

REPORTS

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



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CONTINUES NCSE REPORTS &
CREATION/EVOLUTION

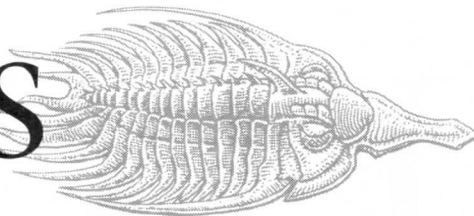


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Comes to Ohio;
Introducing the
Misinfomercial

Analysis of the
Discovery Institute's
Supplemental
Bibliography

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

IN THE NEWS

This issue of *RNCSE* focuses on the efforts to include "intelligent design" in Ohio's science education standards. As readers know, recent efforts to oppose evolution have introduced many new euphemisms for the same tired ideas. Over the decades we have had "balanced treatment", "fair treatment", "equal time", "evidence against", and "alternatives to" as catchphrases for those who oppose evolution on nonscientific grounds. Now, proponents of "intelligent design" want to "teach the controversy" about "origins science". Of course, we know that there is no such thing as "origins science" and that the "controversy" over teaching evolution is not a scientific one, but a political and socio-cultural issue.

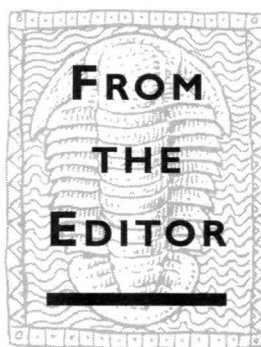
The Discovery Institute launched a major effort to sway the Ohio Board of Education with its "Bibliography of Supplemental Resources for Ohio Science Instruction" — 44 publications that the DI claimed:

represent dissenting viewpoints that challenge one or another aspect of neo-Darwinism (the prevailing theory of evolution taught in biology textbooks), discuss problems that evolutionary theory faces, or suggest important new lines of evidence that biology must consider when explaining origins.

However, when NCSE contacted the authors of the articles to ask whether the DI correctly represented the articles they included, all the respondents denied that their work represented any significant challenge to evolutionary theory as the foundation of modern biology. In this issue, NCSE's Skip Evans and Glenn Branch review the events in Ohio and the DI's efforts to undercut so-called "neo-Darwinism".

IN PRINT

Members and colleagues have been toiling away at the books all year, and



this end-of-summer issue brings you a wealth of reviews. Among these are reviews of two collections of, and one book about, Alfred Russel Wallace — the coauthor with Charles Darwin on

the original paper on evolution by natural selection, who is often relegated to a footnote in the history of evolutionary biology. Reviews of two new biographies of Wallace — by Peter Raby and Michael Shermer — will appear in subsequent issues of *RNCSE*.

There are also 8 other books reviewed, including books by members David Schwimmer and Karl Fezer. Daryl Domning, Phil Spieth, and Hiram Caton review books about the interface between science and religion, and John Wilkins reviews the revised edition of Michael Ruse's *The Darwinian Revolution*.

COMING SOON

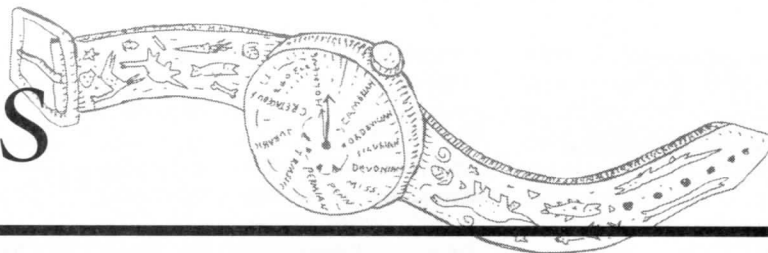
On tap for future issues are papers on current research into the origin of life and the universal genetic code. Recent criticisms of evolution have again focused on both these areas. In origin-of-life research, the criticisms have to do with the correspondence between experimental conditions and the geophysical conditions on earth 4 billion years ago. In criticism of the universal genetic code, anti-evolutionists complain that there is too much genetic variation to be derived from a common ancestral population. Both sets of criticisms are incorrect for a variety of reasons. The articles in upcoming issues will inform our readers of the current state of the science in both.

Future issues will also carry several pieces in memory of 3 people who helped NCSE carry out its mission of supporting evolution education over the past decades. Stephen Jay Gould, John Moore, and Betty McCollister all died this year, and their long-time support of NCSE and its mission will be missed.

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REPORTS



Ohio: An Evolving Controversy

Skip Evans
NCSE Network Project Director

BACKGROUND

As the Ohio science standards controversy continues, it is still anybody's guess whether or not the standards will remain free of pseudoscience. Media coverage and lobbying from both sides of the debate have been steady since the Ohio Board of Education (OBE) asked a 45-member writing team to write new statewide science education standards in 2001.

As reported earlier (*see RNCSE 2002 Jan-Apr; 22 [1-2]: 4-5*), the campaign to get "intelligent design" (ID) into the curriculum has been orchestrated by the Seattle-based Discovery Institute (DI), several other nationally-known anti-evolution groups and individuals, and Science Excellence for all Ohioans (SEAO), a local ID advocacy group that originally presented itself on its web site as a project of the Ohio chapter of the American Family Association (that statement has since been removed from the web site). This coalition has mounted perhaps the most well-organized assault on evolution education since that in Kansas in 1999.

However, shortly after the controversy hit the media, a diverse group of scientists, educators, and citizens began a strong grassroots effort to maintain the integrity of the new standards, which have earned an A rating from nationally recognized science education expert Lawrence Lerner (*see RNCSE 2002 Jan-Apr; 22 [1-2]: 9-10*). Ohio Citizens for Science, the grassroots group formed to support the standards, maintains a web site at <http://www.ohio-science.org>.

MARCH 11: A SWITCH IN TACTICS

Prior to the March 11, 2002, panel discussion of evolution and ID held before the OBE (*see RNCSE 2002 Jan-Apr; 22 [1-2]: 6-8*), advocates of ID had lobbied hard for changes to the standards to weaken evolution and specifically introduce ID into the curriculum. (For an analysis by NSCE staffers of the originally proposed changes, *see* http://www.ncseweb.org/resources/news/2002/OH/884_ncse_analysis_of_ohio_standard_1_2_2002.asp). However, during the panel discussion, the Discovery Institute's Stephen C Meyer pleaded only for "teaching the controversy", insisting that the Discovery Institute was not out to remove evolution or mandate the teaching of ID.

Subsequently SEAO revised its proposed changes to the draft science education standards. SEAO's proposed changes seemed to have been modified to defer to Meyer's wishes (*see* <http://www.sciohio.org/start.htm>). Yet despite the modifications and the ID advocates' claims that they are not young-earth creationists, the proposed changes remain committed to omitting any reference to an ancient earth in the science education standards.

THE BIBLIOGRAPHY SCANDAL

In addition to the testimony at the March 11 meeting, the DI presented the OBE with a bibliography of 44 scientific papers and books, claiming "[t]he publications represent dissenting viewpoints that challenge one or another aspect of neo-Darwinism." NCSE analyzed the bibliography with the aid of many of the authors of the papers, and sent a copy of its completed analysis to each member of the Ohio OBE (*see "Quote-mining comes to Ohio", p 11*). Local activists told us later that the analysis confirmed some board members' suspicions about why the DI

had given them the bibliography in the first place. In the eyes of many of the board members, according to activists in Ohio, the DI had suffered a serious blow to its credibility.

THE UNIVERSITY PRESIDENTS SPEAK OUT

A letter dated March 15, 2002, signed by all 15 presidents of Ohio's public universities and sent to the members of the OBE, urged the OBE to reject ID. The signatories urged the board to "reject the concept of 'intelligent design' creationism as a part of the science curriculum". Additionally, they asked for science education standards "dedicated to rigorous testing and experimentation, strengthened with thorough teaching of evolution in our science requirements" (*see "Presidents of Ohio universities support evolution", p 6*). Their letter is also posted on the NCSE web site at http://www.ncseweb.org/resources/news/2002/ZZ/285_ohio_university_presidents_opp_6_27_2002.asp.

MEANWHILE, BACK IN THE LEGISLATURE...

Over a year ago, Phillip Johnson stated, "We [in the "intelligent design" movement] definitely aren't looking for some legislation to support our views" (*SF Weekly* 2001 Jun 20). Despite such claims, as of this writing there are three bills — two in the Ohio house and one in the Ohio senate — receiving heavy support from advocates of ID. Perhaps the most insidious of these is House Bill 484, which reads in part, "[t]he State Board of Education shall not adopt the science standards ... unless, by concurrent resolution, those standards are approved by both houses of the General Assembly", effectively stripping the OBE of its authority over the state science education standards. HB 481 borrows much



of the same language from the infamous Santorum language in the committee conference report of the federal education legislation signed into law by President Bush earlier this year (see "*Santorum Redux?*" RNCSE 2002 May/June; 22 [3]: 4-5). None of the bills is expected to make it out of committee. To view the text of the bills, see <<http://www.legislature.state.oh.us/>>.

APRIL 8: OCS AT THE BOARD MEETING

Ohio Citizens for Science (OCS) was well represented at the April 8 board meeting; its members effectively and eloquently rebuffed aggressive interrogation from ID sympathizers on the school board, Deborah Owens-Fink and Michael Cochran. OCS cofounder Patricia Princehouse presented the OBE with its petition to keep ID out of the state standards, signed by over 3600 people, and read aloud the comments of 22 of its signatories. OCS cofounder Pamela Keiper read several statements from teachers. And Capital University law professor Dennis Hirsch so impressed one board member with his dismantling of the ID advocates' legal arguments that he solicited Hirsch's opinion on vouchers.

POPULARITY CONTESTS

To advance their agenda, ID advocates cite a 2001 poll conducted by Zogby International that shows 71 percent of respondents agreeing with the statement "[b]iology teachers should teach Darwin's theory of evolution, but also the scientific evidence against it." Only 14 percent agreed with the statement "Biology teachers should teach only Darwin's theory of evolution and the scientific evidence that supports it" (see <<http://www.discovery.org/articleFiles/PDFs/ZogbyFinalReport.pdf>>). The poll was conducted again in 2002 in Ohio, obtaining similar results (see <<http://www.zogby.com/soundbites/ReadClips.dbm?ID=4379>>); ID advocates have been quick to cite the Ohio poll as well.

But there may be other reasons for these poll results, contends NCSE's Executive Director, Eugenie C. Scott. She explains that

these polls make a methodological error in asking whether the evidence against evolution should be taught as well as the evidence for it; as phrased, the question improperly suggests to the respondent that there *is* evidence against evolution. "If you conducted a survey asking whether the evidence against, say, heliocentrism or the laws of thermodynamics or the atomic theory of matter ought to be taught as well as the evidence for it", Scott said, "you would probably obtain similar results, showing only that the American public — which values fairness — will endorse teaching both sides to any issue. A more methodologically sound poll was commissioned by People for the American Way in 2000" (see RNCSE 1999 Nov/Dec; 19 [6]: 4-6). NCSE member Russell K. Durbin made similar points in a letter to the *Columbus Dispatch* (see p. 8).

However, Scott added, what the public is generally not aware of — and what polls like the Discovery-Institute-commissioned Zogby poll exploit — is that there is no credible evidence against evolution. The public's ignorance of the status of evolution parallels its generally poor understanding of scientific knowledge and how science works. In a recently completed survey, Science and Engineering Indicators, conducted since 1979 by the National Science Foundation, about 90 percent of respondents reported being moderately interested in new scientific discoveries. Yet the percentages of respondents lacking knowledge of some of the most basic facts of science learned in grade school was shocking.

For example, only 50% of respondents knew that the earliest humans did not live with dinosaurs, that it takes the earth one year to go around the sun, that electrons are smaller than atoms, and that antibiotics do not kill viruses. One indication of moderate progress in the NSF study was that for the first time, a majority (53%) of respondents agreed with the statement "human beings, as we know them today, developed from earlier species of animals" (see <<http://www.nsf.gov/sbe/srs/seind02/c7/c7h.htm>>); in previous years, agreement with the statement has hovered around 45%.

Confirming the NSF study's appraisal of the general public's knowledge of science and the scientific method, Steve Rissing, Professor of Evolutionary Biology at the Ohio State University, said:

I know from personal interactions with thousands of [graduates from Ohio's public schools] annually that [our students] do not understand the fundamentals of the scientific process and [its] power. This is painfully obvious in their training in biology, which has consisted mainly of memorization of biological terms never placed into some understandable context, especially that of evolution.

Fortunately, the media in Ohio do not seem to be swayed by the tactics of the DI. In a June 14, 2002, editorial in the *Columbus Dispatch*, for example, "intelligent design" was referred to as "the new name for that old-time creationism". Similarly, a June 17, 2002, editorial in the *Dayton Daily News* was firm:

"Intelligent design" isn't a scientific theory; it's a religious belief. But the name has been changed so an old argument can be resurrected with a new spin. ... Downplaying evolution's place in science is compromising science's integrity. The scientific community won't and shouldn't roll over about what's presented as verifiable and what's not. And, really, does anyone think those who want "intelligent design" passing as science are going to settle for swipes at evolution?

And, referring to the DI-sponsored poll, a June 16, 2002, editorial in the *Akron Beacon Journal* pointed out that "attempting to craft a science curriculum around public opinion is an exercise in absurdity. ... Those pushing intelligent design and other repackaged versions of creationism won't be satisfied until they've pushed Darwin into the corner and created a corrupted version of scientific inquiry ..."



JUNE 11: ANOTHER BOARD MEETING

At OBE's next meeting, Daniel Schoenberg, a professor in the Department of Molecular and Cellular Biochemistry at the Ohio State University, told how evolution is used in his own research:

My research group has spent 20 years studying the regulation of messenger RNA, the molecule that carries the genetic information from genes to make new proteins. We began studying this in frogs because the problem I selected to study was too complex to address in humans with the tools available at the time. Nevertheless I knew that what we learned in frogs would be directly applicable to humans because key biological processes are conserved throughout evolution. Indeed this proved to be the case and this week we are submitting a paper to the *Proceedings of the National Academy of Sciences* where we show a direct relationship between our earlier work with frogs and a devastating inherited human disorder of red blood cell formation. We were able to make this connection precisely because of the predictive nature of the theory of evolution.

According to others at the meeting, his emphasis on the practical application of evolution seemed to impress the majority of OBE members.

JUNE 23: THE BOARD MEETS AGAIN

At the June 23 meeting, changes to the standards were submitted by the two co-chairs of the standards subcommittee, Tom McClain and Joe Roman.

For the most part, the proposed changes were innocuous. The most troubling was the change from:

Know [that] life on earth is thought to have begun as simple, one-celled organisms about 4 billion years ago. During most of the history of the earth only single-celled microorganisms existed, but

once cells with nuclei developed about a billion years ago, increasing complex multicellular organisms evolved.

to:

Know that during most of the history of life on earth only single-celled microorganisms existed, but once cells with nuclei developed about a billion years ago, increasingly complex multicellular organisms evolved.

Although removing the specific reference to earliest life's being 4 billion years old seems like a potential concession to anti-evolutionists, the new indicator certainly gives no comfort to young-earth creationists.

The writing committee accepted the changes proposed by McClain and Roman. "This document, the first science standards for Ohio, reflects the existing National Standards while also having the 'local color' of being written by a representative group of Ohio educators", said writing team member and high school chemistry teacher Bernard J Franks.

ID advocates were clearly unhappy with the draft. Robert Lattimer, a writing team member and a member of SEOA, said, "We went along with these, but most of these changes ... don't address our fundamental concerns."

THE LATEST DEVELOPMENTS

On June 27, 2002, the *Columbus Dispatch* reported that the standards would next be evaluated by experts in relevant fields. Their comments will be delivered to the OBE in September, which will vote on the standards by December. However, the battle over science education may not be over even then. In the same article, Lattimer said, "Whoever these new experts are, they aren't going to help us either. Our job is to convince the state school board that public opinion is strongly on our side." Lattimer went on to say that the battle will go next to the legislature and then on to the courts.

NCSE will continue to monitor developments in Ohio as they unfold and keep its members informed.

Presidents of Ohio Universities Support Evolution

[The following letter was sent to the members of the Ohio State Board of Education on March 15, 2002. It is reprinted with the permission of the Inter-University Council of Ohio.]

Dear Members of the Ohio State Board of Education:

We, the presidents of the Inter-University Council of Ohio, request that you adopt elementary through high school science standards that indicate students' understanding of the explanatory and predictive power of science. Such understanding is required for completing a degree at all of our institutions and for functioning as a member of a scientifically literate work force and electorate.

While we recognize the great value of spirituality and faith in today's society, we urge you to reject the concept of "intelligent design" creationism as a part of the science curriculum. We also request that you establish the foundation for a pre-eminent science curriculum in Ohio dedicated to rigorous testing and experimentation, strengthened with thorough teaching of evolution in our science requirements.

We have entered a remarkable new era in genetics and biotechnology, one in which we have the opportunity to benefit from the greatest wave of scientific achievement in human history. As Ohio strives to become a leader in this knowledge-based economy, Governor Taft is promoting a multi-billion-dollar "Third Frontier Project" to rejuvenate Ohio's economy

OHIO PUBLISHES DRAFT SCIENCE EDUCATION STANDARDS

The Ohio State Board of Education has made its draft science education standards available on line. To read the current version, connect to <http://www.ode.state.oh.us/academic_content_standards/science/Sept02.asp>.



through advances in biotechnology and other areas of science and technology. The federal government and private industry are investing heavily in research and development, and our state is dedicating hundreds of millions of dollars to improve science and math education in public schools. Such initiatives rely on the application of basic scientific knowledge and fact-based inquiry to fields as diverse as agriculture, health care, and environmental protection. To adopt "intelligent design" creationism in our state science standards — or to imply that evolution and "intelligent design" are equally valid as scientific theories — will sabotage these educational and economic development efforts at the very time when our children and state need them most.

Evolution is the single unifying scientific theory of life and an essential element of scientific literacy. As noted scientist Theodosius Dobzhansky observed, "Nothing in

biology makes sense except in the light of evolution."

The proposed science standards that the State Board of Education received in December made substantial advances by making evolution a central subject in the curriculum. Now, however, instead of building upon this important step, we risk pushing science education in Ohio back to the 19th century. House Bill 481 and other curriculum recommendations being debated would require public schools to teach concepts such as "intelligent design" creationism when they teach evolution, or would provide little guidance on the issue, leaving decisions up to local schools. Because no data support the belief of "intelligent design", such policies could, in essence, bring creationism into science class and equate supernatural beliefs with scientific theory, which by its very nature is based on testing and rigorous observation of nature. This misrepresents both science and religion and is a disservice to both.

Ohio's young people who are denied a basic understanding of evolution or who are taught the "scientific" validity of non-scientific "theories" will enter college far behind students from other states. A new generation of K-12 teachers that we are now training — and that must pass certification exams — will have significant misconceptions about basic science and scientific methods. Furthermore, if Ohio is perceived as one of the nation's intellectual backwaters, our universities — as well as private industry — will be severely handicapped in trying to recruit and retain top researchers in the biological sciences, as well as other fields. As a result, Ohio will be ill equipped to develop the innovative businesses that will help create the "Third Frontier" envisioned by Governor Taft.

