full length of the shank (Figure 1). In each forelimb and hindlimb of later fossil equids all digits but number III were lost, and in modern horses thin splints of bone are all that remain of the metacarpal (hand) and metatarsal (foot) bones that supported digits II and IV in each limb. The shafts of the ulna (inner bone of the lower arm) and fibula (outer bone of the lower leg) were progressively reduced in the horse lineage, and in today's equids

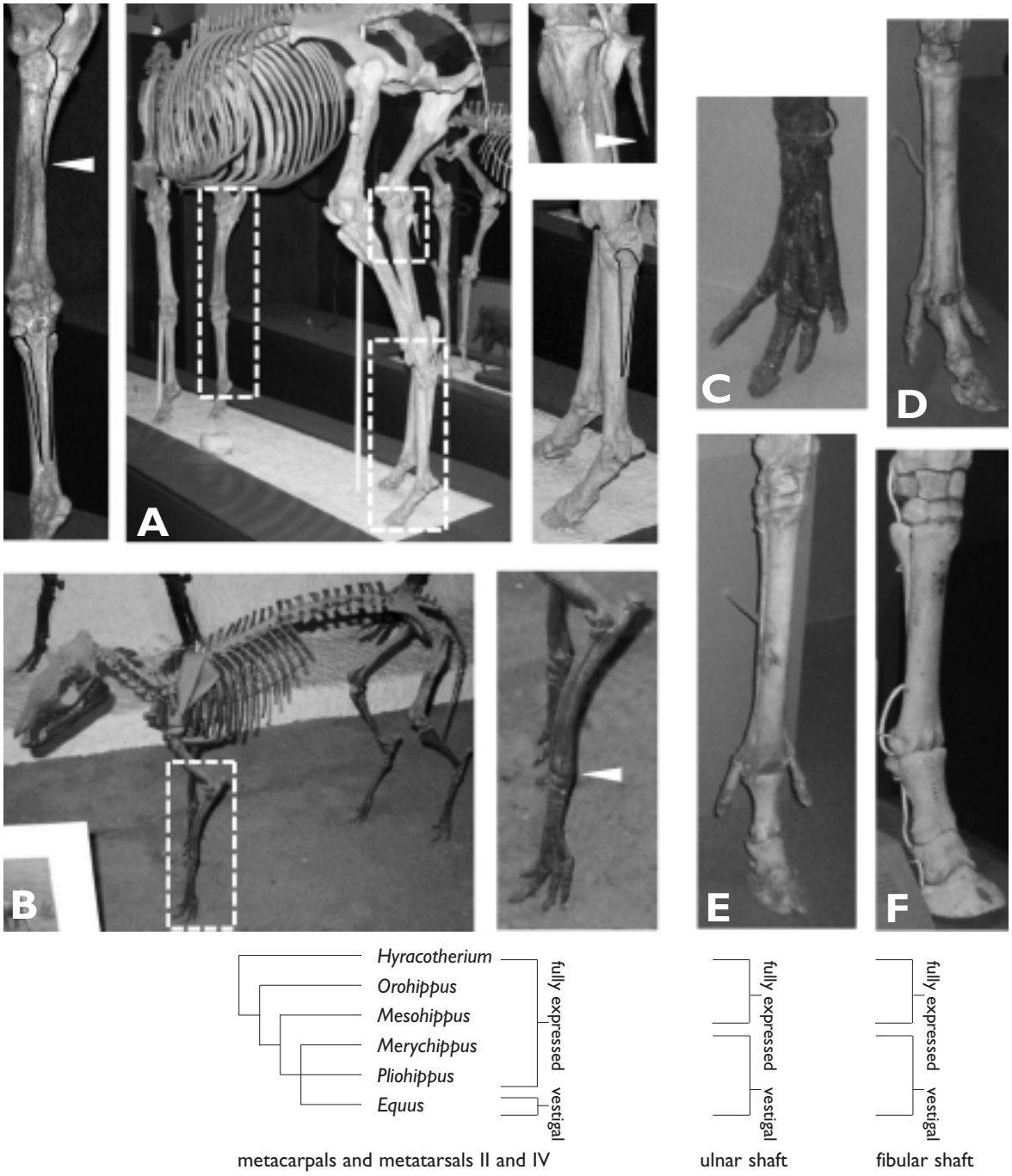

FIGURE 1. Reduction of the digits, ulnar shaft, and fibular shaft to a vestigial state in Equidae, as illustrated by the fossil horse series *Orohippus* — *Merychippus* — *Pliohippus* — *Equus*. A. left posterolateral view of skeleton of the modern horse *Equus*, with enlargements of the forelimb (left), knee (upper right), and foot (lower right); in the enlargements, vestigial metacarpals and metatarsals are outlined in black, and arrows indicate the vestigial shaft of the ulna (left) and the fibula (upper right); B. the early fossil horse *Orohippus*, with arrow in enlargement indicating tip of ulna, showing that it extends all the way to the wrist; C. metacarpus (hand) and phalanges (digits) of *Orohippus*; D. metacarpus and phalanges of the later fossil horse *Merychippus*; E. metacarpus and phalanges of forelimb of the later fossil horse *Pliohippus*; F. metacarpus and phalanges of the modern horse *Equus*.

they are reduced to tiny spikes (Marsh 1879) (Figure 1). The metacarpal and metatarsal splints of modern equids are vestigial bones, and the ulnar and fibular splints are vestigial shafts of bones. Because these rudimentary skeletal structures are demonstrably derived from non-rudimentary structures in ancestral members of the same baramin they must be considered vestigial within the creationist paradigm.

It should be noted that these vestigial skeletal structures perform useful functions in extant horses, and that they are nonetheless vestigial. The metacarpal and metatarsal splints serve as guides for

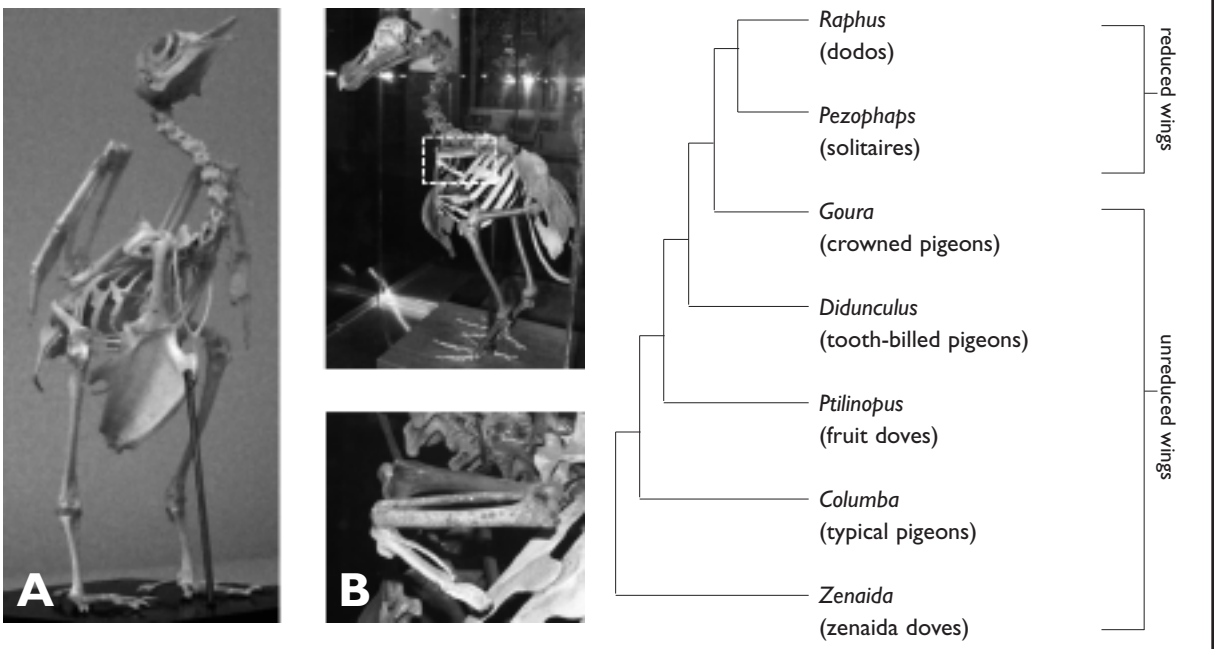

FIGURE 2. Reduction of the wing to a vestigial state in some members of the bird family Columbidae, as illustrated by comparison between the unreduced wings of the Rock Dove (*Columba livia*) and the vestigial wings of the Dodo (*Raphus cucullatus*). A. Rock Dove; B. Dodo.

ligaments, and remnants of the ulna and fibula function as muscle attachment sites (Smythe 1967). Even so, these structures are vestigial because they currently exist in a state of extreme reduction and they are derived from non-rudimentary homologs in ancestral equids.

