

REPORTS



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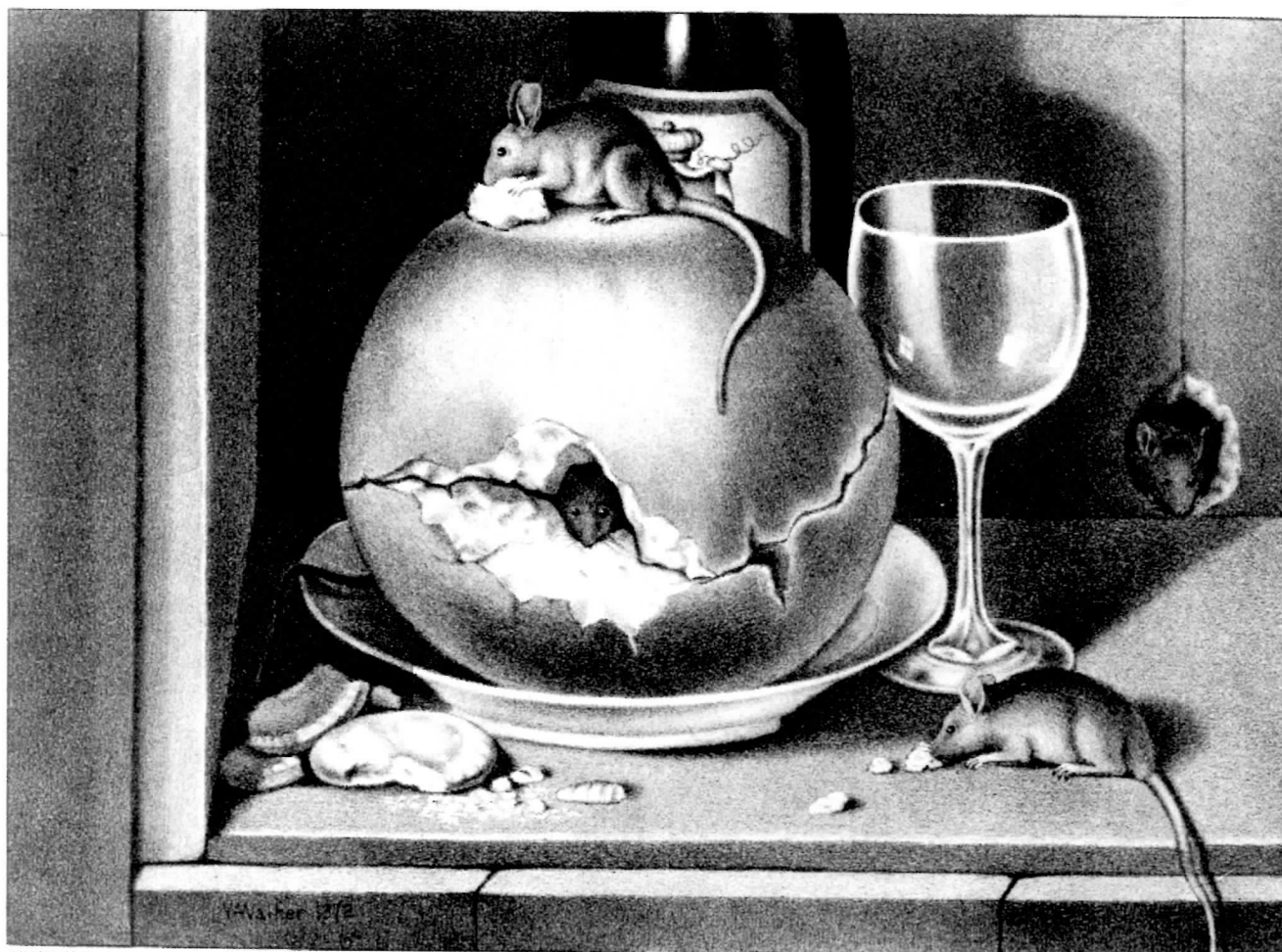
NATIONAL CENTER FOR SCIENCE EDUCATION

DEFENDING THE TEACHING OF EVOLUTION IN THE PUBLIC SCHOOLS

Volume 23, Numbers 5-6

SEP-DEC, 2003

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CREATION/EVOLUTION



A FREE LUNCH

Evolution Still
in Texas Textbooks

History of New
Mexico's Standards

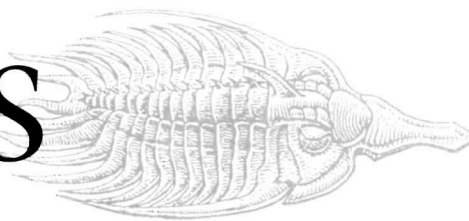
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of William Dembski's
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CW Walker, "A free lunch";
Currier & Ives, circa 1872
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For more information on Ray's work explore his website at <www.trollart.com>.

The fit between form and function in the natural world can hardly escape the notice of anyone who looks carefully. It is one of the most truly awesome aspects of nature — and one on which Richard Dawkins remarked in his essay in the inaugural edition of *RNCSE* in 1997. After

careful consideration, natural philosophers concluded that living things and their components must have been designed precisely for the functions that they performed. It was not logical to assume that this close correspondence between form and function could have come about merely by accident, and no one knew of any other plausible natural process that could produce such intricate structures, so clearly fitted to their functions. Of course, a young naturalist in the mid-1800s changed that situation for ever.

In the nearly 15 decades since Darwin published the first edition of *On the Origin of Species*, his original idea has grown and reached into every aspect of contemporary biology and related fields, even — or perhaps especially — into fields of research Darwin could not have imagined in his time. One thing that this research shows is that the ancients had erred in framing the original question: it was not design or accident. Evolution is not accidental, but rather follows a few general principles in the operation of biological processes. Even though it is not possible to predict specific future outcomes of evolutionary change, it is quite easy to show how populations experience evolutionary change.

The newest manifestation of anti-evolutionism — "intelligent design" — reverts to the original proposition as though the scientific progress since Darwin's time had not occurred. To read the "intelligent design" literature, one would assume that the only question about the pattern of similarity and diversity among living things on earth is whether it was produced by chance or by the designing actions of an intelligent agent. This contrast is maintained only at the expense of ignoring nearly 150 years of scientific research and harking back to "Darwinism" — as though the slow, gradual, step-wise transformation of one species into another were the only process of evolutionary change available.

In this special double issue, we present several detailed analyses and reviews of the state of the art in the "intelligent design" movement. Because he is perhaps the leading fig-



ure in promoting ID and his work supposedly provides the scientific basis for ID, most of the articles in this issue discuss the work of William Dembski — in particular his recent book *No Free Lunch (NFL)*. *NFL* is a complicated book, with lots of equations and special

definitions, so the reviews we carry in this issue are longer, and in parts more complicated, than those we usually print. As our readers know, it is easy to lay out objections to evolution, but it often takes a lot more explanation to demonstrate all the errors in the objections. As Jeffrey Shallit points out in his review beginning on page 35, the most comprehensive critique of this book runs 37 000 words — 10 times as long as the reviews that we have published here. Despite this difficulty, we concluded that a comprehensive critique of *NFL* and its premises was important to present to our readers in some detail. We hope you find it worth the investment.

BUT THERE'S MORE ...

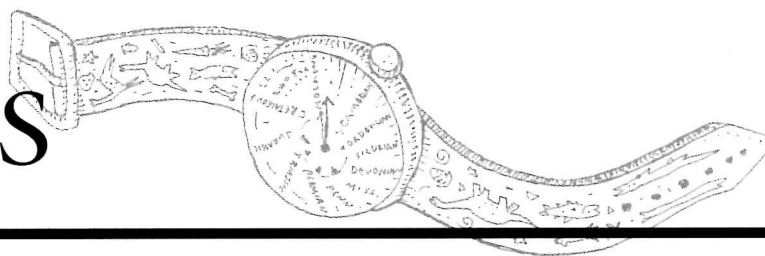
... as there is in every issue. See reports from textbook and standards approval processes in Texas and New Mexico. Follow the anti-evolution action around the country and in Europe in our Updates section. And read a special report from Ulrich Kutschera on anti-evolutionism in the European Union.

Glenn Branch also reports on staff changes at NCSE and news from you, our members. Glenn and Skip Evans team up to tell us about Project Steve. And there are numerous interesting tidbits spread through the issue for your pleasure and edification.

QUOTE UNQUOTE

Finally, you may have noticed that we always write "intelligent design" in quotes. This is because "intelligent design" is a "term of art" — a common phrase used in a very special way by a particular group of people who promote it as an alternative scientific theory for the complexity and diversity of life. However, the term has other meanings in disciplines such as engineering and industrial design (the other ID) that have nothing to do with biology or the history of life. Since this latter usage is prior and still in common practice, we will continue to place "intelligent design" as promoted by the Discovery Institute in quotes to distinguish it from prior professional uses.

RNCSE 23 (5-6) was printed in February 2004.



Evolution: Still Deep in the Heart of Textbooks

Skip Evans
NCSE Network Project
Director

To watchers of the creationism/evolution controversy, the textbook adoption process in Texas is not only familiar but also important. Evolution is historically among the most contentious areas in the process. Moreover, decisions on textbooks in Texas affect far more students than just those in the Lone Star State. Because Texas is the second largest textbook market in the country, behind only California, textbooks adopted there will also be offered in states around the country. The stakes are high for the publishers, too: the state is expected to spend 570 million dollars on new textbooks, of which 30 million dollars is for biology textbooks.

As the adoption process for biology textbooks began in early 2003, the ranks of those vocally opposed to evolution education swelled. For decades, Mel and Norma Gabler's Educational Research Analysts — "a conservative Christian organization that reviews public school textbooks submitted for adoption in Texas" which places "scientific flaws in arguments for evolution" at the top of its list of concerns (<<http://members.aol.com/TxtbkRevws/about.htm>>) — has urged the Texas Board of Education to minimize evolution and even to include creationism in the textbooks adopted for use in the state (see, for example, *RNCSE* 1999 Jan/Feb; 19 [1]: 10). In 2003, the Gablers were joined by a host of homegrown creationists as well as by the Discovery Institute, the institutional home of "intelligent

design", in seeking to undermine the treatment of evolution in the biology textbooks under consideration.

ANTI-EVOLUTIONISTS FACED AN UPHILL BATTLE FROM THE START

First, the state science standards, adopted by the Texas Education Agency (TEA) in 1997, require students to learn about evolution. There is no mention of creationism or "intelligent design" in the standards. The state standards form the basis of the Texas Assessment of Knowledge and Skills test, which students must pass in order to graduate from high school. Consequently, teachers could compellingly argue that it would be counterproductive to minimize evolution, or to introduce creationism, in the biology textbooks.

Second, whereas in the past the board was allowed to edit textbooks for content, in 1995 the state legislature limited the board's power. With regard to textbooks, the board is now allowed only to enforce three requirements:

- they must satisfy each element of the Texas Essential Knowledge and Skills (TEKS) standards;
- they must have good bindings;
- they must be free of factual errors.

There were no complaints about the bindings. Anti-evolutionists were keen, however, not only to allege that the textbooks were laden with factual errors, but also to claim that the books failed to satisfy the TEKS standards — in particular TEKS requirement 112.43c(3)A, which states that students should "analyze, review, and critique scientific explanations, including hypotheses and theories, as their strengths and weaknesses using scientific evidence and information." The language of "3(A)" (as it became known) lent itself to

anti-evolutionist calls to "teach the controversy".

Such claims contradicted the assessment of a 12-member review panel commissioned by the Texas Education Agency, which in June decided that the textbooks were both scientifically accurate and in conformity with the TEKS standards. Anti-evolutionists, including board members David Bradley, Terri Leo, and Don McLeroy, were later to allege that the TEA incorrectly instructed the panel — perhaps intentionally, Bradley speculated (see, for example, the Galveston County *Daily News* 2003 Jul 20, available on-line at <<http://www.galvnews.com/print.lasso?ewcd=97dd2da2a536a818>>). Of course, the final decision on whether to approve the textbooks rested with the board.

Throughout the process, news stories as well as letters to the editor, op-ed pieces, and press releases from all sides of the controversy filled Texas newspapers; for reasons of space they are not discussed here (although Alfred Gilman's op-ed, signed by seventeen members of the National Academy of Science and/or the Institute of Medicine, including four Nobel laureates, is reprinted on p 8). Many of these pieces are archived on the web site of Texas Citizens for Science: <<http://www.txscience.org>>.

THE JULY HEARING

On July 9, 2003, at the first of two scheduled public hearings, nearly three dozen speakers addressed the board, almost all of them speaking in defense of the 11 biology textbooks submitted. (NCSE executive director Eugenie C Scott and postdoctoral scholar Alan Gishlick attended as observers.) "I'm here to keep outside forces from removing science from science books", said David Hillis, Professor of Biology at the University of Texas at Austin, and



president of the Society for the Study of Evolution (*San Antonio Express News* 2003 Jul 10; available on-line at <<http://news.mysanantonio.com/story.cfm?xla=saen&xlb=180&xlc=1023426>>).

Many of the speakers were reacting to a critique of the textbooks submitted by the Discovery Institute (<<http://www.discovery.org/articleFiles/PDFs/TexasPrelim.pdf>>). The critique, based largely on Jonathan Wells's *Icons of Evolution* (Washington [DC]: Regnery, 2000), graded the textbooks on their discussion of 4 "icons": the Miller-Urey experiment, the Cambrian explosion, Haeckel's drawings of vertebrate embryos, and industrial melanism in peppered moths. Only one textbook passed, with a grade of C-.

Two fellows of the Discovery Institute's Center for Science and Culture testified at the June hearing: Raymond Bohlin, executive director of Probe Ministries, and Francis J Beckwith, newly appointed as Associate Professor of Church-State Studies at Baylor University. Consistent with the Discovery Institute's recent tactics, Bohlin insisted that he was not calling for "intelligent design" to be added to the textbooks or for evolution to be removed. Instead, he told CNN, "Every theory has its weaknesses, has its problems, and evolution seems to be the one theory in the textbooks that just isn't treated that way" (2003 Jul 9). Steven Schafersman, president of the pro-evolution education grassroots group Texas Citizens for Science (see *RNCSE* 2003 May-Aug; 23 [3-4]: 9), was unimpressed: "They're trying to get in anti-evolution material by calling it a weakness" (*Houston Chronicle* 2003 Jun 10).

A complete transcript of the July hearing is available on-line at <<http://www.tea.state.tx.us/textbooks/adoptprocess/july03transcript.pdf>>.

Between the July hearing and the September hearing, the BOE received reams of written comments on the textbooks, to which the publishers were required to respond. For example, in his critique of *Biology*, published by Holt, Rinehart & Winston, Mark Ramsey of the newly formed anti-evolutionist group Texans for

Better Science Education asserted that a recent article in a popular journal (RO Prum and AH Bush, "Which came first, the feather or the bird?" *Scientific American* 2003 Mar; 288: 84-93) "fully discredits the dino-to-bird idea." The publisher replied that "[t]he hypothesis that birds evolved from dinosaurs continues to have strong support in the scientific community and has been strengthened recently by new fossil finds in China", and noted that Prum and Bush accept the evolution of birds from dinosaurs, quoting the same article's acknowledgment that "birds are a group of feathered theropod dinosaurs that evolved the capacity of flight" (<<http://www.tea.state.tx.us/textbooks/adoptprocess/2003pubresponses.pdf>>). In the end, the publishers held the line, agreeing to no changes that would materially weaken the treatment of evolution in their textbooks.

THE SEPTEMBER HEARING

On September 10, at the second public hearing, a standing-room-only crowd was in attendance. More than 160 people signed up to speak before the board, and the testimony continued into the wee hours. Supporters of quality science education, including members of NCSE, Texas Citizens for Science, and the Texas Freedom Network, which led the statewide organizing effort; scientists from the University of Texas at Austin and around the state; educators, including many members of the Texas Association of Biology Teachers; and concerned parents, clergy, and citizens in general were out in force — many wearing their "Don't mess with textbooks" T-shirts. (The clever variation on the "Don't mess with Texas" anti-litter slogan, which became the pro-evolution education movement's unofficial motto, was due to NCSE's Archives Project Director, David Leitner; see p 22.)

Samantha Smoot, the executive director of the Texas Freedom Network, told the board, "The weaknesses of evolution alleged here today are founded on ideology, not science. ... There's really no debate about any of this in the scientific community." Her view was

confirmed by the testimony of research biologists such as Andrew Ellington and Matthew Levy of the University of Texas at Austin, whose testimony was a devastating critique of the Discovery Institute's assessment of the biology textbooks' treatment of scientific research into the origin of life.

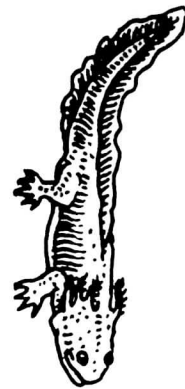
Steven Weinberg, Professor of Physics at the University of Texas at Austin, addressed the common criticism that evolution is "just a theory" by remarking that his theory of the unified weak and electromagnetic interaction between elementary particles won him the 1979 Nobel Prize for Physics. He added that the existence of phenomena unexplained by a given theory is not, in his view, a "weakness". He also reminded the BOE:

[Y]ou're not doing your job if you let a question like the validity of evolution through natural selection go to the students, any more than a judge is doing his job or her job if he or she allows the question of witchcraft to go to the jury. ... I think it's clear that the reason why the issue was raised with regard to evolution is because of an attempt to preserve religious beliefs against the possible impact of the Theory of Evolution.

The Reverend Roger Paynter of Austin's First Baptist Church testified, "It is my deep conviction that creation flows from the hand of a creator God. But that is a statement of faith and not something that I or anyone else can prove in a scientific experiment. To lead children to believe otherwise is a disservice to them."

Creationists, for their part, were vocal, too. Mark Ramsey, of Texans for Better Science Education — who is also the secretary and a board member of the Greater Houston Creation Association — said, "I was indoctrinated, so we would say brainwashed, to believe that evolution was as proven as gravity. ... Today, over two decades later, many of us now know better."

Out-of-state witnesses, including several associated with the Discovery Institute, were not allowed to testify during the hear-





ing; they were, however, permitted to make presentations to board members after the hearing adjourned and to submit written testimony. NCSE's Alan Gishlick and Eugenie C Scott and NCSE member Robert T Pennock stressed the importance of a sound presentation of evolution in textbooks.

A complete transcript of the September hearing is available on-line at <http://www.tea.state.tx.us/textbooks/adoptprocess/sept03transcript.pdf>; the passages of testimony above are quoted from it.

Following the hearing, in October the Discovery Institute sent the textbook publishers and members of the board a document intended to support, reiterate, and extend its criticism of the textbooks under consideration. Literally hundreds of pages long, the document contained excerpts from scientific publications as well as the Discovery Institute's interpretation of them. Evidently attempting to pre-empt criticism of the sort received by its "Bibliography of supplementary resources for Ohio science instruction" (see *RNCSE* 2002 Aug/Sep; 22 [4]: 12-18, 23-24), the document warned of the likelihood of critics "falsely accus[ing] Discovery Institute of misrepresenting the scientific literature by misquoting or quoting out of context."

A less lofty appeal to the board came from Columbine Redemption, a nonprofit organization founded by Darrell Scott, whose daughter was murdered in 1999 at Columbine High School in Littleton, Colorado. In a press release with the headline "Bad science produces bad consequences" (2003 Oct 13; available on-line at <http://www.strengthsandweaknesses.com/D.Scott.Oct.13.PR.2.pdf>), Columbine Redemption alleged that evolution education was responsible for the Columbine massacre and urged the board to "reject proposed Texas biology books that do not teach weaknesses of evolution as required by Texas law."

THE NOVEMBER VOTE

As the November vote approached, the publishers held firm, making only minor editorial changes, but

none of the overhauls requested by anti-evolutionists. "In keeping with their commitment to provide students with the best possible science education, biology textbook publishers have stood up to political pressure," said the Texas Freedom Network's Samantha Smoot. The Discovery Institute, however, claimed that the changes were in response to its critique and vowed to continue to pressure the publishers. "We will be seeking more changes in the textbooks," said John West, associate director of the Discovery Institute's Center for Science and Culture (*Dallas Morning News* 2003 Oct 30; available on-line at <http://www.dallasnews.com/sharedcontent/dallas/politics/state/stories/103103dntexttextbooks.10ff7.html>).

Two public letters to the board that appeared in early November are of particular interest.

On November 1, the American Institute of Physics released a statement signed by more than 550 Texas scientists and educators denouncing attempts to undermine the treatment of evolution in the textbooks: "Any dilution in textbooks of the overwhelming scientific evidence for evolution should sound an alarm to every parent and teacher." In addition to the AIP, the American Geological Institute, the American Astronomical Society, and the American Institute of Biological Sciences and several of its member societies also encouraged their members in Texas to sign the statement. The statement and a list of signatories are available on-line at <http://www.txscience.org/files/texas-scientists.pdf>.

On November 4, David Hillis and Martin Poenie, like Hillis a biologist at the University of Texas at Austin, sent a letter to the board urging that all 11 textbooks be adopted without changes. Poenie's co-authorship was noteworthy because his name appeared on the Discovery Institute's "A scientific dissent from Darwinism" (see *RNCSE* 2001 Sep-Dec; 21 [5-6]: 22-3) and again, without Poenie's authorization, on a similar statement entitled "40 Texas scientists skeptical of Darwin" and because he previously wrote a letter to the board arguing that "Darwinian

(hyperdarwinian) mechanisms are not the only ones molding the evolutionary history of life and that we should be free to consider alternative non-darwinian mechanisms of change". In his November letter, however, Poenie explained, "that letter was not intended to oppose basic evolutionary biology or to support poor teaching or coverage of that topic." Hillis and Poenie went on to say, "We believe that all of the books conform to the TEKS standards and should be approved and placed on the conforming list of textbooks" (their letter is available on-line at <http://www.txscience.org/files/ut-austin-profs2.htm>).

On November 6, at the first day of a 2-day meeting, a motion to vote on the books individually was defeated 11-4, thwarting the plans of anti-evolutionist members of the board to approve only the textbooks that, in their judgment, presented evolution undogmatically (*Fort Worth Star-Telegram* 2003 Nov 6; available on-line at <http://www.dfw.com/mld/dfw/7198627.htm>). A majority of the board was evidently ready to end the discussion, the *Los Angeles Times* reported (2003 Nov 7):

The chairwoman of the board, Geraldine Miller of Dallas, was twice reduced to slamming her fist down as a conservative wing of the panel tried repeatedly to reject most of the books.

After tense arguments, a board member voting with the majority, Joe Bernal of San Antonio, urged Miller to simply stop recognizing people who were holding up their hands to speak. That way, he said, she wouldn't "prolong this agony."