Perhaps most important, in a world in which rapid technological advancement affects nearly every aspect of our lives, Ohio's citizens must possess a solid scientific literacy in order to make intelligent decisions ranging from whether to buy a genetically engineered vegetable at the grocery store to how to determine national policy issues related to human genetics. Understanding the primacy of evolution in the development of such options and the decision to exercise them is fundamental.

Clearly, we must acknowledge and respect the faiths of students and other citizens. Parents and clerics play a crucial role in teaching matters of religious philosophy, and education plays a role in teaching about the history of these ideas. The role of diverse faiths likely belongs in our K-12 curricula in courses on comparative religions and the history of science. However, our public schools and science teachers owe it to our children to pass on to them the very best scientific knowledge available and to instill in them a method of learning based on close observation, thorough testing, and impartial analysis.

For the future well-being of Ohio and its citizens, we strongly urge the Ohio State Board of Education to adopt rigorous science curriculum that makes evolution an integral part of our biological science requirements and that limits scientific endeavors to observable and definable phenomena subject to thorough scientific testing and experimentation.

Sincerely,
Robert Glidden
President, Ohio University
Chair, Inter-University Council

On behalf of IUC presidents:

Luis Proenza,
University of Akron
Sidney Ribeau,
Bowling Green State University
John Garland,
Central State University
Joseph Steger,
University of Cincinnati
Michael Schwartz,
Cleveland State University
Carol Cartwright,
Kent State University
Frank McCullough,
Medical College of Ohio
James Garland, Miami University
Robert Blacklow,
Northeastern Ohio Universities
College of Medicine
William Kirwan,
Ohio State University
Michael Field,
Shawnee State University
Daniel Johnson,
University of Toledo
Kim Goldenberg,
Wright State University
Daniel Sweet,
Youngstown State University



PRESBYTERIAN RESOLUTION ON EVOLUTION

Recently the 214th General Assembly of the Presbyterian Church (USA) met in Columbus, Ohio. The Assembly passed the following resolution regarding its position on evolution:

THE CHURCH

1. Reaffirms that God is Creator, in accordance with the witness of Scripture and the Reformed Confessions.
2. Reaffirms that there is no contradiction between an evolutionary theory of human origins and the doctrine of God as Creator.
3. Encourages State Boards of Education across the nation to establish standards for science education in Public Schools based on the most reliable content of scientific knowledge as determined by the scientific community.
4. Calls upon Presbyterian scientists and science educators to assist congregations, presbyteries, communities, and the public to understand what constitutes reliable scientific knowledge.

Polls Work for Politics, Not Science

[NCSE member Russell Durbin recently wrote to the Columbus (Ohio) Dispatch to point out the difference between public opinion and professional standards in deciding science curriculum for the public schools. We reprint his letter here with his permission. Ed.]

Robert Lattimer [a member both of the Ohio science education standards writing team and of the anti-evolution organization Science Excellence for all Ohioans (SEAO)] wrote that the results of a recent Zogby poll should guide the [Ohio] State Board of Education in crafting its science standards (letter, May 16). This thinking is wrong on at least two points.

First, do we really want public opinion to be the arbiter of science? Maybe we should put the laws of thermodynamics up for a vote. Second, this poll posed ridiculous questions crafted to elicit the desired answers: "When Darwin's theory of evolution is taught in school, should students also be able to learn about scientific evidence that points to an intelligent design of life?" and "Biology teachers should teach Darwin's theory of evolution but also the scientific evidence against it. Do you agree or disagree?"

Not surprisingly, the Discovery Institute, the well-funded right-wing think tank that commissioned this poll and is promoting its "intelligent-design" theory, got the answers it wanted. I strongly oppose inclusion of their neocreationist "theory" in public-science curricula, yet I might agree with both questions. If there were any scientific evidence, either for creationism or against evolution, students should learn about it. However, the poll does not mention that, in fact, there is no such evidence.

On March 11, when representatives of the Discovery Institute presented their case to the state school board in Columbus, they included a bibliography of 44 articles from the scientific literature, purporting to demonstrate that "Darwinism" is scientifically questionable. Only later, after authors of these papers voiced their anger at having their work cynically misrepresented, did the Discovery Institute post the following

disclaimer on its web site: "The publications are not presented either as support for the theory of intelligent design or as indicating that the authors cited doubt evolution."

If there were actually any scientific literature supporting the Discovery Institute's view, one can be certain that the Institute would have cited it. But since there is none, the Institute attempts to blur the difference between legitimate debate among scientists and the social-political-religious debate about evolution, chanting the slogan, "Teach the controversy!"

I hope the State Board of Education will not be fooled.

AUTHOR'S ADDRESS

Russell K Durbin
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Columbus, Ohio 43205

[For news on the state of the science education standards in Ohio, see *Ohio: An Evolving Controversy*, page 4.]

UPDATES

Kansas: Citizens in Kansas headed to the polls on August 6, 2002, to vote in primaries for the state board of education, which, after the 2000 elections, was divided 7-3 in favor of evolution education (see *RNCSE 2000 Jul/Aug: 20 [4]: 11-2*). The defeat of two of the incumbents who support evolution education — Republicans Sonny Rundell from Syracuse and Val DeFever of Independence — means that, after the November election, the board may be evenly split, 5-5, on the issue. The contest that will decide the matter is in District 7, where Democrat L Duane Anstine, a supporter of evolution education, and Republican Kenneth Willard are vying for the seat on the board left vacant by the resignation of Harold Voth (*The Kansas City Star* 2002 Aug 7; available at <<http://www.kansascity.com/mld/kansascity/news/3813379.htm>>).

Nebraska: On June 7, 2002, the Nebraska Board of Education voted 5-2 to add the state's existing science standards, including coverage of evolution, to the official requirements for school accreditation. According to a report in the *Omaha World-Herald*, supporters of "intelligent design" had asked the board to delay this step, hoping that the standards could be changed. The board refused to do so. The state education commissioner expressed support for the current standards, pointing out that local school districts can decide to teach "alternative theories" such as "intelligent design" also, if they wish. However, for public schools to be accredited, they will have to comply with the state's standards, including evolution. See the *World-Herald's* story at <http://www.omaha.com/index.php?u_np=0&u_pg=36&u_sid=415655>.

Ohio, Hamler: The Board of Education of the Patrick Henry Local School District passed a motion supporting "the idea of 'intelligent design' being included as appropriate in classroom discussions in addition to other scientific theories", according to an article in the April 16, 2002, issue of the *Northwest Signal* (see <<http://www.northwestsignal.net/archives/index.inn?loc=detail&doc=/2002/April/16-2685-news04.txt>>). The newspaper quoted the district superintendent as saying students should "have the benefit of being taught both topics of evolution." The rural district in northwestern Ohio is believed to be the first in the state to express an opinion about the teaching of evolution as the Ohio Board of Education prepares to adopt science standards later this year amid controversy over "intelligent design". An Associated Press report



The Discovery Institute Pioneer the Misinfomercial

Skip Evans

NCSE Network Project Director

Remember Jonathan Wells's *Icons of Evolution* (Washington [DC]: Regnery, 2000)? Writing in *Nature* (2001 Apr 12; 410:745-6), Jerry Coyne described it as "a work of stealth creationism, [which] strives to debunk Darwinism using the familiar rhetoric of biblical creationists, including scientific quotations out of context, incomplete summaries of research, and muddled arguments." If you were waiting for the movie, however, your luck is in. A 50-minute video version of *Icons* is now available from a variety of creationist organizations, including Access Research Network, the Discovery Institute's Center for the Renewal of Science and Culture (at which Wells is a Senior Fellow), Chuck Colson's BreakPoint, and James Dobson's Focus on the Family, which produced the video along with Coldwater Media.

The video features several of the "icons of evolution" discussed in Wells's book, including

Haeckel's embryos, Darwin's finches, four-winged fruit flies, homology, and the Cambrian explosion. In addition to Wells himself, several Senior Fellows of the DI's CRSC appear, including David Berlinski, Paul Nelson, Scott Minnich, Stephen C Meyer, and John G West Jr. The video also sympathetically discusses the case of Roger DeHart, a former biology instructor at Burlington-Edison High School in Washington, whose efforts to introduce "evidence against evolution" and "intelligent design" into his biology classes were rebuffed (see *RNCSE 2000 Sep/Oct; 20 [5]: 15*). At one point during the video, John Scopes, the defendant in the famous 1925 Monkey Trial, appears on the screen and then morphs into DeHart.

THE PREMIERE

Icons premiered at Seattle Pacific University (SPU) on May 10, 2002, sponsored by the DI, the Political Union Club at SPU, and the SPU Department of Political Science, in which West is an associate professor. After the presentation, there was a panel discussion moderated by West; the panelists were Wells, DeHart, and the DI's President Bruce Chapman. According to a

report in the SPU *Falcon*, although West invited several members of the Department of Biology to participate in the panel discussion, they all declined; Rick Ridgway, the chair of the department, was quoted as stating that "there is no empirical evidence to support 'intelligent design' theory" (*The Falcon* 2002 May 15; 25 [73]; also available at <<http://www.thefalcononline.com/story.asp?s=2214>>).

Also in attendance at the premiere were several representatives of the Burlington-Edison Committee for Science Education (BECSE), the grassroots group that opposed DeHart's attempts to introduce "intelligent design" into his science classes. Before the showing of the videotape, Carl Johnson and Ken Atkins of BECSE handed out copies of Kevin Padian and Alan Gishlick's review of *Icons*, "The Talented Mr Wells", and of a flier entitled "Jonathan Wells: Who is he, what is he doing here, and why?" (Johnson reports that a member of the audience gave him a copy of the Jack Chick tract "Big Daddy?" in return.) Johnson, Atkins, and Chris Thompson have posted their report on the premiere at <http://www.antievolution.org/people/wells_j/cj_icons_premiere.html>.

in the June 9, 2002, *Cincinnati Enquirer* quotes the district superintendent as well: "It's a conservative area. A good many of us spend a lot of time in churches, and those beliefs are important and should be discussed in these classes" (see <http://enquirer.com/editions/2002/06/09/loc_one_school_stands.html>).

Pennsylvania, Annville: On June 17, 2002, the Annville-Cleona School District Board of Education voted to reject proposed 7th- and 8th-grade reading course textbooks. According to news reports in the *Lebanon Daily News* and the *Harrisburg Patriot-News*, board members objected to some of the topics presented, including evolution and "radical environmentalism". One board member was quoted as opposing one book "because it does include evolution stated as fact ... We get nothing on the opposing view." Objections were also raised to stories stating that the uni-

verse is billions of years old and mentioning the Big Bang. In addition, the *Patriot-News* reported that board member Kathy Horst "suggested that creationism is an issue the Pennsylvania School Board Association should consider for its legislative platform. 'I want to see that the theory of intelligent design be taught in our classrooms, as well as evolution,' Horst said" (<http://www.pennlive.com/education/patriotnews/index.ssf?xml/story.ssf/html_standard.xml?/base/news/1024479008230280.xml>). Because this action was taken against books in the *Language Arts* curriculum, it did not violate the recently approved state standards for science education. However, science advocates in state government tell NCSE that they are braced for more challenges to evolution when Pennsylvania begins to consider the content of its graduation exams in the sciences.

Pennsylvania, Greensburg: A

biblical studies student at Jerry Falwell's Liberty University has asked the school board in the Greensburg-Salem, Pennsylvania, school district to teach "creation science" in science classes, according to an article in the *Pittsburgh Tribune-Review* (<http://www.pittsburghlive.com/x/tribune-review/news/s_75695.html>). Christopher Petrovich, a 1999 graduate of Greensburg High School, contends that "teaching creation science would not offend people's religious beliefs because nearly all religions believe in a supreme being and a significant portion of the local population is Christian." A list of nine alternative textbooks for the 2002-3 school year has been submitted for consideration by the science department.

[NCSE thanks Liz Craig for information used in this article.]

Following the premiere, Roger Downey, who writes a science column for the *Seattle Weekly*, was scathing in his assessment:

[T]o heretics who refuse allegiance to the sociocultural scientific juggernaut called 'the neo-Darwinian synthesis', any competition is welcome, any opportunity for their case to be heard. And, apparently, to judge by the film *Icons of Evolution*, any tactic, however slippery, capable of furthering their cause (*Seattle Weekly* 2002 May 16-22; available at <<http://www.seattleweekly.com/features/0220/news-downey.shtml>>, emphasis in original).

Downey took particular exception to the video's misrepresentation of the DeHart case, to its identification of Berlinski, Meyer, Wells, and Nelson by the institutions at which they earned their PhDs rather than by their present institutions (the Discovery Institute), and its suggestions that evolution is a theory in crisis: "As a threat to Darwinism, it's reminiscent of a woodpecker trying to bring down a sequoia."

ICONS AIRS IN OHIO

On May 11 and 12, 2002, the video of *Icons* was aired on five television stations around the state of Ohio, including three ABC affiliates in the largest of the state's television markets, Columbus, Cincinnati, and Cleveland. The video was broadcast by NBC affiliate WLIO-TV in Lima, ABC affiliates WSYX-TV of Columbus, WCPO-TV of Cincinnati, and WEWS-TV of Cleveland, and CBS affiliate WTRF-TV of Wheeling-Steubenville. It is presumably not a coincidence that the video was aired in Ohio during the state's continuing controversy over newly drafted science education standards that treat evolution as the foundational theory of biology (see "Ohio: An Evolving Controversy", p 4). The broadcast ended with a message urging viewers to encourage Governor Taft and members of the state legislature to oppose the newly drafted standards.

According to representatives of the stations in the largest markets, the broadcasts of *Icons* were paid

programming. A person who works in the television advertising industry estimated the cost of the broadcast as between \$4000 and \$5000, for a total outlay of between \$12 000 and \$15 000. Appropriately, before *Icons* began to air on Cleveland's WEWS-TV, it was prefaced with a disclaimer: "The following is a paid commercial program. WEWS assumes no responsibility for its content." The broadcast on WTRF-TV of Wheeling-Steubenville was paid for by the advertising proceeds, which were split between the station and the program's distributor. Only the Lima station broadcast *Icons* free of charge. Whether or not the funders got their money's worth, however, remains to be seen. In the end, the *Icons* broadcast's received only 1.5 of a possible 40.5 ratings points.

NCSE'S VIEW

After failing to convince the scientific community they have any credible evidence for "intelligent design" and losing repeatedly in statehouses and school boards, the DI has now taken its case to the domain of get-rich-quick-in-real-estate schemes, the Hair Club for Men, and the Ronco rotisserie: the infomercial — or, to be perhaps more accurate in the present case, the *misinfomercial*.

Ironically, the DI poured vast resources last year in a media campaign attempting to discredit the series *Evolution*, produced by WGBH Boston and Clear Blue Sky Productions and broadcast on PBS stations nationwide to general critical acclaim (see RNCSE 2001 Sep-Dec; 21 [5-6]: 5-14). Perhaps one of the most interesting differences between *Evolution* and *Icons* is that stations did not have to be paid by the producers of *Evolution* to show it.

BLACKBURN PRESS REISSUES CLASSIC VOLUME

The Blackburn Press recently announced that it will once again make available the book *Systematics in Prehistory* by Robert Dunnell. According to the publisher, this volume is

[a]n essential book for anyone who wishes to understand the principles of classification and how they apply to archaeology and related areas, *Systematics in Prehistory* ... has persisted as a classic in archaeology, as useful today to the professional and the graduate student as it was when it was first published in 1971. Its materials have not become dated nor have they been superseded by more recent treatments. This work remains a crucial foundation for knowledgeable application of systematics in archaeology.

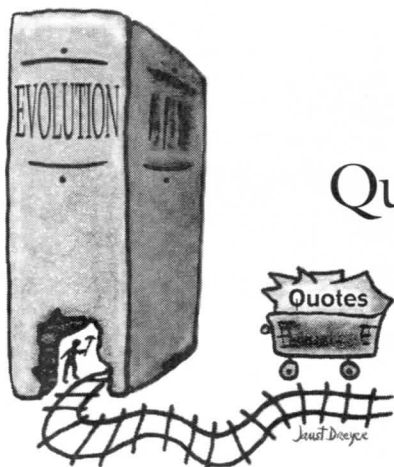
From the Blackburn Press web site:

The Blackburn Press is a relatively new publishing company, founded with the mission of keeping in print and available for purchase at reasonable prices book titles that larger publishers have lost interest in and have declared to be "out of print." We specialize in scientific and technical books and textbooks.

For more information, point your browser to <<http://www.blackburnpress.com/synpreh.html>>.

FACT OR FICTION?

Announcing the premiere of the video version of *Icons of Evolution*, a reporter for the Seattle Pacific University newspaper *The Falcon* wrote, "This event, which is being sponsored by the Political Science Department, the Political Union Club and the Discovery Institute[,] takes its title from a *novel* by the same name, written by local author and microbiologist Jonathan Wells" (*The Falcon* 2002 May 8; 24 [73]; also available on the web at <<http://www.thefalcononline.com/story.asp?s=2186>>; emphasis added).



Quote-Mining Comes to Ohio

Glenn Branch
NCSE Deputy Director

Contributing to the ongoing furor over the proposed science standards in Ohio (see the articles in *RNCSE* 2002 Jan-Apr; 22 [1-2]: 4-5, 6-8, 8-9, 9-10, and 11, and "Ohio: An Evolving Controversy", p 4), the Discovery Institute submitted a "Bibliography of Supplementary Resources for Ohio Science Instruction" to the Ohio Board of Education on March 11, 2002. NCSE sent its analysis of the DI's Bibliography to the members of the Ohio Board of Education (OBE) on April 2 and posted it on NCSE's web site at http://www.ncseweb.org/resources/news/2002/OH/122_intelligent_design_bibliograph_4_5_2002.asp on April 5, 2002.

In a lengthy rebuttal of the NCSE's analysis, the Discovery Institute complained to the OBE on April 8, 2002, that NCSE's "charges are not only groundless, but are a malicious distortion of the public record", adding that "The educational value of the articles is self-evident" and alleging that "every case of misrepresentation claimed by the NCSE dissolves completely on close inspection" (emphasis in original).

The rebuttal was also interesting because, possibly for the first time ever, the Discovery Institute explained what exactly it means by "neo-Darwinism":

- the sufficiency of small-scale random variation and natural selection to explain major changes in organismal form and function;
- the equivalence, given enough time, of the processes of micro- and macroevolution;
- the usefulness of "molecular clocks" to determine historical branching points between species;
- the existence of a single Tree of Life, with its roots in a Last Universal Common Ancestor (LUCA);
- the congruence or matching of evolutionary trees (that is, phylogenies) derived from morphological and molecular evidence;
- the appearance, in embryology, of a conserved stage revealing the common ancestry of all vertebrates.

Needless to say, the Discovery Institute's idiosyncratic definition of "neo-Darwinism" is not shared by anybody outside the "intelligent design" movement.

On April 9, NCSE responded and informed the OBE:

NCSE stands by its analysis: in NCSE's view, and in the view of the majority of the authors of the publications

in the bibliography who responded to NCSE's questionnaire, the DI's bibliography document is inaccurate, tendentious, and misleading.