Other cases exist in which the vestigiality of a structure can be deduced by comparison with close relatives without reference to fossils. For example, the family Columbidae includes flying pigeons and doves with unreduced wings, as well as flightless dodos and solitaires with miniscule wings (Figure 2). The family Columbidae is identified by creationists as a single baramin (More 1998), and molecular phylogenetic analysis confirms that the dodo and solitaire are phylogenetically nested deeply within the family and are descended from flying columbid ancestors (Shapiro and others 2009). Therefore, the extremely reduced wings of dodos and solitaires are derived from the flying wings of ancestral columbids and so must be considered vestigial within the creationist paradigm.

In some cases, a single genus contains some species with an unreduced version of a given structure as well as species with a vestigial version. The cave salamanders *Eurycea rathbuni* and *Eurycea tridentifera* have strongly reduced, nonfunctional eyes, while other species of the genus *Eurycea* that do not live in caves have unreduced, functional eyes (Petranka 1998). In some species of the Australian lizard genus *Hemiergis* the forelimb and hindlimb both have five full digits, while in other species the outer digits are reduced to metacarpal and metatarsal splints with no finger bones (Choquenot and Greer 1989) (Figure 3). Within the African lizard genus *Tetradactylus* is a morphologically continuous series of species of which some possess complete, unreduced limbs; some possess limbs that are drastically

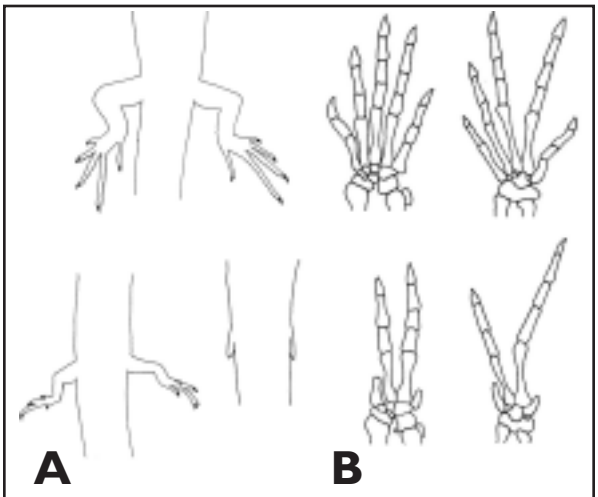

FIGURE 3. Reduction of limbs and digits to a vestigial state in lizards, as illustrated by comparison between members of the same genus. A, dorsal views of hindlimbs of members of the genus *Tetradactylus*, showing a species with full limbs (*T seps*: top), a species with reduced limbs (*T tetradactylus*: bottom left), and a species with vestigial limbs (*T africanus*: bottom right); modified from Berger-Dell'mour (1985). Hands (left) and feet (right) of *Hemiergis initialis* (top) and *H quadrilineatum* (bottom), showing vestigial condition of outer digits in *H quadrilineatum*; modified from Choquenot and Greer (1989).

reduced nubs without digits; and others have lost the limbs altogether (Berger-Dell'mour 1985) (Figure 3). Within the African lizard genus *Scelotes* is another series of species with a similar spectrum of degrees of limb loss (Branch 1998; Whiting and others 2003), and the same is true for the Australian lizard genus *Lerista* (Greer 1990). No baraminological study has yet been carried out on *Eurycea*, *Hemiergis*, *Tetradactylus*, *Scelotes*, or *Lerista*, but because recognized baramins usually correspond to taxa above the genus level (Robinson and Cavanaugh 1998; Wood 2002, 2006) it is doubtful that today any creationist would place members of the same genus in different baramins. Therefore, within the creationist paradigm the eyes of *E rathbuni* and *E tridentifera* are vestigial, as are the reduced fingers of the relevant members of *Hemiergis* and the extremely reduced limbs of the relevant members of *Tetradactylus*, *Scelotes*, and *Lerista*.

Conclusion and discussion

All objections to the existence of vestigial organs are demonstrably invalid, and there are numerous examples of vestigial structures within groups of organisms recognized by creationists as baramins. Thus there is no evidence to falsify the predictions of the hypothesis that vestigial structures exist within the creationist paradigm.

Creationist authors have long maintained that heritable change and speciation occur within baramins (Siegler 1978; Robinson and Cavanaugh 1998; Wood 2002, 2006). Here I have shown that this process sometimes gives rise to incontrovertibly vestigial structures and that their existence is consistent with the creationist paradigm. Creationists should therefore cease to claim that vestigial structures do not exist. That claim should be removed from the arsenal of anti-evolution arguments, because even within the creationist paradigm it is false.

References

Barker DG, Murphy, JB, Smith KW. 1979. Social behavior in a captive group of Indian pythons, *Python molurus* (Serpentes, Boidae) with formation of a linear social hierarchy. *Copeia* 1979: 466–71.

Barton NH, Briggs DEG, Eisen JA, Goldstein B, Patel NH. 2007. *Evolution*. Cold Spring Harbor (NY): Cold Spring Harbor University Press.

Berger-Dell'mour, HAE. 1985. The lizard genus *Tetradactylus*: a model case of an evolutionary process. In: Schuchmann KL, ed. *Proceedings of the International Symposium on African Vertebrates: Systematics, Phylogeny and Evolutionary Ecology*. Bonn: Zoologisches Forschungsinstitut und Museum Alexander Koenig. p 495–510.

Bergman J, Howe G. 1990. *"Vestigial organs" are fully functional*. Kansas City (MO): Creation Research Society.

Bergman J. 2000. Do any vestigial structures exist in humans? *Creation Ex Nihilo Technical Journal* 14: 95–8.

Branch B. 1998. *Field Guide to Snakes and Other Reptiles of Southern Africa*. Sanibel Island (FL): Ralph Curtis Books.

Cavanaugh DP, Wood TC, Wise KP. 2003. Fossil Equidae: a monobaraminic, stratomorphic series. In: Ivey RL, ed. *Proceedings of the Fifth International Conference on Creationism*. Pittsburgh: Creation Science Fellowship. p 143–53.

Choquenot D, Greer are. 1989. Intrapopulational and interspecific variation in digital limb bones and presacral vertebrae of the genus *Hemiergis* (Lacertilia, Scincidae). *Journal of Herpetology* 23: 274–81.

Cousins FW. 1971. A note on the unsatisfactory nature of the horse series of fossils as evidence for evolution. *Creation Research Society Quarterly* 8: 99–108.

Darwin C. 1872. *The Origin of Species*. London: John Murray.

Davies SJJF. 2002. *Ratites and Tinamous*. Oxford: Oxford University Press.

Garner P. 1998. It's a horse, of course! A creationist view of phylogenetic change in the equid family. *Origins* 25: 13–23.

Gish DT. 1973. *Evolution: the Fossils Say No!* San Diego: Creation-Life Publishers.

Glover JW. 1988. The human vermiform appendix—a Surgeon General's reflections. *Ex Nihilo Technical Journal* 3: 31–8.

Greer are. 1990. Limb reduction in the scincid lizard genus *Lerista*. 2. Variation in the bone complements of the front and rear limbs and the number of postsacral vertebrae. *Journal of Herpetology* 24: 142–50.

Hall BK, Hallgrimsson B. 2009. *Strickberger's Evolution, Fourth Edition*. Sudbury (MA): Jones and Bartlett.

Isaak M. 2007. *The Counter-Creationism Handbook*. Berkeley: University of California Press.

Lambe LM. 1917. The Cretaceous theropodous dinosaur *Gorgosaurus*. *Geological Survey of Canada Memoir* 100: 1-84.

Marsh OC. 1879. Polydactyle horses, recent and extinct. *American Journal of Science*; 17: 499-505.

Menton J. 2000. The plantaris and the question of vestigial muscles in man. *Creation Ex Nihilo Technical Journal*; 14: 50-53.