Eventually, in a preliminary vote conducted on the same day, the board voted 11-4 to approve the books. In both votes, David Bradley, Terri Leo, Gail Lowe, and Don McLeroy were in the minority.

On November 7, the board conducted its final vote, approving all 11 textbooks for use in Texas's public schools. (At the time of writing, the minutes of the meeting are not available, and it is unclear from the news reports what the exact tally was.) The

vote, David Hillis said, “means we will be able to provide good quality biology textbooks to the students of Texas” (UPI wire, 2003 Nov 7). “This is great news for the children of Texas,” said Samantha Smoot. “The board sent a clear message that educational and scientific standards come first for Texas schools, not the ideological preferences of a few people” (*Austin Chronicle* 2003 Nov 14; available on-line at <http://www.austinchronicle.com/issues/dispatch/2003-11-14/pols_feature8.html>).

The Discovery Institute, for its part, declared victory, in a press release with the headline “Textbook reformers see last-minute victory in Texas decision” (2003 Nov 7; <<http://www.discovery.org/scripts/viewDB/index.php?command=view&id=1634&program=News-CSC>>). Noting that TEA Chief Deputy Commissioner Robert Scott promised to address any remaining factual errors in the books before they arrive in Texas schools, the Discovery Institute implied that its criticisms of the book were still in play, and later a spokesperson was explicit: “[W]e were happy to hear ... Scott publicly pledge that publishers must address the errors that Discovery had previously identified” (*Science & Theology News* 2003 Dec; 4 [4]: 10). However, a TEA spokesperson explained that the sorts of errors that are corrected after a book is accepted are usually minor, involving such minutiae as dates, pagination, and punctuation (UPI wire, 2003 Nov 7).

Students in Texas’s public schools will learn their biology from textbooks in which the treatment of evolution is uncompromised. NCSE is proud to have worked closely with the dedicated Texans who helped to ensure victory, including not only NCSE members but also the members and staff of the Texas Freedom Network, Texas Citizens for Science, and the Texas Association of Biology Teachers. Thanks and congratulations.

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The Textbook Choosers’ Guide

*James P Barufaldi and
William V Mayer*

[*Science instruction in K-12 schools frequently depends strongly on textbooks that the school or district has approved for use in its curriculum. In this article we excerpt the main points from one of the brochures on the NCSE web site to help our readers to ask questions and be involved in the process of textbook selection in their own communities. The complete text is available at <http://www.ncseweb.org/resources/articles/1723_the_textbook_choosers_guide_7_9_2001.asp>.*]

Textbooks are frequently chosen or rejected for trivial reasons. Appearance often takes precedence over modernity, accuracy, and explication of the discipline. Textbooks frequently *look* better than they *read*. One must be concerned with what a textbook says and how it says it. Illustrations and other materials that accompany the text should be coordinated with the narrative and included to clarify a concept or a process.

Here are 10 points to consider when evaluating a science textbook.

PEDAGOGICAL POINTS

- Beware the *encyclopedic* text — the one that purports to “cover” every conceivable aspect of the discipline. No textbook can do so, and no student should be asked to memorize such a wealth of detail. Instead, consider whether the text fairly presents the major concepts of the discipline and provides examples to illuminate them. The adequate development of selected major principles is more beneficial to the student than are reams of details.

James P Barufaldi is Ruben E Hinojosa Regents Professor of Education at the University of Texas, Austin. The late William V Mayer was Professor Emeritus in the Department of Biology at the University of Colorado, Boulder.

- Beware of any text that emphasizes memorization of vocabulary. Students should learn new words as they become involved with a new discipline; *selected* useful and meaningful vocabulary can be an inestimable aid in broadening understanding. However, avoid any book that substitutes concentrating on words for their own sake rather than as a support for a narrative of inquiry.

- Beware of the text that does not read well — one written in short choppy sentences that develop detail but not a cohesive narrative. The text should provide a narrative of inquiry rather than a rhetoric of conclusions. It should build on previous information and serve as a basis for intellectual growth as the student proceeds through the book. A text should not be merely a passive reading experience, but should be designed to be interactive — eliciting responses from the student by requiring activity related to the subject under consideration.

- Beware of the dogmatic textbook. Science is an ever-growing body of knowledge constantly refined on the basis of new evidence. Texts that present the corpus of science as a fixed and unchanging mass of evidence do not prepare students to live in a world where change may be the only constant. However, texts should also present the settled areas of science as just that — they should not give students the impression that science is no more than a body of untested hypotheses, guesses, and ever-changing data.

- Beware of the text as the sole source of scientific information. The textbook must be regarded as an introduction to science that provides a foundation for future learning. Activities should be included that will expand the student’s horizons and send students to other sources of information on the topic. The text should be teaching the student how to learn and should include activities for independent information gathering.



CONTENT POINTS

- Beware of the text that does not explain the nature of science. One of the major reasons students take science courses is to become acquainted with science as a way of knowing. The processes of science should permeate the textbook and not be confined to an isolated section on what is erroneously referred to as *the* “scientific method”. Also avoid textbooks that present science as a process of uncertainty or include phrases such as “some scientists believe” or “many scientists agree”. Texts should make it clear that scientists reach their conclusions on the basis of currently available data, not based on personal belief or by vote.
- Beware the text that does not clearly explain the role of controlled experiment, hypothesis formulation, and theory in science. These are basic research tools of the scientist, and their proper use has led science to its great contributions.
- Beware of the bland textbook — the one written in such a way as to eliminate controversial or contentious issues and the one that presents the sciences simply as a fixed body of facts unrelated to contemporary issues. The nature of scientific controversy should be presented. Scientific problems currently unresolved should be discussed. Students should be encouraged to analyze, synthesize, and evaluate data collected in support of various hypotheses.
- Beware the textbook that emphasizes only one aspect of the discipline — for example, a biology text that presents biology only in terms of morphology and systematics — and ignores other aspects of the discipline. No text can present all aspects of the subject, but acceptable texts should present some of the different approaches within the discipline — for example, in biology, topics such as ecology, genetics, growth and development, evolution, and behavior. Further, the interrelationships of science with social and technological issues should permeate the text.

- Beware the classical textbook — one that give the student an impression that science is a historical study, not a vital, ongoing exercise. A textbook must deal in some measure with current areas of research and contemporary problems to prepare students for the issues they will face in the future as individuals or as voting citizens. It should emphasize how scientist are *currently* approaching and trying to solve contemporary problems in health, the environment, and so on.

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How Should Schools Teach Evolution? Emphasize the Scientific Facts

*Alfred Gilman
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The state school board recently heard testimony from many people about whether 11 high school biology textbooks should be excluded from consideration for state adoption because they supposedly placed undue emphasis on evolution. The issue has evoked passionate debate.

I write on behalf of 17 members of the National Academy of Sciences and/or the Institute of Medicine; four of us are Nobel laureates. We all live and work in North Texas. We are speaking as individual scientists and clinicians, not as employees of any institution.

We urge board members to use the next several weeks to review the science and, ultimately, to render a decision based solely on whether the texts are scientifically accurate. To do otherwise would undermine the integrity of expert panels that already have indicated the books pass scientific muster. The textbooks in question are used only in science courses, and sci-

ence must be the basis of their information.

Some individuals and organizations have long opposed teaching only scientific bases for the appearance and evolution of life on earth. Those opponents claim that scientific texts systematically misinform readers. Why? Because, according to the critics, the books in question do not expound upon supposed weaknesses in the theory of evolution.

Those assertions have been refuted in great detail by scientists in testimony prepared for the state board and in analyses of the central arguments raised by opponents of the texts. (See <<http://www.txscience.org/files/icons-revealed/index.htm>> and <<http://www.ncseweb.org/icons/>>.)

We note that those supposedly scientific challenges are directed selectively at the theory of evolution. There are no similar campaigns being waged against textbooks that do not discuss alleged weaknesses in other major scientific theories, such as gravitation or relativity. Clearly, the motivation for the current challenges lies *not* in science, and the scientific classroom is *not* the proper forum for such a debate.

Part of the confusion may stem

Alfred G Gilman is a 1994 Nobel laureate and Professor of Pharmacology at the University of Texas Southwest Medical Center at Dallas. Colleagues who support his position include Nobel laureate Michael S Brown, Professor of Biophysics and Molecular Genetics; Nobel laureate Johann Deisenhofer, Professor of Biochemistry; Ronald Estabrook, Professor of Biochemistry; Daniel W Foster, Professor of Internal Medicine; David Garbers, Professor of Pharmacology; Scott Grundy, Professor of Human Nutrition; Nobel laureate Joseph L Goldstein, Professor of Biophysics and Molecular Genetics; Steven McKnight, Professor of Biochemistry; Eric Nestler, Professor of Psychiatry; Eric Olson, Professor of Molecular Biology; Thomas Sudhof, Professor of Basic Neuroscience; Carol A Tamminga, Professor of Psychiatry; Jonathan Ubr, Professor of Cancer Immunobiology; Roger Unger, Professor of Internal Medicine; Ellen S Vitetta, Professor of Cancer Immunobiology; and Jean D Wilson, Professor of Internal Medicine.



from how scientists use the term “theory” in their work. Rather than being someone’s hunch or guess, ideas become accepted scientific theories only after they have been tested repeatedly and confirmed experimentally — and have been shown to account for and explain such a wealth of data that they enable scientists to make reasonable predictions about similar phenomena that have yet to undergo such scrutiny.

The modern theory of evolution has undergone 140 years of testing. It now is so well established that its veracity and robustness are accepted as fact by the overwhelming majority of scientists in this country and around the world. In the scientific community, the unanswered questions surrounding evolution concern not the *fact* of evolution but rather the *mechanisms* by which evolution operates.

We are very concerned that any action by the board to exclude sci-

ence textbooks that have been determined to be scientifically accurate — by independent review panels of scientists and science educators and by expert review committees appointed by the Texas Education Agency — sets a very dangerous precedent.

If successful, such an action would prevent the state’s students from being exposed to one of the most tested theories in science and would place them at a disadvantage in relation to their peers in most other states, where scientific approaches to evolution would continue to be taught. Without a basic knowledge of evolution, how could they begin to comprehend high school or college biology classes?

In addition, because Texas’s textbook adoption policies have a large impact on the US textbook market, we worry that prohibiting the purchase of science books that accurately discuss evolution could push

publishers to eliminate the subject, compromising science education across the country. That would be tantamount to censorship.

The [board’s] decision must be scientifically informed. Like students heading back to school, the state school board must do its homework to understand fully the issues at stake. We call upon our scientific, engineering and medical colleagues across the state to deliver a similar message to the board.

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The History of the New Mexico Science Standards

Marshall Berman, M Kim Johnson, and David E Thomas

Creationists have targeted New Mexico’s science standards for over seven years. Shortly after an *Albuquerque Journal* article in June 1996 implied that creationists were influencing New Mexico’s science standards, a few scientists met with a member of the New Mexico State Board of Education (SBE) to understand better the scientific and political ramifications of the newly proposed science standards. Over the summer, the group of scientists and their supporters grew to about a dozen, suggested changes in the standards to members of the SBE and the State Department of Education (SDE), and made presentations to the SBE and other groups.

Despite these efforts, the SBE voted 13-1 on August 22, 1996, to adopt science content standards that removed all references to evo-

lution and the age of the earth. (The lone “no” vote was cast by a creationist who believed the standards did not go far enough in supporting his position.)

By the fall of 1996, the initial group of 6 activists had grown to about 27. They met with legislators, SBE and SDE personnel, wrote many letters, gave presentations, assisted in the introduction of a pro-evolution bill in the legislature (ultimately unsuccessful), became directly involved in writing science performance standards and in selecting instructional materials, and developed an e-mail communications and planning network — all to no avail.

On October 25, 1996, the original group named itself the Coalition for Excellence in Science Education (CESE: <<http://www.cesame-nm.org>>). CESE greatly expanded its membership to include teachers, clergy, business people, and essentially all stakeholders in science and math education, and grew to its current membership of about 400 people.

But it became clear that it was essential to become part of the education system, rather than remain outside, no matter what

our credentials were. So with the help of CESE (before it achieved 501(c)(3) status), Marshall Berman ran successfully for the SBE and was elected by a 2:1 margin.

Nine months later, on October 8, 1999, by a vote of 13-1, the SBE re-introduced the modern concepts of evolution, geology, and science itself back into the science content standards, benchmarks, and performance standards. Remarkably, almost all the members who had previously voted for the emasculated science standards now supported the improved standards.

This stunning creationist defeat led to personal attacks, and an apparent targeting of New Mexico by creationist religious groups and the “intelligent design” (ID) movement.

About a dozen years ago, Phillip Johnson, the acknowledged father of the ID movement, resurrected “intelligent design” and assembled a group of people to introduce these ideas into society. The primary seat of ID is the Center for Science and Culture (<<http://www.discovery.org/crsc/>>). CSC is amply funded by and housed at the Discovery Institute in Seattle,



Washington (<<http://www.discovery.org/>>). Its web site states: "The theory of intelligent design holds that certain features of the universe and of living things are best explained by an intelligent cause, not an undirected process such as natural selection."

Johnson visited New Mexico in March 2001 and gave presentations at Los Alamos National Laboratory (LANL), Sandia National Laboratories (SNL), the University of New Mexico (UNM), and Calvary Chapel in Albuquerque.

William Dembski of Baylor University, another leader of the ID movement, soon followed. In November 2001, Dembski debated Stuart Kauffman at UNM, and also gave a presentation at the UNM Continuing Education facility.

A third leader of the ID movement, Michael Behe of Lehigh University, arrived in March 2002; he gave presentations at UNM, LANL, SNL, New Mexico Tech, and Calvary Chapel.

The stage had been set for the formal creation, in July 2002, of the New Mexico Intelligent Design Network (IDnet-NM). IDnet-NM is a division of the Intelligent Design Network (IDnet: <<http://www.intelligentdesignnetwork.org>>), managed by John Calvert of Shawnee Mission, Kansas, but IDnet-NM operates autonomously under the supervision of its manager Joseph D Renick of Las Lunas, New Mexico, and its advisory board.

The mission of IDnet-NM, according to its web site <www.nmidnet.org>, involves:

- Promoting the principles of religious and philosophical neutrality, academic freedom, intellectual integrity, and objective bias-free science education in New Mexico's public schools;
- Promoting intelligent design as a scientific theory of cosmological and biological origins; and
- Informing parents, students, teachers, public school administrators and state officials of the scientific, religious, and legal issues associated with the teaching of theories of biological origins in public schools.

In the same vein, IDnet-NM declares its desire to:

promote unbiased evidence-based science education with respect to the teaching of cosmological and biological origins; enhance public awareness of the evidence of intelligent design in the cosmos and in living things; and to inform the public of the underlying philosophical, religious, scientific, and legal issues surrounding the teaching of origins science in public schools.

... IDnet-NM is committed to the principles of objective unbiased science education, promotion of intelligent design as a theory of cosmological and biological origins, and informing New Mexicans about the scientific, religious, and legal issues associated with the teaching of biological origins in public education.

The ID movement's Wedge strategy (<<http://www.antievolution.org/features/wedge.html>>) was now fully engaged for the third time in the New Mexico science standards battle. Although Genesis-based creationists led the battle in 1996 and 1999, it now appeared that they were willing to take a back seat to the ID supporters, or to join the ID group while keeping silent about both God and Genesis.

The SBE, with significant leadership from Berman, had developed a very rigorous process for writing, refining, and reviewing all academic standards. A year-long process began by involving science teachers, academics, and practicing scientists in the initial writing efforts. The draft standards were then reviewed by a "megapanel", representing all stakeholders in education, including parents, teachers, clergy, scientists, and business people. As a result of this review, the revised science standards were then posted for public review by any New Mexican wishing to provide comments and suggest changes. The SDE then incorporated changes as it saw fit and prepared a document for final approval by the SBE.

Three ID supporters were part of the original writing team. They waited until nearly the end of the writing process to begin voicing their concerns about the "special treatment of evolution". They met individually with almost every member of the SBE and wrote lengthy letters to the board, to newspapers, and to their various constituencies around the state, including certain churches and other receptive groups.

At the megapanel review, they again offered their suggested "improvements" in language, reiterating their claims that evolution was being treated in a special and dogmatic way and that "scientific evidence" against evolution was not being presented. They also held additional individual meetings with SDE staff to make their case. This was followed by a flood of letters to the SBE, including church petitions, urging numerous changes in the language of the standards.

ID proponents had clearly evolved from their earlier efforts in New Mexico, Kansas, and Ohio. Their strategy did not include any specific request to add "intelligent design" to the standards. Rather, they focused on their "Wedge" approach to attack and weaken the teaching of evolution and related topics. They also hinted at possible conspiracies and cover-ups in the science community and produced lists of scientists who questioned evolution.

Among their many and very long letters to the SBE, full-page newspaper ads, and press releases, they published the "results" of several Zogby polls. On July 28, 2003, in a press release and letters to all members of the SBE, IDnet-NM reported the results of five polls, three in NM, one in Ohio, and one national, drawing the following conclusions (<<http://www.nmidnet.org/Press%20Release%201.doc>>):

In regard to the teaching of evolution in New Mexico, the overwhelming majority of respondents, both parents and laboratory scientists, favored teaching the evidence both for and against evolution by a factor of over 4-to-1. In regard to teaching



intelligent design, parents and laboratory scientists favored teaching intelligent design by an overwhelming factor of 5-to-1.

Joe Renick, Executive Director of IDnet-NM, said “the results of these polls are of great importance to New Mexicans at this time because the Science Education Standards are in the final stages of the revision process. Language in these Standards in the area of biological evolution mandates an ‘evolution-only’ curriculum that prevents students from hearing about evidence that contradicts the predictions of macro-evolution and censors alternative theories of biological origins such as intelligent design.” He added “the dogmatic language in these Standards suggests that the Department of Education is more interested in convincing students that evolution is true than in teaching them about the science of macro-evolutionary biology. ...

(It is interesting to note that Renick was willing to attack SDE staff members personally in this letter, accusing them of “dogmatism”. Later, it appears that IDnet-NM decided that this was not a good strategy, and switched to congratulating the staff, while still strongly urging them to make the ID-inspired changes.)

“Results of these polls”, Renick said, “could be important in convincing the State Board of Education that the current language developed by the Department of Education does not reflect the general attitudes of parents of schoolchildren in New Mexico or that of scientists in New Mexico’s national labs...”

IDnet-NM’s reference to “scientists in New Mexico’s national labs” was based on the response to a survey sent, it claimed, to approximately 16 000 employees of Sandia and Los Alamos National Laboratories

(SNL and LANL) as well as about 500 faculty in science and engineering departments in New Mexico’s public universities. There were only 248 responses, according to the press release and letters.

On July 28, Berman contacted SNL leadership, including the lab president, to inform them of this poll and to request their review and public comments. Berman also contacted the American Institute of Physics for its assistance and initiated his own survey to check the accuracy of the polls and their claimed conclusions. Kim Johnson and Dave Thomas made the poll results known to other lab personnel and to the news media.

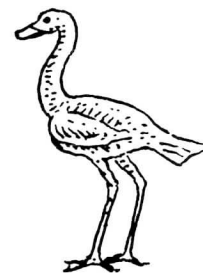
In response to these inquiries, there were 82 responses from SNL or LANL, none of which reported receiving the survey via e-mail at their labs. Of the 91 direct responses from universities, 5 people said they received the survey (5.5%). IDnet-NM had no explanation for the discrepancy between its claim of 16 000 contacts (essentially the *entire* staff of *both* laboratories), and Berman’s inability to find a single individual who received the survey. Furthermore, since this was a voluntary, self-selected poll, professional standards usually require at least a 40% response rate to be meaningful, and the reported response rate of 1.5% (248/16 500) fails even to come close to professional standards — even if it were true.

SNL President Paul Robinson issued a statement on August 13 denouncing the poll, and LANL Director G Peter Nanos later issued a similar denial and a request that IDnet-NM refrain from using the laboratory’s name. To date, IDnet-NM has not yet removed the survey from its website, and indeed continues to claim in its defense that “the math is the math”.

Despite this public discrediting of its poll, IDnet-NM continued to inundate the SBE with letters in support of its suggested changes. To counter this, several New Mexico science organizations (the Coalition for Excellence in Science and Math Education, the New Mexico Academy of Science, and New Mexicans for Science and Reason) and science teachers began a campaign to encourage letters of support for the current stan-

dards language to the SBE and to the press. These same groups also solicited additional support from New Mexico and national science organizations, church groups, and other supporters. Following is a list of those organizations that responded with extremely positive reviews of the standards as written:

National Academy of Sciences
National Science Teachers Association
National Center for Science Education
Lawrence Lerner, primary reviewer of state science standards for the Fordham Foundation
American Institute of Physics
American Institute of Biological Sciences
American Geological Institute
Biological Sciences Curriculum Study
New Mexico Conference of Churches
The United Methodist Church
New Mexico Business Roundtable
New Mexico Math, Science, Technology Partnership
New Mexico Coalition for Excellence in Science and Math Education
New Mexico Academy of Science
New Mexicans for Science and Reason
Los Alamos National Laboratory Fellows
University of New Mexico Biology Department staff
The Science Standards Writing Committee
Groups of K-12 teachers
Karl Johnson, the discoverer of the Hanta virus



Despite this overwhelming support, the outcome of the SBE meetings remained uncertain right up to the day that the standards committee met. One strong science supporter was absent, leaving 6 members, 2 of whom were known to favor the ID changes, and one who was strongly leaning in that direction. So a 3-3 vote was possible, as was a 4-2 vote in either direction. Despite the enormous evidence and scientific and teaching support, board members often look for compromise positions. In addition, several board members

had received many dozens of letters from their constituents arguing on behalf of the ID position. The ID contingent was not asking to specifically include “intelligent design” in the standards. They were arguing “only” for fairness in presenting the “scientific evidence” against evolution, and for “small” word changes to indicate the uncertainties and problems in “Darwin’s” theory of evolution. Their pseudoscientific arguments concerning the difference between micro- and macro-evolution and the difference between “experimental and historical evidence” were mostly ineffective, since none of the SBE members were scientists, and had little understanding of these discussions. Ultimately, the issues were predominantly political and religious, with “fairness” and “can’t we all just get along” thrown in as icing.

The SBE committee met on August 27. The SDE staff were supported in their presentations by LANL Fellow Greg Swift, a major contributor to the standards, and erstwhile ID supporter Rebecca Keller, who had decided to support the standards without change. The chair attempted to get equal numbers of speakers on both sides of the issue. However, only 3 ID defenders were present, and they all spoke. Six pro-science people also spoke, including the Reverend Barbara Dua, Executive Director of the New Mexico Conference of Churches, which represents 600 000 New Mexicans. In addition, the Chair asked those in the audience who supported the standards to stand and be recognized, whereupon 29 people from across the entire state rose. The final count was 35 science supporters in the audience versus 3 creationists. The committee then voted 4–2 to adopt the standards as written.