Moreover, despite the DI's desperate claim that "[t]he educational value of the articles is self-evident", NCSE reiterates that the bibliography is of no conceivable pedagogical value to K-12 science education.

NCSE urges the Ohio Board of Education to rely on the expertise of the writing committee, scientists, educators, and fellow Ohio citizens, who have invested their valuable knowledge and countless hours in producing a superlative set of science standards.

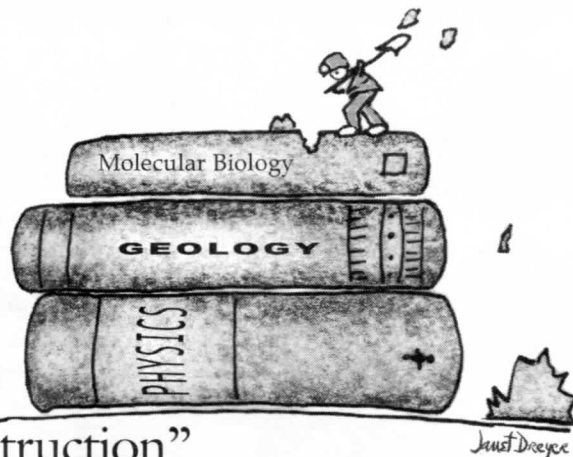
On April 15, a revised version of the DI rebuttal, containing neither the word "malicious" nor any claim about the pedagogical value of the publications in the Bibliography, appeared at <http://www.discovery.org/articleFiles/PDFs/quesAndAnsNCSECritiqueOfBib.pdf>.

WORKING IN THE QUOTE MINE

The tactic of abusing the primary scientific literature for the purpose of misleading the general public is not new to the anti-evolutionist movement. Writing in 1981, John R



Analysis of the Discovery Institute's "Bibliography of Supplementary Resources for Ohio Science Instruction"



Glenn Branch, NCSE Deputy Director

On March 11, 2002, the Discovery Institute — a Seattle, Washington, organization that seeks to promote "intelligent design" — submitted its "Bibliography of Supplementary Resources for Ohio Science Instruction" to the Ohio Board of Education (OBE). Although the publications listed in the Bibliography are valuable contributions to the scientific literature, the Bibliography itself is misleading. The staff of the National Center for Science Education (NCSE) analyzed the Bibliography with the assistance of many of the authors of the publications listed in it, finding (1) that the Discovery Institute misrepresents the significance of the publications in the Bibliography, (2) that the Discovery Institute's descriptions of the publications in the Bibliography are frequently inaccurate and tendentious, and (3) that the Discovery Institute fails to present any principled basis for the

selection of the publications or any pedagogical rationale for their use in the classroom. NCSE concludes that the only purpose of the Discovery Institute's Bibliography is to mislead the OBE and the public about the status of evolution.

I. BACKGROUND

The Discovery Institute (DI) seeks to promote "intelligent design", defined on one of its web sites as follows:

"[Intelligent design]" refers to a scientific research program as well as a community of scientists, philosophers and other scholars who seek evidence of design in nature. Through the study and analysis of a system's components, a design theorist is able to determine whether various natural structures are the product of chance, natural law, ["intelligent design"], or some combination thereof. ... In nature, design theo-

rists cite information[-]rich systems like the genetic code, irreducibly complex systems like the bacterial flagellum, and the fine-tuning of the laws of physics as evidence of ["intelligent design"] (<http://www.reviewevolution.com/whatIsIntelligentDesign.php>).

And it is "intelligent design" that creationist organizations such as Science Excellence for All Ohioans (SEAO) are lobbying OBE to add to the proposed state science standards, over the protests of the 45-member writing committee. (For SEAO's proposals, see <http://www.seao.org>; for the writing committee's objections, see "Curriculum team backs evolution", *Cleveland Plain Dealer*, 2002 Mar 16.)

As Lawrence Krauss of Case Western Reserve University reported at the March 11, 2002, panel discussion in Columbus, there is no

Cole explained:

Creationists have developed a skill unique to their trade: that of misquotation and quotation out of context from the works of leading evolutionists. This tactic not only frustrates scientists but it misleads school board members, legislators, and the

public. Whether such actions by creationists of selectively seeking out quotations or references in order to prove a preconceived case are willful distortion or the product of wishful thinking is irrelevant. Such acts misuse science and scientists in bogus appeals to authority (Cole 1981: 34).

The practice is so frequent among creationists (and other practitioners of pseudoscience) that it receives a name: quote-mining. There are even books devoted to nothing but quote-mining (such as Morris 1998). Quote-mining adds nothing to the discussion of scientific issues and generally confuses the nonspecialist with misleading

published work in the peer-reviewed scientific literature supporting “intelligent design” (see “State board studying theories on start of life”, *Cleveland Plain Dealer*, 2002 Mar 12, and Gilchrist 1997). Peer-review of a scientific publication is an assessment of the work’s scientific merit by experts having knowledge of the research area equal to that of the author. Peer review is essentially a form of quality control in the modern scientific world. The fact that there is no published work in the peer-reviewed scientific literature that supports “intelligent design” contradicts the DI’s claim that “intelligent design” is a *scientific* theory.

But clearly many of the items in the “Bibliography of Supplementary Resources for Ohio Science Education” provided by Jonathan Wells and Stephen C Meyer of the Discovery Institute to the Ohio Board of Education were published in the peer-reviewed scientific literature (the publications listed in the Bibliography — though not the Discovery Institute’s summaries of them — are listed on p 15). The 44 publications listed in the Bibliography are indeed legitimate and valuable contributions to the scientific literature. The material provided to the OBE was prefaced with the following explanation:

The publications represent dissenting viewpoints that challenge one or another aspect of neo-Darwinism (the prevailing theory of evolution taught in biology textbooks), discuss problems that evolutionary theory faces, or suggest important new lines of evidence that biology must consider when explaining origins.

Because the representatives of the

Discovery Institute who appeared at the March 11 meeting — Jonathan Wells and Stephen C Meyer — were widely touted as promoters of “intelligent design”, it would have been reasonable for the OBE to assume that “intelligent design” could be found among the “dissenting viewpoints” included in the Bibliography. But it is not.

NCSE sent a questionnaire to the authors of every publication listed in the Bibliography, asking them whether they considered their work to provide scientific evidence for “intelligent design”. (In the case of publications with multiple authors, NCSE sent a questionnaire to at least one of the authors.) None of the 26 respondents (representing 34 of the 44 publications in the Bibliography) agreed that their cited work provided any support for “intelligent design”; many were indignant at the suggestion. For example, Douglas H Erwin (author of item 8 in the Bibliography), answered:

Of course not — [“intelligent design”] is a *non sequitur*, nothing but a fundamentally flawed attempt to promote creationism under a different guise. *Nothing* in this paper or any of my other work provides the slightest scintilla of support for “intelligent design”. To argue that it does requires a deliberate and pernicious misreading of the papers.

(Quotations from the authors of the publications are reproduced, with permission, from their responses to NCSE’s questionnaire. The questionnaire itself is reproduced on p 26, “NCSE’s Questionnaire to Authors”.) Several respondents even went so far as to say that their work constituted scientific evidence *against* “intelligent design”.

Similarly, on the basis of the explanation prefaced to the Bibliography, it would have been reasonable for the OBE to assume that the publications included in the Bibliography challenged evolution. But they do not. None of the respondents to NCSE’s questionnaire considered their work to provide scientific evidence against evolution. David M Williams (coauthor of item 18), for example, simply remarked, “No, certainly not. How could it possibly?” Almost all of the respondents emphasized that their work provided scientific evidence *for* evolution. Kenneth Weiss (author of item 21), for example, remarked, “I state clearly that evolution is beyond dispute based on all the evidence I am aware of.”

Shortly after NCSE began to send its questionnaire to the authors of the publications listed in the DI’s Bibliography, the following disclaimer to its Bibliography appeared on the DI web site:

The publications are not presented either as support for the theory of intelligent design, or as indicating that the authors cited doubt evolution. Discovery Institute has made every effort to ensure that the annotated summaries accurately reflect the central arguments of the publications (from <<http://www.discovery.org/viewDB/index.php3?command=view&id=1127&program=CRSC%20Responses>>, emphasis in original).

Should not the Discovery Institute have issued such a disclaimer in the first place?

Moreover, in light of Stephen C Meyer’s declaration (“Teach the



and inaccurate interpretations of the original research — which, of course, is its goal.

The NCSE analysis of the DI bibliography combined with the responses of the authors to the specific issues raised by the DI show that this is another case of quote-mining. The DI is placing its own peculiar spin on the research

presented in the scientific literature while ignoring the analyses and conclusions that the studies’ authors have presented.

The text of the NCSE analysis appears in the feature article on p 11. We have also reproduced the original DI bibliography and the text of the query we sent to the authors cited by the DI. On page 25, we

include an in-depth look at one article and the DI’s summary of it.

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controversy on origins", *Cincinnati Enquirer*, 2002 Mar 30) that the Bibliography contains publications "that raise significant challenges to key tenets of Darwinian evolution" — a declaration that significantly postdates the disclaimer — the sincerity of the disclaimer may be doubted.

2. WHAT IS THE REAL SIGNIFICANCE OF THE PUBLICATIONS IN THE BIBLIOGRAPHY?

Within the Bibliography, the publications are divided into 3 categories: Questions of Pattern, Questions of Process, and Questions about the Central Issue: the Origin and Nature of Biological Complexity. In each of these categories, there are two issues to address: what the significance of the publications really is, and what the Discovery Institute would have people believe it is. The two are rarely the same.

A. QUESTIONS OF PATTERN

Phylogenetics is the field of biology that attempts to determine the evolutionary relationships among organisms (phylogenies). Molecular phylogenetics is based on data from genes and other macromolecules (taken from mitochondria, ribosomes, or nuclear DNA). When molecular phylogenetics was first introduced, it was widely believed to be more reliable than morphological phylogenetics, which is based on anatomical characteristics, but more recent research suggests that molecular phylogenetics is subject to difficulties of its own. What the publications cited in the Bibliography

reflect is the current lively controversy in the scientific community about phylogenetic methodology and how to reconcile conflicts when the results of different methods disagree.

The Discovery Institute's selection of publications in the

Questions of Pattern section is idiosyncratic. Over 1600 papers on molecular phylogeny have been published in the last 10 years; why did the Discovery Institute select *these* particular 22? There is no unifying subject of the publications: they deal variously with mammals, insects, bacteria, and metazoans in general. And several of the publications are out of date; for example, Douglas H Erwin (author of item 8) remarks:

Citing [this] paper from 1994 is decidedly poor scholarship, however, given how fast this field has moved. The rapid advances in comparative developmental biology have rendered much of this pretty outdated. We now have a very well substantiated metazoan phylogeny, at least in general outline, allowing some of the tests suggested at the end of the cited passage. Moreover, comparative developmental studies have only served to emphasize the fundamental unity of bilaterian animals.

There are also papers from 1993 and 1991, which are practically ancient by the standards of the fast-moving field of molecular phylogeny.

The only point of similarity among the publications in the Questions of Pattern section appears to be that there are passages in them that, if taken out of context or otherwise misrepresented, *seem* to express doubt about phylogeny in general. But for the DI to insinuate that scientific debates about *how* to determine which organisms are related to which are debates about *whether* organisms are related is misleading. As Peter J Lockhart (coauthor of item 13) carefully explains, in responding to the Discovery Institute's summary of his work:

I don't think it is a good representation of our work — our work does not present "a classic challenge to evolutionary analysis". In our paper we point out that technically it is a hard problem to reconstruct the phylogeny of corbiculate bees regardless of whether you use morphological or molecular data

(the reason for this concerns the pattern of radiation — four different lineages diverged in a short period of time a long time ago — given this pattern it is not surprising that different data types might suggest different phylogenies). In our article we do not say that interpretation of the molecular data is right and that interpretation of the morphological data is wrong (or vice versa). Instead we make some suggestions which we believe will help resolve why the different data types suggest different conclusions — we suggest that the bee morphologists relook at the interpretation of some of their data and we also encourage the molecular biologists to determine some additional data which would help test their hypotheses — we suggest that if these things are done then there should be a resolution to the controversy over which phylogeny is correct. We do not doubt that there is a phylogeny — in contrast, the statement by the Discovery Institute suggests that the bee controversy is *evidence for absence of phylogeny*. No scientist involved in the corbiculate bee debate has ever suggested this to my knowledge.

Kenneth Weiss's article "We hold these truths to be self-evident" (item 21) is the odd article out in the section on Questions of Pattern. Weiss was not discussing phylogeny; the DI apparently included it just in order to quote him as saying, "It is healthy to be skeptical even of truths we hold to be self-evident, and to ask: suppose it isn't true — what would follow? Do we need a theory of evolutionary biology?" Weiss told NCSE, "This is misrepresenting the fuller context. For example, the last question that is quoted was followed by my asking what would be the minimal essential elements of such a theory that biologists would insist on." And although the DI parenthetically added, "Please note that in his footnotes, Weiss is highly skeptical of creationism, and

Over 1600 papers on molecular phylogeny have been published in the last 10 years; why did the DI select these particular 22?

endorses what he calls 'the fact' of evolution", Weiss responded, "The Discovery Institute does not give an honest sense of the clarity that I put in that disclaimer: 'Given the spate of recent anti-evolutionary books, I feel compelled to make the statement here that nothing in this column in any way questions the *fact* of evolution, nor in any way supports creationist accounts (one cannot call them "explanations") for the diversity of life.'"

B. QUESTIONS OF PROCESS

The bulk of the publications in the Questions of Process section of the Bibliography belong to the newly emerging field of evolutionary developmental biology ("evo-devo"), which has provided one of the most powerful models for explaining evolutionary novelty. As Corey S Goodman and Bridget C Coughlin (2000) write,

Once seen as distinct, yet complementary[,] disciplines, developmental biology and evolutionary studies have recently merged into an exciting and fruitful relationship. The official union occurred in 1999 when evolutionary developmental biology, or "evo-devo", was granted its own division in the Society for Integrative and Comparative Biology (SICB). It was natural for evo-

lutionary biologists and developmental biologists to find common ground. Evolutionary biologists seek to understand how organisms evolve and change their shape and form. The roots of these changes are found in the developmental mechanisms that control body shape and form. Developmental biologists try to understand how alterations in gene expression and function lead to changes in body shape and pattern. So although SICB only recently validated evo-devo as an independent research area, evo-devo really started over a decade ago when biologists began using an individual organism's developmental gene expression patterns to explain how groups of organisms evolved.

The emergence of evo-devo is anything but a challenge to evolution.

As with the publications in the Question of Pattern section, the publications in the Questions of Process section seem to have been selected only because they provide passages that, if taken out of context or otherwise misrepresented, *seem* to express doubt about the neo-Darwinian synthesis or macroevolution in general. What must be understood is that

although these debates about the details of evo-devo and the mechanisms of macroevolution are legitimate, they in no way affect the presentation of evolution at the high school level, which is simply not presented in enough detail for these highly technical debates to be relevant.

And as with the publications in the Questions of Pattern section, the authors themselves reject the Discovery Institute's misinterpretation of their work. Thus, for example, Günther P Wagner (coauthor of item 31 and author of item 32), wrote:

In no way does my work represent an attack on the theory of descent with modification, that is, the plain fact of evolution, or even the fundamental insights of the neo-Darwinian theory of evolution. It is intended as an attempt to extend the explanatory reach of Darwinian evolutionary thinking by eliminating some technical limitations that result from the mathematical language currently used to model evolutionary processes. All that work agrees with and is based on the fact that evolution proceeds by the spontaneous generation of genetic variation and the fixation of these variations by

The Discovery Institute's "Bibliography of Supplementary Resources for Ohio Science Instruction"



[These items were included in the bibliography submitted to the Ohio State Board of Education by the Discovery Institute in support of its contention that there is scientific research in support of "intelligent design theory". NCSE asked the publications' authors to respond to the DI's contention. Respondents to NCSE's questionnaire are in **boldface**; authors who responded after NCSE's Analysis of the Bibliography was sent to the Ohio State Board of Education are indicated with an asterisk.]

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5. **Doolittle WF**. Uprooting the tree of life. *Scientific American* 2000 Feb; 90-5.
6. **Doolittle WF**. Phylogenetic classification and the universal tree. *Science* 1999; 284: 2124-8.
7. **Doolittle WF**. The nature of the universal ancestor and the evolution of the proteome. *Current Opinion in Structural Biology* 2000; 10: 355-8.

The publications are a hodge-podge of work from various disciplines...with little in common except they seem to doubt evolution.

selection and/or drift. The points of my papers are narrow technical ones and in no way weaken the fundamental insights of Darwinian evolutionary thinking. They do, however, challenge some of the more speculative extensions of this theory, like the idea that everything is possible with more or less equal probability. But this does not affect the fundamentals of the neo-Darwinian theory of evolution.

Scott F Gilbert (coauthor of items 25 and 27) wrote:

My research on turtles and my research into evolutionary developmental biology is fully within Darwinian parameters. My gripe has been that neo-Darwinism has supposed that *population* genetics was the only genetics needed to explain Darwinian evolution. I claim that *developmental* genetics is also needed. So my research has been to include developmental genetics into the Darwinian mix.

And Douglas L Erwin (author of item 24) told NCSE:

While the article considers the relationship between micro- and macro- evolution, the Discovery Institute is inaccurate in saying that I am challenging the standard view of evolution. The treatment of macroevolution in that paper is an extension, but by no means a challenge. Further, although more work may be needed to fully understand macroevolutionary events, there is no evidence that requires, or even suggests, a role for so-called "intelligent design".

Although Eörs Szathmáry's article (item 44) was not included in the section on Questions of Process, his comments are relevant here. Answering the DI's claim that the publications in the Bibliography "represent dissenting viewpoints that challenge one or another aspect of neo-Darwinism (the prevailing theory of evolution taught in biology textbooks)", Szathmáry replied, "This depends very much on how you define neo-Darwinism. First, like science in general, it is developing. Second, there are cutting-edge and pedestrian conceptualizations of neo-Darwinism. My coauthor on two books, John Maynard Smith, would be regarded by many as an arch-neo-Darwinist. Yet, for those, *The*

Major Transitions in Evolution [by Maynard Smith and Szathmáry] came as a bit of a shock... But that's only because of an outdated idea of how a neo-Darwinist should approach evolution..."

C. QUESTIONS ABOUT THE CENTRAL ISSUE: THE ORIGIN AND NATURE OF BIOLOGICAL COMPLEXITY

According to the Discovery Institute, the publications in the Questions about the Central Issue section "concerns the origin of what makes organisms distinctively what they are: the source of the specified complexity of biological information." It is wholly unclear what the DI intends here; "specified complexity" and "biological information" are not terms with a definite meaning within the scientific community. (This is not to deny that these terms occasionally appear in the biological literature. But they have no consistent, well-established, definite meaning there.) They are, however, prominent terms in the philosophical and theological writings of Discovery Institute Senior Fellow William A Dembski, author of *Intelligent Design: The Bridge Between Science and Theology* (1999), which may explain their appearance in the Bibliography.