More ERJ. 1998. The created kind—Noah's doves, ravens, and their descendants. In: Walsh RE, ed. *Proceedings of the Fourth International Conference on Creationism*. Pittsburgh: Creation Science Fellowship. p 407-419

Morris HM. 1974. *Scientific Creationism*. Cajon (CA): Master Books.

Petranka JW. 1998. Salamanders of the United States and Canada. Washington (DC): Smithsonian Institution Press.

Robinson DA, Cavanaugh DP. 1998. Evidence for a holobaraminic origin of the cats. *Creation Research Society Quarterly* 35: 2–14.

Sarfati J. 2002. *Refuting Evolution 2*. Green Forest (AR): Master Books.

Shapiro B, Sibthorpe D, Rambaut A, Austin J, Wragg GM, Bininda-Emonds ORP, Lee PLM, Cooper A. 2009. Flight of the dodo. *Science* 295: 1683.

Siegler HR. 1978. A creationist's taxonomy. *Creation Research Society Quarterly* 15: 36–8.

Smythe RH. 1967. *The Horse: Structure and Movement*. London: JA Allen and Company.

Tyler DJ. 1997. Adaptations within the bear family: a contribution to the debate about the limits of variation. *Creation Matters* 2: 1–4.

Whiting AS, Bauer AM, Sites JW Jr. 2005. Phylogenetic relationships and limb loss in sub-Saharan African scincine lizards (Squamata: Scincidae). *Molecular Phylogenetics and Evolution* 29: 582–98.

Wood TC. 2002. A baraminological tutorial with examples from the grasses (Poaceae). *Creation Ex Nihilo Technical Journal* 16: 15–25.

Wood TC. 2005. Visualizing baraminic distances using classic multidimensional scaling. *Origins* 57: 9–29.

Wood TC. 2006. The current status of baraminology. *Creation Research Society Quarterly* 43: 149–58.

Xu X, Norell MA, Kuang X, Wang X, Zhao Q, Jia C. 2004. Basal tyrannosauroids from China and evidence for protofeathers in tyrannosauroids. *Nature* 431: 680–4.

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The Most Controversial Person of the Controversy: J Frank Norris

Randy Moore

FIGURE 1. *Frank Norris (left) welcomes William Jennings Bryan to the 1923 meeting of the World's Christian Fundamentals Association, which was hosted by Norris' church in Ft Worth, Texas. Norris brought fundamentalism to the South.*

John Franklyn "Frank" Norris became pastor of McKinney Avenue Baptist Church in Dallas; 13 people attended his first service, but three years later membership exceeded 1000. In 1909, at age 32, Norris — the owner-editor of the *Baptist Standard* (the leading newspaper of Texas Baptists) — became pastor of First Baptist Church of Fort Worth. At this "Church of the Cattle Kings" Norris (Figure 1) hosted numerous visits by anti-evolution crusaders William Bell Riley, Billy Sunday, and William Jennings Bryan, and he increased the church's membership from 100 to over 12 000 in 10 years. Norris was pastor of First Baptist Church until his death in 1952.

Like most other fundamentalists of his day, Norris campaigned against gambling, prostitution, booze, dancing, Catholics, and communists. Norris, an unapologetic racist, was sympathetic to the Ku Klux Klan while calling for Southerners to join his holy war against northern infidelity. Norris was the only southern fundamentalist whose stature approached that of Minnesota's Riley, the leader of fundamentalism in the United States. Norris created many of today's unflattering stereotypes of fundamentalists. He was a star and founding member of the World's Christian Fundamentals Association (WCFA) and believed that fundamentalism was "the greatest religious revival that time has ever witnessed."

Norris had an unquenchable thirst for fame, controversy, and publicity. He was indicted for a variety of felonies, such as perjury, several arsons (including the burning of his own church), and murder. After accusing the mayor of Ft Worth (HC Meacham) of corruption and telling his congregation that Meacham "isn't fit to manage a hogpen", Norris was visited on July 17, 1926 at his church office by Dexter Chipps, a wealthy supporter of the mayor. At that meeting, Norris shot and killed Chipps (Figure 2). Norris claimed that Chipps "was reaching for a gun," but Chipps had no weapons. As his trial approached, newspapers throughout the country invoked the sensational Scopes Trial in headlines like "Minister's Trial to Rival Dayton".

Despite strong evidence indicating that Norris was guilty of each crime, he was always acquitted, after which he used his trials' publicity to boost his fame and attack his detractors. After escaping the death penalty with an acquittal for murder, Norris told his overflowing church that "I offer no apology for what I've done." As a newspaper editor noted after the trial, "In Ft Worth, the 11th Commandment is 'Thou shalt not mess with J Frank Norris.'"

THE BEST SHOW IN TOWN

Norris, a militant fundamentalist who roamed the stage weeping and shouting when he preached, tolerated no dissent and often told disgruntled members to "go to hell". Anyone who questioned Norris became an enemy whom he attacked relentlessly. Norris fired entire groups of deacons, slandered and humiliated politicians, and, after jailing and publicly denouncing his own son, offered to pay the costs for his wayward son to change his last name. When he was away from the pulpit, Norris would often curse and swear, excusing his coarse language by claiming that "God has no use for sissies."

Norris hired detectives to investigate his enemies and then published his findings in local newspapers and in his own newspaper, which he called *Searchlight*. (The front-page of each issue showed Norris holding a searchlight in one hand and a Bible in the other, with Satan cowering in the opposite corner.) *Searchlight*, which had editorial offices throughout the United States, published a variety of anti-evolution articles, as well as articles, advertisements, and occasional announcements about the Ku Klux Klan. In 1927, Norris — in an attempt to make his newspaper appear as an official publication of the WCFA — changed the name of his newspaper to *The Fundamentalist*. This produced

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EXTRA The Press EXTRA

J. Frank Norris Shoots D. E. Chipps to Death

FIGURE 2.
Norris, who promoted himself as "The Texas Cyclone" and "The Pistol-Packin' Parson," was repeatedly arrested and acquitted for felonies such as perjury, arson, and murder.

an increase in the newspaper's circulation and a bitter split with Riley, who later said that he regretted ever working with Norris. Other pastors were more blunt; as one noted, "The world would be better if Frank Norris had never lived."

Although Norris was pastor of a Baptist church, he often sought fights with Baptist leaders; for example, on May 29, 1925, Norris used the front-page headline of *Searchlight* to announce that "Texas Baptist Machine Renews War of Retaliation on 'Norris' Because of His War on Evolution." The attacks didn't stop there — he regularly denounced other Baptist preachers as "weeds", "worthless bastards", "dirty diapers", "lepers", "old baboons", and, in one instance, "a beer guzzling bunch of hair". Norris refused to use Baptist literature in his church and was thrown out of the city, county, state, and denominational associations of Baptists. The Baptist General Convention permanently excluded Norris in 1924; when he showed up at the convention the next year, police escorted him from the meeting. Norris's antics drove away hundreds of church members (600 in 1911 alone), but they were quickly replaced by others wanting to be part of what a local newspaper called "the best show in town".

Late in 1934, Norris — who defended fundamentalist "with both hands loaded with religious TNT" — also became pastor of Temple Baptist Church in Detroit, Michigan. He was pastor of both churches — and their combined membership of over 25 000 — for 15 years. In Detroit, as in Ft Worth, crowds flocked to hear Norris preach. Membership increased from 800 in 1934 to over 6000 twelve years later. Although Norris was despised by many (for example, the *Atlanta Constitution* noted that Norris "is one, good, sound, reason why there are 50 000 000 Americans who do not belong to any church at all"), his ultra-militant version of Christianity appealed to legions of fundamentalists who longed for uncompromising certainty. Norris's sermons attracted thousands per service. Norris owned a radio station named KFQB (later renamed KFJZ), which stood for "Keep Folks Quoting the Bible."

NORRIS'S ANTI-EVOLUTIONISM

Norris aimed many of his attacks at "that hell-born, Bible-destroying, deity-of-Christ-denying, German rationalism known as evolution." He supplemented his sermons with monkeys, denounced colleges for teaching "evolution and infidelity," and demanded that several "modernist" professors be fired. Like other anti-evolutionists, Norris linked evolution with societal ills, claiming that evolution was "made in Germany," that evolution was like the "poison gas of German armies … sweeping through our schools", that "evolution and dance are to each other as cause and effect," and that the "damnable and despicable" biologists who teach evolution "have hands dripping with innocent blood".