The full board met the next day. There was no longer any question that the standards would pass, but the margin of victory was unknown. The board president requested that presentations be short, and science teacher Malva Knoll and Berman spoke briefly. Unfortunately, they spoke first. Joe Renick then spoke for ID. Instead of a presentation, he began an inquisition of the SDE staff, reinter-

preting the standards so that they would support the ID position in the public record, despite the fact that he would be unable to get any written changes made to the standards language. It took several of these carefully scripted questions before the SDE realized what was going on: having lost on every issue, the ID people were trying to succeed by verbally reinterpreting the written material to suit their desires. Board member Flora Sanchez quickly realized what was occurring and asked the staff for clarification. SDE staff replied that the standards speak for themselves, and only good science will be taught.

The final vote was 13–0 in favor of adopting the standards. But the ID supporters continued their attempts to describe their defeat as a victory. An op-ed was published in the *Albuquerque Journal* (2003 Sep 4; available on-line at <http://www.abqjournal.com/opinion/guest_columns/guest09-04-03.htm>), entitled “Schools’ science standards will serve students well”, by two proponents of ID, Rebecca Keller and Michael Kent. Here are some excerpts:

A great strength of the new standards is that they explicitly recognize these issues, and require their presentation and discussion. Intelligent Design members were involved in the process of formulating the new state science standards from the outset.

Our goal from the beginning has been to keep all ideology and dogma out. With this in mind, we felt that the original draft had shortcomings in the area of biological origins. We brought these to the attention of those working on the standards at the state Department of Education.

Because of their cooperation, strong leadership and

willingness to listen to diverse viewpoints, enormous improvements were made. The final draft is a huge step toward teaching science as objectively as possible.

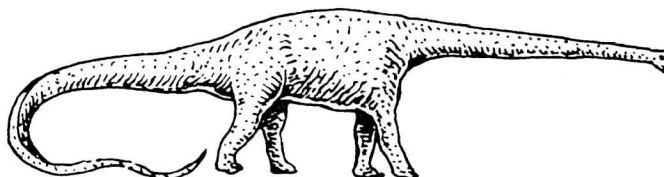
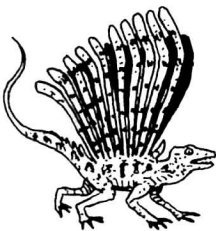
Evolution will be taught as the mainstream consensus view that it is, but these standards also will allow healthy discussion and critical examination of its claims. These standards will serve all of New Mexico’s children well....

This is a great victory for excellence in science education, for the integrity of science and for objectivity in the teaching of biological origins. Most important, this is a great victory for all New Mexico students, regardless of their faith or background.

So it is once again very clear that the struggle for good science will go on indefinitely. Even if the best and clearest standards are developed, the ID supporters will bring their own pro-ID interpretations to the table, regardless of the actual outcomes. And in Texas, the battleground has expanded to include textbooks. Indeed, eternal vigilance is the price of good science.

We would not have achieved success in New Mexico without the enormous support of science teachers, scientists, and state and national organizations. However, we might not have accomplished very much if we did not have the incredible and steadfast support of Department of Education staff members Sharon Dogruel and Steven Sanchez. It is now up to all of us again to ensure that good science is both taught and assessed in K–12 classrooms in New Mexico. That is our ongoing challenge.

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UPDATES

Arkansas, Rogers: At its meeting on September 16, 2003, the Rogers School Board voted to deny Bob Dunning's request to adopt a policy that would allow students to be exempted from studying material for religious reasons, including but not limited to evolution — "certain parts of what's taught in sex education" were also cited (*Northwest Arkansas News* 2003 Sep 17). Dunning submitted his request at the August 19 meeting of the board (see *RNCSE* 2003 May-Aug; 23 [3-4]: 5-10), although he subsequently asked the board to delay voting on it. Alluding to advice given to the board at its August meeting, board president Joye Kelley commented, "I'm uncomfortable with this policy when the school board's attorney and the state school board attorney have advised us that we should not and cannot pass this policy." Disagreeing with her assessment of the legal issues, Dunning said that he would pursue the issue with the aid of the Christian Law Association. (For the CLA's views on evolution education, see <http://www.christianlaw.org/different_approach_pf.html>.) According to a story in the *Northwest Arkansas News* published before the meeting (2003 Sep 16), Dunning's eventual goal is the elimination of evolution in the public schools.

California, Modesto: On September 29, 2003, at a 90-minute forum sponsored by the League of Women Voters of Modesto, eight candidates for the Modesto City Schools Board of Education expressed their views on a variety of issues, including the teaching of creationism. According to the *Modesto Bee* (2003 Sep 30), Ted Dickason said that creationism and evolution should get equal billing in science classes; Armando Flores, incumbent Odessa Johnson, and Belinda Rolicheck said that creationism was suitable for social studies classes, as part of a discussion of religion; incumbent Connie Chin said that teachers and students should be able to discuss creationism in both science and

social studies classes; and incumbent Robin Brown, incumbent Gary Lopez, and Rickey McGill said that both creationism and evolution should be taught but did not specify in what venues. In the November 4, 2003, election, Brown, Chin, Johnson, and Lopez won.

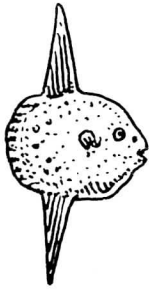
California, Roseville: The Board of Trustees of the Roseville Joint Union High School District decided at its meeting on September 2, 2003, not to enact any district-wide policy on teaching evolution, according to the *Sacramento Bee* (2003 Sep 7). The decision follows months of discussion on the part of the school board and activism on the part of creationists and supporters of evolution education alike (see *RNCSE* 2003 May-Aug; 23 [3-4]: 5-10). In the meeting, Assistant Superintendent Steven Lawrence told the board that the district's teachers expressed concern at the idea of teaching "arguments against evolution", which are not part of the state curriculum. Additionally, several students told the board that evolution was not taught dogmatically in the classroom. But anti-evolutionists in attendance, including several members of the board, were not satisfied: "[s]cience is its own religion", said Board President Jan Pinney: "Since we're already teaching one religion that's agnostic or atheist, we need the alternative, too." The discussion culminated with a speech by trustee Jim Joiner, whom the *Bee* described as impassioned in his opposition to what he called "a blind rush to a moral agenda": "I prefer to have biologists define biology and religious people define religion," he said. "The last people I want to define either one are politicians like us." Decrying a "top-down" approach to curriculum development, Joiner "recommended that people who want to change the teaching of evolution follow the same process used for making other decisions related to classroom instruction — a process that starts with teachers, administrators and parents at each school." Larry Caldwell, a local parent who had proposed a draft pol-

icy that would require teachers to help students to "analyze the scientific strengths and weaknesses" of evolution, indicated after the meeting that he would pursue his efforts in the individual high schools in the district. (After the preceding article was posted on the NCSE web site, Caldwell asked NCSE to make it clear that he is not advocating the teaching of the biblical creation story in public science classrooms.)

California, Vacaville: According to the *Vacaville Reporter* (2003 Oct 19; available on-line at <<http://www.thereporter.com/Decision03/pages/1019.html>>), a regional branch of Planned Parenthood circulated a 5-question survey — including the question, "What is your position relative to teaching creationism as an alternative, or in addition to, the theory of evolution to students in public schools?" — to the candidates for school board. In Area 1, incumbent Mary Kay Sogge and candidates Margaret Larsen and Carol Landry rejected teaching creationism; candidate Jay Yerkes, however, advocated "an all-inclusive model, teaching creationism, evolutionism, intelligent design and other theories in as many forms as possible." In Area 2, candidates Lisa Fink, Michael Kitzes, and Terri Martin-McCaffrey rejected teaching creationism, and incumbent Sarah Chapman commented, "this is not an issue to be decided by a School Board trustee." Candidates Patricia Packer (who subsequently withdrew from the election) and Staci Pauly in Area 2, however, endorsed teaching creationism: Pauly wrote, "Being a Christian, I strongly support teaching creationism as an alternative to evolution ... Creationism should be taught by using the Bible," adding, "I feel children could be taught Bible stories as young as kindergarten, and it would be their introduction to history, since creationism [*sic*] is the beginning of time." In the November 4, 2003, election, Sogge and Yerkes won in Area 1 and Kitzes and Pauly won in Area 2.

Iowa, Des Moines: At a candidates' forum on September 4,





2003, one of the three candidates running for two seats on the Des Moines Independent School District board, Ako Abdul Samad, expressed support for teaching biblical creationism in the public schools (*Des Moines Register* 2003 Sep 5; available on-line at <<http://www.dmregister.com/news/stories/c4780927/22167652.html>>). Samad, a Muslim imam, said, "I support the teaching of all doctrines," adding "I wish that sometimes when we begin to talk about procreation and the different sciences that we did it without being biased and we did it without being afraid to teach our children." The other two candidates, Connie Boesen and incumbent Marc Ward, disagreed; Ward said, "I oppose the teaching of biblical creationism in the schools, and I don't think it's appropriate for a science class." In the September 9 election, Samad and Boesen were elected.

Louisiana: Creationism surfaced during a candidates' forum of the 7 major gubernatorial candidates held at Tulane University in New Orleans on September 25, 2003, and broadcast on public television stations across the state. Conservative Republican candidate Piyush "Bobby" Jindal was asked by a *Times-Picayune* reporter to clarify his views on teaching creationism alongside evolution in the public schools. Pierson Cross, who teaches government at the University of Louisiana, Monroe, told the Lafayette, Louisiana, *Advertiser* that it was a tricky question for Jindal, who "had to maneuver around the question in such a way that he did not alienate conservative Christian voters who support him and, at the same time, did not drive away other potential voters, Cross said" (2003 Sep 26; available on-line at <<http://www.theadvertiser.com/news/html/1FE5D1EF-0693-4C90-9B14-95FF5C296A26.shtml>>). The Associated Press's reporter, however, observed, "Jindal has already told the Louisiana Family Forum that 'the scientific weaknesses of evolution' should indeed be taught. At Thursday night's forum he elaborated, saying 'with evolution there are flaws and gaps. I think it's appropriate to tell our students that no scientific theory

can prove evolution'" (2003 Sep 26; available on-line via <<http://www.heraldtribune.com/apps/pbcs.dll/article?AID=/20030926/APN/309260654>>). In the October 4, 2003, open primary, Jindal, running in a field of 17, received 33% of the vote, and consequently faced the incumbent lieutenant governor, Democrat Kathleen Babineaux Blanco, in a run-off election. Blanco, according to the *New Orleans Times-Picayune* (2003 Nov 2; available on-line at <<http://www.nola.com/news/t-p/index.ssf?/base/news-0/106775965172020.xml>>), opposes teaching creationism in the public schools. In the November 15, 2003, election, Jindal lost to Blanco.

Massachusetts, Boston: Among the 12 hopeful candidates running for 4 at-large seats on the Boston City Council was Roy Owens of Roxbury, who told the *West Roxbury Transcript* (2003 Aug 7; available on-line at <http://www.townonline.com/west-roxbury/news/local_regional/wrt_covpwcouncilms08072003.htm>) that he would support teaching creationism in the public schools if he were elected. "When they took creationism and they stopped teaching that man was made by God and has a higher purpose in life, they began to teach that we were involved [*sic*] from apes and monkeys. They [children] began to act like apes and monkeys," he was quoted as saying. Owens was described by the *Boston Globe* (2003 Aug 27) as a "perennial" council candidate; although he is reportedly a Pentecostal preacher, he identified himself as a real estate owner to the *Transcript*. In the November 4, 2003, election, Owens placed eighth in a field of 8 candidates, with about 5% of the vote.

New Mexico, Albuquerque: An honors class at the University of New Mexico in which "intelligent design" is advocated was a focus of controversy in January 2003, according to the *Albuquerque Journal* (2003 Oct 1). The class, entitled "Origins: Science, faith, and philosophy", and taught by UNM psychology professor Harold Delaney and Sandia National Laboratories chemist Michael Kent, was reportedly inspired by the Nature of Nature conference held

at Baylor University in 2000 under the auspices of the now-defunct Michael Polanyi Center (see *RNCSE* 2000 Jan-Apr; 20 [1-2]: 9-12 and 2000 Jul-Aug; 20 [4]: 9-11). In January, UNM science faculty protested the fact that students could take the class to satisfy a science requirement; Les McFadden, chair of the Earth and Planetary Science Department, complained that students in the class are presented with material that they are not equipped to evaluate on its scientific merits: "How do you make a judgment about something if you don't have the background?" McFadden also characterized "intelligent design" as creationism in a new guise. In a memorandum dated January 20, 2003, the dean of UNM's College of Arts and Sciences agreed that the class was better classified as a humanities course.

Virginia, Fairfax County: In the race between Republican Mychale B Brickner and Democrat Gerald E Connolly for the post of Chair of the Board of Supervisors of Fairfax County, creationism was a recurring theme. During her two terms as a member-at-large of the Fairfax County School Board, Brickner supported a conservative agenda, including teaching creationism in the county's public schools. In his campaign, Connolly repeatedly cited Brickner's support of teaching creationism as evidence of her far-right agenda (see, for example, the *Washington Post* 2003 Aug 24; available on-line at <<http://www.washingtonpost.com/wp-dyn/articles/A37490-2003Aug23.html>>), with apparent success: the *Falls Church News-Post* cited Brickner's "arch-conservative, pro-creationist ideological agenda" as part of its reason for endorsing Connolly (2003 Sep 4; available on-line at <<http://www.fcnp.com/326/editorial.htm>>). In the November 4, 2003, election, Connolly won.

Virginia, Loudoun County: On August 28, 2003, while seeking the endorsement of the Loudoun County Democratic Committee, three candidates for the Loudoun County School Board expressed their views on teaching creationism in the public schools (*Leesburg Today* 2003 Aug 29; available on-line at <<http://www.leesburg2day.com/current.cfm?>

catid=31&newsid=7634>). Priscilla Godfrey (running in the Blue Ridge district) said that creationism could be taught alongside evolution and that students could decide for themselves; Phyllis Randall (running in the Broad Run district) said, "I'm a Christian. I don't believe in evolution. I believe in creationism"; and Tom Marshall (running in the Leesburg district) said, "I don't think there is a conflict between evolution and creationism. Clearly creationism is not a science, it's a philosophy." All three candidates received the com-

mittee's endorsement. In the November 4, 2003, election, Godfrey won, and Marshall and Randall lost.

Wyoming, Worland: The Associated Press (2003 Aug 29) reports that on August 26, 2003, the school board of Washakie County School District Nr 1 voted to recommend the adoption of the following to the district's policy committee: "It shall be the policy ... when teaching Darwin's theory of evolution that it is only a theory and not a fact. Teachers shall be allowed in a neutral and objective

manner to introduce all scientific theories of origin and the students may be allowed to discuss all aspects of controversy surrounding the lack of scientific evidence in support of the theory of evolution." Board member Tom Ball, who initiated discussion of the proposed policy, said that he would have preferred "required" to "allowed" in the second sentence. Pastor Bud Surles told the board, "evolution is more a product of Hollywood movies than based on real science." The head of the high school's science department said

THE WAY SCIENCE WORKS

Wendee Holtcamp

In communicating with the public and the press, it is important to emphasize that science has three characteristic aspects:

1. **Discovery** — seeing things for the first time. This includes "seeing" old data in a new light, but not necessarily having tested the new insight scientifically — at this stage. Examples of such discoveries in science include the discovery of cells and other organelles by ever-better microscopes, the "accidental" discovery of the antibiotic nature of penicillin, and purely observational phenomena such as observing and recording an animal's behavior.
2. **Developing ideas and drawing implications** — Scientists are creative. They think up ideas that they can test. They also take existing knowledge and ponder its meaning. They draw conclusions they think are reasonable from their findings. Scientists do this both in the scientific literature and in the popular media (via books, magazine articles, and other forums). The significance of the contributions of scientists such as Stephen Jay Gould, Jared Diamond, and Robert MacArthur is largely due to their involvement in professional dialog, generating *new* ideas, discussing the implications of other people's ideas, and summarizing the progress of science. Indeed, this is actually an extremely powerful way that science progresses and is sometimes underemphasized.
3. **Hypothesis testing** — Despite the fact that #2 significantly moves science forward, hypothesis testing is where science differs from all other fields of study. All, or many, other fields (history, mathematics, philosophy, cultural studies, and so on) use #1 and #2 and so does science — but science is distinguished by the testing of ideas and rejecting of incorrect notions. Hypothesis rejection is not always "automatic", for other possibilities (poor experimental design, a new twist on an

old theory, discovery of a new aspect of an old theory) must be considered. A major problem with pseudoscientific ideas, such as "intelligent design", is that they rely on #2 without #3. ID proponents have an "idea" that they have philosophically and logically justified to their own group. Many intelligent, thoughtful Christians I know think that the ID arguments are "air-tight". However, great logic alone does not make great science. Complex logical arguments can be flawed if their underlying assumptions are proven false. This is what happened with many of Aristotle's brilliant — but ultimately wrong — ideas.

Before any ideas — no matter how logical they sound — should be introduced into our schools as a scientific idea, they *must* at least begin to go all the way through the scientific process — not just the idea-generating phase. We do not allow unproven or discredited ideas such as alchemy or cold-fusion to be introduced into science textbooks, except as examples of "bad science"! While cold fusion may happen one day in the future, we would not think of introducing it into the curriculum as a valid scientific idea before it is even discovered (#1) and then tested by multiple, independent scientific teams.

I believe that if our nation's people understood the implications of these three aspects of science, it would be easier to convince them that ID — and a lot of the "alternative scientific ideas" that various groups propose to include in the curriculum — is not science and should not be taught as science. None of them includes aspect #3 — which is, after all, the transformative step that turns a good idea into good science.

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that Wyoming teachers are required to teach in accordance with the state science standards and are prohibited by the Supreme Court's ruling in *Edwards v Aguillard* from teaching creationism, and the attorney for the school district warned that adopting such a policy would be problematic. Yet local pastor Mike Brush, who endorsed the policy, contended, "Intelligent design is not religious[ly]-based. I would not want you to teach religion in any way, shape, or form." Subsequently, at a well-attended board meeting on September 22, the policy was approved by a vote of 5-2; it must be approved by vote at three meetings to take effect, according to the Associated Press's report (2003 Sep 25). Worland, the county seat of Washakie County in northern Wyoming, is home to 5250 people, three elementary schools, one middle school, and one high school.

Europe: In November 2002, at the behest of the European Commission, the Gallup Organisation, Hungary, conducted a survey of public opinion about science and technology in the thirteen countries that are candidates for entry into the European Union, collectively known as CC-13: Bulgaria, Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia, and Turkey. Its 55-page report, entitled "Candidate countries Eurobarometer on science & technology", is available on-line in PDF format at <http://europa.eu.int/comm/research/press/2003/pdf/cc-report_en.pdf>. Four of the statements used to assess knowledge of basic scientific facts (together with the percentage of correct responses from CC-13 and from a similar Eurobarometer survey of the 15 members of the European Union, EU-15, conducted in 2001):

- The continents on which we live have been moving for millions of years and will continue to move in the future. CC-13: 73%; EU-15: 82%.
- The Sun goes around the Earth. CC-13: 69%; EU-15: 67%.
- Human beings, as we know them today, developed from earlier species of animals. CC-13: 51%; EU-15: 69%.
- The earliest humans lived at the same time as the dinosaurs. CC-13: 49%; EU-15: 59%.

The report also discusses responses to "three subject matter questions that, to some degree, contradict what people can read about in Genesis, the letter of the Koran, or the Bible", categorized by religious affiliation and level of participation in religious observances (see Table 1 below).

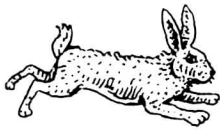


TABLE I

Religion affiliation, level of participation, and scientific facts that conflict with religious theories in the CC-13 countries (adapted from Table 1.4d of "Candidate countries Eurobarometer on science and technology")

Percentages are those categorizing the statements as "fairly scientific".

	PARTICIPATION:	ROMAN CATHOLIC			ALL
		++ AT LEAST ONCE A WEEK	+ AT LEAST YEARLY	- NEVER	
The continents on which we live have been moving for millions of years		70	76	75	73
Human beings developed from earlier species of animals		47	56	58	52
The earth goes around the sun*		70	74	68	72
	PARTICIPATION:	PROTESTANT			ALL
		++ AT LEAST ONCE A WEEK	+ AT LEAST YEARLY	- NEVER	
The continents on which we live have been moving for millions of years		71	76	77	76
Human beings developed from earlier species of animals		24	53	70	52
The earth goes around the sun*		71	75	70	74
	PARTICIPATION:	ORTHODOX			ALL
		++ AT LEAST ONCE A WEEK	+ AT LEAST YEARLY	- NEVER	
The continents on which we live have been moving for millions of years		67	72	70	71
Human beings developed from earlier species of animals		45	54	51	52
The earth goes around the sun*		54	69	71	66
	PARTICIPATION:	MUSLIM			ALL
		++ AT LEAST ONCE A WEEK	+ AT LEAST YEARLY	- NEVER	
The continents on which we live have been moving for millions of years		61	62	**	61
Human beings developed from earlier species of animals		22	34	**	30
The earth goes around the sun*		48	43	**	45

* the original report lists "the sun goes around the Earth", presumably in error
 ** data was not included due to small sample size

Norway: A group of creationist medical students at the University of Oslo have petitioned the medical faculty there “not only [to] argue the cause for evolution, but also the evidence against”, according to the *Aftenposten* (2003 Nov 19; available on-line at <<http://www.aftenposten.no/english/local/article.jhtml?articleID=672888>>). Contending that evolution is taught dogmatically and that dissenters are subjected to harassment, the Christian Medical Students Circle proposed that the medical curriculum be revised to include 3 points: that complex biological structures such as the eye could not have evolved, that there is no fossil evidence for transitional forms between, for example, apes and humans, and that evolution is too improbable to occur. The faculty apparently was not responsive to the proposal; biology professor Nils Christian Stenseth argued that the medical school should offer a course in fundamental evolutionary biology, on the grounds (echoing the famous dictum of Theodosius Dobzhansky) that “nothing in biology could be understood out of an evolutionary context.”