The publications are a hodge-podge of work from various disciplines (biomimetics, artificial life

8. Erwin DH. Early introduction of major morphological innovations. *Acta Palaeontologica Polonica* 1994; 38: 281-94.
9. Gura T. Bones, molecules...or both? *Nature* 2000; 406: 230-3.
10. Lee MSY. Molecular clock calibrations and metazoan divergence dates. *Journal of Molecular Evolution* 1999; 49: 385-91.
11. Lee MSY. Molecular phylogenies become functional. *Trends in Ecology and Evolution* 1999; 14: 177-8.
12. Leipe DD, Aravind L, Koonin EV. Did DNA replication evolve twice independently? *Nucleic Acids Research* 1999; 27: 3389-401.
13. Lockhart PJ, Cameron SA. Trees for bees. *Trends in Ecology and Evolution* 2001; 16: 84-8.
14. Mindell DP, Sorenson MD, Dimcheff DE. Multiple independent origins of mitochondrial gene order in birds. *Proceedings of the National Academy of Sciences USA* 1998; 95: 10693-7.
15. Morris P, CoBabe E. Cuvier meets Watson and Crick: The utility of molecules as classical homologies. *Biological Journal of the Linnean Society* 1991; 44: 307-24.
16. Mushegian AR, Garey JR, Martin J, Liu LX. Large-scale taxonomic profiling of eukaryotic model organisms: A comparison of orthologous proteins encoded by the human, fly, nematode, and yeast genomes. *Genome Research* 1998; 8: 590-8.

and artificial intelligence, the origin of life, investigations into the minimal genome) with little in common — except, of course, that they contain passages that, if taken out of context or otherwise misrepresented, seem to express doubt about evolution. Again, the authors themselves reject the Discovery Institute's misinterpretation of their work.

Philip Ball told NCSE that his paper on biomimetics (item 33) is in fact evidence for "the effectiveness of evolution in fine-tuning the properties and features of natural systems." Rodney Brooks (author of item 34) complained that "they have selectively quoted just parts of what I wrote in order to distort completely what I said in the article." Leslie E Orgel (author of item 43) wrote,

The paper is intended to support a conventional Darwinian form of evolution based on reproduction, selection, and mutation of polymeric molecules and to argue against a different form of evolution based on self-organizing cycles of chemical reaction. Supporters of both sides of the argument take evolution for granted, as do all competent biologists, but they disagree about important details. ... it would be appropriate to point out that all scientists carrying out experimental

work on the origins of life believe that one form or another of Darwinism can adequately explain the origin of life on the earth without any recourse to "intelligent design".

3. IS THE BIBLIOGRAPHY RELIABLE?

As the preceding discussion indicates, the Discovery Institute's view of the significance of the publications in its Bibliography was uniformly rejected by the authors themselves. But was the DI able to summarize the arguments of the publications in its Bibliography correctly? No. More than half of the respondents to NCSE's questionnaire considered the summaries in the Bibliography to be inaccurate and tendentious. Here is a sampling of their responses.

Eugene V Koonin (coauthor of item 12): "...the conclusion that this is 'a hypothesis quite unexpected on neo-Darwinian (common ancestry) assumptions' is (i) not taken from our paper and (ii) not at all compatible with the data or ideas presented in the paper."

David P Mindell (coauthor of item 14): "The words enclosed in quotation marks are accurate. However, the quotes are entirely misinterpreted and taken out of context. This is just as the scientific community, and at least some of the public, has come to expect from the Discovery Institute."

Paul Morris (coauthor of item 15):

The quotations are accurate; their assembly is a little misleading (the context of the first quote is a discussion of similar amino acids assembled by different synthesis pathways, where the evidence for homology lies in the synthesis pathways rather than in the amino acids, while the second quote is in the context of discussion of protein sequence similarity). The implications, particularly that molecular data are unable to reconstruct the history of life, are complete distortions of what we said.

David M Williams (coauthor of item 18): "The short answer to your question, 'Do you consider this accurate?', is no."

Michael K Richardson (coauthor of item 19):

Partly accurate and partly ambiguous. The creationists have taken a very complicated argument and extracted from it the bits and pieces that fit their world view. In particular, I have some problems with the following statement: "There is no single stage of embryogenesis in vertebrates where all forms are similar". In fact, there

17. Naylor GJP, Brown WM.* *Amphioxus* mitochondrial DNA, chordate phylogeny, and the limits of inference based on comparisons of sequences. *Systematic Biology* 1998; 47: 61-76.

18. Patterson C, Williams DM, Humphries CJ. Congruence between molecular and morphological phylogenies. *Annual Review of Ecology and Systematics* 1993; 24: 153-88.

19. Richardson MK, Hanken J, Gooneratne MJ, Pieau C, Raynaud A, Selwood L, Wright, GM. There is no highly conserved stage in the vertebrates:

implications for current theories of evolution and development. *Anatomy and Embryology* 1997; 196: 91-106.

20. van Holde KE. Respiratory proteins of invertebrates: Structure, function and evolution. *Zoology: Analysis of Complex Systems* 1998: 100: 287-97.

21. Weiss K. We hold these truths to be self-evident. *Evolutionary Anthropology* 2001; 10: 199-203.

22. Woese C.* The universal ancestor. *Proceedings of the National Academy of Sciences USA* 1998; 95: 6854-9.

23. Carroll RL. Towards a new evolutionary synthesis. *Trends in Ecology and Evolution* 2000; 15: 27-32.

24. Erwin D. Macroevolution is more than repeated rounds of microevolution. *Evolution & Development* 2000; 2: 78-84.

25. Gilbert SF, Loreda GA, Brukman A, Burke AC. Morphogenesis of the turtle shell: the development of a novel structure in tetrapod evolution. *Evolution & Development* 2001; 3: 47-58.

26. Rieppel O. Turtles as hopeful monsters. *BioEssays* 2001; 23: 987-91.

are strong resemblances between vertebrate embryos at various times in development, but it is not possible to ascribe them to a single stage.

Douglas L Erwin (author of item 24):

While the article considers the relationship between micro- and macro-evolution, the statement above is inaccurate in saying that I am challenging the standard view of evolution. The treatment of macro-evolution in that paper is an extension, but by no means a challenge.

David W Deamer (author of item 35):

No! The misleading (and loaded) words, of course, are "greater realism". Those were supplied gratis by the Discovery Institute folks. The correct words would be "increased understanding". The main cultural gap separating thoughtful scientists from creationists and "intelligent design" adherents is that the life blood of science is to ask questions about the world around us, while the creationists seek a feeling of certainty that they have all the answers. Those answers, of course, are encapsulated

in an unquestioning belief in religious doctrine (the creationists) or that the universe must have a greater purpose of some sort ("intelligent design"). Therefore whenever a scientist writes about questions to which we don't yet have answers, the creationists pounce on this "confession" as proof of weakness, implying that they have all the answers.

Again, *more than half* of the Discovery Institute's summaries were rejected as inaccurate and tendentious by the authors themselves. So if the DI were being graded on its ability to summarize these publications, it would score less than 50% — a failing grade in any school. Should the state of Ohio be guided in the development of its science standards by people who are apparently incapable of reliably and objectively summarizing the scientific literature?

4. WHAT IS THE PEDAGOGICAL VALUE OF THE BIBLIOGRAPHY?

The preceding sections have already amply demonstrated that the Discovery Institute's interpretation of the publications in the Bibliography is tendentious and that its understanding of the publications is unreliable. But what about the pedagogical value of the Bibliography?

According to the Bibliography, "These 44 scientific publications represent important lines of evidence and puzzles that any theory of evolution must confront, and that science teachers and students should be allowed to discuss when studying evolution."

But what is the basis of expertise and analysis on which the DI makes these judgments? Does the staff of the DI, to which the authorship of the Bibliography is credited, include any important scientific contributors to the topics discussed? No — significantly, the Bibliography contains no publications by anyone associated with the DI. Does the Bibliography cite the experience of any working K-12 science teachers? No. Does it rely on the research of any specialists in developing science curricula? No. Is any indication given in the Bibliography that the DI has actually examined the instructional materials in use in Ohio and ascertained their deficiencies? No. Are there any concrete suggestions in it for science teachers how to incorporate these publications in their lessons? No. There is merely the blanket, anonymous, unsubstantiated claim that these publications "represent important lines of evidence and puzzles that any theory of evolution must confront, and that science teachers and students should be allowed to discuss when studying evolution."

(The Discovery Institute may

both articles continue on page 23

27. **Gilbert SF**, Opitz JM, Raff RA. Resynthesizing evolutionary and developmental biology. *Developmental Biology* 1996; 173: 357-72.

28. **Miklos GLG**. Emergence of organizational complexities during metazoan evolution: Perspectives from molecular biology, palaeontology and neo-Darwinism. *Memoirs of the Association of Australasian Palaeontologists*. 1993; 15: 7-41.

29. **Shubin NH**, Marshall CR. Fossils, genes, and the origin of novelty. *Paleobiology* 2000; 26 (4; supplement): 324-40.

30. **Thomson KS**. Macroevolution: The morphological problem. *American Zoologist* 1992; 32: 106-12.

31. **Stadler BMR**, Stadler PF, **Wagner GP**, Fontana W. The topology of the possible: Formal spaces underlying patterns of evolutionary change. *Journal of Theoretical Biology* 2001; 213: 241-74.

32. **Wagner GP**. What is the promise of developmental evolution? Part II: A causal explanation of evolutionary innovations may be impossible. *Journal of Experimental Zoology* 2001; 291: 305-9.

33. **Ball P**. Life's lessons in design. *Nature* 2001; 409: 413-6.

34. **Brooks R**. The relationship between matter and life. *Nature* 2001; 409: 409-11.

35. **Deamer DW**. The first living systems: A bioenergetic perspective. *Microbiology and Molecular Biology Reviews* 1997; 61: 239-61.

36. **Katz MJ**. *Templets and the explanation of complex patterns*. Cambridge (UK): Cambridge University Press, 1986.

GENETICS SOCIETY OF AMERICA

Statement on Evolution

Science operates first by observation, and then by developing a hypothesis as a preliminary explanation of the data. A theory is a hypothesis that has been subsequently confirmed by abundant, consistent data obtained from tests of the hypothesis. The theory of evolution by natural selection is exactly such a confirmed hypothesis, as developed through the ongoing investigation and understanding of many different areas of biological, chemical, physical, and earth science. As such, it is modifiable and constantly refined as new research and information come to light. Without evolutionary theory, we would be forced to discard completely much of what we understand about fields such as genetics, botany, zoology, paleontology, and anthropology.

“Scientific creationism”, “intelligent design”, and other terms have been offered as alternate explanations for past and present biological processes. However, these represent a collection of beliefs based on a literal interpretation of religious texts, and are thus disguises for religious doctrine, and not scientific theories. They ignore the empirical data around us and fail to provide a testable hypothesis. Consequently, since no testable explanation for biological history has been provided, they cannot be considered scientific theories, and should not be part of school curricula.

As evolution is the only scientific theory to explain the biological history of life and as the GSA supports the education of students in genetics, the GSA hereby endorses the teaching of the facts and theory of evolution at all levels, including in elementary and secondary schools.

Based on a statement by Jeffrey M Otto PhD, Genaissance Pharmaceuticals, New Haven CT 06511. Reprinted by permission.

GENETICS À GOGO

Where would evolutionary biology be without genetics? Back in the first decades of the 20th century, perhaps, when (as Peter Bowler writes) “Mendelism emerged not as the savior of Darwinism but as yet another alternative to it. The two sides battled back and forth in a debate that did credit to neither and which we can now see to have been futile, because each had access to part of the true picture” (*Evolution: The History of an Idea*, revised edition, Berkeley: University of California Press, 1989: 256). Nowadays, over half a century after the modern synthesis, it is impossible fully to understand evolution without understanding genetics. So check out the following books — encompassing popular treatments, personal accounts, historical surveys, and discussions of what genetics discloses about the history of the human species — all of which are now available through the NCSE web site: <www.ncseweb.org/bookstore.asp>. And remember, every purchase through the web site benefits NCSE!

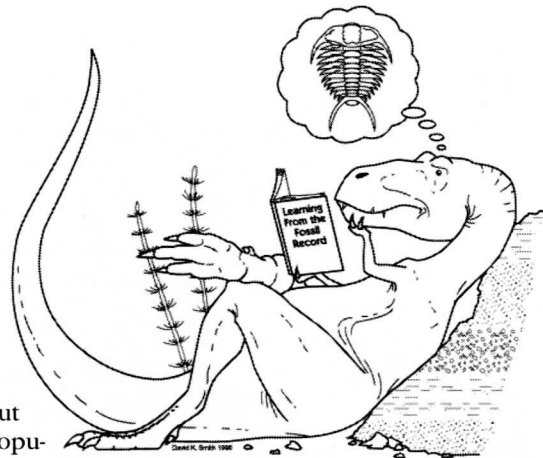


Illustration by Dave Smith, used with permission of the University of California Museum of Paleontology.

FOR THE BEGINNER

The Cartoon Guide to Genetics
by Larry Gonick and Mark Wheelis
The author/illustrator of *The Cartoon Guide to the Universe* teams up with the University of California at Davis microbiologist to explain the basics of genetics in words and pictures. First published in 1983, and updated in 1991, the continuing success of *The Cartoon Guide to Genetics* is testimony to its usefulness. The reviewer for TIGR's *Genome News Network* writes, “The amount of detail is impressive. ...The major strength of [The] *Cartoon Guide* is that the drawings by Larry Gonick are close to brilliant at presenting the physical events of the cell and the gene.”

Genome: The Autobiography of a Species in 23 Chapters
by Matt Ridley

The author of *The Red Queen* and *The Origins of Virtue* here turns his attention to telling “the unfolding story of the human genome, now being discovered in detail for the first time, chromosome by chromosome, by picking a gene from each chromosome to fit the story as it is told”. James Watson describes *Genome* as “[a] lucid and exhilarating romp through our 23 human chromosomes that lets us see how nature and nurture combine to make us human.”

The Impact of the Gene: From Mendel's Peas to Designer Babies
by Colin Tudge

From the publisher: “In the mid-nineteenth century, a Moravian friar made a discovery that was to shape not only the future of science but also that of the human race. With his deceptively simple experiments on peas in a monastery garden in Brno, Gregor Mendel was the first to establish the basic laws of heredity, laws from which the principles of modern genetics can be drawn. In this fascinating account, acclaimed science writer Colin Tudge traces the influence on science of Mendel's extraordinary ideas, from the 1850s to the present day, and goes on to ask what might happen in the coming century and beyond.”

GETTING PERSONAL

The Monk in the Garden: The Lost and Found Genius of Gregor Mendel, the Father of Genetics

by Robin Marantz Henig
From the publisher: “The perplexing silence that greeted Mendel's discovery and his ultimate canonization as the father of genetics make up a tale of intrigue, jealousy, and a healthy dose of bad timing. Telling the story as it has never been told before, Robin Henig crafts a suspenseful, elegant, and

richly detailed narrative that fully evokes Mendel's life and work and the fate of his ideas as they made their perilous way toward the light of day. *The Monk in the Garden* is a literary tour de force about a little-known chapter in the history of science, and it brings us back to the birth of genetics — a field that continues to challenge the way we think about life itself.”

A Feeling for the Organism: The Life and Work of Barbara McClintock
by Evelyn Fox Keller

A scant five months after the original publication of Keller's biography in 1983, McClintock won the Nobel Prize for her discovery of mobile genetic elements — transposons, or “jumping genes”. As Rollin Hotchkiss writes in the foreword, “Keller's calm recital of how McClintock faced professional gender hurdles and prejudices is factual reportage that can give every reader, male or female, a vicarious experience of these problems. Moreover, her analysis of McClintock's scientific work — in its broad context — describes some difficult aspects of modern genetics and itself constitutes a significant contribution to the broad history of thought.”

*Sewall Wright and
Evolutionary Biology*
by William B Provine

A massive (545 pages) biography of and testament to the work of Sewall Wright, who, together with RA Fisher and JBS Haldane, founded modern theoretical population genetics. Provine's book was praised by Stephen Jay Gould, writing in *Isis*, as "the finest intellectual biography available for any twentieth-century evolutionist. In its wealth of detail and richness of insight it has established a standard for historical work in this field." Several of Wright's seminal papers are included. The author is the Charles A Alexander Professor of Biological Sciences at Cornell University.

*The Double Helix:
A Personal Account of the
Discovery of the Structure of DNA*
by James D Watson

Originally published in 1968, Watson's classic personal account of the discovery of the structure of DNA continues to infuriate, titillate, and inspire its readers. The Norton Critical Edition, edited by Gunther Stent, includes reproductions of the original 1953 and 1954 papers describing the double helical structure of DNA, retrospectives from Francis Crick and Linus Pauling, and reviews of *The Double Helix* by a variety of authors, including Richard C Lewontin, Peter M Medawar, Robert K Merton, and Philip Morrison. Watson shared the Nobel Prize for Physiology or Medicine in 1962.

HUMAN GENETICS

*The Great Human Diasporas:
The History of Diversity and
Evolution*

by Luigi Luca Cavalli-Sforza and
Francesco Cavalli-Sforza

The lifework of Luigi Luca Cavalli-Sforza has been to investigate the history of humanity through its genetic makeup; *The Great Human Diasporas*, written in collaboration with his filmmaker son and translated from the Italian, distills his prodigious scientific knowledge into a form accessible

to the general reader. A central chapter explains how Cavalli-Sforza used archaeological and genetic data to reconstruct the human population movements of the last ten thousand years (especially in Europe). *The Great Human Diasporas* also touches on the fundamentals of evolutionary theory as well as issues of eugenics, linguistics, racism, and genetic engineering.

*What It Means to Be
98% Chimpanzee:
Apes, People, and Their Genes*

by Jonathan Marks

A compelling look at the evidence for, and the implications of, our genealogical connections with the other apes, accompanied by a debunking of those who misuse the evidence to support various social, legal, and technical claims that it is incapable of supporting. The reviewer for *The Nation* praised Marks for "his broad history-of-science background, his take-no-prisoners stance on scientific stupidity and overreaching, and his hilarious Groucho Marx delivery".

*Mapping Human History:
Discovering the Past
Through Our Genes*

by Steve Olson

From the publisher: "In this sweeping narrative of the past 150 000 years of human history, Steve Olson draws on new understandings in genetics to reveal how the people of the world came to be. ... He shows how groups of people differ and yet are the same, exploding the myth that human races are a biological reality while demonstrating how the accidents of history have resulted in the rich diversity of people today. Celebrating both our commonality and our variety, *Mapping Human History* is a masterful synthesis of the human past and present that will forever change how we think about ourselves and our relations with others."



GENETICS IN THE TWENTIETH CENTURY

*Fly: The Unsung Hero of the
Twentieth Century*

by Martin Brookes

From Thomas Hunt Morgan onward, the unassuming fruit fly, *Drosophila melanogaster*, has been at the center of genetic research. Brookes's lively book follows the fruit fly through the history of 20th-century biology, where it inspired the work of at least three Nobel laureates (Morgan, Muller, and Lewis), all the way to the *Drosophila* Genome Project.