Throughout the 1920s, Norris demanded that the Texas legislature ban the teaching of evolution. In 1923, Norris's church hosted the annual meeting of the WCFA, at which Norris arranged a mock trial of evolutionists who were convicted and hanged. Norris was responsible for resignations of several faculty, and was behind a resolution passed by the University of Texas Board of Regents in 1924 requiring all employees to believe in God.

William Jennings Bryan invited Norris to Dayton to testify in the Scopes Trial. Norris accepted Bryan's invitation, but he did not attend, instead sending a stenographer (LH Evridge) to Dayton. Norris later used Evridge's transcript to produce *The Only Authentic Book on the Dayton Trial*. On the day before he died, Bryan asked Norris if he would "let me correct my part in the trial before you publish it."

In 1939, Norris organized the Fundamental Baptist Bible Institute to train preachers. The institute sponsored many missionaries, including John Birch, who had enrolled in the Institute in Ft Worth after hearing Norris preach in Georgia. Birch's death prompted Norris to renew his attacks on Communism. Norris's fame attracted invitations from world leaders, including Winston Churchill and Pope Pius XII (Norris was the first Baptist minister to meet with the Pope). The Fundamental Baptist Bible Institute later became the Bible Baptist Seminary, which today is Arlington Baptist College. The World Baptist Fellowship, founded by Norris, continues to publish *The Fundamentalist*, which lists Norris as the publication's "Founder".

In 1950, after Temple Baptist Church voted 3000 to 7 to fire Norris, his health began to fail. Deserted by many of his friends, Norris died on August 20, 1952 at a youth rally in Keystone Heights, Florida. His admirers sold postcards of the bed in which he died. Following a funeral attended by 5000 people, Norris was buried along the northern edge of Greenwood Cemetery near the Trinity River in Ft Worth, Texas, beneath the inscription "America's Foremost Fundamentalist".

Businessmen of Fort Worth commissioned sculptor Pompeo Coppini to create a life-size statue of Norris, which was displayed downtown. Today, that statue welcomes visitors to Arlington Baptist College, a campus located on the former Top O' Hill Casino property. This casino was known as "Vegas Before Vegas" and was frequented by Joe Louis, Bugsy Siegel, Bonnie and Clyde, and other colorful figures of the past. At a tent meeting in the 1930s in Arlington, Texas, Norris vowed one day "to own the place." His prediction came true in 1956 when the institution that he founded purchased the property and converted the "casino to a seminary."

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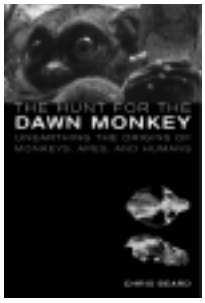

The Hunt for the Dawn Monkey: Unearthing the Origins of Monkeys, Apes, and Humans

by Chris Beard
Berkeley: University of California Press, 2004, 348 pages

Reviewed by Eric Delson

Modern humans, *Homo sapiens*, are one of many species belonging to the zoological order Primates, in turn one of several dozen such major subdivisions of the mammals. Among other living primates are the apes, monkeys of Africa and Asia, monkeys of Central and South America, tarsiers of Southeast Asia, lemurs (or lemuriforms) of Madagascar, and lorisiforms of Africa and southern Asia. There is abundant research on our fossil relatives throughout the Old World from South Africa to England to Indonesia, and the latest discoveries appear in the pages of journals such as *Nature*, *Science*, the *Journal of Human Evolution* and the *American Journal of Physical Anthropology*. Excellent less technical summaries of the state of this field, paleoanthropology, are provided by Ian Tattersall (2008; 2009), for example. Far fewer books written for non-specialists survey the long history of primate evolution from the time the last dinosaurs disappeared through the diversification of modern groups in the past 10 million years. This book by Chris Beard fills part of that gap neatly: clearly and engagingly written by a leading scholar for the general reader, it concentrates on the search for fossils documenting the middle third of primate history and role of these species in the emergence of the monkey predecessors of humans.

Beard provides a good review of both the evolutionary development of early primates and the history of their discovery. At the time he wrote, Beard and most other paleontologists considered that the earliest primates were the lemur-like adapiforms and tarsier-like omomyiforms of the early Eocene (about 55 Ma [million years ago]. These animals are best known from fossils from the western US and western Europe, with more fragmentary remains known in Indo-Pakistan, China, and North Africa collected beginning in the 19th-century.

Modern analyses of new fossils from the even older Paleocene time period (65–55 Ma) show that at least some plesiadapiform mammals shared anatomical features such as grasping hands and feet with later primates and should be included within the Order Primates; this view refutes one of Beard's ingenious but apparently incorrect hypotheses, which allied plesiadapiforms with a distant relative of primates, the Southeast Asian colugo or "flying lemur", and he has unfortunately not moved on to the current consensus.

The central point of this book, as I mentioned, is the search for the ancestry of anthropoids. Beard describes well the history of study at the world-famous Fayum fossil site in northern Egypt, which has yielded remains of nearly two dozen species of early primates. Elwyn Simons of Duke University. Simons and his colleagues have demonstrated that some of these fossil species are definite anthropoids, close to the common ancestral stock of humans, apes, and the monkeys of Africa and Asia.

Other forms are more distant relative, some close to the ancestor of all living anthropoids and others farther away from the modern branch of the anthropoid evolutionary tree. The oldest of these known when Beard wrote lived perhaps 35 Ma, but in fact new forms have recently pushed the Fayum record back to 37 Ma. Another North African species possibly related to some Fayum forms may be as old as 45 Ma, but the anthropoid nature of that species has recently been rejected by Tabuce and colleagues (Tabuce and others 2009).

This brings us to Beard's own work in China, where he has found remains of an animal he has named *Eosimias* (dawn monkey in a mixture of Greek and Latin). *Eosimias* was first recognized by fragments of lower jaw with a few loose teeth, but in a later expedition, Beard and his colleagues recovered a nearly complete lower jaw and later still some fragments of skull and isolated limb bones.

In one of my favorite passages, Beard recalls how he examined that lower jaw in the Institute of Vertebrate Paleontology and Paleoanthropology in Beijing and asked if anyone there had a copy of *Evolutionary History of the Primates*, my 1979 book with Fred Szalay which illustrated all the fossil primates then known. Based on this analysis, he determined that *Eosimias* had the front teeth of an

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anthropoid: small but vertical incisors something like our own, as opposed to the procumbent ("forward-leaning") incisors of various early and lower primates. Beard then spends a lot of time and words explaining why *Eosimias* is the earliest known anthropoid, living before all the Fayum species and convincing him to replace Africa with Asia as the ultimate home of higher primates.

There are two related problems with this conclusion. First, is it correct? Beard presents his conclusion without offering the reader a chance to weigh the alternatives. He also offers a somewhat disingenuous (or disrespectful) interpretation of the motives of several scholars with whose views he disagrees, such as Simons and Beard's French contemporary Marc Godinot. They want to prove Africa as the source area, Beard suggests, because they have found early African primates that might qualify as protoanthropoids, so they and others have rejected Beard's true protoanthropoid *Eosimias*; Beard himself is the white knight of unfettered true science, fighting to be recognized for the value of his ideas...and so on.

In fact, there are alternative interpretations of *Eosimias* which I find more convincing than Beard's. I have seen some of the original specimens and replicas of others, and I am impressed by Szalay's (2000) brief suggestion that this and other Asian species are in fact closest to the ancestry of living tarsiers. I am not convinced by any of the purported protoanthropoids recovered in recent years from Pakistan, Thailand, Myanmar, or China. Many of those appear to me (and a number of other specialist colleagues) best interpreted as relatives of non-anthropoid primates; none appears to be a protoanthropoid much less already an anthropoid, as are the Fayum species.

But science is really about putting down one's ideas on paper and holding them up to scrutiny by colleagues. That is what Beard has done, here and in numerous technical papers. We are not always correct, and most of us recognize that. What makes science different from other explanatory systems is that we accept the idea of criticism from our peers and work to convince them by reason and logic, rather than by revealed truth of any kind. Beard's book is successful in presenting relatively novel views and especially in doing so in a framework of scientific detail that will entice the reader to learn more about this exciting field.

References

Szalay FS. 2000. Eosimiidae. In Delson E, Tattersall I, Van Couvering JA, Brooks AS, eds. *Encyclopedia of Human Evolution and Prehistory*, 2nd ed. New York: Garland, p 235.