United Kingdom: The British Broadcasting Corporation reports (2003 Sep 8) that the King’s Academy in Middlesbrough, at which biblical creationism is to be taught alongside evolution, is now open. As reported in *RNCSE* (2003 May-Aug; 23 [3-4]: 5-10), the King’s Academy is one of six proposed secondary schools in north-east England that would be run by a partnership between the Department for Education and the Vardy Foundation, headed by millionaire automobile dealer and evangelical Christian Sir Peter Vardy. The Vardy Foundation also runs Emmanuel College in Gateshead, Tyneside, which was in the headlines in 2002 for teaching biblical creationism alongside evolution (see, for example, *The Guardian* 2002 Mar 19; available on-line at <<http://education.guardian.co.uk/schools/story/0,5500,669846,00.html>>), which Richard Dawkins described as “educational debauchery”.

[NCSE thanks Barbara Forrest, Molleen Matsumura, and Dave Thomas for information used in this article.]

Darwinism and Intelligent Design: The New Anti-Evolutionism Spreads in Europe

Ulrich Kutschera

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According to a 2002 poll of adult Europeans conducted by a professional institute (IHA-GfK, Hergiswil, Switzerland), only 40% of the respondents agreed with the statement that the universe, the earth, and all organisms of the biosphere are entirely the product of a natural evolutionary process. Twenty-one percent were adherents of theistic evolution, 20% believed that God created all organisms at one time within the last 10 000 years, and 19% answered “don’t know/other opinion” (<http://www.factum-magazin.ch/whats_new/news.cgi?v=news&c=Schoepfung&id=04073104514.shtml>). Among the 20% who believed in a recent creation — mostly fundamentalist Christians who are biblical literalists — the highest percentage was in Switzerland (21.8%), followed by Austria (20.4%) and Germany (18.1%). Compared with the situation in the United States, where almost half of all adults deny evolution as a fact of nature (see for example Futuyma 1995; Gross 2002), the creationists in German-speaking European countries (Kutschera 2003) are still a minority that accounts for just one fifth of the population. Who are the conservative Christian anti-evolutionists in Europe and how are they organized? What role does the “intelligent design” (ID) argument play in the anti-evolution propaganda in European countries?

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CREATIONISM AND ID IN EUROPE

In March 2002, British newspapers revealed that Emmanuel College in Gateshead, a prestigious Christian-run secondary school that has been praised by Prime Minister Tony Blair, presented the creationist view as a “scientific” alternative to evolution (Gross 2002). After leading scientists, including Richard Dawkins, wrote to the Office for Standards in Education, and the bishop of Oxford intervened (“Evolution is a theory of great explanatory power ... and not a faith position as the college in Gateshead alleges”), the teaching of creationism as a scientific alternative was suspended (Gross 2002).

In Switzerland and Germany, two societies, *pro Genesis* (<<http://www.progenesis.ch>>) and the *Studiengemeinschaft Wort und Wissen* (<<http://www.wort-und-wissen.de>>) are the dominant anti-evolutionist associations. They publish newsletters, distribute videotapes, and promote their viewpoint via two professional journals, *factum* and *Studium Integrale Journal* (Kutschera 2003). The most important production of the European anti-evolutionists is a book edited by the *Wort und Wissen* employee Reinhard Junker and the microbiologist Siegfried Scherer (a fellow of the Discovery Institute) entitled *Evolution: Ein kritisches Lehrbuch* [*Evolution: A Critical Textbook*] (2001). In the preface, the authors elucidate their aim: to present an alternative to the “concept of macroevolution”, which is, in their view, not supported by convincing data. Interestingly, microevolution (the origin of new



species that display the same basic body plan) is accepted, but the occurrence of novel "types" in the fossil record is disputed and described as an unsupported claim of the Darwinists.

Junker and Scherer revitalized the Bible-based pre-Darwinian "theory of creation" as a theistic alternative to evolution. In order to circumvent logical problems concerning the documented continuum between micro- and macroevolution, the authors introduced a new "species concept", the so-called Basic Types of life. Since, according to chapter 1 of Genesis, God created animals and plants after their own kind (microorganisms, fungi, and protocista are not mentioned), these kinds must represent higher taxonomic groups. As examples, Junker and Scherer discuss the following Basic Types: Anatidae (ducks, geese, and swans), Canidae (dogs, wolves, and foxes), Triticeae (wheat, barley, and oats) and humans (one species, *Homo sapiens*). This novel "Bible-based theory" postulates that God created an in-built capacity for variation within a kind, but not between different Basic Types. Hence, what the Darwinists label as macroevolution is replaced by supernatural acts of the Creator, but microevolution (that is, the diversification of the Basic Types, with the exception of humans) is theistic-naturalistic evolution. This concept was introduced by Scherer several years ago at the Third International Conference on Creationism and at the European Creationist Congress (<<http://www.pages.org/bsc>>).

In the last chapter of their book, Junker and Scherer discuss the possibility that the Creator may communicate with the biologist via "design-signals", which are expressed in the beauty of flowers, butterflies, and other creatures. On these pages, the designer is equated with the biblical Creator-God. This European version of modern "theobiology" has been classified as ID-creationism (Kutschera 2003).

The impact of the Junker and Scherer textbook is difficult to assess. Due its low price and its attractive design, many more copies have been sold than of academic textbooks on evolution. It

has been translated into several European languages (Russian, Serbian, Finnish, and Portuguese), was awarded with a German textbook prize (sponsored by private conservative Christian associations), and is used in some public schools. However, the textbook is not accepted by the German Ministry of Education and Cultural Affairs as an official schoolbook, in spite of several lobbying attempts by German creationists. Positive book reviews are largely restricted to periodicals published by Bible-educated Christians. However, the international journal *Flora*, which is edited by a team of respected plant scientists, published a positive review of this book (Weberling 2002). This fact documents that anti-evolutionism in German-speaking countries has already infiltrated some academic circles.

DARWIN'S ANSWER

The discussion concerning the argument from design is as old as evolutionary biology itself. In his autobiography, Darwin treated this issue as follows: "The old argument of design in nature, as given by Paley, which formerly seemed to me so conclusive, fails, now that the law of natural selection has been discovered. We can no longer argue that, for instance, the beautiful hinge of a bivalve shell must have been made by an intelligent being, like the hinge of a door by man" (Barlow 1958). Indeed, modern scientists successfully explain the real world without reference to miracles, "intelligent designers", or other products of human imagination. If we were to admit "intelligent designers", "vital forces", and other spiritual entities, modern science would soon cease to exist (Futuyma 1995; Mahner and Bunge 1997). This is the main reason that scientists reject the modern version of Bible-based creationism under the cover of the currently popular ID rubric.

Charles Darwin provided an appropriate answer to the claims of the creationists of his time when he wrote: "It should be well to bear in mind that by the word 'creation' the zoologist means 'a process he knows not what'" (Darwin 1872). Likewise, the cur-

rently popular statement "the designer did it" is no answer, but a synonym for "we believe, but have no evidence". For those who believe no proof is necessary, discussions between scientists and the dogmatic proponents of ID are difficult and usually do not lead to a consensus.

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MAYBE A LIGHT SNACK?

In his "Rebuttal to William A Dembski's Posting and to his book *No Free Lunch*", Thomas Schneider disputes Dembski's claims about his program *ev*, which models the gain of information by genetic systems through evolutionary processes. In addition to claiming that Dembski misunderstands *ev*'s significance, Schneider also accuses him of shoddy and irresponsible scholarship. His rebuttal is available on-line at <<http://www.lecb.ncifcrf.gov/~toms/paper/ev/dembski/rebuttal.html>>; Jeffrey Shallit discusses Schneider's work and what Dembski makes of it in section 3 of his review of *No Free Lunch* (p 35).



NCSE NEWS

News from the Membership

Glenn Branch
NCSE Deputy Director

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

A letter to the editor of the Mansfield, Ohio, *News Journal* from **Tim Berra** appeared in the September 29, 2003, issue, rebutting a previous correspondent's assertion that "irreducibly complex" structures pose a puzzle for evolution. "Evolution is a tinkering process", Berra explained, "and often co-opts a pre-existing system for completely different duty when mutations accumulate in a changing environment. Given a mutation in a biochemical pathway or an anatomical structure the new arrangement may have survival value in a completely different way from the original system and therefore will be preserved by natural selection." He ended his letter with the advice "If you want to know something about a scientific theory such as evolution, ask a biologist, not someone with a religious agenda that bypasses the scientific method." Berra is Professor Emeritus of Evolution, Ecology, and Organismal Biology at the Ohio State University at Mansfield. [Thanks to Andrew Lutes for the news.]

Phina Borgeson, NCSE's Faith Network Project Director, reviewed RJ Berry's *God's Book of Works: The Nature and Theology of Nature* (London: T & T Clark, 2003), for *Research News & Opportunities in Science and Theology* (2003 Sep; 4 [1]: 24). Berry, who was Professor of Genetics at University College London from 1978 to 2000, is also a prominent writer on topics in science and religion from an evangelical Christian point of view. "Berry's effort as a whole can be seen as evangelical", Borgeson comments, "for it is a personal tes-

timony to a living faith and a lifetime in science, reflected upon and working together."

The *Albuquerque Journal* recently (2003 Sep 7) ran a story about the Valles Caldera, one of the largest volcanic craters in the United States, and the geologists who have studied it, including NCSE Supporter **G Brent Dalrymple**, Professor Emeritus of Oceanic and Atmospheric Sciences at Oregon State University, and **John Geissman**, Professor of Earth and Planetary Sciences at the University of New Mexico and RNCSE's associate editor for geosciences. In the 1960s, Dalrymple and his colleagues at the United States Geological Survey worked in the Valles Caldera, investigating the history of the earth's magnetic field as recorded in the volcanic rock; their research corroborated Frederick Vine's hypothesis that sea-floor spreading was the mechanism by which continental drift occurs. "Nearly four decades after Dalrymple found those rocks in the Valles Caldera, [plate tectonics] is taken for granted", the *Journal's* reporter writes. "But Geissman likes to remember how hard it was to get to that point. Coming to terms with plate tectonics was hard, and Geissman believes the rocks above Jaramillo Creek make the Valles Caldera arguably the most important place on [e]arth for his science."

C Mackenzie Brown's article "The conflict between religion and science in light of the patterns of religious belief among scientists" appeared in *Zygon* (2003 Sep; 38 [3]: 603-32). Brown argues that "Recent summaries of psychologist James H Leuba's pioneering studies on the religious beliefs of American scientists have misrepresented his findings and ignored important aspects of his analyses, including predictions regarding the future of religion." (It was Leuba's work that Edward J Larson and Larry Witham famously attempted to replicate; see their "Scientists are still keeping the faith", *Nature* 1997 Apr 3; 386: 485-6.) Brown is Professor of

Religion at Trinity University in San Antonio, Texas. Of interest in the same issue of *Zygon* is Leif Edward Ottesen Kennair's "Challenging design: how best to account for the world as it really is" (543-58), which challenges the proponents of "intelligent design" to "become a predictive theory of what design one may expect to find", particularly with respect to evolutionary psychology.

Daniel C Dennett was elected as a Fellow of the Committee for the Scientific Investigation of Claims of the Paranormal, as announced in CSICOP's journal *Skeptical Inquirer* (2003 Nov/Dec; 27 [6]: 9-10). Dennett is Director of the Center for Cognitive Studies and University Professor and Austin B Fletcher Professor of Philosophy at Tufts University; his latest book is *Freedom Evolves* (New York: Viking Penguin, 2003). Of interest in the same issue of *Skeptical Inquirer* are news stories about the "bogus" poll conducted for the Intelligent Design Network of New Mexico (p 5-7; see also p 9 of this issue of RNCSE) and the battle over evolution in Texas biology textbooks (p 6; see also p 4 of this issue of RNCSE), the Botanical Society of America's Statement on Evolution (p 12-4; the statement also appears in the Voices for Evolution section of NCSE's web site), and a piece by Bruce Martin and Frances Martin entitled "Neither intelligent nor designed" (p 45-9).

Wilfred Elders reviewed Thomas Vail's creationist compilation *Grand Canyon: A Different View* (Green Forest [AR]: Master Books, 2003) for *Eos*, the weekly newspaper of the American Geophysical Union (2003 Sep 23; 84 [38]: 384-5), characterizing it as "an example of a new, slick strategy by biblical literalists to proselytize using a beautifully illustrated, multi-authored book about a world-famous, spectacular locality." From a scientific point of view, however, "[e]xtraordinary interpretations require extraordinary evidence, and in this regard *Grand Canyon: A Different View* is an extraordinary failure." Elders is Professor Emeritus of Earth Sciences at the University of California, Riverside. An expanded version of his review



will appear in a forthcoming issue of *RNCSE*.

Barbara Forrest participated in a special program on "Evolution and intelligent design" held at Louisiana State University on October 29, 2003, speaking on "What is intelligent design? Why should we care?" She was joined by Trenton Holliday, Associate Professor of Anthropology at Tulane University, whose topic was "Human evolution: Thousands of fossils and growing". Forrest is Professor of Philosophy at Southeastern Louisiana University, *RNCSE*'s associate editor for philosophy of science, and coauthor, with Paul R Gross, of *Creationism's Trojan Horse* (New York: Oxford University Press, 2003).

NCSE Supporter **Patricia Kelley** received the 2003 Association for Women Geoscientists Foundation Outstanding Educator Award at the AWG breakfast, held at the annual meeting of the Geological Society of America in Seattle on November 3, 2003. A dinosaur lover as a child, Kelley received her PhD under the late **Stephen Jay Gould**, going on to hold positions at the University of Mississippi, the National Science Foundation, the University of North Dakota, and the University of North Carolina at Wilmington, where she is now Professor and past Chair of the Department of Earth Sciences. She is also past president of the Paleontological Society. "It's hard to imagine a career that would allow me to use my talent and have so much fun at the same time", she commented.

Denis O Lamoureux, Professor of Science and Religion at St Joseph's College, University of Alberta, presented two lectures, "The Bible and science: Beyond conflict and concord" and "Beyond the 'evolution vs creation' debate", at Brock University in St Catharines, Ontario, Canada (*The Brock Press* 2003 Oct 21; available on-line at <<http://www.brockpress.com/main.cfm/include/detail/storyid/534358>>). "This is one of the problems with the origins debate, if someone is an evolutionist or scientist, automatically there is no room for God; or, if you believe in God, you have to read the [B]ible literally and I would say this is another mistake", Lamoureux was quoted as saying.

"And I am an example of someone who both believes in God [and] has a really high view of faith and Christianity, but I am also an evolutionary biologist including the evolution of humanity."

In a recent paper, **Adrian Melott** and his colleagues hypothesize that the late Ordovician mass extinction, which occurred about 440 million years ago, was due to a gamma-ray burst ("Did a gamma-ray burst initiate the late Ordovician mass extinction?"; preprint available on-line at <<http://xxx.arxiv.org/abs/astro-ph/0309415>>). The abstract of their paper: "At least five times in the history of life, the earth experienced mass extinctions that eliminated a large percentage of the biota. Many possible causes have been documented, and gamma-ray bursts (GRB) may also have contributed. GRB produce a flux of radiation detectable across the observable universe. A GRB within our own galaxy could do considerable damage to the earth's biosphere. Rate estimates suggest that a number of such GRB may lie within the fossil record. The late Ordovician mass extinction shows a water-depth dependent extinction pattern that is a natural result of the attenuation of the strong ultraviolet radiation expected to result from a nearby GRB. In addition, a GRB would trigger global cooling which is associated with this mass extinction" [all references omitted]. The paper was the subject of news stories in both *Nature* (2003 Sep 24) and *New Scientist* (2003 Sep 24; available on-line at <<http://www.newscientist.com/news/news.jsp?id=ns99994198>>).

On November 1, **Kevin Padian** was awarded the 2003 Carl Sagan Prize for Science Popularization for his contributions to the public understanding and appreciation of science. The Sagan Prize is given annually by Wonderfest, a 5-year-old organization of scientists, educators, and journalists that produces major conferences for the general public on controversies and advances in science, to a San Francisco Bay Area researcher who brings scientific discoveries and insights to the attention of the general public. Padian was also recently profiled and interviewed in

California Monthly (2003 Nov; 114 [2]: 27-30), the magazine of the California alumni association. The article discusses not only his paleontological work but also his education, beginning, "There can't be many biology professors who hated science in high school. But that's exactly how Kevin Padian puts it, and with passion — 'I *bated* it.'" In addition, Padian clearly and forcefully explained NCSE's *raison d'être*: "A great deal of the work that our nonprofit [the National Center for Science Education] does is to advise teachers and principals and school board member about what the science is and what the legal decisions about the science have been." In addition to serving as president of NCSE's board of directors, Padian is Professor of Integrative Biology at the University of California, Berkeley.

Two book reviews by **Robert T Pennock** were recently published. First, he reviewed NCSE Supporter **Michael Ruse**'s latest book, *Darwin and Design: Does Evolution Have a Purpose?* (Cambridge [MA]: Harvard University Press, 2003), for *Science* (2003 Aug 22; 301: 1051), saying "This has to be the best of Ruse's many books, and it is hard to imagine how a better one could be written on this subject." Second, he reviewed Peter J Bowler's *Reconciling Science and Religion: The Debate in Early-Twentieth-Century Britain* (Chicago: University of Chicago Press, 2001) for *Endeavour* (2003 Sep; 27 [3]: 101-2). After praising Bowler's nuanced account of early-20th-century attempts to reconcile science and Christianity, he adds that in the 21st century, "We still hear from some quarters the same denunciations of naturalism, materialism and modernism. Conservative Christians continue to regard evolution as anathema and to blame it for social ills. Such unappetizing, reheated fare reminds one of CD Broad's acerbic 1939 comment that the debate on science and religion was not just stale, but had acquired something of the repulsiveness of half-cold mutton in half-congealed gravy."

On October 1, 2003, **Stephen H Randak** received an honorary Doctor of Science degree from his alma mater, Wabash College in



Crawfordsville, Indiana. Wabash awarded the degree to Randak at the dedication of its new Biology and Chemistry Building in recognition of his life-long contribution to and record of excellence in science education. The college bragged of its distinguished alumnus and his "30 years as an innovative and award-winning high school science teacher."

NCSE Executive Director **Eugenie C Scott** and Deputy Director **Glenn Branch** collaborated on "Evolution: what's wrong with 'teaching the controversy'", which appeared as an opinion piece in *Trends in Ecology and Evolution* (2003 Oct; 18 [10]: 499-502). The abstract of their article: "A new slogan in the fight against evolution education in the USA and elsewhere is 'teach the controversy'. Although there are scientific controversies about the patterns and processes of evolution that are appropriate topics for the science classroom, and there is a continuing social controversy in certain circles about the validity of evolution, it is scientifically inappropriate and pedagogically irresponsible to teach that scientists seriously debate the validity of evolution." Copies are available from the NCSE office; call, write, or e-mail.

The Pew Forum on Religion and Public Life and the Freedom Forum jointly sponsored a conference on "Teaching about religion in public Schools: Where do we go from here?", held May 20-22, 2003, in Arlington, Virginia. The session on "Religion and science: Should schools teach the controversy?" featured Kent Greenawalt of Columbia University Law School as the main speaker and Warren Nord of the University of North Carolina, Larry Witham (the author of *Where Darwin Meets the Bible*), and **Jay Wexler** of Boston University Law School as panelists. Unsurprisingly, the status of creationism (and "intelligent design") was a recurring topic in the panel's discussion. A transcript of the session is available on-line at <<http://pewforum.org/events/0520/discussion7.pdf>>.

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



Arthur Strahler Dies

*Eugenie C Scott,
NCSE Executive Director*

Most members of NCSE will recognize Arthur Strahler as the author of what is perhaps the most useful single volume of scientific refutations of creation "science", *Science and Earth History: The*

Evolution/Creation Controversy (Buffalo [NY]: Prometheus Books, 1987; reprinted with a new preface in 1999). The title of his book obscures the fact that it includes refutations not only from geology but also physics and astronomy, biology, and anthropology. For years it has been — and continues to be — the "one-stop shopping" source for people seeking scientific refutations to such creationist chestnuts as "dust on the moon", or "gaps in the fossil record", or "polystrate fossils".

Art died on December 6, 2002, at the age of 83, of complications of Alzheimer's disease. He is survived by his daughter Elaine and his son Alan, his coauthor on several textbooks. I and other members of the NCSE staff will miss Art's advice and good humor.

Arthur Newell Strahler was born in Kolhapur, India, where his parents were Presbyterian missionaries. He received his bachelor's degree at the College of Wooster in Ohio in 1938, and his master's degree and PhD from Columbia University in 1940 and 1944, respectively. His professional academic career was spent in Columbia University's geology department, which he joined in 1941 (while still a student!). He served as departmental chair from 1958 to 1962. In 1962, at age 44, he left academia to become a full-time author, and authored 16 major textbooks, which educated generations of university-level geologists, as well as *Understanding Science: An Introduction to Concepts and Issues* (Buffalo [NY]: Prometheus Books, 1992).

Many non-geologists will not be aware of Art's significant research career and contributions to the science of geology. He was among the first to apply statistics and mathematical modeling to the evolution of landforms by erosion and deposition. As his colleague Stanley Schumm wrote in a tribute, "He single-handedly transformed geomorphology from a historical descriptive science that lagged decades behind other geologic disciplines to a dynamic quantitative science with significant applications to sedimentology, stratigraphy, and civil and agricultural engineering."

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Office Biz

Glenn Branch,
NCSE Deputy Director

AN ANTHOLOGY OF ARCHIVISTS

NCSE's copious collection of books, periodicals, articles, correspondence, and ephemera relating to the creationism/evolution controversy is a unique trove of material, and we regard it as part of our mission to preserve it for posterity. Accordingly, in 2000 we decided to establish the position of NCSE Archivist (since upgraded to Archives Project Director) to catalog, organize, expand, and preserve our collection of information of historical, current, or future importance to the creationism/evolution controversy.

In the last "Office biz" — which appeared geologically long ago, in *RNCSE* 2000 Jul/Aug; 20 (4): 18 — I introduced **Emily Cheng**, NCSE's first archivist. Emily departed for graduate studies in literature at the University of California, San Diego, in August 2001, and was replaced by **Abraham Kneisley**, who kept the archives afloat, first on a full-time basis and then part-time while pursuing his studies full-time at the University of California, Berkeley. As the academic demands on Abraham's time increased, it was necessary to hire a new archivist in May 2002. Fortunately, **David Leitner** was available, first part-time and then full-time. David first came to NCSE as a volunteer and to interview the staff for his senior anthropology thesis on the creationism/evolu-

tion controversy. Building on Emily's and Abraham's work, he brought a welcome new level of organization to NCSE's archives before he departed for graduate studies in social anthropology at Cambridge University in September 2003.

NCSE's new Archive Project Director, who started work in October 2003, is **Jessica Moran**, who brings a wealth of experience to NCSE's archives from her previous work at the Emma Goldman papers at the University of California, Berkeley, and elsewhere. With a MLIS from San Jose State University, Jessica is the first person to work on the NCSE archives with the appropriate professional background. She says, "I'm so excited about working with such an interesting and valuable collection. If anybody out there has documents, collections, papers, or anything else they would like to donate, or if you would like to use the NCSE collection, please contact me!" (Jessica's e-mail address here is moran@ncseweb.org.) Welcome aboard!