*Genetics and the
Origin of Species*

by Theodosius Dobzhansky

Originally published in 1937 (before the discovery of the structure of DNA) and reissued by Columbia University Press in 1982 with a new introduction by Stephen Jay Gould, Dobzhansky's book advanced a comprehensive account of the evolutionary process in terms of genetics. By citing experimental evidence to support the theoretical arguments of Sewall Wright, JBS Haldane, and RA Fisher, *Genetics and the Origin of Species* was one of the seminal works of the modern synthesis, prompting a surge of evolutionary studies throughout biology.

A History of Genetics

by Alfred H Sturtevant

As one of Thomas Hunt Morgan's brightest students, Sturtevant was ideally placed to write his *History*, first published in 1965. Nobel laureate ED Miller (and student of Sturtevant) writes in his foreword, "The reprinting of this classic book provides students with one of the few authoritative, analytical works dealing with the early history of genetics. Those of us who had the privilege of knowing and working with Sturtevant benefited greatly from hearing first-hand his accounts of that history as he knew it and, in many instances, experienced it. Fortunately, Sturtevant put it all together in this book."



NCSE on the Road

A CALENDAR OF SPECIAL EVENTS, PRESENTATIONS, AND LECTURES

DATE October 24, 2002
CITY Berkeley CA
PRESENTER Philip Spieth
TITLE The Creationist Assault on Evolution
TIME 7:00 PM
LOCATION Canterbury House, 2334 Bancroft Way
CONTACT Gary R Brower, (510) 845-5838
information@berkeleycanterbury.org

DATE October 26, 2002
CITY San Francisco CA
PRESENTER Eugenie C Scott
TITLE The Big Ideas of Human Evolution
EVENT California Science Teachers Association
TIME 8:00 AM
LOCATION Bill Graham Civic Auditorium
CONTACT Judy Scotchmoor, jscotch@uclink4.berkeley.edu

DATE October 27, 2002
CITY Denver CO
PRESENTER Eugenie C Scott
TITLE Scientists and Congressional Anti-evolutionism
EVENT Geological Society of America panel discussion
TIME 8:00 AM
LOCATION Colorado Convention Center
CONTACT Eugenie Scott, scott@ncseweb.org

DATE November 4, 2002
CITY Austin TX
PRESENTER Eugenie C Scott
TITLE Why is Evolution Not Being Taught?
EVENT Southwest Educational Development
Laboratory panel discussion.
TIME TBA
LOCATION 211 E 7th St
CONTACT Eugenie Scott, scott@ncseweb.org

DATE November 21, 2002
CITY New Orleans LA
PRESENTER Eugenie C Scott
TITLE An Anthropological View of the
Creation/Evolution Controversy
EVENT American Anthropological Association
TIME 7:00 PM
LOCATION Hyatt Regency Hotel Poydras Plaza
CONTACT Sara Stinson, sara_stinson@qc.edu

DATE April 9, 2003
CITY Spokane WA
PRESENTER Eugenie C Scott
TITLE The Old and New Anti-evolutionism:
Creationism Evolves
EVENT Gonzaga University Biology Department
Lecture Series
TIME 7:30 PM
LOCATION TBA
CONTACT Hugh Lefcort, lefcort@gonzaga.edu

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

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wish to claim in response that its Senior Fellow Jonathan Wells's book *Icons of Evolution* [2000] constitutes a contribution to the literature on science education. But the reviews of *Icons of Evolution* in the scientific journals have been uniformly scathing. For example, Jerry A Coyne's review in *Nature* — which, as the Bibliography proclaims, is "one of the top two science journals in the world" — concludes with the ironic comment that "*Icons* is exactly as even-handed and intellectually honest as one would expect from someone whose 'prayers convinced me that I should devote my life to destroying Darwinism'" [Coyne 2001; the passage Coyne quotes is from Wells's essay "Darwinism: Why I went for a second PhD", to be found on a Unification Church web site at <<http://www.tparents.org/Library/Unification/Talks/Wells/DARWIN.htm>>].)

NCSE's questionnaire also asked whether the authors considered their work appropriate for use in high-school biology classes. Some simply did not know; but several explained that their publications would be inappropriate for use in high-school biology classes, for a variety of reasons.

First, despite the Discovery Institute's boast that "Over half of the papers listed below were published within the past 2-3 years, with the remainder published

throughout the 1990s", several respondents noted that their work was already outdated. For example, David M Williams (coauthor of item 18) wrote:

Our review was written nearly 10 years ago and things have moved on since then. Many of the possible solutions to data incongruence we suggested then have now been acted upon and molecules and morphology agree in many more cases. In fact, many more examples using molecules and morphology together highlight and clarify topics relating directly to many evolutionary issues.

Second, many respondents remarked that their publications were intended for a specialist audience; for example, Keith Stewart Thomson (author of item 30) replied, "No, it is totally inappropriate, as it can only be judged in terms of a knowledge of the particular detailed subject matter. It is part of a sophisticated professional discussion within a part of the subject of evolution, not a general exposition for general readers".

Third, several respondents explained that their work is as yet too speculative to be included in high-school biology classes. Leslie E Orgel (author of item 43), for example, remarked, "I work at the frontiers of present-day knowl-

edge. I doubt that the time is ripe for a detailed and correct interpretation of my work at the high-school level." And Günther P Wagner (coauthor of item 31 and author of item 32) explains, "This is cutting-edge research, and we cannot yet know whether it will stand up under the scrutiny of our colleagues. There is too much work to be done to determine whether our ideas and results turn out to be correct and useful for further research." Orgel's and Wagner's attitude instructively contrasts with that of the promoters of "intelligent design", who wish for their views to be taught at the high-school level before they have been accepted by the scientific community.

NCSE also asked Brian J Alters, an internationally recognized expert on science education who holds appointments at Harvard University and McGill University, where he is the Director of the Evolution Education Research Centre, to comment on the pedagogical value of the Bibliography. Alters (who is also *RNCSE's* Associate Editor for Education) responded:

**Why were these papers selected?
... Not only is this selection of papers inappropriate for the high-school level, it will likely engender numerous misconceptions.**

37. Fraser CM, Gocayne JD, White O, Adams MD, Clayton RA, Fleischmann RD, Bult CJ, Kerlavage AR, Sutton GG, Kelley JM, Fritchman JL, Weidman JF, Small KV, Sandusky M, Fuhrmann JL, Nguyen DT, Utterback T, Saudek DM, Phillips CA, Merrick JM, Tomb J, Dougherty BA, Bott KE, Hu PC, Lucier TS, Peterson SN, Smith HO, Venter JC. The minimal gene complement of *Mycoplasma genitalium*. *Science* 1995; 270: 397-403.

38. Hutchison III CA, Peterson SN, Gill SR, Cline RT, White O, Fraser CM, Smith HO, Venter JC. Global transposon muta-

genesis and a minimal mycoplasma genome. *Science* 1999; 286: 2165-9.

39. Koonin EV. How many genes can make a cell: The minimal-gene-set concept. *Annual Review of Genomics and Human Genetics* 2000; 1: 99-116.

40. Maniloff J. The minimal cell genome: "On being the right size". *Proceedings of the National Academy of Sciences USA* 1996; 93: 1004-6.

41. Mushegian AR, Koonin EV. A minimal gene set for cellular life derived by comparison of complete bacterial

genomes. *Proceedings of the National Academy of Sciences USA* 1996; 93: 10268-73.

42. Peterson SN, Fraser CM. The complexity of simplicity. *Genome Biology* 2001; 2: 1-7.

43. Orgel LE. Self-organizing biochemical cycles. *Proceedings of the National Academy of Sciences* 2000; 97: 12503-7.

44. Szathmáry E. The evolution of replicators. *Philosophical Transactions of the Royal Society of London B* 2000; 335: 1669-76.

When high school students read such relatively complex discussions written for scientists, they often believe that the authors are contending that evolution is a theory in crisis. But when such articles are read by those with the proper university training in science, those readers do *not* conclude that the authors are contending that evolution is a theory in crisis. This difference is very telling and probably explains why the Discovery Institute selected these particular papers. After all, the Institute gives no rationale for the selection. Of all the colleagues I know in North America, none of those university science educators with expertise in training high school teachers would have selected these papers for high school students. So again, why were these particular papers selected? Not only is this selection of papers inappropriate for the high-school level, it will likely engender numerous misconceptions among high school students about the science of evolution — something no science teacher would want.

So not only has the Discovery Institute failed to *provide* any pedagogical rationale for its Bibliography, science educators cannot *find* any pedagogical value in it.

5. WORKING IN THE QUOTE MINE

RNCSE readers and others who have examined anti-evolution literature are well acquainted with quote-mining — the combing of the scientific literature to extract quotes that seem to contradict current scientific practice and theory, and using them to confuse public officials and the general public. The Discovery Institute is accumulating quite a record of quote-mining. Jonathan Wells's *Icons of Evolution* (2000) is essentially a compendium of quote-mining intended to discredit evolution in general; the reviewers for *Nature*, *Science*, and *The Quarterly Review of Biology* were unani-

mous in finding nothing of scientific or pedagogical value in it (Coyne 2001, Scott 2001, Padian and Gishlick 2002). The Discovery Institute's *Getting the Facts Straight: A Viewer's Guide to PBS's Evolution* (2001) is another exercise in quote-mining, intended to discredit the recent critically acclaimed PBS series on evolution in particular. Jerry Coyne, one of the scientists whose views were misrepresented by the Discovery Institute in *Getting the Facts Straight*, commented:

The Discovery Institute is up to its old tricks. Given the complete absence of evidence for their own theory of "intelligent design" — a theory that has produced not a single scientific paper in a peer-reviewed journal — they instead seek "confirmation" of their views in controversies about evolutionary biology. Their strategy (transparent to all thinking people) is to sow doubt about the fact of evolution simply because scientists do not know every detail about how evolution occurred (Anonymous 2001).

In fact, the Discovery Institute's reputation for quote-mining is apparently spreading in the scientific community. In his response to NCSE's questionnaire, for example, David P. Mindell (coauthor of item 14), wrote, "I am appalled that the Discovery Institute would find anything in any of my work to support their unscientific views. I am of course familiar with them as a source of misinformation and misunderstanding about nature and propaganda for anti-science education legislation."

Because it cites 44 valuable, if abstruse, contributions to the scientific literature, the Bibliography may at first glance appear scientific itself. But make no mistake: quote-mining is neither scholarship nor research. It is propaganda. What John R. Cole wrote over twenty years ago is still true today: "Instead of searching for quotations, creationists should test their ideas against empirical evidence" (Cole 1981: 43). Until the staff of the Discovery Institute follows his advice, the Ohio Board of Education should not take theirs.

ACKNOWLEDGEMENTS

Thanks to Alan Gishlick for providing the bulk of the scientific content and Philip Spieth for assistance on a point about molecular phylogeny; thanks to Sujatha Jagadeesh Branch and Skip Evans for useful advice about style and tone; thanks to Brian J. Alters for his prompt response to our request to evaluate the pedagogical value of the DI's Bibliography; and most of all, thanks to the many scientists who took the time to rebut the DI's misrepresentation of their work.

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READ ABOUT THE DI'S QUOTE-MINING ON-LINE

To read the original documents on which these articles are based, connect to the NCSE website:

HTML version:

<http://www.ncseweb.org/resources/articles/3878_analysis_of_the_discovery_inst_4_5_2002.asp>

PDF version:

<http://www.ncseweb.org/media/Analysis_of_the_Discovery_Institute.pdf>



Buzzing Up the Wrong Tree: Discovery Institute Caught Out on a Limb

Throughout its response to NCSE's analysis of its Bibliography, the Discovery Institute (DI) restates its misinterpretations of the literature, frequently accusing the authors of misunderstanding what they themselves wrote. However, one case stands out among the predictable misinterpretations and misrepresentations in the DI's response.

The DI took special exception to a reply from one of the authors of a paper entitled "Trees for Bees" in the journal *Trends in Ecology and Evolution*. The article explores the problem of modeling the evolution of social behavior in four bee taxa using morphological and molecular data (Lockhart and Cameron 2001). In their paper, Lockhart and Cameron argue that none of the analyses with existing data gives a clear picture of the evolutionary history of eusociality in these taxa. The authors contend that the lack of agreement among trees produced by different methods is caused by the timing of the actual evolutionary event that the data represent. Lockhart and Cameron are clear that the lack of resolution in their studies does not indicate a problem with evolutionary theory or represent a challenge to the idea of common descent of these bee taxa.

THE BEE TREE "PROBLEM"

According to the DI, this article qualified for its Bibliography because it was one of the publications that

represent dissenting viewpoints that challenge one or another aspect of neo-Darwinism (the prevailing theory of evolution taught in biology textbooks), discuss problems that evolutionary theory faces, or suggest important new lines of evidence that biology must consider when explaining origins.

The DI Bibliography summarizes the Lockhart and Cameron paper this way:

The relationships of the four major groups of bees (the highly eusocial honey bees, the stingless bees, the bumble bees, and the solitary orchid bees) presents a classic challenge to evolutionary analysis. Lockhart (Massey University, New Zealand) and Cameron (the University of Arkansas) explain that "molecular and morphological data have suggested strikingly different phylogenetic relationships among corbiculate bee tribes" (pp 84-5), an unresolved problem that they conclude does not stem from the different methods used by different investigators trying to reconstruct the history of the bees. "Disagreement exists because analyses of [DNA] sequences and morphology suggest different hypotheses, and not because researchers have used different criteria for building and testing evolutionary trees" (p 87) (DI 2002a).

In reply to NCSE's questionnaire, Lockhart responded:

[O]ur work does not present "a classic challenge to evolutionary analysis". In our paper we point out that technically it is a hard problem to reconstruct the phylogeny of corbiculate bees regardless of whether you use morphological or molecular data (the reason for this concerns the pattern of radiation — four different lineages diverged in a short period of time a long time ago — given this pattern it is not surprising that different data types might suggest different phylogenies) (Branch 2002: 14).

At issue is a well-known phe-

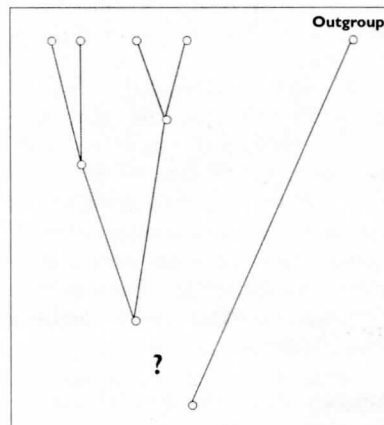


FIGURE 1: The long branch attraction problem is caused by two patterns of evolutionary change. In the first, taxa that diverged slightly a long time ago will be difficult to distinguish on the basis of molecular data. In the second, recent divergences are easier to analyze than those that occurred long ago, even when the amount of molecular divergence is the same. The result is that the pattern of evolutionary branching and the relationship between earlier branches and the outgroup are difficult to characterize reliably. (Redrawn from Figure 2a, Lockhart and Cameron 2001: 85).

nomenon known as "long branch attraction" (Figure 1; Felsenstein 1978; Hendy and Penny 1989; Huelsenbeck and Hillis 1993; Huelsenbeck 1997) — a situation described by NCSE's Kevin Padian as analogous to "depth of field" in optics.

If we use binoculars to view several people in a field half a mile away, it is possible to see them very clearly, but it is difficult to measure accurately how close they are to each other — or even to tell whether one is a little closer to us than the other is. The optical qualities of the lens make it possible to see objects clearly from a great distance, but at the expense of our ability to assess differences among the people that are very small relative to the distance between us and the people as a group. In the same way, the first problem with the "Bee Tree" is that the molecular divergence that originally separated the evolutionary branches is small compared to the large amount of molecular divergence since then.

The second problem associated with long evolutionary branches is that it is easier to assess small amounts of change that are more recent than a similar amount of change that occurred long ago. Padian notes that reading glasses allow us to distinguish small type on a page a foot from our eyes, but the same lenses make it difficult to read book titles on a shelf across the room. In the long branch prob-

lem, the small amount of more recent evolutionary divergence is easier to identify and assess unambiguously than similar small evolutionary changes that happened long ago. Thus, when long branch problems crop up, they alert scientists to the possibility that the changes involved occurred a long time ago, but within a relatively short interval. This leads to new lines of investigation.

Because the relationships among the earliest branches are difficult to assess reliably, it is difficult to “root” the phylogenetic tree — that is, to establish the ancestral state of the characters used to construct subsequent branches of the tree and to place the corbiculate bees in relationship to other, more distantly related taxa.

DISSENTING VIEWPOINTS?

The first criterion for including articles in the DI Bibliography is that they represent “dissenting viewpoints that challenge neo-Darwinism”. However, Peter Lockhart replied:

[W]e suggest that the bee morphologists relook at the interpretation of some of their data and we also encourage the molecular biologists to determine some additional data [that] would help test their hypotheses — we suggest that if these things are done then there should be a resolution to the controversy over which phylogeny is correct. We do not doubt that there is a phylogeny — in contrast, the statement by the Discovery Institute suggests that the bee controversy is *evidence for absence of phylogeny*. No scientist involved in the corbiculate bee debate has ever suggested this to my knowledge (Branch 2002: 14, emphasis in original).

So much for dissent that challenges the prevailing theory of evolution.

PROBLEMS FOR EVOLUTIONARY THEORY?

In its response, the DI asserts “the Supplementary Bibliography is entirely accurate in what it says about this article” (DI 2002b). But, as Lockhart explained in his reply, the DI’s summary ignores the fact that the paper’s point was in part that

the difficulty in reconciling the bee phylogenies suggested by molecular and morphological data was only to be expected because of the evolutionary history of these lineages. The problem, according to Lockhart, was in the data themselves and methods used, not in the theory that generated the research. Lockhart summarized the work this way:

Reconstructing the evolutionary relationships amongst corbiculate bees is a difficult problem for researchers because there has been a lot of morphological and DNA sequence change since the four bee tribes diverged from each other. It is well known from theoretical studies that under these conditions reconstructing evolutionary history is a difficult task (Lockhart 2002).

Indeed, Lockhart and Cameron (2001) show *many* evolutionary trees successfully reconstructed from the existing data. All of them

confirm that evolutionary theory is an appropriate and fruitful foundation for this research. The problem is knowing which of the possible evolutionary trees is most likely to be the correct one. In this case, the theory is working fine, but the data do not allow sufficient discrimination among evolutionary options — hence the call for more data.

NEW LINES OF EVIDENCE?

What “important new lines of evidence” do Lockhart and Cameron (2001) suggest that “biology must consider when explaining origins”? In his response to NCSE’s questionnaire, Lockhart wrote, “[W]e make some suggestions which we believe will help resolve why the different data types suggest different conclusions” (Branch 2002: 14). In their paper, Lockhart and Cameron (2001) also demonstrate the benefits and problems associated with a number of approaches to analyzing existing data. They call for new data

NCSE’s Questionnaire to Authors

{In response to the Discovery Institute’s “Bibliography of Supplementary Resources for Ohio Science Education”, NCSE sent this query to authors whose work was cited to ask whether they agreed with the DI’s assessment of their work. Text in [brackets] is explanatory and was not part of the questionnaire.}

Dear [addressee],

I’m writing from the National Center for Science Education, a nonprofit organization that works to defend the teaching of evolution in the public schools. We are an affiliate of the American Association for the Advancement of Science.