Szalay FS, Delson E. 1979. *Evolutionary History of the Primates*. New York: Academic Press.

Tabuce R, Marivaux RL, Lebrun R, Adaci M, Bensalah M, and others. 2009 Anthropoid versus strepsirhine status of the African Eocene primates *Algeripithecus* and *Azibius*: craniodental evidence. *Proceerdings of the Royal Society Part B* 276: 4087–94.

Tattersall I. 2008. *The World from Beginnings to 4000 BCE*. New York: Oxford University Press.

Tattersall I. 2009. *The Fossil Trail*, 2nd ed. New York: Oxford University Press.

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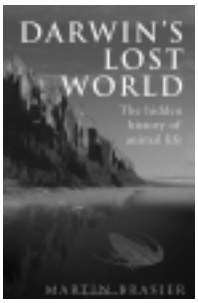

Darwin's Lost World: The Hidden History of Animal Life

by Martin Brasier
Oxford: Oxford University Press, 2009. 304 pages

Reviewed by Roy E Plotnick

Oxford paleobiologist Martin Brasier's new book, *Darwin's Lost World* is first of all a recounting of his own research history, beginning with a 1970 trip to study the modern reef environments of Barbuda and continuing with expeditions to far-flung localities in China, Mongolia, Siberia, Oman, Newfoundland, and Scotland. At the same time, it is a documentation of Brasier's role in investigating one of most intensely studied episodes in earth history, the roughly 100-million–year period that culminated in the appearance of recognizable animal life, including such familiar fossils as brachiopods, trilobites, and snails. This culmination is the so-called Cambrian explosion.

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At the time of Darwin's writing of the *Origin of Species*, there was little or no evidence of fossils prior to the earliest Cambrian strata, making it seem as though complex animal fossils had appeared suddenly worldwide. In the first edition of the *Origin*, while recounting the difficulties in his theory associated with the imperfections of the geological record, Darwin confessed

> if my theory be true, it is indisputable that before the lowest Silurian was deposited, long periods elapsed as long as, or probably longer than the whole interval from the Silurian age to the present day; and that during these vast, yet quite unknown periods of time, the world swarmed with living creatures. To the question why we do not find records of these vast primordial periods, I can give no satisfactory answer.

(At the time, the Silurian encompassed what we now call the Cambrian.)

Readers of *RNCSE* are aware that this 150-year–old conundrum is still considered state-of-the-art science by many in the creationist community. For example, the acting chair of the Texas state board of education, Don McLeroy, in his failed confirmation hearing before the Texas Senate on May 28, 2009, stated that the sudden appearance of phyla in the Cambrian explosion is evidence from the fossil record against evolution.

But research over the past 50 years has conclusively shown that Darwin's "lost world" did indeed exist and that the explosion was not really so sudden. The history of life on earth has now been documented for about 3 billion years prior to the Cambrian. Many of the critical discoveries of Precambrian life and their interpretation are entertainingly recounted in

Andrew Knoll's *Life on a Young Planet* (Princeton [NJ]: Princeton University Press, 2003), which I highly recommend. The current book focuses on the last part of the Precambrian, the recently established Ediacaran Period (630–542 million years ago) and the succeeding Early Cambrian Epoch (542–513 million years ago). This is the period during which complex multicellular life, including animal life, became established.

Reading Brasier's book will introduce readers to many of the key localities and discoveries, as well as provide glimpses of many of the major investigators, of Ediacaran and early Cambrian life. The well-known animals of the Burgess Shale — often offered as exemplars of the Cambrian radiation — are about 505 million years old and thus actually postdate the radiation, which was pretty much over by 520 million years ago.

Older still are the Ediacaran fossils, best known from places such as Australia, Newfoundland, Russia, and England, but clearly occurring worldwide. What is not clear is exactly what these forms were; opinions range from the earliest representatives of familiar animal groups to a separate and extinct group of multicellular organisms. Brasier's own opinion is that they were ancestral to sponges, ctenophores, and jellyfish, living mostly by absorbing nutrients from the water.

One of the ongoing disputes in the field of Precambrian–Cambrian research is when major animal groups first appeared. Paleontologists mostly place originations conservatively at or about their first appearances in the fossil record. Others also use "molecular clocks" based on estimates of the rates of genetic change between groups and calibrated with the fossil record. These clocks have almost always placed the origin of animal groups well before their first appearance, with the lack of fossils being explained as a failure of preservation. Brasier dismisses such explanations as based on of what he terms "Lyell's hunch" — the hope that we lack the fossil ancestors because they have not been found yet. In contrast, Brasier argues that fossil preservation in the late Precambrian was better than it was later in earth history, so that if these early forms were present, we should have found them by now.

The book is illustrated with the author's own photos and line drawings. It is also enlivened by his sense of humor. I especially liked the "MOFAOTYOF principle", which stands for "my oldest fossils are older than your oldest fossils" and represents the excitement, attendant publicity, and as Brasier stresses, the necessity for concrete evidence when the oldest member of a fossil group is first discovered and published.

Darwin's Lost World often assumes too much prior knowledge by the reader. The geologic time scale, for example, is not introduced until p 42. The "Snowball Earth" glaciations are mentioned without explanation on p 96 and are not really discussed until some 90 pages later. I also found his occasional attempts to illustrate a point by arranging the text to resemble a picture or graph to be more irritating than illuminating. A recurring problem is the use of the phrase "Cambrian explosion" to refer to the Cambrian part of this story. As often pointed out by my Berkeley colleague Jere Lipps, the use of the word "explosion" is both a misnomer and misleading. How can something that takes tens of millions of years be an explosion? As a result, you will see many paleontologists using the phrase "Cambrian revolution," to refer to the profound biological changes occurring during this interval. I prefer the even milder phrase "Cambrian radiation".

These quibbles notwithstanding, I readily recommend this book as an entertaining introduction to a major field in studying the history of life. It will give you invaluable information for the next time you get asked to explain how evolution explains the Cambrian "explosion".

Acknowledgments
Thanks to Jere Lipps and Stephen Dornbos for their comments on this review.

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Cruisin' the Fossil Freeway: An Epoch Tale of a Scientist and an Artist on the Ultimate 5000-Mile Paleo Road Trip

by Kirk Johnson and Ray Troll
Golden (CO):
Fulcrum Publishing, 2007.
208 pages
includes 4' x 5' illustrated companion road map

Reviewed by Thomas R Holtz Jr

"Every road cut asks a question
Every fossil tells a story
All the rocks that lay around us
They speak of prehistoric glory"

So begins artist Ray Troll's poem at the end of this one-of-a-kind book. A collaboration between paleobotanist Kirk Johnson of the Denver Museum of Science & Nature and artist Ray Troll (familiar to readers of *RNCSE* as the creator of the cartoons that adorn every issue of this journal), *Cruisin' the Fossil Freeway* is part road trip narrative, part introduction to paleontology, historical geology, and evolutionary biology, and part tale of the myriad personalities involved in the discovery, collection, preparation, interpretation, and appreciation of the abundant fossil remains found throughout the North American West. The theme of Troll's poem plays throughout *Cruisin'*: there are wonders of the transformations of earth and life through time to be found wherever rock is exposed and fossils discovered, for those who care to look.

In the late 1990s, Johnson and Troll worked together on a traveling exhibit for the Denver Museum from which this book derives its title. This inspired the pair to take their own road trip throughout the American West and to create the

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companion map to the book (about which more later). Their travels take them from Denver on a winding trek to spots throughout Colorado, the Dakotas, Wyoming, Montana, Utah, and New Mexico. Along the way they examine outcrops produced by many different environments: deserts, swamps, volcanic ashfalls, forests, streams, shallow marine settings, and more. The pair concentrate on fossil localities from the Mesozoic (the so-called Age of Dinosaurs, 251–65.5 million years ago) and the Cenozoic (the Age of Mammals, 65.5 million years ago to the present) Eras, but with some representation of the older Paleozoic (542–251 million years ago) as well. The fossil species encountered on the trip of course include dinosaurs and large fossil mammals, the charismatic paleomegafauna that form the centerpieces of natural history museums worldwide. (Indeed, many of the localities visited are the very spots where those museum specimens were found.) But Johnson's love of ancient plant species ("fossil leaf lust is hard to explain", declares one of the many cartoons in the book) and Troll's fascination with Paleozoic fish comes through, and these groups as well as scuttling Paleozoic trilobites, diverse Mesozoic ammonites, and others are encountered on the way. And the pair are able to use the road trip to emphasize the importance of understanding the rocks themselves and the sedimentary structures (such as footprints, ripple marks, and ash beds) that are the keys to the realization that any given spot on earth has been through phenomenal changes of environment over time.