OTHER STAFF CHANGES

Now at the administrative assistant's desk is **Nina Hollenberg**, who replaced Mercedes Aguirre in November 2001 (and whose presence we should have acknowledged long



Jessica Moran

before now). Her responsibilities include taking care of new memberships, renewals, and donations, helping with information requests, and making sure that the day-to-day work of the NCSE office proceeds smoothly. Nina's training in graphic design

is also a real asset to us: she contributed the cover art for *RNCSE* 2002 Jan-Apr; 22 (1-2), for example, and she designed the "Don't mess with textbooks!" graphic that appears on the Texas Citizens for Science web site and on the Texas Freedom Network's t-shirts. If you call the office, it will probably be Nina who greets you!

Finally, I should note that, after the April 2002 meeting of NCSE's board of directors, I was promoted to the new position of Deputy Director. As such, I assumed increased responsibility for NCSE's internal administration as well as our fundraising and outreach efforts. I continue to be responsible for the production and circulation of *RNCSE* and for generally serving as utility infielder around the

office. Thanks to all who noticed the hitherto unannounced promotion and called or wrote to congratulate me.

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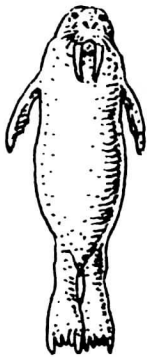
Nina Hollenberg

On February 11, 2002, Edward O Wilson, Pellegrino University Research Professor and Honorary Curator in Entomology of the Museum of Comparative Zoology at Harvard University, was interviewed on the "Forum" program on San Francisco's KQED public radio station. A listener e-mailed, "Please ask Professor Wilson to comment on the current movement by members of the Ohio Board of Education to have intelligent design taught alongside of evolution." Wilson answered:

Well, if you take it strictly in terms of what the evidence is, that's teaching religious belief alongside of science. There's no evidence, not a shred of evidence, for intelligent design. You know, if someone, presumably a biologist who's delving into the genome, or what we now call the pro-

teonome — that's this complex cascade of events involving proteins that are triggered by genetic coding — if something — if we ever found evidence in that — and it's under an intensive examination now — of some kind of direction or program that was way outside the chance changing of natural selection of genes, that would be one of the most sensational discoveries of all time, and believe me, there are thousands and thousands of very bright ambitious young biologists who would just love to find it. But there's not a shred of evidence, no indication that we are going to find it yet.

"Forum" shows are archived on KQED's web site at <http://www.kqed.org>.



Eight Challenges for Intelligent Design Advocates

Wesley Elsberry, Texas A&M University, and Jeffrey Shallit, University of Waterloo

Thus far, “intelligent design” advocates have produced many popular books, but essentially no scientific research. (See, for example, Gilchrist 1997; Forrest 2001.) Future success for the movement depends critically on some genuine achievements. In this article, we provide some challenges for intelligent design advocates, particularly William Dembski.

1 PUBLISH A MATHEMATICALLY RIGOROUS DEFINITION OF CSI

We challenge Dembski to publish a mathematically rigorous definition of “complex specified information” (CSI) and a proof of the Law of Conservation of Information in a peer-reviewed journal devoted to information theory or statistical inference, taking into account the criticisms in Elsberry and Shallit (2003) and elsewhere.

2 PROVIDE REAL EVIDENCE FOR CSI CLAIMS

Here is a brief catalog of some of the things Dembski has claimed exhibit CSI or “specified complexity”:

1. 16-digit numbers on VISA cards (Dembski 1999: 159);
2. Phone numbers (Dembski 1999: 159);
3. “All the numbers on our bills, credit slips and purchase orders” (Dembski 1999: 160);

4. The “sequence corresponding to a Shakespearean sonnet” (Dembski 2002: xiii);
5. Arthur Rubinstein’s performance of Liszt’s “Hungarian Rhapsody” (Dembski 2002: 95);
6. “Most human artifacts, from Shakespearean sonnets to Durer woodcuts to Cray supercomputers” (Dembski 2002: 207);
7. Scrabble pieces spelling words (Dembski 2002: 172-3);
8. DNA (Dembski 2002: 151);
9. Error-counting function in an evolution simulation (Dembski 2002: 217);
10. A fitness measure that gauges degree of catalytic function (Dembski 2002: 221);
11. The “fitness function that prescribes optimal antenna performance” (Dembski 2002: 221);
12. “Coordination of local fitness functions” (Dembski 2002: 222);
13. What “anthropic principles” explain in fine-tuning arguments (Dembski 2002: 144);
14. “Fine-tuning of cosmological constants” (Dembski 2002: xiii);
15. What David Bohm’s “quantum potentials” extract in the way of “active information” (Dembski 2002: 144); and
16. “The key feature of life that needs to be explained” (Dembski 2002: 180).

We challenge Dembski either to provide a complete, detailed, and rigorous argument in support of his claim that each of the items #1-16 has CSI, or explicitly retract each unsupported claim. Any supporting argument should describe which of the two methods (causal-history-based or uniform probability; see Elsberry and Shallit 2003: 17-21 for further discussion) is used to estimate probabilities, and provide a detailed description of the appropriate probability space, the relevant background knowledge, the rejection region, and the rejection function.

3 APPLY CSI TO IDENTIFY HUMAN AGENCY WHERE IT IS CURRENTLY NOT KNOWN

Thus far CSI has only been used to assert design in two classes of phenomena: those for which human intervention is known through other means, and those for which a precise step-by-step causal history is lacking. We challenge Dembski or other intelligent design advocates to identify, through CSI, some physical artifact — currently *not* known to be the product of human design — as an artifact constructed by *humans*. After this prediction through CSI, provide confirming evidence for this conclusion, *independent* of Dembskian principles.

Along similar lines, apply CSI to identify a suspicious death, currently thought to be from natural causes, as foul play. Furthermore, also provide confirming evidence for this conclusion, *independent* of Dembskian principles.

We note that Dembski himself has stressed the importance of independent evidence (Dembski 2002: 91).



Wesley Elsberry, a long-time evolution education activist, received his PhD in Wildlife and Fisheries at Texas A&M University in 2003. Jeffrey Shallit is Professor of Computer Science at the University of Waterloo.

4 DISTINGUISH BETWEEN CHANCE AND DESIGN IN ARCHAEOASTRONOMY

The Anasazi, or ancestral Puebloans, occupied what is now the southwestern United States from about 600 to 1300 CE. Several of their buildings — including those at Chaco Canyon, Hovenweep National Monument, and Chimney Rock — have been interpreted as astronomical observatories, with alignments correlated to solstices, equinoxes, lunar standstills and other astronomical events (Malville and Putnam 1989). Using the techniques of *The Design Inference*, provide a rigorous mathematical analysis of the evidence, determining whether these alignments are due to chance or human design.

Similar challenges exist for the claimed astronomical alignments at Stonehenge (Hawkins 1965; North 1996) and Nabta (Malville and others 1998), and the enigmatic drawings at Nazca in southern Peru. Which of the proposed alignments were designed, and which are pure coincidence?

5 APPLY CSI TO ARCHAEOLOGY

Another interesting question about the Anasazi is the presence of large numbers of pottery shards at certain ruins. Some archeologists have interpreted the number of these shards as exceeding the amount that could be expected through accidents. Use CSI to determine if the pots were broken through accident, or human intent (possibly in support of some religious ritual).

Archeologists have developed methods for determining whether broken flints cracked due to human intervention or not (Cole and others 1978). Attempt to re-derive this classification, or prove it wrong, using the methods of CSI.

Provide a useful means of applying CSI to distinguish early stone tools from rocks with random impact marks.

6 PROVIDE A MORE DETAILED ACCOUNT OF CSI IN BIOLOGY

Produce a workbook of examples using the explanatory filter, applied to a progressive series of biological phenomena, including allelic substitution of a point mutation. There are two issues to be

addressed by this exercise. The first is that a series of fully worked-out examples will demonstrate the feasibility of applying CSI to biological problems. The second is to show that assigning small-scale changes to “chance” and “design” only is indicated for much larger-scale changes or systems already noted as having the attribute of “irreducible complexity”. It is our expectation that application of the “explanatory filter” to a wide range of biological examples will, in fact, demonstrate that “design” will be invoked for all but a small fraction of phenomena, and that most biologists would find that many of these classifications are “false positive” attributions of “design”.

7 USE CSI TO CLASSIFY THE COMPLEXITY OF ANIMAL COMMUNICATION

As mentioned in Elsberry and Shallit (2003: 9), many birds exhibit complex songs. We challenge Dembski or other design advocates to produce a rigorous account of the CSI in a variety of bird songs, producing explicit numerical estimates for the number of bits of CSI.

Similar challenges can be issued for dolphin vocalizations, as in providing a definitive test of the “signature whistle” hypothesis (Caldwell and others 1990), and estimation of information of a dolphin biosonar click (compared to the information measure suggested by Kamminga and others 1998).

8 ANIMAL COGNITION

Apply CSI to resolve issues in animal cognition and language use by non-human animals. Some of these outstanding issues include studies of mirror self-recognition (Gallup 1970, 1982) and artificial language understanding in chimpanzees (Savage-Rumbaugh 1993), dolphins (Herman and others 1993), and parrots (Pepperberg 1993). We note the use of examples in Dembski’s work involving a laboratory rat traversing a maze as an indication of the applicability of CSI to animal cognition (Dembski 1998, 1999, 2002).

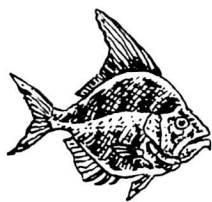
These, we feel, are reasonable challenges that Dembski, or others who wish to pursue “intelligent design” as a scientific research paradigm, ought to be eager to meet.

ACKNOWLEDGMENTS

We are grateful to Anna Lubiw, Ian Musgrave, John Wilkins, Erik Tellgren, and Paul Vitányi, who read a preliminary version of the longer paper from which this article is derived (Elsberry and Shallit 2003) and gave us many useful comments. We owe a large debt to Richard Wein, whose original ideas have had significant impact on our thinking.

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What Design Looks Like

Mark Isaak

You know, people think it must all be very easy, creating. They think you just have to move on the face of the waters and wave your hands a bit. It's not like that at all. —Terry Pratchett, *Eric*

“Life looks designed” is a common refrain among a variety of creationists. The claim is intuitively appealing because we have experience with design. For most people, that is the only way they know for making a functional machine. Since design is the only explanation they can imagine, they naturally consider it the best explanation. To this extent, “looks designed” is just an argument from ignorance. But many creationists further claim that this appearance of design is objective, can be (and, some say, has been) demonstrated scientifically, and therefore is suitable for teaching in public schools (for example, Dembski 2001a). The little evidence they present, though, is maddeningly vague. In most cases, the supposed evidence for design consists simply of pointing to various examples from natural history and saying, “Look, can’t you see it?” Typically, this is accompanied by the usual creationist attacks on evolution and the claim, implicit or explicit, that design is the only alternative. Often there are vague analogies with human artifacts such as watches or writ-

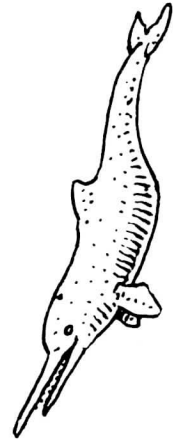
ing, but never with objective standards of comparison. In design theory, “looks designed” has been left to the imagination of the believer.

When done properly, though, the “looks designed” method, or the method of analogy, is an effective method for detecting design. In fact, it is almost always how we recognize design in our daily lives. We learn through direct experience that some things are designed — by seeing the things made — or through testimony of the designers themselves. Most artifacts, though, we recognize as designed because they look like things that we already know are designed.

Analogy is used in science, especially in fields such as archaeology and forensics, to distinguish design from non-design. For example, archaeologists can tell whether a flint was broken deliberately or naturally because flints known to be worked by humans differ from naturally broken flints in features such as fracture angle (Cole and others 1978). SETI researchers, in searching for non-human design, use analogy by assuming human-like properties of extraterrestrials — namely, an interest in communi-

cating and a desire to do so efficiently. And analogy is explicitly accepted, even promoted, by some creationists as a valid method of determining design (Moreland 1994; Thaxton 2001). Analogy to known design should be one way to detect design that evolutionists and creationists can agree upon.

Of course, the analogy method can only provide comparisons with designs produced by humans, since those are the only designs with which we have significant experience. Other design arguments suffer a fatal weakness: Without knowing anything about a designer, we cannot say anything about what to expect from one (Hume 1779; Sober 2003). Detecting a certain pattern does not indicate a designer until it can be demonstrated that the designer produces such a pattern, and this task would seem to be impossible when dealing with potentially supernatural designers. By assuming at least some commonality between humans and the unknown designer, we can avoid that problem. The analogy argument, despite the weakness of its assumption of human-like designs,



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[Adapted with permission from section 12 of Wesley Elsberry and Jeffrey Shallit, “Information theory, evolutionary computation, and Dembski’s ‘complex specified information’”. Available on-line at <<http://www.talkreason.org/articles/eandsdembski.pdf>>.]

is one design argument which leads somewhere other than in circles. To use this method, though, we must first say what design looks like.

Determining what design looks like is no trivial matter. A communications satellite, a drainage ditch, OPEC, a mathematical proof, a jelly bean, false teeth, a limerick, the controlled burn of a forest, and shampoo have little in common, but all are designed. Probably no single criterion can ever describe them all. Still, design does have some properties that are fairly general. I examine some of these properties below and consider how they compare with what we see in life. I also consider other properties that creationists claim as indications of design. There are some similarities and some differences between life and design, but as we shall see, even the similarities argue against design as a scientific theory.

STRUCTURE

Probably the most obvious aspect of designed things is an intermediate level of structural order. Unfortunately, this sort of structure is difficult to characterize quantitatively, but its quality is apparent. Almost all designs have an arrange-

ment that is neither very regular nor very random, but instead is between those extremes. There are exceptions, of course; a brick wall is highly ordered, and a stew is very disordered. Most designs, how-

ever, are neither uniform nor random, neither regular nor chaotic. Such an intermediate level of structure arises as a consequence of design. Objects that are too highly ordered are limited in their applications by their simplicity. Objects that are too chaotic are generally more expensive to produce, or their disorder keeps them from fitting and functioning well with other designs.

An intermediate level of structure plainly exists also in life. It is probably the most important characteristic people have in mind when they say that life looks designed. It is related to concepts

of information, so it may have inspired some creationist arguments about information theory. Since there is no commonly accepted word for this property, and since it is hard to characterize, it is not surprising that creationist claims about design are vague and ill-formed. Despite the lack of rigorous description, though, we can be fairly confident that having an intermediate level of structure is an important quality shared by both design and life.

This is not enough to conclude that life looks designed, though, because an intermediate level of structure can arise naturally, too. Such structure can be found in molecules, cave formations, the Northern Lights, and Jupiter's atmosphere, to give just a few examples. Structure arises spontaneously from a variety of processes; in fact, it takes only a couple of seconds for structure to appear in a candle flame. With regard to life, there is evidence that structure not only *can* arise naturally from ordinary processes, but perhaps should be expected from it (Kauffman 1993; Adami and others 2000).

SIMPLICITY

An underappreciated aspect of design is simplicity. Although many people associate design with complexity, almost all designs aim for maximum simplicity. (Complexity is another concept whose exact meaning is hard to pin down. As I use it here, greater complexity indicates that something is generally harder to understand; simplicity, of course, is the opposite.) Simplicity is important in design because simple designs are easier to invent, easier to implement, easier to modify, and usually easier to use. A good design is a simple design.

Of course, most designs require a certain amount of complexity. A home computer, for example, would not be able to do much if it consisted of nothing more than a solid block of silicon. (Although an advanced civilization could reputedly do a lot with a rectangular black obelisk.) It is in such seemingly complex designs, though, that the principle of simplicity is most important. A computer is

actually a fairly simple arrangement of components — CPU, memory, various peripherals, and wires connecting them — with fairly simple interfaces among the components. Each of the components, in turn, is a simple arrangement of sub-components, which may themselves consist of smaller sub-components, and so on until the simplest level is reached. In this way, each component, at whatever level, can be treated as a separate, almost independent unit, making it relatively easy to understand. Without such a simply-connected modular structure, each piece would have the potential to affect any other piece, and considering all the possible interactions would be impractical to say the least.

Simplicity is not what we see in life. Although most life has modular structure — that is, organisms made up of organs made up of cells made up of organelles — the complexity of life is far greater than we see in design. The individual parts are still very complex, the interfaces between parts are very complex, and individual parts can usually directly affect a large number of other parts. This complexity is compounded by the fact that organisms change a great deal over their lifetimes. After decades of work, biologists have scarcely begun to understand how a human body works, much less how all the various organisms in an ecosystem work and interact. A good illustration of the complexity of life is the difficulty of designing a drug with no unwanted side-effects. But I need not elaborate; creationists themselves cite complexity as one of the hallmarks of life. Notwithstanding disagreement over its source and significance, the complexity of life is another thing that evolutionists and creationists can agree upon.

Although simplicity is a goal, complexity can still enter into design in some ways. One way that complexity enters into design is through the process of modification. If a change is made that renders part of a system obsolete, it is often easier to leave in some or all of the old parts, which then add unnecessary complexity to the design. Modification also adds

continued on page 31

Determining what design looks like is no trivial matter.

Statement on Evolution in Textbooks

EVOLUTION AND SCIENCE

The coverage of evolution in biology textbooks we have written reflects the broad consensus in the scientific community. As noted in a booklet issued by the National Academy of Sciences, "Evolution pervades all biological phenomena. To ignore that it occurred or to classify it as a form of dogma is to deprive the student of the most fundamental organizational concept in the biological sciences" (*Science and Creationism*, National Academy Press 1985, p 22).

Our textbooks are written from this point of view. Evolution occupies a prominent position, and is covered explicitly. Many sections use evolutionary concepts to explain the diversity of living and fossil organisms, the adaptations of organisms to their environments, and similarities of structure and function shared by related organisms. In this way, we present students with the understanding of biology shared by the overwhelming majority of working scientists in the United States and throughout the world.

WHAT DO STATES REQUIRE OF BIOLOGY TEXTBOOKS?

Although state requirements vary, the majority require that biology curricula must include extensive coverage of evolution. The few states where standards or curriculum guidelines do not mention evolution by name nonetheless require the coverage of evolutionary topics. If we omitted proper coverage of evolutionary facts and theories, we would not be in compliance with these and other curricula that require complete, accurate, up-to-date, and conceptually-based educational materials.

OUR MESSAGE TO TEXTBOOK ADOPTERS

As scientists and teachers, we find it unacceptable that school districts considering our books for adoption would be encouraged to choose one book over another based on the perception that teachers should avoid the topic of evolution. We encourage school districts deciding among our books to use genuine scientific and educational criteria.

We also deplore the efforts made in some states and districts to require that evolution be disclaimed. Such disclaimers single out evolution from all other scientific ideas as somehow less reliable or less accepted by scientists, or as "only a theory". Evolution is a normal part of science and should be treated the same way as all other scientific ideas. It does a disservice to students to mislead them about the important position that evolution holds in biological and other sciences.

Those who have joined in this statement do so as individuals. We do not speak on behalf of our publishers, but for ourselves, as biologists, authors, and educators.

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The Statement on Evolution in Textbooks is sponsored by the National Center for Science Education, a non-profit organization affiliated with the American Association for the Advancement of Science that works to defend the teaching of evolution in the public schools. For information:

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PHILOSOPHIZING ABOUT BIOLOGY

"It is neither possible nor necessary for all men, nor for many, to be philosophers", commented Samuel Taylor Coleridge in *Biographia Literaria*. Be that as it may, for those interested in the creationism/evolution controversy, a grounding in the philosophy of biology is important: just as anti-evolutionists are quick to misrepresent biology in the service of their cause, so are they quick to misrepresent the philosophy of biology. (Consider, for example, how Karl Popper's comments on the unfalsifiability of evolutionary theory continue to circulate, despite the fact that philosophers of science generally agree that he was mistaken and despite the fact that Popper himself came to change his mind: see Stephen G Brush's "Popper and evolution", *NCSE Reports* 1993/4 Winter/Spring; 13[4]/14[1]: 29; available on-line at <http://www.ncseweb.org/resources/articles/8401_popper_and_evolution_9_10_2003.asp>.) Moreover, independently of its importance to the creationism/evolution controversy, the philosophy of biology is a burgeoning and fascinating field unto itself. So for a sampling of introductions to and essays on the philosophy of biology, anthologies of important work by philosophers and biologists, and studies of the possible philosophical implications of evolution, consult the following books, now available through the NCSE web site: <<http://www.ncseweb.org/bookstore.asp>> — look in the "In the latest RNCSE" section. And remember, every purchase benefits NCSE!

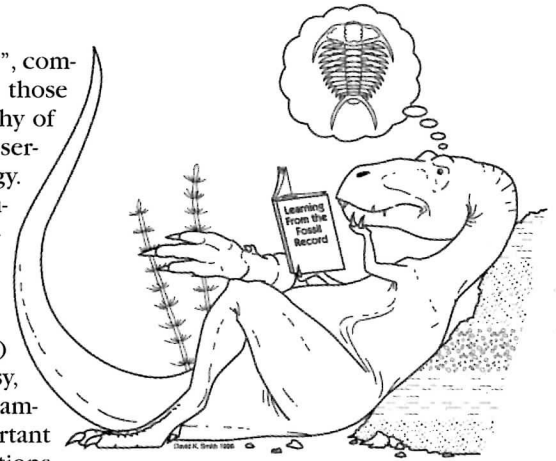


Illustration by Dave Smith, used with permission of the University of California Museum of Paleontology.

ESSAYS AND INTRODUCTIONS

In Mendel's Mirror: Philosophical Reflections on Biology

by Philip Kitcher

From the publisher: "Philip Kitcher is one of the leading figures in the philosophy of science today. Here he collects, for the first time, many of his published articles on the philosophy of biology, spanning from the mid-1980s to the present.

... Kitcher's articles cover a broad range of topics with similar philosophical and social significance: sociobiology, evolutionary psychology, species, race, altruism, genetic determinism, and the rebirth of creationism in Intelligent Design. Kitcher's work on the intersection of biology and the philosophy of science is both unprecedented and wide-ranging, and will appeal not only to philosophers of science, but to scholars and students across disciplines."