An article [or “a book” or “several articles”] written [or “co-authored”] by you — [citation of publication or publications] — has [or “have”] been cited in a “Bibliography of Supplementary Resources for Ohio Science Instruction” prepared by the staff of the Discovery Institute (DI), a Seattle-based public policy organization. According to the Discovery Institute, the publications cited in this bibliography

represent dissenting viewpoints that challenge one or another aspect of neo-Darwinism (the prevailing theory of evolution taught in biology textbooks), discuss problems that evolutionary theory faces, or suggest important new lines of evidence that biology must consider when explaining origins.

The DI prepared the bibliography to give to the Ohio Board of Education, which is presently being lobbied by several organizations either to weaken the newly-proposed state science standards’ coverage of evolution or to include material on “alternative theories” in their coverage of evolution. The DI, for its part, is the institutional home of the so-called “intelligent design” movement, spearheaded by Phillip Johnson (author of *Darwin on Trial*) and having William Dembski (author of *Intelligent Design: The Bridge Between Science and Theology*), Michael Behe (author of *Darwin’s Black Box*), and Jonathan Wells (author of *Icons of Evolution*) among its Senior Fellows.

We would appreciate your reviewing the information about your work included in the DI’s bibliography and answering a few questions. Please feel free either to answer just yes or no, or to expand as you see fit.

because none of the existing methods resolves the phylogenetic relationships of these bee tribes using the existing data.

Does that conclusion constitute considering “new lines of evidence”? Not according to Peter Lockhart, the *author* of the article and a leader in evolutionary analysis.

WHEN IS A “PROBLEM” A “CHALLENGE”?

So a close examination of one of the items in the DI Bibliography along with detailed correspondence with the study’s author show that this item fails to meet *any* of the 3 criteria set out by the DI for its inclusion.

It does not represent a “dissenting viewpoint that challenge[s] one or another aspect of ... the prevailing theory of evolution taught in biology textbooks”; it does not “discuss problems that evolutionary *theory* faces” (emphasis added); and it does not “suggest important

new lines of evidence that biology must consider when explaining origins”. On the contrary, this article demonstrates that evolutionary biology is a vital, active scientific field — one that is still coming to grips with a methodology and a type of data that have become widely available and useful in evolutionary analyses only in the past few decades.

The DI’s response to Lockhart reiterated its earlier claims and defended its characterization of this work as “a classic challenge to evolutionary analysis”:

The Supplementary Bibliography did not pull the phrase “classic challenge” from thin air. Rather, “classic challenge” is a *nearly* identical restatement of Lockhart’s own phrases, “classic problem” and “classic example ... in which it [is] difficult to place outgroups correctly.” (DI 2002b; emphasis added).

1. The DI describes your work as follows:

[*The Discovery Institute’s summary of the publications, taken from the Bibliography:*] Do you consider this accurate?

2. The DI seeks to promote “intelligent design,” which it describes on one of its web sites as follows:

“Intelligent design” refers to a scientific research program as well as a community of scientists, philosophers and other scholars who seek evidence of design in nature. Through the study and analysis of a system’s components, a design theorist is able to determine whether various natural structures are the product of chance, natural law, intelligent design, or some combination thereof. ... In nature, design theorists cite information rich systems like the genetic code, irreducibly complex systems like the bacterial flagellum, and the fine-tuning of the laws of physics as evidence of intelligent design. [Quoted from <<http://www.reviewevolution.com/whatsIntelligentDesign.php>>.]

Do you consider your work to provide scientific evidence for “intelligent design”?

3. Do you consider your work to provide scientific evidence against evolution?

[*In questionnaires sent after the Bibliography appeared on the Discovery Institute’s web site with the disclaimer, the sentence “Please note that (perhaps having gotten wind of our questionnaire) the DI now disclaims any intention to portray your work either as supportive of [“intelligent design”] or as providing evidence against evolution: see <<http://www.discovery.org/viewDB/index.php3?command=view&id=1127&program=CRSC%20Responses>>.” appeared here. The same information was sent separately to those respondents to whom questionnaires were sent before the Bibliography appeared on the web site.*]

4. Do you consider your work to be appropriate for use (e.g., as a supplement to a textbook) in high school biology classes?
5. May we have your permission to publish or otherwise disseminate your responses to this questionnaire?

Thanks very much for your time. We would appreciate hearing from you as soon as possible. If you have any questions about NCSE or this questionnaire, please feel free to get in touch with us.

The real problem with the DI’s semantic maneuvers is that a casual reader would be likely to equate “classic challenge to evolutionary *analysis*” with a classic challenge to evolution *itself*. Lockhart agrees: “This interpretation would be wrong” (Lockhart 2002). And that is the heart of the matter. By careful wording that is *nearly* identical with the original, the DI has managed to convey a meaning completely at odds with the authors’ intent. Either the DI can tell the difference, or it cannot. In either case, as Peter Lockhart concludes, “[i]t is hard to imagine that this approach is going to help anyone” (Lockhart 2002).

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[Contributions to this article were made by Alan Gisblich, Kevin Padian, Andrew Petto, and Glenn Branch.]

BOOKREVIEWS

INFINITE TROPICS: AN ALFRED RUSSEL WALLACE ANTHOLOGY

Edited by Andrew Berry. London: Verso, 2002. 320 pages.

Reviewed by Charles H Smith

Some of the earliest surviving thoughts committed to paper by the English naturalist and social critic Alfred Russel Wallace (1823–1913) were in a lecture he entitled “The Advantages of Varied Knowledge”. Composed around 1843, it advocates a broad-based approach to the individual’s education, one that recognizes the assimilation of a wide range of facts — and their logical integration — as the foundation for a dependably evolving belief system. He argues: “... here we see the advantage possessed by him whose studies have been in various directions, and who at different times has had many different pursuits, for whatever may happen, he will always find something in his surroundings to interest and instruct him ...”. He concludes the essay with the following vivid imagery:

Is it not fitting that, as intellectual beings with such high powers, we should each of us acquire a knowledge of what past generations have taught us, so that, should the opportunity occur, we may be able to add somewhat, however small, to the fund of instruction for posterity? Shall we not then feel the satisfaction of having done all in our power to improve by culture those higher faculties that distinguish us from the brutes, that none of

the talents with which we may have been gifted have been suffered to lie altogether idle? And, lastly, can any reflecting mind have a doubt that, by improving to the utmost the nobler faculties of our nature in this world, we shall be the better fitted to enter upon and enjoy whatever new state of being the future may have in store for us?

No one has ever heeded his own good advice better than Wallace did. Born poor but with an intense native curiosity, he worked as a surveyor to his mid-20s before abandoning that occupation to turn professional natural history collector. He spent the years 1848–1852 in the Amazon Valley, then the even longer period 1854–1862 in the Indonesian archipelago (then known as the “Malay Archipelago”), collecting up a storm. His 12-year stint in the tropics would eventually make him famous — not only for his formulation of the theory of natural selection, but as the father of the modern approach to biogeography, and arguably as history’s foremost field biologist and tropical naturalist.

Wallace’s success was due in large part to his perseverance: both in amassing facts of significance to the naturalist and in tying these facts to logical explanatory structures. He gave his attention to just about anything that was deserving of interest: the manner of construction of native huts; the economic uses of plants; the colors of animals; trade between cultures; the geology, climatology, and physical geography of the lands he visited; native languages and vocabularies; special biological adaptations; the presence or absence of species from location to location; ethnological similarities and differences; the relative sizes of insects; and so on. His 1869 book *The Malay Archipelago* in particular is a gold mine of such information, woven together with a compelling narrative that still never fails to amaze — especially when one considers how he accomplished all of it

by himself, as a solo, unsupported naturalist/explorer.

Thankfully, all this determination and insight as an investigator of nature and humanity was wed to an easy and lucid — yet forceful — writing style. In 1855 Wallace published his first essay on evolutionary biogeography; this was followed in 1858 by the famous elaboration of natural selection sent to Charles Darwin. From then on, it was off to the races: he averaged over a dozen published works per year for the next 55 years, right up through the year of his death. Neither was there even any falling off in production as he aged; in the last (ninth) decade of his life he edited or wrote eight books, plus a hundred or so shorter items.

Which brings us to Andrew Berry’s splendid anthology. This is the fourth print anthology of Wallace writings; earlier collections were edited by Barbara Beddall (1969), Charles H Smith (1991), and, just this year, Jane Camerini (2002). Beddall’s and Camerini’s studies are relatively short works that focus on Wallace’s work from his period in the field. Smith attempted to survey the full range of Wallace’s interests, relying primarily on the entire texts of about a hundred key works. Berry has taken a new track, sampling, again, from the entire range of Wallace’s oeuvre, but usually showcasing short excerpts of a couple of pages or less in length. This tactic allows Berry a flexibility lending itself to a more biographically contextual approach, and he has used this strategy to produce a study combining writings and editorial narrative that does a very good job indeed of delivering the man and his ideas to the reader.

The selections themselves are very well chosen — and in the case of Wallace, a man who published nearly eight hundred works, most of which almost no one has cast eyes on for upwards of a hundred years, this is by no means an insignificant accomplishment. Further, Berry, who unlike the individuals mentioned earlier has never done any other serious research on Wallace, has managed to produce an editorial commentary which is just about free of error, and which avoids overgeneralizing about a man regarding whom overgeneralization runs rampant in the literature. I do find Berry’s fascination with the possibility that Darwin stole material from Wallace somewhat ill-advised, and to that extent agree with the late

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Stephen Jay Gould's reservations on this matter as stated in his Foreword. On the other hand, I take issue with the accuracy and/or advisability of some of Gould's other remarks — here, as in his many other writings on Wallace, his comments seem more relatable to prior agendas than to a dispassionate view of Wallace's ideas and achievements.

The summary outcome of Berry's collection is that it succeeds admirably as a tease inviting further exploration. In a 430-page project, it is hardly possible to review a man's work thoroughly when that man himself published well over 10 000 pages of material; in the case of Wallace, the goal of review is especially difficult, as he was anything but a conventional thinker and often projected neatly logical trains of thought that led to wholly unanticipated conclusions. As a result, scholarship (not to mention public opinion) has made the mistake of paying too much attention to the sensational in Wallace's world view, and overlooking the elemental.

As a good example, it is well known that Wallace was a prominent anti-vaccinationist — a fact that might lend itself to a variety of premature conjectures as to the quality of his judgment. Actually, however, Wallace did not deny that smallpox vaccination had been a useful means of dealing with the problem in its early years of application. But, he argued, ambient improvements in public health, unsanitary vaccine preparation standards, and conflicts of interest within the medical community by the later part of the 19th century had possibly led to a situation wherein the vaccination procedure was causing more mischief than the disease itself. And he backed this up with a never-refuted statistical analysis of the best available smallpox incidence data: among the first epidemiological studies of its kind.

A second example lies in Wallace's beliefs as to the possibility of life on other worlds. It is often stated, incorrectly (and in the Foreword Gould contributes to the misunderstanding), that Wallace believed life existed only on earth. Actually, his view was that only earth harbors conditions promoting higher (consciously self-aware) life-forms. Of greater interest, one might argue, was the methodology he used to come to such conclusions. In the case of his famous criticism of astronomer Percival Lowell's belief that humanoid-constructed

canals existed on the surface of Mars, this method invoked a close analysis of the probable climate of Mars and the likely condition of its surface. Many of his conclusions in this regard have turned out to be quite close to modern knowledge of the situation, and for his efforts he is slowly gaining recognition as a founder of the science of exobiology.

There is hardly a historical individual whose world-view touched on a wider range of subjects still relevant to present-day concerns than Alfred Russel Wallace. Berry has performed a great service by producing this collection, which manages to avoid hero-worship or uncritical review, yet offers up a thoroughly sympathetic portrait of a truly exemplary human being.

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THE ALFRED RUSSEL WALLACE READER: A SELECTION OF WRITINGS FROM THE FIELD

Edited by Jane Camerini. Baltimore (MD): Johns Hopkins University Press, 2001. 219 pages.

Reviewed by Douglas Palmer

At last, Alfred Russel Wallace is getting a fairer share of the lime-light. He had almost been written out of the story of evolution through neglect, but in many ways he is a more interesting person than his more famous collaborator Charles Darwin.

The contrasts between their circumstances and personalities reveal

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the nuances of Victorian middle-class society. Although Wallace came from a professional background, he had to rely on self-help and that great Victorian creation, the Mechanics' Institute, for his secondary education. Wallace had to make his own way in the world and earned his living as a professional collector of wildlife in some of the most uncomfortable places on earth. But he still found time to theorize about what he saw, and communicate his ideas to established scientists by letter.

Jane Camerini's excellent selection of Wallace's copious and diverse writings allows the man to speak for himself. Wallace was author of about 22 books ranging from *Island Life* to *Land Nationalisation* and even *On Miracles and Modern Spiritualism*, a topic in which he tried unsuccessfully to get Darwin and Huxley interested.

As his children recalled, "an uphill fight in an unpopular cause, for preference a thoroughly unpopular one, or any argument in favor of a generally despised thesis, had charms for him that he could not resist." He was a much more independent thinker than Darwin, openly espousing Owenite socialism and religious skepticism. If only Karl Marx had written to Wallace rather than Darwin about evolution, he might have got a reply.

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JUST BEFORE THE ORIGIN: ALFRED RUSSEL WALLACE'S THEORY OF EVOLUTION

by John Langdon Brooks.
Lincoln (NE): iUniverse.com, 1999.
304 pages.

Reviewed by Charles H Smith

When this book was first published in 1984 (New York: Columbia University Press), it created a bit of a stir. Brooks had not been content just to write a clear and concise account of the early evolution of Alfred Russel Wallace's ideas on — well, evolution — he had gone ahead and claimed that Darwin had stolen some of Wallace's ideas in fashioning his landmark book *On the Origin of Species*. This actually was not a new claim; four years earlier the journalist Arnold Brackman had made the same assertion in his book *A Delicate*



Arrangement: The Strange Case of Charles Darwin and Alfred Russel Wallace (New York: Times Books, 1980), and gone to equal lengths in trying to defend his accusation. And Brooks himself had written on the same subject even earlier. Brackman was neither a scientist nor a historian of science, and his book was criticized as carping and sensationalist. Brooks, however, had a respectable reputation as a biologist, and consequently his arguments were taken a bit more seriously.

Both authors made much of the possibility that Darwin had received Wallace's 1858 manuscript on natural selection — the one that pushed Darwin into completing the *Origin* — a month earlier than has generally been credited. Their evidence on this score, involving mail route records and the trail of other letters sent at the same time, is actually fairly good; but only fairly good, not definitive. Brooks added fuel to the fire by trying to show that Darwin's pre-publication manuscripts of the *Origin* contained sections that appeared to have been written later than the others. These sections included Darwin's model of the process of divergence, a subject with which Wallace had also grappled.

Intrigue involving major historical figures is always fodder for interest, but one needs to be alert to the possibility of distortions from the underlying agendas of investigators. In this instance, although it seems clear that Brooks really believes that Wallace has been done an injustice, we are within our rights to ask whether the accusation made is worthy of the subject. It might have been more useful — if initially less noteworthy — to have devoted the full thrust of the analysis to Wallace's thought, and why we should care about it to begin with. In point of fact, Brooks does not really add that much insight into the progression of Wallace's early views on evolution to the work produced some years earlier by three other Wallace scholars, H Lewis McKinney, Barbara Beddall, and Malcolm Kottler.

Reviewers of the time criticized Brooks for not laying out enough sociological context within which to view Wallace's early development, but my main criticism is instead with Brooks's unwillingness to relate Wallace's early years to his post-1858 views. Indeed, Brooks hardly mentions this succeeding period, or refers to any of Wallace's later writings (that

is to say, over 90% of his total output). The assumption, a bad one at best, must have been that we already understand enough about Wallace's subsequent development to be able to identify a simple linearity in the evolution of his world view. This is doubtful now as it was in 1984.

The work of McKinney, Beddall, Kottler, and Brooks has given historians a firm basis upon which to understand Wallace's development in Darwinian terms, but has been a good deal less successful at providing such a basis in Wallacian terms. This is truly unfortunate, because as a result most investigators have clung to the notion that Wallace's ideas contained internal inconsistencies that required him to "change his mind" on the matter of a couple of significant issues later on. The fact that he was able to write successfully on so many subjects thoughtfully in the following years alone suggests that this is a dubious conclusion; perhaps in the future investigators will more seriously consider other approaches to unraveling the philosophy of this extraordinarily capable thinker.

This does not mean that *Just Before the Origin* is an unworthy read; on the contrary, it does a very good job of tracing the basic stages of Wallace's intellectual development in his early years in the Amazon and Malay Archipelago. It is well-researched and well-written, incorporating among other helpful features the text of a dozen or so letters Wallace published while in the field that had been lost to historians and the public for over a hundred years. But rest assured that, Darwin notwithstanding, this is one history that has yet to be completely written. At least five books on Wallace are to be published this year alone, and the writer knows of several others that are in preparation. We may well see Wallace raised to a loftier place in history than his "other man" status yet.

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KING OF THE CROCODYLIANS: THE PALEOBIOLOGY OF *DEINOSUCHUS*

by David R Schwimmer.
Bloomington: Indiana University Press, 2002. 221 pages.

Reviewed by Kevin Padian,
NCSE President

Ever wonder how many books have been devoted to just a single fossil species? Jack Horner and Don Lessem did *The Complete T rex*. Ned Colbert published *Little Dinosaurs of Ghost Ranch*, about *Coelophysis*. Peter Dodson wrote about *The Horned Dinosaurs* and Ken Carpenter about *The Armored Dinosaurs*, but those were groups, not individual species. Besides, all those are dinosaurs. What about less "sexy" critters, like crocodiles?

Longtime NCSE member David Schwimmer, a professor at Columbus State University in Georgia, has published a very nice study of the giant crocodylian *Deinosuchus*, which was a contemporary of the last Cretaceous dinosaurs and certainly one of the largest crocodylians that ever lived. For that matter, it was one of the biggest land predators ever, even though its squatty crocodylian legs kept it closer to the ground than the big theropod dinosaurs like *Tyrannosaurus* and *Gigantosaurus*. It may have been up to 12 m long, or even longer, much like those dinos. And maybe it even fed upon them. And this may be the first book devoted to a single non-dinosaurian critter.

For people who get chills from big fierce animals, or even from good in-depth studies of big fierce animals, this is a fine book to curl up with. The interest is not only due to the fact that *Deinosuchus* was so big and fierce; in fact, it is hard to tell just how big and fierce it was because there are no complete specimens, and much of the skeleton behind the head is only known from fragments. But the charm of this book is that Dave Schwimmer takes readers through the processes by which paleontologists reconstruct animals like this from less than perfect remains. He covers the anatomy, and explains the functional morphology that gives us clues to the animal's behavior (with help from living crocs). He shows the lines of evidence from other animals, plants, and surrounding sediments that tell us what the environment of

Deinosuchus was like. He explains its relationships and compares it with other crocodylians in its fauna (and elsewhere in the world), and he sizes it up against other heavy contenders. He demonstrates how paleobiologists have been able to calculate individual ages of specimens and reconstruct the growth strategy that explains how the animal could get so big. He even identifies what may be *Deinosuchus* poop (coprolites, for you purists)!