However, this is not a field trip guidebook (although the reader is given sufficient information to duplicate their voyage). As much time is spent on the people whose lives have intersected with fossils as on the fossils themselves. These include some information on historic figures of the field, but for the most part are individuals they encountered on the trip. And what an array of people they are: professional research paleontologists, field technicians, commercial collectors, local landowners, folk artists, public school children, and more. In particular, Johnson and Troll seem to be the first to formally diagnose IPNS, or Isolated Paleonerd Syndrome: "lone rangers, one- or two-member dinosaur fan clubs in small towns." (On the companion map they provide the "Top 10 Signs That You Suffer from Paleonerd Syndrome", the more generalized condition.) Through their encounters with fossil lovers across the West, Johnson and Troll are able to discuss many of the issues, tensions, and concerns about the interactions between humans and ancient remains: access to sites, conservation, commercial sales, promotion of fossil resources by small towns, and especially education.

The narrative is extremely readable, and is punctuated by numerous sidebars, photographs of fossils, outcrops, and people, and especially Ray Troll's art. These wonderful color illustrations range from straightforward life reconstructions of fossil animals and plants to cartoons to surreal images (such as "Dreams of *Didymoceras*" on p 46, where a pair of the named aberrant coiled ammonites float suspended over a couple in bed, in a room with ammonoid wallpaper, a framed photo of giant Cretaceous sea turtle *Archelon* on the wall, and the 1961 British giant dinosaur movie *Gorgo* unwatched on television). I would quibble with some of the life restorations: in particular, the fossil record now makes it clear that certain groups of Mesozoic dinosaurs — such as deinonychosaurs ("raptors") and oviraptorosaurs — were as covered in feathers as any living bird. (While of course evolution might have eliminated feathers in any given subgroup of these, there is as yet no positive evidence that this happened, so at present illustrating featherless deinonychosaurs and oviraptorosaurs is arguing for an evolutionary change for which there is no support!)

Cruisin' the Fossil Freeway is no textbook, although it covers such a variety of ancient life that important new discoveries are revealed even for professionals. It can serve as an introduction to many readers to the wide variety of types of fossils that exist around us. For anyone interested in the world before us, or even just in good road trip books, this is an excellent read.

And should you wish to plan your own fossil road trip, there is the companion map. It has expanded coverage from the text, running as far north as the southern tier of the Rocky Mountain and Prairie provinces of Canada, as far West as the Nevada–California border, and as far east as the Dakota–Minnesota border and the Oklahoma panhandle. Major highways and museums are marked, as are illustrations of fossil animals and plants placed near the spot at which they were found. The map is full of so many little details and surprises (a cheeseburger in every state and commentary on fossils, town names, and more) that like a *Where's Waldo?* picture it invites long periods of joyful contemplation. The legend of the map includes useful tips about fossil collecting locations, dos-and-don'ts, museum localities, and helpful websites. The map is available separately from Fulcrum Books (<http://www.fulcrumbooks.com>); I have to admit that I have seen it on the walls of the offices and collections rooms of several different museums already. If you suffer from Paleonerd Syndrome (isolated or otherwise), this map is a guide to allowing full expression of your condition.

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Evolution: The Story of Life

by Douglas Palmer, illustrated by Peter Barrett
Berkeley (CA): University of California Press, 2009. 367 pages

Reviewed by Donald R Prothero

The topic of evolution is nearly always the subject of specialized academic books, and occasionally by more popular approaches, but it has been a long time since it has

received the lavish full-color, large-format "coffee table book" treatment. Palmer's book is exactly what is needed to reach a market of people who enjoy books with lavish color images and beautiful new reconstructions and dioramas of extinct animals. It has plenty of pictures of dinosaurs and hominins, of course, to draw the primary market for books of this kind. But it also has plenty of rigor in its pages alongside the stunning illustrations that draw in the casual reader.

A short introductory section gives the historical background to our discovery of evolution, and covers some of the basic principles as well, at a level comprehensible to the general reader. The meat of the book (214 pages in total) is a long series of double-page spreads by Peter Barrett featuring stunning reconstructions of specific fossil localities, with not only extinct animals and plants but also realistic portrayal of the landscapes as well. Inset at the bottom of these pages are paleogeographic maps, photographs of the actual fossils; across the top of each spread is the time line, showing the place of that reconstruction in geologic history.

If this were not reason enough to buy the book, the next section is also outstanding: a visual representation of the tree of life, following the principles of cladistics and specifically rejecting outdated paraphyletic taxa. This is a major breakthrough for a book written for a popular audience. Most of the trade books with lots of pretty pictures do not show the phylogeny of life at all. If they do, they continue to propagate outdated concepts of phylogeny and invalid paraphyletic taxa like "Amphibia," or "Reptilia" including synapsids and other primitive amniotes. By contrast, this book explicitly eliminates them, or explains (p 251) the reason for not using "false groupings" like "fish." Unfortunately, there are still a few invalid wastebaskets left in the tree, such as "Eupantotheria." The author also follows some of the groupings of organisms based on molecular phylogeny (like the higher groups of placental mammals) that have no support with anatomical evidence or fossil record, and are still not widely accepted by paleontologists.

The third section is also surprising: a gazetteer of the major fossil sites on which the dioramas were based, giving actual detailed location and both published papers and web references for further reading about the locality. Such transparency of the source of the fossils is very valuable. This helps the reader see that the diorama is not a composite of many localities, and also lets the reader know about actual places with real fossils that are the basis for the reconstructions. The same approach is apparent in some of the newer natural history museum displays (such as those at the Denver Museum of Nature and Science), where the dioramas are shown in the context of the actual localities with real fossils in the case next to the reconstructions. In this age when creationists distort the fossil record at will, it is valuable to let the general audience see things like this, and give them a taste of "how we know what we know" so there is no sense that paleontologists fake their data. The final section is a "species listing" that gives the taxonomic placement of each organism portrayed in the dioramas and then a nice glossary of all the huge mass of technical terms that must cause a layman's head to spin.

As one would expect from such a massive effort by a science writer who is not a paleontologist, small errors of outdated names or age assignments or other factual details did creep in here and there. Just in the area of my expertise, for example, I found a few, and thus I cannot vouch for the accuracy of the other dioramas that are not part of my own training. These mistakes are not critical to the audience for whom this book was intended, but it would have been nice to have the book checked by a few more paleontologist reviewers who might have caught them. In addition, the entire Cenozoic section (especially from the Miocene onward) focuses primarily on primates and hominins, with a strong anthropocentrism that gives the impression that there are no other localities, and no other animals evolving since the Oligocene except our lineage. I realize that general audiences always care more about humans than any other group, but this anthropocentric bias is annoying and gives a very distorted view of earth and life history.

Other than these minor quibbles, the book is an outstanding example of how to reach a general audience, capture the interest in dinosaurs and fossil hominins, and channel it toward a modern understanding of evolution and how it works. It belongs on your coffee table and in every library as welcome antidote to the garbage that creationists are putting out year after year.

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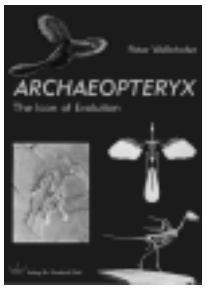
Archaeopteryx: The Icon of Evolution



by Peter Wellnhofer
Munich: Verlag Dr Friedrich Pfeil, 2009. 208 pages

Reviewed by Kevin Padian

Peter Wellnhofer holds the distinction of having been the pre-eminent world authority on both *Archaeopteryx* and the pterosaurs for over 30 years, a distinction enjoyed by few scholars on comparable fossil organisms. This semi-popular, lavishly illustrated, and copiously documented book is the crowning achievement of his work on *Archaeopteryx*. It comes at an auspicious time, given the Darwin celebrations of 2009 and the role that the world's most famous fossil bird has played in evolutionary theory.