Toward a New Philosophy of Biology: Observations of an Evolutionist

by Ernst Mayr

"Too often in the past the biologists have ignored the analyses of the philosophers, and the philosophers have ignored the discoveries of the biologists," Ernst Mayr writes

in the preface to his now-classic 1988 book. "My hope is that this book will help to strengthen the bridge between biology and philosophy, and point to the direction in which a new philosophy of biology will move." *Toward a New Philosophy of Biology* is a book to be developed, to be argued with, a book whose margin should be filled with excited scribbblings," wrote the reviewer for *Nature*.

Philosophy of Biology, 2nd edition

by Elliott Sober

Commenting on the first edition of Sober's book, David L Hull wrote, "Elliott Sober has written *Philosophy of Biology* as an introductory text, and as such it succeeds admirably. But in addition to addressing more popular controversies such as sociobiology and creationism, he also motivates, elucidates, and even advances the current debates among his peers. As always, Sober's exposition is clear and penetrating." The second edition (2000) brings the text up to date. Sober is Hans Reichenbach Professor of Philosophy at the University of Wisconsin at Madison and the editor of *Conceptual Issues in Evolutionary Biology* (described below).

Sex and Death: An Introduction to Philosophy of Biology

by Kim Sterelny and

Paul E Griffiths

"The results of the biological sciences are of obvious interest to philosophers because they seem to tell us what we are, how we came to be, and how we relate to the rest of the natural world." Thus Sterelny and Griffiths begin their lucid, lively, and comprehensive introductory text. Reviewing *Sex and Death* for *RNCSE*, Niall Shanks wrote, "Those readers wanting to get acquainted with the basic issues in the philosophy of biology (as well as those seeking an introduction to the biological ideas and concepts upon which such philosophizing feasts) will find this book to be a valuable resource."

ANTHOLOGIES

But Is It Science? The Philosophical Question in the Creation/Evolution Controversy

edited by Michael Ruse

Prompted by his experience testifying for the plaintiff's side in *McLean v Arkansas*, the eminent philosopher of biology and NCSE Supporter Michael Ruse assembled *But Is It Science?* As the reviewer

for the *Journal of Church and State* wrote, "Ruse has performed a great service." Judiciously selected essays and excerpts present information on the 19th-century background, the state of evolutionary theory, the nature and source of the creationist challenge, and the philosophical aftermath of the decision in *McLean* (consisting of exchanges between Ruse and his fellow philosophers Larry Laudan and Philip L Quinn).

Conceptual Issues in Evolutionary Biology, 2nd edition edited by Elliott Sober
Commenting on the first edition of Elliott Sober's anthology on the philosophy of biology, Richard C Lewontin wrote, "I can think of no one better qualified to put together a book on the subject. It will be of very great interest to a large number of philosophers interested in evolutionary biology, and also to biologists." The revised and expanded second edition (1993) includes essays on fitness, function and teleology, adaptationism, units of selection, essentialism and population thinking, species, systematic philosophies, phylogenetic inference, reduction of Mendelian genetics to molecular biology, ethics and sociobiology, and cultural evolution and evolutionary epistemology.

The Philosophy of Biology edited by David L Hull and Michael Ruse
From the publisher: "Drawing on work of the past decade, this volume brings together articles from the philosophy, history, and sociology of science, and many other branches of the biological sciences. The volume delves into the latest theoretical controversies as well as burning questions of contemporary social importance. The issues considered include the nature of evolutionary theory, biology and ethics, the challenge from religion, and the social implications of biology today (in particular the Human Genome Project)." The topics addressed are adaptation, development, units of selection, function, species, human nature, altruism, the Human Genome Project, progress, and creationism.

Philosophy of Biology edited by Michael Ruse
The topics addressed in Ruse's anthology are what is life?, explaining design, Darwinism and the tautology problem, the challenge of punctuated equilibrium, problems of classification, teleology: help or hindrance?, molecular biology, the recombinant DNA debate, human sociobiology, extraterrestrials?, evolution and ethics, God and biology, and cloning. The selections include classic discussions by Aristotle, Paley, and Darwin and up-to-the-minute articles by Arthur L Caplan, Stephen Jay Gould, and EO Wilson. Ruse, a Supporter of NCSE, is the Lucyle T Werkmeister Professor of Philosophy at Florida State University; his most recent book is *Darwin and Design* (Cambridge [MA]: Harvard University Press, 2003).

THE PHILOSOPHICAL IMPLICATIONS

Darwin's Dangerous Idea by Daniel C Dennett
"Darwin's dangerous idea cuts much deeper into the fabric of our most fundamental beliefs than many of its sophisticated apologists have yet admitted, even to themselves", Dennett writes. Thus he introduces his philosophical exploration of the far-ranging consequences of what he calls "the universal acid" of Darwin's dangerous idea of evolution by natural selection, which he famously describes as "the single best idea anyone has ever had". Dennett is the Distinguished Arts and Sciences Professor and Director of the Center for Cognitive Studies at Tufts University; his latest book is *Freedom Evolves* (New York: Viking Press, 2003).

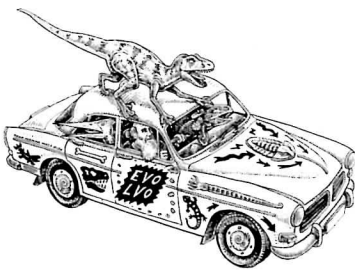
Created from Animals by James Rachels
In *Created from Animals*, philosopher James Rachels poses the provocative question, "What sort of moral view is consistent with a Darwinian understanding of nature and man's place in it?" His thoughtful answer takes the reader through chapters on evolution, ethics and morals, religion, and human-nonhuman relations. "Evolutionary biologists will likely

be fascinated with his explanation," wrote NCSE Executive Director Eugenie C Scott in her review for the *Journal of Human Evolution*. Rachels was Professor of Philosophy at the University of Alabama, Birmingham, until his death in September 2003.

Human Nature after Darwin by Janet Radcliffe Richards
"It is difficult," Janet Radcliffe Richards acknowledges, "to know whether to count [*Human Nature after Darwin*] as a substantive thesis about the implications of Darwinism with a subsidiary methodological thesis, or a Darwinian introduction to philosophy." Either way, her book is a clear and lively introduction to the debates surrounding the philosophical implications — real and supposed — of evolutionary biology. Reviewing *Human Nature after Darwin* for *Philosophy Now*, NCSE Deputy Director Glenn Branch wrote, "Throughout the book, Radcliffe Richards's philosophical acumen is on vivid display, as is her spritely sense of humor."

Taking Darwin Seriously, 2nd edition by Michael Ruse
"I do not know if *Taking Darwin Seriously* is my best or most important book," Ruse writes in the preface to the second edition (1998), "but I do know that it is my most personal and the one which in respects means the most to me." In it, he attempts to "work out a full and satisfying position on the basic questions of epistemology (theory of knowledge) and ethics (theory of morality)" in the light of evolution. The second edition includes a new chapter — "Darwin's new critics on trial" — in which Ruse scrutinizes the anti-evolutionary claims of Phillip Johnson, Michael Behe, and Alvin Plantinga.





NCSE on the Road

A CALENDAR OF SPECIAL EVENTS, PRESENTATIONS, AND LECTURES

DATE February 27, 2004
CITY Hamilton NY
PRESENTER Eugenie C Scott
TITLE How Politics Affects Evolution Education
EVENT A lecture sponsored by the Department of Education of Colgate University
TIME TBA
LOCATION Colgate University
CONTACT Ernie Nolan, enolan@mail.colgate.edu

DATE March 8, 2004
CITY Claremont CA
PRESENTER Eugenie C Scott
TITLE The Case Against Intelligent Design
EVENT A lecture for the Salvatori Center and Department of Philosophy
TIME 6:45 PM
LOCATION Claremont McKenna College, Marion Minor Cook Athenaeum
CONTACT Joseph Bessette, joseph@bessette@claremontmckenna.edu

DATE March 21, 2004
CITY Los Angeles CA
PRESENTER Glenn Branch
TITLE Opposing Creationist Groups
EVENT A lecture for the Center for Inquiry West
TIME 11:00 AM
LOCATION 4773 Hollywood Boulevard
CONTACT Jim Underdown, jim@cfiwest.org

DATE March 21, 2004
CITY Costa Mesa CA
PRESENTER Glenn Branch
TITLE Opposing Creationist Groups
EVENT A lecture for the Center for Inquiry West
TIME 4:30 PM
LOCATION 1845 Park Avenue
CONTACT Jim Underdown, jim@cfiwest.org

DATE March 26, 2004
CITY Lexington KY
PRESENTER Eugenie C Scott
TITLE Teaching Evolution and Avoiding the Minefields
EVENT A talk for faculty and staff
TIME 2:00 PM
LOCATION University of Kentucky
CONTACT Anna E Watson, watson@uky.edu

DATE March 26, 2004
CITY Lexington KY
PRESENTER Eugenie C Scott
TITLE Dissing Darwin for Fun and Profit: Antievolutionism in the 21st Century
EVENT Kentucky Paleontological Society "Darwin Day" Celebration
TIME 7:00 PM
LOCATION University of Kentucky Library Auditorium
CONTACT Anna E Watson, watson@uky.edu

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

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complexity when changes are jury-rigged onto the existing structure rather than incorporated into the fundamental design. For example, some fixes to the Y2K bug involved checking the 2-digit year and trying to determine which century was intended, rather than the simpler and more correct, but much harder to do retroactively, fix of using 4-digit years. Such complexity is not necessarily bad design, either, since a frequent requirement of design is to get a working product out quickly, even if it is not as elegant as possible. Such complexity seems to appear in life, too, in the form of vestigial and jury-rigged features such as the appendix and the panda's thumb. Evolutionists cite these as examples of poor design, which they may be from the standpoint of an omnipotent creator, but they are traits that life shares in common with our experience of design.

In summary, although creationists frequently cite complexity as evidence of design, simplicity would be the real evidence. Complexity can enter design through careless modification, but again such complexity can often be recognized as such, as with jury-rigged or vestigial parts. Besides, such complexity is what we expect from evolution.

Finally, design can become complex through evolutionary algorithms, which use repeated cycles of reproduction of initially random designs, selection from among them, and slight modifications and recombinations of the results (Davidson 1997). Such a design procedure does not need to minimize complexity because it always treats the design as a whole. The final design is extremely difficult to understand, but there is no need to understand it. The use of such a design method by humans is still in its infancy, but if it becomes widespread, we may then be justified in saying that life's complexity looks designed. Of course, at that point "designed" and "evolved" become synonyms.

REPRODUCTION

One of the defining features of life is that life reproduces itself. This is

very different from designed things, which, with very few exceptions, are designed so that their production is separate from their other functions. A separate manufacturing process offers extreme benefits of efficiency for the simple reason that a manufacturing plant does not need to be built into each artifact. The few designed things that do reproduce themselves, such as computer viruses, can do so only because the production process and necessary resources are trivially cheap. And even the self-replicating human designs differ from life in that they do not go through the growth and development that living things experience before they can reproduce.

Let us suppose, along with Paley (1802, ch 2), that someone on a heath found a watch that "possessed the unexpected property of producing, in the course of its movement, another watch like itself." Paley said, "The first effect would be to increase his admiration of the contrivance, and his conviction of the consummate skill of the contriver." But would it? Such a watch, even with today's technology, would be far too large to wear. Even if it were small enough, it would still be far larger than necessary. What's more, the watch would need some way of obtaining raw materials, which would mean either the watch leaves its owner from time to time, or it manipulates its owner to bring it and the materials together. We could certainly admire the consummate skill of the contriver, but our admiration of the contrivance would be severely mitigated by the unnecessary impositions that reproduction would require. Reproduction may find some uses in design; for example, a self-reproducing factory for ordinary watches could conceivably produce an endless supply of useful watches with little requirement for labor. However, there is also a demand for non-reproductive manufacturing of designed items. Almost all designs that people are familiar with today would be useless if they had to include the capability of reproduction.

Repair of designed objects also has to come from the outside. The same economies that keep repro-

duction out of design also prohibit self-repair. Life forms, in contrast, include the ability to repair minor and in some cases extreme damage. This difference between life and design is so familiar that I need not go into further detail.

FORM AND FUNCTION

Another aspect of design is that form tends to follow function. A designer looking for a component to perform a particular function will, when possible, use an existing design rather than inventing a new one. When a useful innovation is introduced, it quickly gets applied to a wide variety of uses. This leads to the property that similar parts fulfill a common function even on very different products. For example, zippers of essentially the same design are found on clothing, tents, luggage, and other things. The same basic engine design can be found on motorcycles, motor boats, and lawnmowers. Some parts, such as screws, resistors, and software libraries, are even standardized so as to make it easy to use them in a wide variety of applications.

Life, in contrast, shows much less connection between form and function. Different taxa achieve similar functions with very different forms. For example, bats, birds, insects, and pterosaurs all have quite different wing anatomies. In different groups of insects, various forms of hearing organs are found in at least 11 different places on the body (Yack and Fullard 1993; Hoy and Robert 1996). And similar forms in life do not imply similar function. A human hand, a bat's wing, a mole's paw, a dog's paw, and a whale's flipper all have the same basic bone structure, despite their different functions of grasping, flying, digging, running, and swimming.

This difference between life and design is most apparent in the fact that life arranges naturally into a nested hierarchy, but design does not. With life forms, taxa defined by major features fall either entirely inside or entirely outside other taxa. This property led to the famil-

**Life arranges
naturally into a
nested hierarchy,
but design
does not.**

Purpose ... is what someone intends a thing to be used for; function is what the thing actually does.

iar hierarchical classification begun by Linnaeus. The hierarchy is not perfect, but it is a *natural* hierarchy in that there are enough common traits to make most of the groupings obvious. With designed things, on the other hand, overlap is the norm. Although it is possible to form a nested hierarchy of designed

things (indeed, it is possible to arrange *any* set of different objects in a nested hierarchy), there is no *natural* nested hierarchy. Consider sports, for example. There are lots of different features one could consider in classifying various sports: team sports, sports played on a rectangular field,

sports played with a ball, and so on. However one classifies them, though, the groups overlap. The category of sports itself overlaps with other categories such as combat, art, and fitness. No obvious classification scheme presents itself. In fact, the only classification scheme that is commonly used with designed things generally is alphabetical order.

TRIAL AND ERROR

Creationists seem to think of design as a single event that is done quickly and is over with. Even those creationists who see creation spread over time seem to envision many individual creation events. Real design, however, is a process. Designs are rarely completed in one attempt. They must be tested and modified to account for unforeseen consequences. Testing is done at many stages, from the first conception to field tests of the final product. Entire industries are devoted to the testing of structures, vehicles, computer systems, and other designs. All of these tests (if they are effective) result in information that guides the subsequent design. Furthermore, designers draw upon the experience of previous designers. When an architect designs a simple bridge or building, the process may seem straightforward, but that design is based on an education that comes from literally

centuries of trial and error by earlier architects and builders (Petroski 1982).

This last point raises another observable property of design. Because designs are so often built upon previous designs, designs evolve over time, with new designs appearing as modifications of previous ones. This, of course, is also a property of life, as the fossil record shows. However, because people can intelligently combine a wide variety of innovations and other features, designs can change rapidly over time. Very few human designs have been around for more than a few thousand years, and most do not last nearly that long. Furthermore, the more complex designs are generally the shorter-lived. Although life changes over time, it does not do so nearly as fast as we see in human-driven modifications in design.

PURPOSE AND FUNCTION

Creationists often claim that purpose indicates design. But purpose is hard to specify without knowing the designer, and it is often conflated with function. Purpose, as I use it here, is what someone intends a thing to be used for; function is what the thing actually does. The intent is useless for determining design, because it can be whatever anyone proposes, and the same object can, and often does, have different purposes for different people. Purposes often conflict. For example, a lynx's purpose for a rabbit is likely quite different from that of the rabbit itself. Undesigned things often have purpose. For example, a stone need not be designed for people to give it a purpose as a pounding stone. The designer of an object can design a purpose into it, but others can find their own uses, as any *MacGyver* rerun shows.

Function also fails to indicate design for many of the same reasons. People can find functions other than what the designer intended. And functions can change in a heartbeat, as when the muscles of the fleeing rabbit become food for the lynx. Most importantly, undesigned things can have function — in fact, we expect function to evolve (see below). In short, purpose and function are

too variable and subjective, and do not discriminate designed items from undesigned items.

COMPLEXITY-SPECIFICATION

Dembski proposes to recognize some design through a property he calls complexity-specification. If a pattern is highly improbable and yet matches a specification that was given beforehand, then that pattern has complexity-specification and, he says, must have been designed (Dembski 1999). For example, if I deal a hand of 13 cards that exactly matches an example bridge hand you saw in the newspaper that morning, you can be confident the deal was designed to come out that way. To detect this sort of design, Dembski proposes an "explanatory filter" which, if it rules out regularity (natural law) and chance, finds design as the only alternative (Dembski 1998). But because complexity-specification is defined simply as the lack of known causes, it is nothing more than an argument from ignorance given formal mathematical form. It does not say a thing about the properties of design.

However, it is instructive to consider complexity-specification at greater length anyway. Specification means matching something that was given elsewhere. Complexity (in Dembski's unorthodox usage) simply means unlikelihood of occurring by chance in its observed configuration. By these definitions, patterns of complex specification can be produced naturally, too, with chance providing complexity and regularity acting selectively to reduce it. Evolution proceeds in large part by random mutations causing variation and natural selection winnowing that variation according to constraints of the environment. The mutations produce a form of complexity, and natural selection acts as a specifier. Since evolution includes complexity (mutations) plus specification (selection), it is only to be expected that evolution would produce complexity-specification in evolved life.

It is because Dembski's filter fails to consider this combination of regularity and chance acting together that it will inevitably



group together the products of evolution with design. Dembski claims that natural selection cannot create complexity-specification, but he only argues against the straw-man of creating it *de novo*. Even he admits that natural selection can bring the specification in from the environment (Dembski 2001b). And this, after all, is what natural selection is all about.

Actually detecting the results of specification, though, can be a tricky business. Ideally, we conclude specification when an observation matches a complex pattern that was given earlier. This does not work, though, when the observation comes before we know what we are supposed to match it with. In such cases, the "specification" comes from finding a pattern in part of the object and seeing the same pattern carry through the rest of the object. (This is the general procedure that Dembski suggests. To the best of my knowledge, he has never provided a way of detecting complexity-specification in life that is objective and practical enough for two people to get the same results.) In other words, complexity-specification implies, in practice, some amount of regularity, but not so much that the word "complex" no longer applies. This just describes the intermediate level of structure discussed in a previous section. And since this property originates via both natural processes and design, it cannot be used to distinguish between them.

FUNCTIONAL INTEGRATION

Another property that has been taken to indicate design is functional integration, or multiple parts working together to produce a particular function or end (Lumsden, quoted in Alters 1995). This property seems intuitively appealing because much design consists of assembling parts to create a particular function. But functional integration may be claimed even when origins are known to be natural. For example, the climate of the Mississippi Basin is determined by the Rocky Mountains, the Gulf of Mexico, trade winds, and other factors. Since the climate is a functional end (it allows an ecology suitable for certain organisms) produced by multiple factors, it fits

the definition of functional integration. And in fact this example was used as an argument for design by the 19th-century creationist George Taylor (Morton 2001). Obviously, though, any arrangement of physical factors, whether designed or not, is going to create some kind of climate. Since functional integration arises from non-design, it cannot reliably indicate design.

It may still be argued that functional integration that arises naturally is not necessarily very functional (the inland Antarctic climate is not terribly hospitable) or very integrated (we do not often think of trade winds, mountains, and a gulf as a single unit). Again, however, functional integration is a quality of evolution as well as of design. Evolution cannot proceed without units to reproduce. "Unit" already implies some integration, and reproduction is itself a function. Furthermore, survival entails many additional functions such as finding food and escaping predators. Natural selection would ensure that such functionality and integration are maintained. So functional integration indicates evolution at least as much as it indicates design.

FINE TUNING

Although it applies not to life but to the universe around it, the fine-tuning argument for design deserves some consideration here. This argument claims that many physical constants and other features of the universe fall in the only narrow range that would allow life to be possible — so many features, in fact, that the combination could not be explained by chance and must be designed (Barrow and Tipler 1986; Ross 1994). Others have shown the problems with this argument (Le Poidevin 1996; Stenger 1997). Of interest here is a prior question, namely whether fine-tuning indicates design in the first place.

Fine-tuning is an aspect of design, of course; the term even comes from engineering. Designing components to mesh well with other components or with the outside environment is a common necessity. However, designers are not entirely stupid.

When they fine-tune, they tune the parts that are easy to change. If parts are added later that have not been built yet, they fit the new parts to the existing design, making the fine-tuning of the new parts part of designing them. Fine-tuning is done to malleable parts and parts that come later.

This is very different from the fine-tuning argument from "intelligent design theorists". The physical constants of the universe, to all appearances, are not easily changeable, if they are changeable at all. Life, on the other hand, is extremely adaptable. Furthermore, life appeared much later than the universe and exists in only a minuscule fraction of it. The universe we see is compatible with a universe designed in fine detail to support life as we know it (design theory is compatible with anything), but an argument *based on analogy to design* would claim that life is fine-tuned to the universe, not vice versa. The claim that the universe was fine-tuned for life is the very opposite of a design argument.

CONCLUSIONS

Table 1 (p 34) shows a summary of the similarities and differences between life and design. Although there are a number of similarities, the differences are large and important. In particular, life's growth and reproduction alone are enough, it seems to me, to place life and design in quite separate categories. Life's complexity and its nested hierarchy of traits are also highly significant differences. The overall conclusion is clear: life looks undesigned.

It bears repeating that the properties of design that I have considered are properties of *human* design, and they do not necessarily apply to a supernatural designer. However, human design is the only model of design we have by which to tell what design looks like, to the extent that design can be said to look like anything. If it does not look like this, it does not look designed.

The claim that the universe was fine-tuned for life is the very opposite of a design argument.



TABLE I. SIMILARITIES AND DIFFERENCES BETWEEN LIFE AND DESIGN.

	DESIGN	LIFE
SIMILARITIES	Intermediate level of structural complexity	Intermediate level of structural complexity
	Modular structure	Modular structure
	Evidence of careless modification (jury-rigging, vestigial parts)	Evidence of careless modification (jury-rigging, vestigial parts)
	Change over time; new forms are modifications of previous forms	Change over time; new forms are modifications of previous forms
	Functional integration	Functional integration
DIFFERENCES	Blueprints, tools, and other evidence of the design process	No evidence of design process
	Simple organization	Complex organization; intermodular interdependence
	Manufacture	Reproduction, growth, and development
	Generally repaired from outside	Self-healing, at least in part
	Form follows function	Form follows nested hierarchy
	Rapid change	Slow change

The reader has probably realized by now that most of the aspects of life that look designed are also evidence of its evolution. In the cases of evidence of careless modification and change over time, the connection is explicit. An intermediate level of structural complexity probably arises from the selection and recombination inherent in evolution. Functional integration is not necessarily evidence for evolution but is an essential aspect of it. Modular structure is the only other aspect that design has in common with life that is not *also* evidence for evolution, but it is at least consistent with evolution. Even fine-tuning argues for life's changing to fit the environment.