After running this whole gamut, Schwimmer astutely acknowledges that his audience may not be completely satisfied, because he has not talked that much about dinosaurs. Could *Deinosuchus* have preyed upon dinosaurs? Can we realistically visualize it, waiting under the water's surface for a hapless duckbill or juvenile ceratopsian? Could it have dispatched such creatures with a single lunge and crunch? Do we have evidence for any of this? Do you really think I would spoil the ending?

I must, however, clear Dave's name in one respect. Some readers will wonder, "But wait: David Schwimmer. Isn't he the actor who plays the paleontologist Ross on the TV show *Friends*? How could he write a book like this?" Amazing coincidence: Dave and the actor share the same name, and Dave (like Ross) did a good deal of paleontology work in New York, where there is a good collection of *Deinosuchus*. But there the coincidence ends. In fact, our Dave has an e-mail tag that reads simply: "I'm not Ross."

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DOING WITHOUT ADAM AND EVE: SOCIOBIOLOGY AND ORIGINAL SIN

by Patricia A Williams
Minneapolis: Fortress Press, 2001.
227 pages.

Reviewed by Daryl P Domning,
Howard University, Washington, DC

Winds of change increasingly blow through the stale debate over creation and evolution. It once seemed to some that "intelligent design" (ID) proponents might offer a

fresh alternative to the polar extremes of biblical literalism and atheistic materialism, and reinvigorate the neglected middle ground of theistic evolution. But the ID movement has so far failed to deliver anything of scientific substance, purveying instead a heterogeneous stream of rhetoric broadly overlapping with that of creationists, and sometimes going so far as to explicitly reject even theistic versions of evolution (Dembski 1995, quoted by Scott 2001).

A better claim to the mantle of theistic evolution is asserted by the burgeoning field of evolutionary theology. Starting with the conspicuous contributions of Pierre Teilhard de Chardin, Catholic writers have been most prominent in this field in recent years (as reviewed in Domning 2001b). However, there is also a Protestant tradition of evolutionary theology, dating back to the 19th century, and it continues to bear good fruit.

Patricia Williams is a philosopher of biology nourished in the Episcopal Church, whose particular interests are in evolutionary ethics and sociobiology. In *Doing without Adam and Eve*, she seeks to "unite classical Christianity and modern science"; perceptively, she does this by "focus[ing] on the Christian doctrine of original sin, because it is amenable to scientific analysis" (p xiii). "Science", she says, "offers Christianity a new way to reformulate ancient Christian doctrines — original sin, the atonement, and an answer to the problem of evil" (p xiv).

"[T]he argument of the book has two parts, negative and positive" (p xv). In Part One, Williams gives a rather scathing critique of the traditional ideas about original sin, while stressing the vital importance of reconciling the divergent views of this doctrine about human nature that are held by the Protestant, Catholic, and Eastern Orthodox branches of Christianity. She sets forth three philosophical "tests of truth" (coherence, correspondence, and consilience) and uses them to deconstruct the notions of the Fall, original sin, and Adam and Eve as these developed in the Christian tradition(s). She demonstrates that "the doctrine of original sin is not in Genesis 2 and 3", but rather "stem[s] from Christian theological beliefs and misreadings, especially the egregious misinterpretations of Augustine and Calvin" (p 81).

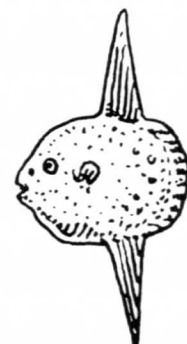
In Part Two, Williams outlines evolutionary and sociobiological theory, showing that it easily passes her "tests of truth" and provides a powerful scientific model of human nature. She then uses this scientific understanding to replace the theological doctrines of original sin, with results "both surprising and salutary for Christian theology" (p 142). Evolution underpins her explanations of freedom, sin, love, and punishment, and also provides essential ingredients for her solution to the problem of evil and her explanation of the doctrine of atonement.

These explanations are basically the correct ones, in my opinion — since I had independently come to the same conclusions myself, though by a very different route (arguing mainly from biology rather than philosophy). The central issue, of course, is the problem of evil and suffering (and no defender of evolution should ever forget that this is what is of paramount importance to creationists, with scientific questions trailing far behind).

Williams's "central answer to the problem of suffering ... is that having a self compensates for almost any suffering we might endure" (p 176). In other words, we could not be human without the very attributes that make it possible and inevitable for us to suffer and sin. "In God's eyes, it must be better for human beings to exist — beings with selves, beings who suffer — than for us not to exist. Having the attributes more than compensates for the evils that come with having them. This is the only answer required to solve the problem of evil because it justifies the existence of evil" (p 177). Exactly.

More generally, the attributes of the material universe that make possible physical evil (including suffering and death) are inseparable from the natural laws that make possible evolution and all the good things that result from it (including ourselves). There was no better way for God to create.

I find hardly any points of real substance on which to disagree with Williams. The major one (and even that rather slight) is that she goes on to add another, secondary solution to the problem: "Frequently, good comes out of evil. In the case of suffering, suffering helps build the self, the very cause of suffering" (p 177). In short, "we recycle evil to build better characters" (p 176). To my mind, this is an





old and weak argument that is superfluous, given the correct, "central", answer stated above. Maybe suffering does (sometimes) build character, but only as an inevitable byproduct of natural processes. It is misleading to give the impression that some divine drill instructor gratuitously added suffering to the creation for our own good. Williams makes it sufficiently clear that in an evolutionary world the suffering is necessary and not gratuitous; but emphasizing the idea that it is nonetheless for our own good unnecessarily dilutes her argument.

The other problems I see are mostly semantic. In demolishing both literal and liberal interpretations of the narrative of Adam and Eve (including the idea that we are somehow alienated and exiled here in this world), Williams claims to have done away with the doctrine of original sin itself. But this involves a mistaken definition of that doctrine, which is fundamentally not a statement about our alienation from the world (let alone the historicity of the Garden of Eden), but rather a statement of the empirical fact that we all do wrong and cannot, by our own efforts, entirely avoid doing wrong. Williams presents all the elements needed to explain this simple fact, both scientifically and theologically, and thereby provides not a negation of original sin but a quite satisfactory reformulation of it, in all but name (see Domning 2001a).

Another source of needless confusion is Williams's prominent use of the word "sociobiology" in both title and text. This will put off some readers, because early uses of this term by EO Wilson and others invoked large doses of genetic determinism in explaining human behavior. Williams, in contrast (p 143-7), specifically disavows this extreme view. I would rather she had labeled her own moderate and reasonable position with some less controversial and emotionally charged expression, such as "evolutionary ecology" or even just "evolutionary biology".

Quibbles over words aside, this is (by a slim margin) the best book I have seen published to date on original sin and the evolutionary explanation of evil — which are a central focus of the creation/evolution conflict. I recommend it to any Christian sincerely struggling with evolution and existential issues, to any theistic evolutionist looking for a satisfactory modern synthesis of theology and biology, and to any agnostic or atheist

who doubts the possibility of an adequate Christian response to the challenge of Darwinism.

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AN EVOLVING DIALOGUE: THEOLOGICAL AND SCIENTIFIC PERSPECTIVES ON EVOLUTION

Edited by James B Miller.
Harrisburg (PA): Trinity Press
International, 2001. 544 pages.

Reviewed by Philip T Spieth

The purpose of *An Evolving Dialogue* is "to provide a multidisciplinary educational resource for college, university and theological seminary educational settings, that will contribute to a constructive understanding of the dialogue between science and religion on the topic of biological evolution" (p 4). The book is admirably suited to its purpose.

Divided into five parts, the volume is composed of 28 articles that are reprints or revisions of papers published in the 1990s or late 1980s. The authors are major contributors in their disciplines. For the most part, their articles were addressed to a general readership. In its 2001 edition, *An Evolving Dialogue* is actually a clonal reproduction, with a macromutation, of an earlier version with a longer subtitle published in 1998. The fifth

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section of the 1998 version is "Evolution and Ethics"; in the 2001 version, it is replaced with a completely new fifth section consisting of 6 articles devoted to "intelligent design" (ID).

If a dialog between science and religion is to be successful, it needs to get its science right in order to provide a common ground upon which to build the dialog. The first two parts of *An Evolving Dialogue* provide a topical overview of evolutionary biology with articles by leading professionals such as Stephen Jay Gould, Mark Ridley, Douglas Futuyma, and Francisco Ayala. The two sections provide a reasonably good background for readers who are not versed in the evidence, theories, and principles of contemporary evolutionary biology. Biologists might find the articles useful for brushing up on a detail here or there.

The third part, "Historical and Philosophical Perspectives", includes an article on the concept of species by Ernst Mayr, followed by two particularly interesting historical articles. The article by Ronald L Numbers, published in 1986, predates the ascendancy of "intelligent design" as an anti-evolutionary perspective. Nevertheless, it provides illumination upon the mindset of creationists — for whom biblical inerrancy trumps scientific expertise — and serves as a needed reminder of the widespread hostility towards evolutionary biology that sadly exists among a significant fraction of the general public. John R Durant's 1987 article also predates ID but is eminently relevant to the issue. Durant gives a lucid exposition of the historical philosophical context that underlies the concepts of special creation and design and shows how these concepts were made philosophically untenable by the revolutionary impact of Darwin's insights.

The final article in the section is a reprint of Stephen Jay Gould's 1997 column in *Natural History* in which he elucidated his concept of non-overlapping magisteria (NOMA). It is not the most profound article in the volume, yet it gives a simple, clear definition of a philosophical point of view that pervades much of the book. Most of the scientists — and some of the theologians — whose articles touch upon both science and religion express some form of NOMA. A forceful example is Durant's comment:

If today we continue to be wor-

ried about the relationship between Darwinism and Christian belief, more often than not it is because we are faced either with science masquerading as theology or with theology masquerading as science. Only history can show us the full extent of the damage that is done by such pretense (p 266).

The fourth part is "Theological Perspectives". The authors include some of the leading contemporary theologians who strive to combine both good evolutionary science and good theology in their quests to find the proper relationship between these two important domains of intellectual endeavor.

In his article from 1996, John F Haught directly addresses the relationship between theology and evolutionary science, setting forth four "positions" — conflict, contrast, contact, and confirmation. This quartet provides an excellent functional framework for recognizing and classifying the contributions that different participants make to a dialog (or, for that matter, a debate) between science and religion. Haught's framework might provide a basis for developing a fuller, more closely reasoned, concept of NOMA, which falls under the rubric of "contact".

An important leitmotif in dialogs between theology and evolutionary science is the role of chance and indeterminacy. Haught explicitly recognizes the role of chance in evolution and its positive theological implications. And the theologian Elizabeth A Johnson, in her article from 1996, addresses the issue head-on. In a wonderful passage, she says:

No chance, no evolution of the universe. If it were not such an impossible oxymoron, chance might even be called a law of nature itself. Chance, consequently, is not an alternative to law, but the very means whereby law is creative. The two are strongly interrelated and the universe evolves through their interplay (p 358).

For evolutionary biologists, this passage should immediately bring to mind Sewall Wright's seminal ideas on the interplay between natural selection and genetic drift.

The fifth part is the site of the macromutation. It is also the section in which NOMA is violated. In the

previous version of the book, the fifth part consisted of articles on evolutionary ethics, in which the authors pushed the envelope at the border between the domains of science and religion. In the current version, leading writers from the ID movement seek to infiltrate the magisterium of science with religiously-based philosophical ideas. Articles by the ID writers are paired with rebuttal articles, much as in the April 2002 issue of *Natural History*.

Two ID articles are by William Dembski; one is by Michael Behe. The first article by Dembski (from 1998) is an overview of the history and goals of the ID movement. The phrase "undirected natural causes" appears repeatedly, always in contexts in which it is equated with "Darwinism". Do not ask where natural selection is in this equation; it is not there. The major thrust of the article is Dembski's conflation of methodological naturalism and philosophical naturalism. He clearly wishes both to be removed from science. Raymond Grizzle's article from 1995 should be read immediately after this article. Directly addressing the proponents of ID, Grizzle essentially accuses them of violating NOMA. He makes a clear case for the necessity of maintaining methodological naturalism within the magisterium of science.

Dembski's second article (from 1997) is a semi-technical summary of his ideas of actualization-exclusion-specification and his theory of complex specified information. Brandon Fitelson, Christopher Stephens, and Elliott Sober provide an even more technical rebuttal published in 1999. Dembski has some interesting ideas for readers interested in probability. Unfortunately, his treatment is based upon a "neutral" theory of evolution. Natural selection is never included, which makes Dembski's arguments irrelevant to evolutionary biology.

Behe's article from 1996 gives an introduction to his concept of irreducible complexity. In turn, the article by Kenneth R Miller from 1994 shows that, when the evolutionary roles of contingency and jerry-rigging are taken into account, the empirical examples cited by Behe fail to justify the conclusions that Behe wants to draw from them. More generally, Miller marshals an array of empirical examples to demonstrate that the facts of natural history are not in accord with predictions that can reasonably be made from a hypothesis of "intelligent design".

Overall, *An Evolving Dialogue* is a fascinating book. It makes a good resource for courses that delve into the relationship between the magisteria of science and religion; Gould's and Miller's essays are both on the agenda for my course at Berkeley. Be warned, however, that the book's physical layout has a few problems. One must look in three places to find out when and where the articles first appeared and who the authors are. Typos abound. The winner is in the Southern Baptist statement quoted on page 285: "this Convention accepts Genesis as teaching that man was the special creation of God".

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THE DARWINIAN REVOLUTION: SCIENCE RED IN TOOTH AND CLAW

by Michael Ruse
Chicago: University of Chicago Press,
2000. 346 pages.

Reviewed by John Wilkins

In 1959, at the centenary celebrations of the publication of *The Origin of Species*, interest was revived in the way evolution became a scientific theory instead of metaphysical speculation, and a historical research program that became known as "the Darwin Industry" began. Twenty years on, much work had been done but there was no single overview and introduction to the results. Michael Ruse filled that gap with his *The Darwinian Revolution*. Now it has been reissued with revisions and an afterword to bring it into the context of the many recent biographies and historical overviews of the period of Darwin's development and later success (for example, Bowler 1984, 1990; Browne 1995; Desmond 1984, 1989, 1994; Desmond and Moore 1991; Mayr 1982; Young 1985). How well does it bear up? The answer is, remarkably well.

Ruse, like all historians of ideas (although he is professionally a philosopher of biology, who along



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with David Hull and Elliott Sober has helped define this new field), has an agenda. His agenda is to uncover the philosophical motivations and social connections of the early evolutionists from 1830 to 1875. This is worth doing, for philosophy of science had only just been formally begun by the astronomer John Herschel, a friend of Darwin's, and Ruse argues that Herschel influenced Darwin significantly. A keystone of Herschel's philosophy was the *vera causa* — the "true cause". The aim of science was, according to Herschel, to uncover true causes, and a theory was only worthwhile if it attempted to present a mechanism that causes the phenomena being explained. Darwin, of course, famously presented natural selection as a cause of adaptation and the appearance of new species (we now think that selection has little to do with speciation). He was, says Ruse, trying to be a "good Newtonian" and was extremely hurt by Herschel's dismissal of *The Origin* as "the law of the higgledy piggledy".

Ruse is not the first to make Darwin a philosopher of science — Michael Ghiselin did this in his 1969 *Triumph of the Darwinian Method*. But whatever one may think of the case that Darwin was a philosopher, he clearly tried to follow the canons set down by Herschel and his other philosophical friend William Whewell as good science. Since he was (and is) attacked as "not doing science" later on, it is worth recalling this self-conscious heuristic of Darwin's.

A large part of understanding a scientific revolution is knowing who the main players are and what they contributed. All too often, writers tend to assume the reader knows who all these people are, and names drip from papers as if any fool ought to know who Reimarus, von Baer, Ray and so forth are. Putting them into a context is not easy, and here Ruse's book is without peer.

But there is a problem with the social context of a scientific movement: one of the prevailing trends these days is to "explain" scientific ideas in terms of their social context. Thus, Darwinism is an apologia for capitalism, or a radical political statement, and so forth. Desmond and Moore's generally excellent biography of Darwin (1991) is an example. Darwin is a "tormented evolutionist" because his theoretical views are an act of class betrayal. Ruse rightly, in his afterword, dismisses this view, as have others (for

example, Sulloway 1996), but there is a deeper issue. Is evolution just a social construction? Ruse has tried to argue that it is and is not, in his recent book (Ruse 1999). It is in the sense that the social interactions and concerns of the scientists in their society forces some conclusions and prohibits others; but it is not because scientists have as their basic epistemic values evidence, testability and so forth. Ruse, who is more fond of Thomas Kuhn's view of science as a series of revolutions interspersed by "normal science" than are many others today, tries to make a case that what distinguishes science from — say — theology is not a lack of metaphysics, for science has that in spades, nor the influence of social mores, but the link to evidence, data, experiment and testing.

For my money, Ruse is too willing to allow that science is a quasi-religious pursuit. In his 1996 book, he presented arguments that all evolutionists since Lamarck were progressionists implicitly or explicitly. While this was done with panache and much evidence, the interpretations seemed strained in many cases. He plays on Darwin's own ambiguities to make even him a progressionist, which seems to me unnecessarily sharp. Darwin was striving to invent a new way of looking at the world; he failed to clear himself entirely of common metaphors and ways of thinking; but in his theoretical arguments he laid the foundations for a decidedly, and sometimes explicitly, non-progressionist science. Even less can we argue that modern evolutionary biologists are progressionists (some are, some are not; see, for example, Nitecki 1988). But these cavils notwithstanding, Ruse's book is well worth reading and studying, even if one has a different philosophy of science or historical method. This is, after all, the best test of a historical book — whether its idiosyncrasies detract from its factual and narrative foundations. Ruse's book survives that test, and is still the best single overview of the Darwinian Revolution.

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UNWEAVING THE RAINBOW: SCIENCE, DELUSION, AND THE APPETITE FOR WONDER

by Richard Dawkins
Boston: Houghton-Mifflin Co, 1998.
337 pages.

Reviewed by Jim Sullivan

Early in this book, Dawkins writes:

My title is from [the English poet John] Keats, who believed that Newton had destroyed all the poetry of the rainbow by reducing it to the prismatic colours. Keats could hardly have been more wrong, and my



aim is to guide all who are tempted by a similar view towards the opposite conclusion. Science is, or ought to be, the inspiration for great poetry (p x).

Dawkins's solution to this perceived problem is to point out, often in boring detail, at unnecessary length, and with mind-numbing metaphor, several amazing things that science has revealed about nature. He compares phenomena such as radio waves to bar codes of the air, DNA and its uses to bar codes at the bar, and spectroscopes' breaking up starlight to identify components of a particular galactic orb as bar codes of stars.

Dawkins also delves deeply into human features, such as the brain — how it may have come to be and why it performs as it does. Along the way, the author debunks paranormalism, religion, and outright scams. Frequently, he also adds a bit about "the selfish gene" — a subject with which he is both identified and very familiar.

Perhaps the most startling portion of this book has to do with Dawkins's refutation of the work of other prominent scientists, such as Stephen Jay Gould. According to Dawkins, Gould — and others like him — have got Darwin wrong and they are misleading others because of their own error. Of course, Gould has repeatedly taken strict "selectionists" like Dawkins to task for failing to take account of a wide variety of sources of biological variation that could contribute significantly to evolutionary change.