For the readers of NCSE, it should first be said that the "controversy" that *Archaeopteryx* has traditionally played in the creationist literature (including the more

recent instars of the "intelligent design" movement) is not his subject. Wellnhofer feels that NCSE takes care of that very well, which is a real compliment to our organization. This frees him to explore the science of *Archaeopteryx*. Wellnhofer's approach is fundamentally historical: the background of the story, each specimen, each paleobiological problem, is treated historically and comprehensively. Wellnhofer is in a very good position to do this, because he has surveyed the historical literature in the field for 40 years. His survey reminds us that few ideas are really new, and that even though the internet can bring us scads of recent articles on any subject, this is no excuse for lack of scholarship in ferreting out and reading the older literature. Of course, some of this literature is obscure, not widely accessible, so it is good to have it brought to our attention.

Wellnhofer begins with the town and region of Solnhofen, Bavaria, whence all ten of the skeletal specimens as well as the original feather have come. He situates Solnhofen in its historical, cultural, geographical, and geological context, presenting information that will be unfamiliar to most American readers. The famous Solnhofen limestones, which have been quarried for millennia, represent the bottom of an ancient, relatively quiescent, anoxic lagoon where critters in various stages of decomposition settled and were buried. Occasionally they died in their tracks there, like the fossil crabs that wandered in and found the poisonous environment not to their liking. This also prevented a lot of scavenging and other *post-mortem* biotic destruction of the specimens, and thereby improved fossilization potential.

The bulk of the book concentrates on descriptions, historical accounts, and illustrations of the *Archaeopteryx* specimens themselves. It is wonderful to have these clear, straightforward descriptions in one place, laid out in simple language with both color photos and concise illustrations. All of these characteristics have been hallmarks of Wellnhofer's work throughout his career, and they should be emulated by all paleontologists. He also provides a comparative table of measurements, all the more reliable for being taken by a single expert researcher.

The final part of the book concerns various issues that have historically involved the *Archaeopteryx* specimens. How many species are really present? (One) What is the correct nomenclature? (*Archaeopteryx lithographica*) ... and so on. These questions seem to have easy answers, but they are historically complex. Other questions are less easy to answer. Wellnhofer bends over backward to be open-minded, although some of the more recent literature has rather settled many of these. He is also not much of a cladist, so he does not situate *Archaeopteryx* into nested sets of shared derived characteristics that demonstrate its phylogenetic position (perhaps to the relief of many readers). On the other hand his literature review is admirably complete, with the exception of some of the most recent works.

One of the most poignant aspects of the book is Wellnhofer's description of how the friable, easily separated layers of Solnhofen limestones (the Fäulen) are cleared away as rubble, because they can't serve as building or lithographic stone (the Flinze). How many irreplaceable fossils, he wonders, are destroyed by this process? And this is echoed in his Afterword, which laments that in Bavaria there is no law to protect the destruction or private sale of such specimens, a problem that has touched several of the ten current skeletal specimens of *Archaeopteryx*.

Obviously, paleontologists, ornithologists, and fossil fanciers will want this book, but it should also be on the shelves of public and school libraries, because it lays out in clear and unbiased detail the facts that surround the world's most famous fossil and a true icon of evolution. No one is likely to replace this book's scholarship or its production quality for a very long time, so it should be bought and cherished for the future.

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Geology and Religion: A History of Harmony and Hostility

edited by Martina Kölbl-Ebert
London: The Geological Society, Special Publication 310, 2009.
357 pages

Reviewed by
Stephen M Rowland

This book is a collection of thirty-two chapters, most of which are expansions of papers presented at a 2007 conference on Geology and Religion, organized by the International Commission on the History of the Geological Sciences, in Eichstätt, Germany. The editor has organized the chapters into seven clusters: (1) From mythological approaches towards the European Enlightenment, (2) The Flood and the age of the Earth, (3) Geology within "religious" organizations, (4) Geological clerics and Christian geologists, (5) Evolution, (6) History of creationism, and (7) Theology and creationism. The book contains many interesting examples of harmony and hostility in the history of the relationship between geology and religion, but the examples of harmony outnum-

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ber those of hostility. Several case studies are presented of 19th-century theologians who found satisfaction in combining their dual interests of theology and geology, but there are also excellent discussions of 20th- and 21st-century conflicts between mainstream geology and creationism. Due to space limitations, I am able to describe just a few chapters that I think will be of greatest interest to readers of *Reports of the NCSE*.

Predictably, examples of the interpretation of geological phenomena as products of the biblical Flood are well represented. One such chapter, by Martin Rudwick explores the contrasting interpretations of diluvial deposits among early 19th-century European naturalists.

> By the early 19th century, educated people in most European countries, including those who would now be called "scientists", were coming to recognize that biblical literalism was no long tenable, and that it had not been characteristic of Christian thinking in the earlier history of the Church. (p 109)

He makes the case that the earth sciences were originally ahistorical. By the late 18th century, however, earth scientists were beginning to realize that the earth cannot be understood solely in terms of unchanging "laws of nature". This was a radical new outlook on the natural world, and it put earth scientists on a collision course with biblical literalists.

Published in the 150th anniversary year of *On the Origin of Species*, the book appropriately contains a chapter that chronicles the life of James Buckman, little-known today, but a scientist who played a role in the support of Darwin's arguments. Buckman's career was dramatically affected in a negative way by the controversy that followed publication of the *Origin*. Darwin cited Buckman's botanical experiments with grasses to "solve the problem of the identity of species" in support of his own conclusions about the mutability of species. Then, at the 1860 meeting of the British Association for the Advancement of Science (famous for a heated and witty verbal exchange between TH Huxley and Bishop Samuel Wilberforce), Buckman presented a paper that further supported the Darwinian position. The Anglican Principal of the Royal Agricultural College where Buckman was Professor of Geology, Botany, and Zoology was incensed that one of his staff would support Darwin's views, and ordered the destruction of Buckman's research garden. Buckman left the College shortly thereafter, a victim of the perceived incompatibility of orthodox Christianity and the mutability of species. This chapter by Hugh Torrens is a delight to read and a model of scholarship in the history of 19th-century science.

In a fascinating chapter entitled on the geology program at Wheaton College in Illinois, SO Moshier, DE Mass, and JK Greenberg review the history of the college's geology curriculum and the tensions it has weathered as creation issues have waxed and waned within the evangelical subculture in which the college exists. Wheaton is one of the few evangelical Christian colleges offering a degree in geology, and many of Wheaton's geology graduates have earned doctorates in the geosciences, several with very distinguished careers. The key to maintaining a viable, not-too-far-out-of-the-mainstream geology curriculum at an evangelical Christian college has been the assiduous rejection of young-earth creationism and Flood geology.

The chapter about Wheaton College reminds us that creationists come in many varieties and Richard A Peters's chapter concerns the other extreme on the creationist spectrum. Peters himself is a former fundamentalist Christian whose conversion from radical creationism to a more science-friendly worldview gives him a rare perspective on the tension between science and religion. If this book contains a "must read" chapter for non-creationists who are trying to understand the creationist mindset, this is the one. Peters first classifies creationists into three camps: (1) intelligent designers, (2) theistic evolutionists, and (3) radical (or, Peters's own new term, "theodicic") creationists; then he proceeds to explore the motivations of the third camp. His term "theodicic" comes from "theodicy," which refers to the theological dilemma of the existence of evil and suffering in the world. According to Peters, the single most powerful factor that motivates radical creationists (who are generally young-earth creationists) is the "desire to clear God of the charge of creating a world full of suffering and death." Within their worldview, the only conceivable explanation for suffering and the death of any of God's creatures is the sins of Adam and Eve, as described in the book of Genesis. No animals or plants could have died before the existence of Adam and Eve, so it follows that the fossil-rich strata of the earth must postdate the creation of humans. There is no room for compromise between this theodicic perspective and the mainstream scientific worldview.

The book ends with an insightful chapter by Michael B Roberts, who is an Anglican priest with expertise in the history of geology. Roberts provides an interesting and useful taxonomy of believers with respect to creation and earth history, and he discusses the alarming spread of Christian fundamentalism within the Church of England and throughout the world.

In spite of the fact that many of the authors' first language is not English, the book is very well edited, well illustrated, and free of typographical errors. In her introductory chapter, editor Martina Kölbl-Ebert writes that "[b]oth geology and religion have evolved through time, often intensely entwined, and mutually influencing one another." This book offers an excellent sampling of the history of that relationship, presented in many more chapters than I have space to discuss in this brief review.