To the extent that life looks *designed*, life looks *evolved*. This should not come as a great surprise, because the process of design and the process of evolution share some important commonalities (see also Shanks and Joplin 2000). Both processes build upon what has gone before, and both processes select the "good" features and discard what does not work. There are also important differences, to be sure, but the simi-

larities in process should not be overlooked.

Creationists have been criticized for their misrepresentations of biology and other sciences. Their representation of design is no less faulty. They consider complexity to be a hallmark of design, while simplicity is typically the designer's aim. They believe that design and chance are mutually exclusive, whereas trial and error is sometimes used in design and, in the long run, is an inevitable and invaluable part of it. Finally, they treat design as an event, when in fact it is a process — a process that itself can be designed. Such misconceptions not only make for flawed theology, they cannot be good for engineering practices, either.

In fact, it would not be an exaggeration to say that "intelligent design theory" is not about design at all. Since most of the people who espouse it seem to view the design as a sudden all-at-once event, their model (not surprisingly) seems to be that of the *fiat* creation described in the Bible and Koran, not the extended process that familiar design entails. If creationists want to describe a differ-

ent mechanism than design, they should use a different label for it. I suggest "decree", which has the advantage of fitting the theological position that underlies their ideas.

In both science and engineering, precise specifications are important. Two hundred years have passed since Paley popularized "intelligent design theory" (Paley 1802), and creationists have not yet satisfactorily clarified what they mean by "design", much less suggested useful tests for detecting it. At best, "intelligent design theory" is undefined and thus wholly useless. At worst, taking the phrase "looks designed" at face value as indicating analogy to human design, "intelligent design theory" is contradicted by the evidence.

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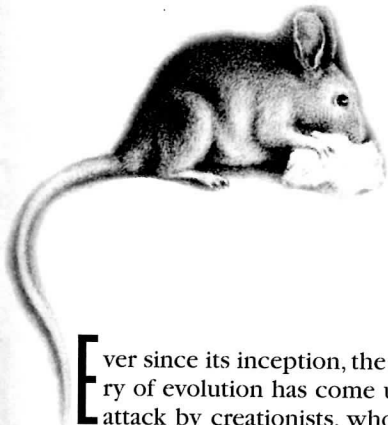
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Propaganda and Pseudomathematics



NO FREE LUNCH: WHY SPECIFIED COMPLEXITY CANNOT BE PURCHASED WITHOUT INTELLIGENCE

by William A Dembski

Lanham (MD): Rowman and Littlefield, 2002. 404 pages

Reviewed by Jeffrey Shallit, University of Waterloo

Ever since its inception, the theory of evolution has come under attack by creationists, who find its account of life's diversity threatening to their religious beliefs. Modern creationists have had essentially zero impact on *science*, but their *political* impact has been significant, especially in the US. There they have managed to get evolution downplayed in biology curricula and to have disclaimers inserted in biology textbooks.

Recently, a group of neo-creationists financed by the Discovery Institute, a conservative Seattle think tank, has attempted another approach to dismantle biological education: the so-called "Wedge Strategy". This strategy is based on an allegedly scientific approach called "intelligent design" (ID). Roughly speaking, advocates of ID

wish to infer intelligent causes from complex phenomena. Since life is complex, ID proponents conclude it must have been designed by an intelligence. Many ID advocates openly admit that this "intelligence" can be identified with the deity of Christianity (Maynard 2001). ID proponents have received much media attention, although their scientific output, as measured by articles in peer-reviewed scientific journals, is non-existent (Gilchrist 1997; Forrest 2001).

But as the Wedge Strategy document (Anonymous 1998) makes it clear, the real goal behind ID is not scientific, but political and religious. ID proponents wish to "defeat scientific materialism" and replace science with a new discipline that is "consonant with

Christian and theistic convictions".

Philosopher and mathematician William Dembski is one of the intellectual leaders of the ID movement. In *The Design Inference* he gave an account of his methodology from which one can supposedly infer design, but did not seriously address evolution, which can generate the appearance of design (Dembski 1998). Later, in *Intelligent Design* (Dembski 1999), he began an attack on the theory of evolution and evolutionary algorithms that is continued in *No Free Lunch*, the book under review, whose title I abbreviate henceforth as *NFL*.

Central to Dembski's argument is his concept of "specified complexity" or "complex specified information" (CSI). CSI is not Shannon information or

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Has Dembski succeeded in making ID intellectually respectable? No.

Kolmogorov complexity, although both concepts are drawn on in *NFL*. Roughly speaking, an event exhibits CSI if it matches a pattern that is both improbable and describable with the background knowledge of an intelligent agent. Dembski contends that the presence of CSI is a reliable marker of ID, and that CSI cannot be generated by algorithms, chance, or any combination of them. He proposes a “Law of Conservation of Information” and argues that evolutionary algorithms cannot generate CSI, thus casting doubt on evolution’s ability to account for the complexity in biological organisms.

Has Dembski succeeded in making ID intellectually respectable? No. Let me not pull any punches: Dembski’s *No Free Lunch* is a poorly written piece of propaganda and pseudomathematics.

What precisely, is wrong with *NFL*? A detailed list of problems would require dozens of pages, if not more: the recent critical review by Wein (2002) weighs in at 37 000 words. In this review I restrict myself to 6 major themes: mathematical difficulties, grandiose claims, equivocation, poor writing, misrepresentation, and poor scholarship.

I. MATHEMATICAL DIFFICULTIES

For an event to contain CSI, it must be improbable. But improbable with respect to which probability distribution? An event may appear very improbable with respect to one distribution while being significantly more probable with respect to another. Dembski wishes to infer design in the absence of a causal history — hence, in the absence of any historical basis for probability estimates — yet omits any detailed

discussion how, after observing an event, we decide what class of events it was drawn from.

Furthermore, Dembski appears to use two different methods of evaluating the probability of an event. If a human being was involved in the event’s production, he typically estimates its probability relative to a uniform probability hypothesis. For Dembski, a Shakespearean sonnet exhibits CSI because it would be unlikely to be produced by choosing several hundred letters uniformly at random from the alphabet. On the other hand, if no human being was involved, Dembski nearly always bases his probability calculations on the known causal history of the event in question. This flexibility in the choice of a distribution allows Dembski to conclude or reject design almost at whim.

Another significant problem occurs on pages 152–4 of *NFL*, where Dembski offers what appears to be a complete proof that deterministic functions cannot generate CSI. This proof is a crucial step justifying his “Law of the Conservation of Information” mentioned earlier. First, he assumes that j is an event containing CSI, i is another event, and $f(i)=j$ for some function f . Next, he argues that “ i constitutes specified information at least as complex as j ”. (Here the complexity of j is measured by $-\log_2 P$, where P is the probability that a random event would match a chosen pattern to which j conforms.) Dembski’s argument is full of the trappings of genuine mathematics: domains, subsets, inverse maps, and homomorphisms of boolean algebras; it looks convincing at first glance. There is no doubt that it really is intended to be a proof, because on page 154 he states “Bottom line: for functions to generate CSI they must employ pre-existing CSI”.

But further down on that page, we learn that the proof just presented was, in fact, not a proof at all. Dembski’s reasoning “did not take seriously the possibility that functions might add information”. Strange — a reader might suppose this was ruled out by the argument just covered. But no! He apparently forgot that “the information in f must now itself be taken into

account.” (Exercise: exactly where in the argument on pages 152–4 does this omission occur?) To handle this, Dembski introduces an operator U such that if $f(i)=j$ then $U(i, f)=j$ and blithely states (p 155), “Clearly, the information inherent in (i, f) is no less than that in j ”. But it is not so clear.

For one thing, it is not “information” that is at stake here, but Dembski’s CSI. It is certainly possible that both i and f could fail to be specified in Dembski’s technical sense, while at the same time j is specified. For example, consider the case where i is an encoded English message and f is an unknown and obscure decryption function. If our background knowledge does not include f , we may recognize $j=f(i)$ as matching a pattern while i and f do not.

For another, Dembski’s notion of information is a statistical one; it measures “information” through a rescaled form of probability. But what is the probability distribution corresponding to f ? We are not told. It would certainly be possible, at least in some cases, to invent a probability distribution for f and reason about it, but this crucial point is simply not addressed in sufficient detail.

Dembski also overlooks the possibility that additional information can be accumulated simply by iterating f . If f is a length-increasing mapping on strings, this makes measuring the information content of f problematic, since choosing the correct associated probability distribution becomes more obscure.

Dembski confuses things even further by stating, “Note that in the case of algorithms U is a universal Turing machine.” Does this mean that CSI could, in fact, be increased if f were noncomputable (in the theory of computation sense)? How, indeed, would the CSI of a noncomputable f even be defined? (Lest the reader think this is a fine technical point, let me observe that Pour-El and Zhong [1997] have shown that the unique solution of a certain wave equation with computable initial conditions is uncomputable.) None of this is explored.

Omissions such as these cast serious doubt on the mathematical foundations of Dembski’s claims.

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2. GRANDIOSE CLAIMS

Dembski has a high opinion of his own work. He states (p xii–xiii) that CSI “is increasingly coming to be regarded as a reliable empirical marker of purpose, intelligence and design”, although to my knowledge Dembski’s coined term “CSI” has not adopted by any other probabilist or information theorist. Nor have any papers about CSI been published, either by Dembski or other researchers, in peer-reviewed mathematics or statistics journals. Nevertheless, he insists that specified complexity is the *only* way to detect design (p 116). He also claims his “Law of Conservation of Information” has “profound implications for science” (p 163).

On occasions, Dembski elevates mathematical trivialities to the level of profound insights. On page 166, he justifies a claim that “CSI is holistic” (that is, it cannot be accumulated through an iterative process) by calculating that the Shannon information of an English sentence exceeds the sum of the information contained in its individual words. But a careful examination of his argument shows the missing information is precisely that contained in the space characters between the words.

3. EQUIVOCATION

The fallacy of equivocation is to use the same term to mean two different things. For example: “Nothing is better than complete happiness. A ham sandwich is certainly better than nothing. Therefore, a ham sandwich is better than complete happiness.” The conclusion follows only because of the equivocation about the meaning of “nothing”.

The equivocation fallacy is an integral part of the argument in *NFL*. For example, the word “specified” is a term of art for Dembski; it means something very precise and particular, involving a complicated interplay between functions, probability, rejection regions, and background knowledge. One can certainly argue that the definition is incoherent (as I do in *Elsberry and Shallit*, submitted for publication), but that is not the point I wish to make here. The point is that according to Dembski’s own rules

as laid out in Section 2.5 of *NFL*, claiming that an event is specified requires a detailed argument involving a probability calculation. It is not enough to simply assert it.

But simply asserting it is just what Dembski does what it comes to analyzing biological organisms. On page 289 he asserts: “At any rate, no biologist I know questions whether the functional systems that arise in biology are specified”. Perhaps they do not. But the questions is not *Do biologists call such systems specified?*, but *Are they specified in the precise technical sense demanded by Dembski?* This is equivocation at its finest (or worst).

Another example appears on page 213. There, Dembski discusses the work of Schneider (2000), who provided an experimental model showing how Shannon information may increase in evolution. Dembski says, “As an example of smuggling in complex specified information that is purported to be generated for free, consider the work of Thomas Schneider.” Considering that Schneider, like everyone else who works in information theory, has not made any reference to Dembski’s CSI in his paper, this claim of “smuggling” is unwarranted. Dembski’s equivocation fallacy comes from equating Shannon information — a well-understood concept that has been used for 50 years in literally thousands of scientific papers — with Dembski’s own CSI, which has not.

There are many other examples of equivocation in *NFL*. The reader may enjoy constructing a detailed list.

4. POOR WRITING

Even a book with bad ideas and poor reasoning may be enjoyable if the writing is good enough. (I have in mind almost anything by Wendell Berry.) But *NFL* does not possess even this saving grace. The book gives the impression of having been assembled haphazardly from previously published essays.

Take the name choice in “complex specified information”. As we have seen, Dembski takes “information” to mean $-\log_2 P$, where P is the probability of an event’s matching a chosen pattern. He calls the information “complex” if

P is small. Dembski’s use of “complex” has little to do with “complicated”: for example, the record *HHH ... H* representing flipping 500 heads in a row constitutes “complex information” under his definition, even though the record of the event is very simple. To add further to the confusion, to be “specified” for Dembski means to conform to a pattern. He apparently modeled this after another theory of information, the theory of Kolmogorov complexity. But in the Kolmogorov theory, a string is called “complex”, or said to possess “high information”, if *no* simple way to specify it exists! Another term, such as Robin Collins’s “specified improbability”, would have been less confusing.

Sometimes the poor writing takes the form of choosing strange notation, as in the formal statement of the “Law of Conservation of Information” on page 160:

$$I(A\&B)=I(A) \text{ mod } \text{UCB}$$

Here “mod” does not mean what every computer scientist or number theorist would expect: namely, “ $a \text{ mod } b$ ” as “the remainder upon division of a by b ”. No, the reader has to wait until the next page to find out that what Dembski *really* means is the inequality

$$I(A\&B)\leq I(A)+\text{UCB}$$

where UCB is 500. Then why not just say that, instead of bringing in the confusing term “mod”?

Sometimes the form of the argument seems to be designed more to impress and confound, rather than convey meaning, as in the discussion of compact topological groups and Haar measures on page 105, or algebraic groups on page 201. This material is inessential to the main argument and could easily have been excised or summarized in a footnote. Similarly, the concept of “invariant” is trivial enough that I can explain it to my 7-year-old, but Dembski’s discussion on page 274 is extravagant in its use of mathematical notation.

Other times the impact of poor exposition is felt more deeply, as in

Sometimes the form of the argument seems to be designed more to impress and confound.

the definition of CSI itself. Is CSI a quantity expressible in bits as implied on page 160? Or does something either “exhibit” CSI or not exhibit it, as implied on page 163?

5. MISREPRESENTATION

I found several instances of misrepresentation in *NFL*. For example, on page 211, Dembski dismisses the work of artificial life researcher Tom Ray as follows:

Thomas Ray’s *Tierra* simulation gave a similar result, showing how selection acting on replicators in a computational environment also tended toward simplicity rather than complexity — unless parameters were set so that selection could favor larger sized organisms (complexity here corresponding to size).

I have to wonder how carefully Dembski has read Ray’s work, because this is not the conclusion I drew from reading Ray’s papers. Curious, I wrote an e-mail message to Ray asking if he felt Dembski’s quote was an accurate representation of his work. Ray (2002) replied as follows:

No. I would say that in my work, there is no strong prevailing trend towards either greater or lesser complexity. Rather, some lineages increase in complexity, and others decrease. Here, complexity does not correspond to size, but rather, the intricacy of the algorithm.

A similar misrepresentation occurs in Dembski’s selective quotation of Keith Devlin’s review of Dembski’s earlier book, *The Design Inference*. Dembski writes (*NFL*, p 372),

Take for instance ... mathematician Keith Devlin’s appreciative remarks about my work in his July/August 2000 article for *The Sciences* titled “Snake Eyes in the Garden of Eden”: “Dembski’s theory has made an important contribution to the theory of randomness — if only by highlighting how hard it can be to differentiate the fingerprints of design from the whorls of chance.”

But, as anyone reading Devlin’s review in its entirety will realize, this line — coming at the end of the review — was an effort to mitigate previous harsh comments. For example, in the very same review Devlin observes that Dembski’s work can be used to support two different conclusions: human life arose by a combination of chance and natural processes, and human life arose by design, and states: “But if Dembski’s new mathematics, which he developed to help poke holes in the theory of evolution, can sustain two such contradictory conclusions, then it does not resolve the debate at all”. When I informed Devlin that Dembski was quoting only one positive line of the review — as done in *NFL*, in a paper (Dembski 2000), and a Diane Rehm radio interview (Dembski 2001) — he labeled it misrepresentation and told me, “Anyone who read the entire article would realize I was negative about Dembski’s thesis” (Devlin 2002).

Yet another misrepresentation occurs in Dembski’s discussion of Dawkins’s example of the power of selection, the famous *Methinks it is like a weasel* illustration. Dawkins (1987) starts with a randomly chosen string of 28 characters, and then breeds it by copying, together with a certain probability of random error. He, or rather, his computer, next evaluates a fitness function to find the string that most resembles the target string “Methinks it is like a weasel”. All the less-fit strings die out, and the most-fit then goes on to breed again. After only a small number of generations (64 in Dawkins’s example) the target is reached.

Dembski discusses this example on pages 181–3 of *NFL*, but he gets it wrong. He insists that Dawkins’ algorithm, instead of evaluating a fitness function, behaves as follows: it “randomly alter[s] all the letters and spaces in the current sequence that do not agree with the target sequence” and “whenever an alteration happens to match a corresponding letter in the target sequence, [it] leave[s] it and randomly alter only those remaining letters that still differ from the target sequence.”

But Dawkins said nothing of the sort. To add insult to injury,

Dembski goes on in pages 193–4 to propose an algorithm that he calls “slightly different but more realistic”. It turns out that this supposed new algorithm is, in fact, much closer to Dawkins’ original algorithm as described in *The Blind Watchmaker*.

It is true that Dawkins did not provide many details about his implementation. But researchers other than Dembski seem to have no problem understanding Dawkins’ algorithm. Discussions by both Bach (1993) and Jacob (2001) make it clear they understand that, in Dawkins’s model, letters are not fixed once they match the target.

Even minor details are subject to careless misrepresentation. For example, in Dembski’s discussion of a certain sequence of bits corresponding to prime numbers that appears in the movie *Contact*, he says (p 9): “The SETI researcher who in the movie *Contact* discovered this sequence put it this way: ‘This isn’t noise, this has structure.’”

Dembski gets it wrong three ways. The discoverer of the prime sequence was Dr Ellie Arroway (played by Jodie Foster). The character who remarked about structure was not Arroway, but Kent Clark (played by William Fichtner). The correct line in the movie is actually, “You know the interlaced frames that we thought were noise? This has structure. I’m hearing structure.” And finally, this character was not commenting about the prime sequence at all! His comment is about another signal at a different frequency, which later proved to encode blueprints for a machine.

These are just 4 of the misrepresentations in *NFL*. I could give several more, but by now I hope the reader gets the point.

6. POOR SCHOLARSHIP

For a book that purports to discuss fundamental questions about information, complexity, and biology, there is remarkably little discussion or awareness of previous work. Dembski does not cite any of the following works, just to list a few:

- Kimura’s paper in which he shows how natural



The Story of an ID Urban Legend

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This is the story of a particular creationist claim. It is not a particularly important claim, but its career is illustrative of a certain reckless disregard for scholarship that is distinctive of anti-evolutionists. The way in which it was uncritically transmitted appears to have more in common with urban legends than with scientific scholarship.

The story starts, as far as I can tell, with Del Ratzsch's contribution to the anthology *Mere Creation*, in which he makes the following claim: "The Smithsonian Institution has a collection of obviously designed human artifacts, concerning the purposes of which no one has a clue" (Ratzsch 1998: 294). No citation is provided for this claim.

In a subsequent book that expands on his essay, Ratzsch writes, "The Smithsonian reportedly has a number of obviously human, recognizably designed artifacts, the purposes of which have been entirely forgotten" (Ratzsch 2001: 18-9). So far, so good. Although Ratzsch still fails to provide a reference, his inclusion of the word "reportedly" serves to acknowledge the unconfirmed status of his claim.

Now the fun starts. In 1998, William Dembski wrote, "There is a room at the Smithsonian filled with objects that are obviously designed but whose specific purpose anthropologists do not understand" (Dembski 1998). No citation is provided for this claim, but Dembski may have borrowed it from Ratzsch, since Dembski was the editor of *Mere Creation*.

In *No Free Lunch*, Dembski repeats his claim: "Consider that the Smithsonian Institution devotes a room to obviously designed artifacts for which no one has a clue what those artifacts do" (Dembski 2002: 147). Dembski cites Ratzsch's essay in *Mere Creation*, but he changes the meaning: Ratzsch's cautious "collection of ... artifacts" is now "a room" "filled with" or "devote[d]" to these artifacts.

Curious about Dembski's claim, I wrote to the Smithsonian, and received the following fax dated April 16, 2002, from Kenneth Burke, Acting Program Coordinator, Public Inquiry Mail Service, Smithsonian Institution. It is reproduced in its entirety.

Your letter of March 21 has been referred to this office from the office of the Secretary for response.

The Smithsonian has no room such as described in William Dembski's book. He may be referring to a section of an exhibition called Nation's Attic which was displayed at the National Museum of History and Technology (now the National Museum of American History, Behring Center) from April 1, 1980 through February 8, 1981. We have enclosed a photocopy of a short article concerning the exhibition from Smithsonian magazine, April 1980. In one showcase in the exhibition a number of unidentified articles were displayed, but there was never a whole room devoted to them.

Your interest in the Smithsonian Institution is appreciated. [emphasis added]

The *Smithsonian* article reveals that the entire exhibition consisted of 125 objects, and the purpose of nearly all of these objects was known (Park 1980). The only reference to objects of unknown purpose consists of a single line: "The final category, Unidentified Objects, consists of several items that no one can figure out" (emphasis added).

In other words, "several items" exhibited once in 1980-1, in one showcase of an exhibition, have become "an entire room" devoted to the artifacts. Urban legends often take on a life of their own — conceived in vague circumstances and elaborated at each successive telling. Scientific research, on the other hand, is concerned with checking and rechecking the accuracy of its basic information — so much so that scientists volunteer to have their ideas and inferences tested by their peers before publication. It is clear that the "Case of the Smithsonian Artifacts" is an ID urban legend.

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selection can increase Shannon information (Kimura 1961);

- Wicken's book on evolution and information (Wicken 1987);
- The papers of Saunders and Ho (Saunders and Ho

1976, 1981) that argue that complexity increases during evolution;

- The paper of Nehaniv and Rhodes (1997) showing how, in a finite automation model, complexity can evolve in biological systems.

The field of artificial life evidently poses a significant challenge to Dembski's claims about the failure of evolutionary algorithms to generate complexity. Indeed, artificial life researchers regularly find their simulations of evolution producing the sorts of novelties and

increased complexity that Dembski claims are impossible. Yet *NFL*'s coverage of artificial life is limited to a few dismissive remarks, the longest of which I have already quoted above. Indeed, the term "artificial life" does not even appear in *NFL*'s index. There is no reference to, for example, the work of Adami and others (2000), which suggests the possibility of increased complexity over time. As a scholarly work, Dembski's *NFL* falls dramatically short.