This book is not easy to read. This reviewer happily considered abandoning the unfinished book several times. Dogged determination, however, won out. Dawkins covers too many subjects, belabors them, and assumes that nonscientists know — or remember — enough to understand. Although the author implies that he wanted to write an optimistic tome — a response perhaps to the charge from readers that his earlier books were too pessimistic — he does not succeed; the book is a jumble of facts, metaphors, and unnecessary detail that leaves the general reader with a sense of neither optimism nor pessimism!

Jim Sullivan is a free-lance writer and former director of a history museum. He has published in several magazines and journals, including book reviews in RNCSE.

Dawkins is the Charles Simonyi Professor of the Public Understanding of Science at Oxford University. He is both a scientist of international stature and one of the scientists best known to the general public around the world. His previous books include *The Selfish Gene* (1990) and *The Blind Watchmaker* (1996). *Unweaving the Rainbow* does not succeed in its stated aims, but to get the sense of Dawkins's intent, readers might read his essay in the inaugural issue of *RNCSE* (Dawkins 1997).

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BUILDING PLANET EARTH

by Peter Cattermole
New York: Cambridge University Press, 2000. 283 pages.

Reviewed by Antony Wyatt

There are not many books that attempt to describe the history of our planet in terms understandable by the general public. As with most fields of science, new information and ideas are constantly appearing, adding to a abundance of existing knowledge. Perhaps the most important finding from these studies is that the history of life was not played out on an unchanging field. The luminosity of the sun changed through time, the atmosphere changed in composition, the continents moved relative to one another and to the poles, mountain chains appeared and then were eroded, global temperatures fluctuated. When we think of survival of the fittest, we need to ask ourselves, fit for what?

This book is a revision and update of *The Story of the Earth* (Cambridge [UK]: Cambridge University Press, 1985), which appeared about 15 years ago, and attempted to describe the history of our planet for the general public. That book was co-authored by Cattermole, who spent many years as a lecturer in geology at the University of Sheffield, and Patrick

Moore, who is well-known in Britain as the presenter of *The Sky at Night*, a television program dealing with events in astronomy. In this revision, Moore provides a foreword only.

Cattermole writes in an easy-to-follow style; in places it is almost as if he is talking straight to the reader. In general, his common-sense style is successful, though in places he goes a little far. For example, in referring to possible temperatures and pressures inside the early earth, he talks about "making very reasonable guesses". I would have preferred the use of a term like "estimates", as "guesses" could be read by some as implying that there are no scientific standards for the calculations. Some of his use of terminology when referring to fossils is also nonstandard, which may reflect his academic background as a petrologist with interests in vulcanology and planetary geology.

The book is divided into 4 parts. Part one, Beginnings, deals with the formation of the solar system and the early earth. It concludes with a chapter introducing the methods of earth scientists. Throughout this part of the book, there are brief reviews of the historical development of some of the ideas and methods, introducing the reader to many of the important figures in the development of earth science. As might be expected in a book designed for a general readership, these historical vignettes say little about the real people behind the caricatures.

Part two, The Earth's Heat Engine, introduces basic concepts of the layering of the earth, the physical and chemical properties of the layers, the earth's magnetic field, the gravity field, and the concepts of plate tectonics. There is a simple introduction to rocks and minerals and to the different types of volcanoes and their products.

Part three, Patterns of Earth History, begins by explaining how rocks are dated, and then attempts a global synthesis of the development of the earth through time, concentrating on particular mountain-building episodes. This part includes discussion of the earliest rocks and comparison with materials derived from the moon. It also includes a very brief discussion of fossils and early life, with the emphasis more on the utility of the forms for stratigraphic correlation and the implications for changing atmospheric composition than on evolutionary changes.

Part four, Gondwanaland and More Recent Events, holds together rather



less well than the previous parts. Its first few chapters continue the previous part's story of continental collisions, concentrating on continental break-up and the development of oceans. It is the last four chapters of this part that do not seem to fit in; they could perhaps have been put in a separate part.

At relevant places throughout the text, Cattermole mentions the contemporary fauna and flora, usually with a few illustrations. He discusses some of the problems in interpreting the fossil record, extinction events, and some of the theories put forward to explain these faunal and floral changes. He also touches on the fact that there are opponents to the idea of evolution. As he puts it:

In Britain, the Evolutionist Protest Movement is regarded with amused tolerance, but in Arkansas and other parts of the USA there is a move to restore the teaching of creationism... The reasons for this belief are religious (or, rather, pseudo-religious) but the movement does show that still today scientists have to battle with prejudice as well as ignorance.

As may have already become clear, one of the main problems with this book is the lack of editorial control. Although the book contains a large number of illustrations in both color and black and white, many of which are good, there are a large number that should have been replaced. Some are so dark that it is difficult for an experienced viewer to pick out details of the geology; they are unlikely to mean much to a novice. Some of the diagram labels are also confusing. The spelling of some names in the figures is different from that in the text. On one page, Mt Unzen is located in Japan, but later it is shown as being in the Philippines. There are also many typographic errors in the text.

A lack of editorial control is also evident in the geology. There is confusion in places between the crust and the lithosphere. The diagram on page 218 shows the San Andreas line as a destructive plate margin, though in the text it is correctly referred to as a transform fault. On pages 186–7, the flowering plants are referred to as having first appeared during the early

Cretaceous, but then Cattermole states that “These flowering plants underwent their greatest proliferation during the Jurassic and early Cretaceous, just as the ruling reptiles were giving way to the mammals.” Presumably this should have read “during the Cretaceous and early Tertiary”. There are not many of these mistakes, and they could easily have been corrected, but their presence in the published version severely diminishes the value of the work.

So, is this a book that you might want to read or use? The answer has to be that, rather like the curate's egg, it is good in places. For a general introduction to modern ideas about the physical development of the earth, and to get some idea about the wealth of information that supports these ideas, you may well want to look at it. It shows how the background for organic evolution was a constantly changing earth, and that part of this change was caused by the activities of the organisms. But, because of the inconsistency in a number of significant details, let the reader beware.

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SCHOLARLY WORLD, PRIVATE WORLDS: THINKING CRITICALLY ABOUT SCIENCE, RELIGION, AND YOUR PRIVATE BELIEFS

by Karl D Fezer
Philadelphia: Xlibris, 2001. 464 pages.

Reviewed by Brant Abrahamson

For a quarter century, I taught a required semester-long critical thinking course in a large public high school. Students learned how to avoid common fallacies and prejudice. They analyzed various sources of “truth” including religion and science. We practiced spotting con artists, pseudoscientists, and miscellaneous deluded people — and thinking about our personal ways of influencing others. Given this background, I was pleased to be able to review *Scholarly World, Private Worlds* by Karl D Fezer. The

subtitle, *Thinking Critically About Science, Religion, and Your Private Beliefs*, seemed to resonate with my own instructional priorities. I was not disappointed.

There are three major themes underlying Fezer's book. First is that there is a common core of intellectual principles that provide the foundation of all academic fields, and students in all academic areas should learn what they are.

Second is that human understanding is limited. Science is universal in that it is based upon evidence that is acknowledged as factual in many cultural settings, but science too is circumscribed. It is limited to matters for which factual evidence can be found.

Third is that people's intellectual boundaries widen and their ability to deal with conflict increases when they thoughtfully consider worldviews other than their own (p xi).

The worldviews idea is central to Fezer's work. Worldviews are “systems of thought and action that acknowledge no limit to the scope of their concerns” (p xiii).

Everyone has a worldview. ... It tells us what our lives are about, the meaning of our lives, the things that are most important to us. It tells us what ideas, what sources of information, which people we can trust. It tells us how to interpret the information that comes to us. It tells us of our relationships to other people, to other components of the world we live in, and to whatever supernatural beings we believe in. ... It determines our attitudes toward life and death (p 4).

Being limited to factual matters, scientific methods of inquiry can be used by people with many diverse worldviews. However, it is a mistake to try to turn science itself into a worldview. Fezer says the result is scientism, or *philosophical* materialism, the claims of which, like those of supernatural religions, are not acceptable to outsiders.

In developing his major themes, Fezer divides *Scholarly World, Private Worlds* into 5 sections: Section 1 is Your Private Beliefs and Social Systems of Thought. Next is Reasons For Doubt. Section 3, Reasons for Belief, is next, followed by Section 4, What is Science? The fifth and final section is Science and Worldviews. Three appendices follow: Some Highlights in the History of Science; Species, Races, and Your Ancestor,

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Brant Abrahamson is a former high school teacher and a cofounder of The Teachers' Press, <<http://www.angelfire.com/biz/tchpr/index.html>>, which produces critical thinking course material.



Genghis Khan; and Summary of Major Kinds of Evidence for Evolution. The 434-page paperback concludes with Thoughts for Teachers, Questions for Thought and Discussion, a glossary, endnote, references, and an index.

Fezer tells us that *Scholarly World, Private Worlds* was "aimed initially at an audience of American college students." It began as a textbook, but it is more than that. It includes "a wide range of concepts and topics that, in the author's judgment, should be included in every collegiate program of general studies." In addition, Fezer says that reviewers have "suggested that the book should be of interest to a wider audience" (p xii). Therefore, I understand it to be three things in one: a text, a core-curriculum outline, and a trade book.

Can an author successfully accomplish so much in one volume? As a textbook author, Fezer tries mightily to keep his student readers focused on his main themes as he takes them through his informational cornucopia. He tells them what he is going to tell them in his Main Concepts and Synopsis section (p xiii-xx). He reminds them frequently how a particular chapter relates to previous ones as well as those yet to come. Then, on pages 314-5, The Argument [is] Summarized.

And yes, the book could be used to design a whole core curriculum. It is stuffed with important information and teaching suggestions reflecting Fezer's long, varied, and highly successful career. As I read, I repeatedly thought, "Yes! Good!" The margins of my copy are laden with positive comments. I wish I could take Fezer's course — even if it covered only a small portion of his informational compendium. But can such a book become a successful trade book?

There is the problem. Texts — even the best ones — are rarely read by anyone not taking an associated course, and there are sound reasons for this avoidance. Unlike scholarly trade books, texts are all-inclusive. They are designed to provide an overall view of the field, to be studied bit-by-bit along with associated class work. With a text, an instructor can focus on those elements needing special emphasis. But without lectures, other readings, class discussions, and the like, readers face a kaleidoscope of briefly described ideas, and mental fatigue sets in. For example, chapter 14, Consilience and Coherence, includes "A Brief History of Beliefs About the Age of Earth; Development of the Geologic Time Scale;

Radioactive Isotopes; Radiometric Dating; Formation of the Solar System; [and] Coherence With the Age of Our Galaxy and the Universe." All of this is in just one chapter!

Fezer writes in a clear, straightforward manner, but there are a few quirks that a general reader must work around. He frequently uses phrases such as "This chapter argues that..." Such depersonalization is fairly common in scientific papers, but it is not usually found in many other academic publications, much less in writing for a general audience. Fezer also peppers the first half of his book with Generally Accepted Principles. I did not find these particularly helpful, and Fezer stops using them after chapter 13.

As for content, I wonder if Fezer is right to claim that "the human condition requires at least two distinct intellectual approaches — two distinct, mutually contradictory systems of thought" (p 280 and repeated elsewhere). Of course, we must have ethical systems that guide our conduct, and in large measure these come from outside of science. But is there an unavoidable contradiction? Large numbers of people do not accept supernatural intrusions into the natural world. They may not be religious at all, or they may follow pantheistic faiths in which God is the natural order. And people can "[m]odify [their] religious faith so that it becomes consistent with science but still retains whatever in it [they] find to be important" (p 277). (This is number eight on Fezer's list of "Twelve Ways That People Handle Conflicts Between Science and Their Religious Beliefs".) Fezer himself may feel torn between "two distinct, mutually contradictory systems of thought", but is this a "human condition"?

I think that a slimmed-down text resolutely focused on the characteristics of science, major religious systems, and the "Twelve Ways That People Handle Conflicts Between Science and Their Religious Beliefs" (p 272-80) might find readers outside of the classroom. A few texts do become successful trade books. In history, for example, a junior-high-school text series that has made the transition is Joy Hakim's American history called *A History of Us*, despite its inclusion of material that many educators would consider questionable. As it is, however, *Scholarly World, Private Worlds* is, I fear, too bulky and complex to enjoy a popular readership.

That said, those educators, curriculum directors, and members of the

general public who make the effort to read *Scholarly World, Private Worlds* will be rewarded. Mature readers will be reminded of important concepts they may have forgotten over the years or somehow missed out on. Others can start on (or continue) their individualized "core-curriculum" study. College students could read the material bit by bit as they take an associated class. Others too will more fully appreciate Fezer's effort if they take their time reading it and not take too ambitious a swig from Fezer's overflowing cup of knowledge.

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THE ESSENCE OF DARWINISM

by Kirsten Birkett
Kingsford (New South Wales,
Australia): Matthias Media, 2001.
142 pages.

Reviewed by Hiram Caton
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This slender volume is the fifth by the author in a series meant to digest questions of importance to contemporary Christians. Other topics covered are feminism, psychology, the Reformation, and the conflict between science and religion. Birkett also edits the quarterly *kategoria: a critical review* that describes itself as a "journal of quality research that aims to question and uncover the false thinking and unfounded conclusions of the non-Christian world". Among the author's contentions is the view that science and religion are not truly in conflict (the title of her book on the subject is *Unnatural Enemies: An Introduction to Science and Christianity*) and hence that nonessential conceptual errors drive the religion-science quarrel. Her solution is to allocate science and religion to separate domains — causal knowledge of the world and meaning and divine purpose, respectively. Such was the accommodation proposed by Galileo and Bacon centuries ago. It has been affirmed many times, most recently by SJ Gould in his proposal to deem science and religion to be "non-overlapping magisteria". Is this Birkett's position?

Birkett discusses Gould in combi-



nation with Richard Dawkins and EO Wilson. Dawkins is the odd man out in this triptych, for he believes that science, especially evolutionary science, disproves the existence of God and disproves as well the numerous factual claims made by religions. Wilson concurs that religion's empirical claims are false if they conflict with science, but unlike Dawkins he ascribes great human significance to religion and would re-deploy it, purged of factual error, to serve ethical ends. (This détente is typical of American humanism, with which Wilson identifies.) Such subordination is not to Birkett's liking. Thus the higher dignity ascribed to religion by the two magisteria concept has greater appeal. Under the auspices of this distinction, Birkett argues that scientific atheism cannot interpret the "reality" of human existence and that its attempt to do so plunges it beyond science into ideology.

But it is still not enough, for Gould's rendition strips religion of truth claims, whereas without some claims to a factual basis Christian ethics has no basis (p 109). What facts might these be? The author's response is guarded. That the world is the creation of God who providentially guides humankind and imbues life with meaning is among the few propositions that emerge clearly in her study. Another clear proposition is that Christians are not obliged to credit creation in six days because a close reading of Genesis 1-2 shows that the text does not intend to set forth a chronology (Epilog). In all, the author's express requirements of the factual basis and creed are minimalist indeed.

The main body of the book is devoted to explaining why evolutionists, in contrast to scientists from other fields, habitually exceed the limits of science to encroach upon or attack the religious magisterium. Her historical account seeks to establish that evolutionary thought, from its French beginnings, hankered for a secular vision of ultimate things, inspired in this by the expansive aspirations unleashed by the French Revolution and the tide of secularism and political turbulence washing England during the Industrial Revolution.

I find this approach unsatisfactory. The simple and direct reason for the "encroachment" is that religious belief was quite literalist and hence "encroached" substantially on the science magisterium. Conflict was unavoidable. (The author seems to concede this, at least in part, when she

regrets that the church committed itself to the ontology of Paley's *Natural Theology*, much as in a previous age the church hitched Faith to Ptolemy and Aristotle). There is a vast historical literature on the eclipse of Faith in Victorian England upon which the author might have drawn but does not. This is a pity because it has the potential to instruct those troubled by the Faith-Reason conflict (see, for example, Peter Bowler's *Reconciling Science and Religion: The Debate in Early-Twentieth-Century Britain*. Chicago: University of Chicago Press, 2001).

Another dimension of the author's historical argument is a brief review of the trajectory of Darwinism from its inception to its neo-Darwinist incarnation. The burden of this account is to suggest that evolutionary theory, notwithstanding its public posture of high certainty, is highly variable and is just another theory that may or may not be true. New evidence and theories, her story goes, are constantly coming to light and it may be that some decades hence evolutionary theory will undergo profound revision. Faith accordingly should not be revised to suit current scientific belief (p 126).

In addition to this measured skepticism, Birkett has another card to play. Even if evolutionary theory is true, "*it doesn't really matter*" (p 127). It does not really matter because the existence of God and the salvation plan can be known independently of science. She writes: "If you care about what is special about humans ... then the Bible is the place to look. Evolutionary theory ... is simply an interesting detail in the story of a greater and far more important truth: that this is God's world" (p 129). Reduction to this "interesting detail" is equivalent to abandoning the aspirations she ascribes to the founders of science — to find the signature of the Creator by the study of his creation.

The author wrote in the expectation that creationists would not find her apologia acceptable, and they do not. Jonathan Sarfati wrote a lengthy review of her book entitled "Evangelical compromise misses the essentials" (<www.answersingenesis.org/reviews/essence_darwinism>). The "essentials", of course, are the "fundamentals" — the literal truth of scripture, especially Genesis 1-2. The criticism involves the exegetical thesis that scripture is to be understood literally, together with the interpretative thesis that to accept the "long-age" view of "days" entails loosening of

doctrine that leads to the liberal Christianity which regards even the mission of Jesus as symbolic. Sarfati concludes his review by declaring that "the book provides a confused, illogical apologetic".

Since I have no stake in biblical controversy, it is not for me to pass judgment here on that aspect of the book. Let me take a longer view and recall an observation of the philosopher Thomas Hobbes. He wrote in the midst of his struggles to curb fanaticism that "religion may never be so expelled from human nature that it might not be made to spring up again." Four centuries later we still hear his pessimistic sigh and say, "Amen." Intensive, state-controlled atheist propaganda failed to expel religion in the former Soviet Union, and the gentler but still intense secularism of democracies has weakened doctrinal belief but has not discouraged the mushrooming of innumerable fringe sects — nor damped the unabated energy of evangelical Christianity and the resurgence of fundamentalism. Even as militant atheism comforts atheists, it also stimulates evangelicals while adding evidence that the rapprochement between the two magisteria is makeshift. Is the Wilson proposal for incorporating the religious impulse into a new natural religion, disciplined by science, the most feasible option?

Wilson's proposal — an environmentalist belief cherishing the intrinsic value of biological life — has the advantage of timeliness and a record of successful recruitment in its short history. Its appeal may be expected to increase as ever more painful environmental blowbacks against the high metabolic rate of consumer culture occur. An environmental religion is uniquely poised to imbue the coming austerity with meaning and purpose. But will it be enough? As best I can see, there is nothing in the environmental orientation to deal with social conflicts that are likely to intensify with population increase and land and water degradation. But that is another discussion. Perhaps Kirsten Birkett will contribute by writing a book on the Christian response to the environmental crisis.

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