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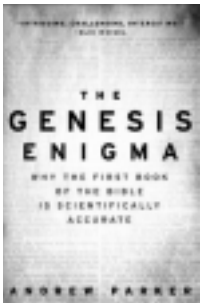

The Genesis Enigma: Why the Bible is Scientifically Accurate

by Andrew Parker
New York: Penguin, 2009.
284 pages

Reviewed by Alexander Glass

Andrew Parker, evolutionary biologist and Honorary Research Fellow at Green Templeton College at Oxford University, is perhaps best known in scientific circles for his "light-switch theory" (Parker 2003), the proposition that the evolution of vision coupled with predation was an important driver of the "Cambrian Explosion" half a billion years ago. In his new book, *The Genesis Enigma: Why The Bible is Scientifically Accurate*, Parker joins the ranks of those scientists who are weary of having their faith be represented by anti-evolutionists and having their science claimed by atheists. Parker's plea is that faith in God and an acceptance of modern science is indeed possible without holding on to a naïve biblical literalism. That is the good part of the *Genesis Enigma*. Unfortunately, Parker takes on far more than can be sufficiently addressed in his 280-page book, leaving both conservative and progressive Christian readers wholly unconvinced.

Parker's main premise is that when the book of Genesis is read figuratively, the events appear to match our modern reconstruction of earth history. According to Parker

> when the biblical text is taken literally, it is left in the wake of advancing science. But when it is read figuratively, it not only keeps pace with the hottest science, it precedes or heralds it. (p 130)

In other words, the creation chronology of Genesis describes events that took the scientific community several thousand years to identify and piece together. This then is Parker's "Genesis Enigma": how is it that an ancient pre-scientific text could accurately describe the early geological and biological history of earth? Parker sees in this match between Scripture and science possible evidence of divine inspiration. This claim alone is complex and controversial enough — and the argument should really have stopped there.

Unfortunately for the coherence of the book, Parker takes it several steps further by seeking to convince the reader that Genesis is not only scientifically accurate but that the *entire* Bible is historically reliable. The resulting read is an odd mixture of biblical archaeology, paleontology, cosmology, evolutionary biology, and theology, all interspersed with long but superficial reviews of the history of science, many of which actually detract from the main argument.

The book begins with a brief summary of the development of the biblical text, in essence arguing that despite minor copying errors and manuscript variations the version we have today is reliable. Parker's selective treatment is reminiscent of many popular conservative Christian apologetics books and should leave any reader — believer or nonbeliever — unconvinced. Unfortunately, this section is followed by an equally meager assessment of biblical archeology. The reader is asked to conclude that the Bible is historically accurate based on a few archeological discoveries that allegedly corroborate the existence of a handful of biblical sites and figures. However, even a casual glimpse through the latest volumes of the *Biblical Archaeology Review* (<http://www.bib-arch.org>) makes it clear that the correspondence between actual archeological discovery and biblical accounts is much more tenuous than Parker would like us to believe.

The heart of the book follows the creation events of the first 25 verses of the book of Genesis based on the King James version. Each event is linked to an actual physical, geological, or biological milestone in the 4.55-billion–year history of the earth. At first, Parker's figurative reading of the text is relatively straightforward: the creation of light (Genesis 1:3) actually describes the formation of our sun accompanied by the coalescing of the planets and other bodies of the solar system. Parker's figurative reading begins to take much greater liberties on the third day of creation when he argues that the appearance of "grass, herb, and fruit trees" corresponds with the evolution of photosynthetic life in the oceans.

Continuing this free-spirited reading, the fourth day is characterized not by the creation of the sun, moon, and stars, but by the evolution of sight by the first multicellular animals. In a discussion reminiscent of interpretations by old-earth creationist Hugh Ross that Genesis 1:14–17 describes not the creation but the first visible appearance of stellar objects to an observer on earth, Parker argues that this verse stresses the appearance of sight in animals. He supports this interpretation with a thorough discussion of the seminal impact of vision, his "light-switch theory", on the evolution of life on earth.

Parker develops this line of reasoning further for Genesis 1:20–21 the creation of abundant life in the oceans. He sees this as a reference to the so-called "Cambrian Explosion", during which most of the phyla of animals first diversified in the oceans. Parker concludes his analysis with a brief nod to Genesis 1:24–25, seeing in it a description of the evolution of land animals before the final appearance of humans.

Parker's figurative reading in light of the evolution of vision is interesting and creative. However, it is also a great example of how such approaches are prone to reflect the biases and wishes of the reader rather than the intended meaning of the text. Conservative Christians will criticize Parker for not taking the language of Genesis seriously enough, whereas progressives will ask why he perceives such a need to find congruence between the text and modern science. Experienced science-and-religion readers will also be baffled by the near-complete lack of treatment of previous scholarly works on this subject. If Parker's goal was

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to add a new serious voice to the now voluminous creation–evolution discussion, he should have spent more time discussing contemporary issues relevant to his interpretation.

A central mantra of the anti-evolutionists has long been that atheism and evolution are two sides of the same coin. Parker's voice as a well-known and respected scientist and believer aids in dispelling this myth. Unfortunately, it also reinforces another: namely that a Christian cannot accept the findings of modern science without also stretching the bounds of scriptural interpretation to its utmost limit.

Reference

Parker A. 2003. *In the Blink of an Eye*. New York: Basic Books.

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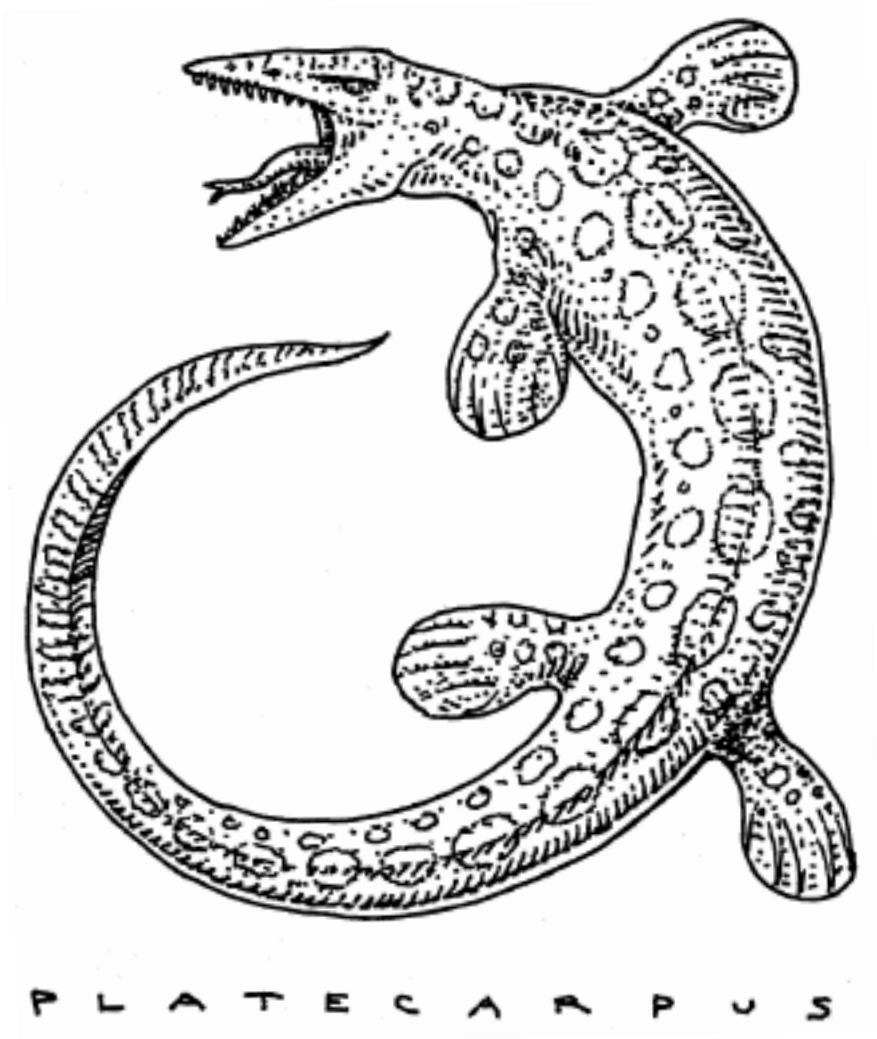

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