CONCLUSIONS

I have covered 6 of the most significant problems with *NFL*. At least some of these problems could have been avoided had Dembski been more willing to test his claims through the peer-review process. But ID advocates have consistently failed to publish their work in scientific journals (Gilchrist 1997; Forrest 2001). When pressed, some say this is because academia is a "closed shop" run by an "elite" that is biased against them.

This claim is undermined by the fact that many non-mainstream and controversial views routinely get published in the scientific literature. Just recently, controversial claims of table-top fusion induced by the collapse of super-hot bubbles were published in a major scientific journal (Taleyarkhan and others 2002).

What ID advocates fail to realize is that the peer-review process could benefit them enormously, by identifying weak arguments and incorrect claims before they are published. For example, a thorough peer-review might have revealed that a crucial calculation on page 297 of *NFL* is off by a factor of about 10^{65} .

The benefits of peer-review are so obvious that I can only conclude that some ID advocates are not really interested in the advancement of science. Their goal is to replace science as it is currently done with a form of religion, and that in turn may have unintended consequences. In today's science it is not uncommon for Christians, Jews, Muslims, and atheists to work together without friction. But I doubt many Muslim, Jewish, or atheist scientists will

want to cooperate with a movement that insists, as Dembski does in *Intelligent Design* (1999: 210), that "Christ is indispensable to any scientific theory, even if its practitioners do not have a clue about him." One of science's most attractive aspects is the way it transcends religious and political differences. Let's keep it that way.

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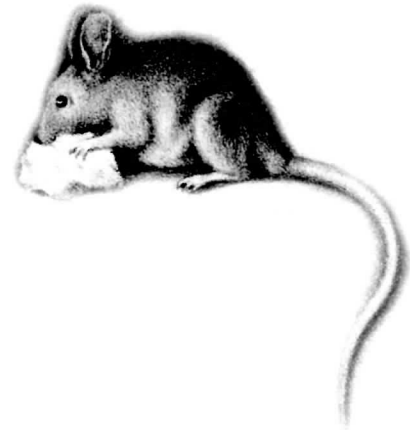


The Return of Intelligent Design

NO FREE LUNCH: WHY SPECIFIED COMPLEXITY CANNOT BE PURCHASED WITHOUT INTELLIGENCE

by William A Dembski
Lanham (MD): Rowman & Littlefield, 2002. 404 pages

Reviewed by H Allen Orr, University of Rochester



All science, even the divine science, is a sublime detective story. Only it is not set to detect why a man is dead; but the darker secret of why he is alive.

— GK Chesterton (1930: 72)

Nothing evolves as surely as anti-evolutionism. The anti-Darwin movement, at least in its popular form, began in the primitive whoops and hollers of young-earthers and seven-day literalists. Their claims, as you might guess, were short on science and long on Genesis. But somewhat higher in the strata we find a thoroughly transformed, though recognizably related, beast: the scientific creationist. While still relying on some scriptural sources (many believed the fossil record reflected a certain 40-day deluge), these creatures did talk science, disputing radioactive dating and making lots of interesting claims about hydrology, pH, and sedimentation. Following their extinction, the strata reveal yet another and far more advanced form, the “intelligent design” champion. Compared to this modern species, its predecessors look downright primordial. Indeed the “intelligent design” advocate is characterized by at least three novel traits: (i) advanced academic

degrees; (ii) sophisticated arguments accompanied by expert knowledge; and (iii) strict avoidance of religious language, including any speculation on just who the designer might be.

While usually admitting that life on earth is billions of years old and that people, pigs, and petunias are related by common descent, the “intelligent design” (ID) movement maintains that some bits of biology show the unmistakable handiwork of an intelligent agent. And while this agent may not wholly displace Darwin, the two at least stand shoulder to shoulder. The ID movement further maintains that “intelligent design”, as a legitimate scientific hypothesis, deserves a place alongside blind evolution in public schools and that students should, at the least, be exposed to both sides of the debate. Indeed Ohio, which recently revised its curricular standards, was seriously embroiled in a dispute over the possible introduction of “intelligent design” into its biology classes. (See Clines 2002; see also Gura 2002. Texas, which dominates the US textbook market, recently faced a similar struggle.) The ID movement is led by four tireless academics or ex-academics: Michael Behe (Professor of Biochemistry at Lehigh University), Jonathan Wells (biologist and Senior Fellow at the Discovery Institute, a Seattle think tank concerned with the “renewal of science and culture”), Phillip

Johnson (Professor Emeritus of Law at Berkeley), and William Dembski (Associate Research Professor in the Conceptual Foundations of Science at Baylor University and Senior Fellow at the Discovery Institute). (For links describing their publications, as well as those of other ID advocates, see the Discovery Institute on-line, <<http://www.discovery.org>>. For a critical analysis of the creationist “intelligent design” movement, see Pennock 1999. For a recent collection of papers defending and attacking “intelligent design”, see Pennock 2001b.)

Dembski — whose new book, *No Free Lunch*, is sure to ignite new firestorms over design vs Darwin — is perhaps the most impressively credentialed of the lot. He wields a PhD in mathematics from the University of Chicago, another in philosophy from the University of Illinois at Chicago, and a Master of Divinity degree from Princeton Theological Seminary. He is also author, coauthor, or editor of seven books, including *The Design Inference* (1998), a fairly technical work that laid out a statistical method allegedly allowing reliable detection of design. He is also an able writer, a skilled polemicist, and an indisputably bold thinker. And, yes, he believes — contrary to everything biologists told us for the last 150 years — that an intelligent agent helped shape you and me.

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To appreciate the magnitude of Dembski's claims in *No Free Lunch* you need to appreciate the relative modesty of Darwin's claims in the *Origin of Species*. Darwin did not rule out the formal possibility of a designer. Instead, he showed that the (apparent) design residing in organisms could be explained naturally, without

recourse to a designer. And while he marshaled great masses of evidence for the role of his natural mechanism (natural selection) and against the role of a designer, Darwin made no claims about the impossibility of the latter hypothesis. Dembski's claims are more ambitious. Darwinism, he says, is *formally incapable* of explaining certain features of organisms. This is not to say that Darwinian mechanisms might not act now and then — Dembski agrees they might — but it is to say that Darwinism is mathematically barred from explaining certain things we always thought it could explain. And unfortunately for evolutionary biology, these things are not trivial arcana but the characteristic features of organisms: their staggeringly complex designs. (We'll sharpen the sense of "complex" below.) Dembski does not mince words: "[I]ntelligent design utterly rejects natural selection as a creative force capable of bringing about the specified complexity we see in organisms."

This is a big claim. And it explains why Dembski gets so much attention. You might whip up a bit of applause if you say that a designer can explain biology. But you'll bring down the house if you say that Darwinism *cannot* and only a designer can. Especially if this claim gets dressed up in fancy mathematics of the sort that presumably intimidates biologists but snows the general reader. And this is precisely how Dembski dresses his claims. Borrowing results from computing theory — the so-called No Free Lunch theorems — Dembski claims to prove that Darwinism is utterly impotent

before organismic complexity. Hence a designer. Unfortunately, Dembski's proof has nothing whatsoever to do with Darwinism, and his claim to the contrary is hopelessly silly.

To show this, I need to back up and do two things. First, explain what kind of biological complexity Dembski is so worked up about and, second, explain why he thinks the No Free Lunch theorems stand in the way of Darwinism's accounting for it. Doing this will require getting slightly technical for a moment. But don't worry — things will get simple again quickly.

NO FREE LUNCH

Not all complexity is a thumb in the eye of Darwinism. The problem, Dembski tells us, comes from a particular variety he calls "specified complexity":

An object, event, or structure exhibits specified complexity if it is both complex (that is, one of many live possibilities) and specified (that is, displays an independently given pattern). A long sequence of randomly strewn Scrabble pieces is complex without being specified. A short sequence spelling the word "the" is specified without being complex. A sequence corresponding to a Shakespearean sonnet is both complex and specified.

Dembski argues that biology is replete with specified complexity. It is certainly true that organisms are fantastically complex. It is also true that in some ways (but not others — this will become an issue) they are specified. It is clear for instance that the various parts of an organism are fitted to each other: the curvature of the lens is fitted to the distance to the retina so as to produce a sharp image. Dembski spends a great deal of time formalizing specified complexity in the language of information theory. Roughly speaking, we know we have a case of complex specified information if out of all possible ways of putting together a set of elements — say, all possible sequences of a set of letters and blank spaces — only a small subset

represents a prespecified target and the actual outcome belongs to that target. Meaningful English phrases, for instance, represent a small target: the overwhelming majority of random combinations of English letters and blank spaces yield gibberish. So if you see a meaningful phrase (as you hopefully do now), you are seeing complex specified information. (Strictly speaking, Dembski says we can infer complex specified information only if a phrase is long enough that the probability it would arise by chance falls below a "universal probability bound" of 10^{-150} . So we'll assume throughout that target phrases are long.)

Now it is obvious how we go about making meaningful phrases: we use intelligence and crank them out at will. But how do biologists explain the complexity that resides in organisms? By Darwinism. To get a feel for what this means, consider the following caricature of Darwinism offered by Richard Dawkins and discussed at length by Dembski. Our target will be Hamlet's line, METHINKS IT IS LIKE A WEASEL. (Real evolution occurs in a sequence space that uses the four DNA "letters" A, G, C, and T, but this is a distinction that does not make a difference.) First consider the odds of forming this target sequence by blind chance, that is, with monkeys at word-processors. Draw a random letter from the alphabet for the first position in the phrase; now another for the second position, and so on. The odds that you've spelled out the phrase METHINKS... are essentially nil: in fact, with 26 letters plus a blank space, the probability of getting the word METHINKS alone is already less than 1 in 280 billion.

But now consider the following "evolutionary algorithm": start with a random sequence as before but (i) randomly change each character that does not match the target sequence; (ii) if a resulting character matches the target keep it and in the next round change only those characters that do not match. So, if we start with SATHINKS, at the next step we will randomly change only the first two letters; and if those changes yield MQTHINKS, then at the next step we will randomly change only the second letter. This 2-step evolutionary algo-

Dembski's proof has nothing whatsoever to do with Darwinism, and his claim to the contrary is hopelessly silly.



rithm of mutation plus selection arrives at the phrase METHINKS... with surprising speed.

This example also illustrates the idea of a fitness function. Fitness is a measure of quality; high fitness is good and low is bad. (In biology the only kind of quality that matters is how good you are at having kids. High fitness means you have a lot of kids and low means you have few.) A fitness function is just a mathematical function that assigns a fitness value to each possible sequence. In our Hamlet example, the best sequence is the phrase METHINKS..., so the fitness function assigns it the highest value. A sequence that matches METHINKS... at every position but one gets a slightly lower fitness, and one that matches METHINKS... at every position but two gets a yet lower fitness, and so on. A random sequence typically suffers a quite low fitness. If we now pretend that all possible sequences sit in a plane, we could plot their corresponding fitness values above this plane, forming a 3-D plot. (Fitness landscapes are usually high dimensional, not three, but it is easiest, though not quite right, to imagine a 3-D landscape. Note also that the target evolution is shooting for need not be a single sequence; it could include several. But, overall, the target is small.) Evolutionists thus sometimes speak of fitness "surfaces" or "landscapes". Because evolution always moves from one sequence to another having *higher* fitness, natural selection can be thought of as moving populations uphill on fitness surfaces. In Dawkins's example this process ultimately arrives at the sequence METHINKS..., which sits atop a fitness peak.

Dembski's chief argument is that Dawkins's algorithm — and Darwinism generally — does not do what it seems. Indeed, despite our unerring arrival at METHINKS..., the "Darwinian mechanism does not generate actual specified complexity but only its appearance." How can Dembski possibly claim such a thing? Enter the No Free Lunch (NFL) theorems.

The NFL theorems compare the efficiency of evolutionary algorithms; roughly speaking, they ask

how often different search algorithms reach a target within some number of steps. (These theorems were introduced by Wolpert and Macready [1997]. Dembski's "generic" form of the NFL theorem is loosely based on that of Culberson [1998].) Because the NFL theorems are deeply counter-intuitive, it will help to start with an informal rendition. It runs like this: If algorithm A beats algorithm B at some class of problems there will always be another class of problems at which B beats A. Further, one can show that A and B are equally efficient when averaging over all possible problems. The NFL theorems thus show that there is no such thing as a universally efficient algorithm: when faced with all problems, any algorithm is as good as any other. To appreciate Dembski's "generic" form of the NFL theorems, you need to appreciate that reaching a prespecified target with a particular fitness function is an example of a problem. Reaching the target with a different fitness function is a different problem. The NFL theorems thus say that if we average over all possible fitness functions — where some lead directly uphill to the target and others do not, and some are smooth and others rugged — no evolutionary algorithm outperforms any other. But one allowable algorithm is blind search, where we randomly move to a neighboring sequence regardless of its fitness (remember our monkey with a word-processor). The NFL theorems thus prove that no evolutionary algorithm beats blind search when *averaging over all fitness functions*. A surprising result.

The apparent success of Dawkins's algorithm at getting to METHINKS... must therefore be just that, an appearance. If Dawkins tried reaching his target when averaging over all fitness functions, he would find he does no better than blind search. So why does Dawkins's algorithm seem to work? The answer is that it subtly cheats: it starts not only with a target but also with a fitness function that leads straight to it. Everything's been cooked into the fitness function. Algorithms like Dawkins's thus "fail to generate specified complexity because they smuggle it in during construction

of the fitness function." (To see that there's specified complexity in the fitness function, consider Dembski's further point: picking the right fitness function out of all those that are possible requires even more searching than picking the original target out of sequence space. So evolutionary algorithms just displace the task of finding a target back to the task of finding a desirable fitness function.)

Hence Dembski's big claim: "Darwinian mechanisms of any kind, whether in nature or *in silico*, are in principle incapable of generating specified complexity." At best, Darwinism just shuffles around pre-existing specified complexity, using up that available in the fitness function to give the appearance of producing it *de novo*.

We can now complete the Dembskian Syllogism: Organisms show specified complexity; Darwinism cannot make it; therefore, something else does. You won't be surprised to learn that that something else is intelligence. Indeed the "great myth of contemporary evolutionary biology is that the information needed to explain complex biological structures can be purchased without intelligence."

NICE ANSWER, WRONG QUESTION

The problem with all this is so simple that I hate to bring it up. But here goes: Darwinism is not trying to reach a *prespecified* target. Darwinism, I regret to report, is sheer cold demographics. Darwinism says that my sequence has more kids than your sequence and so my sequence gets common and yours gets rare. If there is another sequence out there that has more kids than mine, it will displace me. But there is no pre-set target in this game. (Why *would* evolution care about a pre-set place? Are we to believe that evolution is just inordinately fond of ATGGCAGGCAGT...?)

Dembski can pick a prespecified target, average over all fitness functions, and show that no



**The bottom line
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NFL theorems
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[but] that they
ask the wrong
question....**

algorithm beats blind search until he is blue in the face. The calculation is irrelevant. Evolution is not searching for anything and Darwinism is not therefore a search algorithm. The bottom line is not that the NFL theorems are wrong. They are not. The bottom line is that they ask the wrong question for what Dembski wants to do. More precisely, the proper conclusion is not that the NFL theorems derail Darwinism. The proper conclusion is that evolutionary algorithms are flawed analogies for Darwinism. (NFL theorems may well proscribe certain ways of

There are so many problems with [Dembski's] view that it is hard to know where to start.

talking about Darwinism [for example, as a universally efficient optimizing algorithm] but that is a different matter. Dembski, incidentally, claims that "evolutionary algorithms... constitute the mathematical underpinnings of Darwinism" and that by "assimilating

the Darwinian mechanism to evolutionary algorithms, [evolutionists] have invited a mathematical assessment of the power of the Darwinian mechanism to generate life's diversity." This is wrong. The mathematical underpinnings of Darwinism are population genetics, which does not consider pre-set targets and about which Dembski says nothing.)

The astonishing thing is that Dembski knows all this. In a remarkable revelation — and one that follows 200 pages of technical mumbo-jumbo — Dembski suddenly announces that Darwinists will not find his NFL objection terribly relevant. And why not? For the very reason I just gave. Dembski even quotes Richard Dawkins at length, who, it turns out, warned all along that his METHINKS... example is

... misleading in important ways. One of these is that, in each generation of selective "breeding," the mutant "progeny" phrases were judged according to the criterion of resemblance to a distant ideal target, the phrase

METHINKS IT IS LIKE A WEASEL. Life isn't like that. Evolution has no long-term goal. There is no long-distance target, no final perfection to serve as a criterion for selection. ... In real life, the criterion for selection is always short-term, either simple survival or, more generally, reproductive success. (Dawkins 1996: 50. Remarkably, Culbertson — on whom Dembski leans for his interpretation of NFL — makes a similar point. Asking how biological evolution is possible given the NFL theorem, he speculates that perhaps "there is no global requirement on life other than it survive. Evolution was not necessarily looking for the human genome.... We are not assuming the need for universal optimization, only very localized advantage" [Culbertson 1998: 123].)

At this point the reader of Dembski's book is a tad confused. Why, given the above revelation, is the book entitled *No Free Lunch*? Why is its dust jacket lined with blurbs from physicists attesting that Dembski has done something big? And, most important, why did I spend two nights reading about a theorem that reports an irrelevant result? The reader at this point has some right to know what Dembski's *real* problem with Darwinism is. And he comes through. After 200 pages, Dembski finally unveils his Über-Objection: Darwinism does "not guarantee that anything interesting will happen." (I am not making this up.) Darwinism, he admits, will work on a small scale — it will make bacteria resistant to antibiotics and insects resistant to insecticide — but it might not work on a big scale, yielding complex critters and the breathtaking biological diversity that envelops the earth. Dembski's problem is not then with Darwinism *per se*. Like the scientific creationists before him, it is with Darwinism writ large. Dembski is worried about the proper limits of extrapolation. And the non-extrapolationist evolution he ends up allowing — one that tinkers but does not innovate — is

"certainly not a form of Darwinism that is worth spilling any ink over."

There are so many problems with this view that it is hard to know where to start. For one thing, it is wholly subjective. Though Dembski enjoys dressing up his claims in mathematical garb, his key objection to Darwinism ends up being a tad less rigorous than set theory: whether he finds the likely products of natural selection "interesting". For 2 billion of the 3.5 billion years of life, nothing fancier than bacteria lived on earth. Is this interesting? A virus might only have 4 genes. Is this interesting? Just where does one draw the line between beasts or changes that are sufficiently uninteresting that they can be subsumed under a Darwinian mechanism and those that are sufficiently interesting that they cannot? Dembski's equations are silent here.

For another thing, Dembski's anti-extrapolationist view leads him into some formal muddy waters. If, as he oddly continues to claim, the NFL theorems pose a problem for Darwinism, why don't they pose a problem for a *little* Darwinism? The NFL theorems do not say anything about *scale*. To say then, as Dembski does, that a little bit of Darwinism is okay (despite NFL) but a lot is bad (*because* of NFL) is to say something odd. Dembski comes precariously close here to saying that while there is no such thing as a free lunch, you can help yourself to brunch. Last, surely it is the *refusal* to extrapolate Darwinism from the small to the large scale that needs justifying. If Darwinism can explain small changes in organisms over the last 50 years (antibiotic resistance, say), surely it can explain progressively bigger changes over the last 500, 5000, or 50 000 years. The cumulative effects of mutation and selection are not going to get *smaller*. Dembski's anti-extrapolationism seems a lot like saying that, while Kepler's laws might hold on any given day, they do not hold over whole years. Such a position is, I suppose, formally possible but it — and not extrapolation — requires special justification.

Alas, Dembski's attempts to explain why Darwinism will not extrapolate do not wash. He offers

two reasons. The first is that things get simpler not fancier under Darwinism. "Simplicity by definition always entails a lower cost in raw materials ... than increases in complexity, and so there is an inherent tendency in evolving systems for selection pressures to force such systems toward simplicity." Darwinism thus chokes when confronting a biological world that is so baroque. This is an ancient argument, and the replies to it are equally old. Even if selection favors simplicity, note that the history of life *must* show a trend of increasing complexity. The reason is this history starts at zero complexity. On average it can only go up (where we cannot see the descendants of lineages that crashed and burned back into zero complexity).

There are also good reasons for thinking that organisms get stuck at higher levels of complexity. John Maynard Smith and Eörs Szathmáry argue at book length that the formation of complex assemblies is often irreversible (Maynard Smith and Szathmáry 1985). When free-living mitochondria and early cells came together, for instance, to make the first eukaryotic (nucleated) cells, they swapped genes, so that mitochondrial proteins are now encoded by nuclear genes and vice versa. At this point, things are essentially irreversible and the two partners cannot go their separate, simpler ways. Dembski seems unaware of this well-known point.

Dembski's it-just-gets-simpler argument also relies on an erroneous assumption that natural selection cares primarily about the cost of raw materials. But selection cares *only* about how many kids you have. If I use more raw materials but have more kids than you, my type gets more common, period. Last, Dembski's argument is betrayed by his own examples of admitted Darwinism. When *Salmonella* evolved penicillin resistance and the mosquito *Anopheles* evolved DDT resistance, just how did they get simpler? The answer is they did not. (In fact the evolution of antibiotic resistance often involves the *gain* of an extrachromosomal plasmid — that is, an increase in the organism's total genome and, presumably, complexity.)

Dembski's second anti-extrapolationist argument is that

Darwinism could explain the fantastic range of biological diversity only if fitness functions are well-behaved. As he puts it, "the fitness function induced by differential survival and reproduction [may not be] sufficiently smooth for the Darwinian mechanism to drive large-scale biological evolution." If not, natural selection cannot gradually ascend lofty fitness peaks and "there is no reason to think you will get anything interesting." Dembski tries here to reconnect his argument with the NFL world — you have to sneak in a fitness function that is just right. But the argument does not fly.

To see this, consider fitness functions that are as unsmooth as you like, that is, rugged ones, having lots of peaks and few long paths up high hills. (These are the best studied of all fitness landscapes: Kauffman and Levin 1987; Gillespie 1984; Orr 2002.) Now drop many geographically separate populations on these landscapes and let them evolve independently. Each will quickly get stuck atop a nearby peak. You might think then that Dembski's right; we do not get much that is interesting. But now *change the environment*. This shifts the landscape's topography: a sequence's fitness is not cast in stone but depends on the environment it finds itself in. Each population may now find that it is no longer at the best sequence and so can evolve somewhat, even if the new landscape is still rugged. Different populations will go to different sequences as they live in different environments.

Now repeat this for 3.5 billion years. Will this process yield interesting products? Will we get different looking beasts, living different kinds of lives? My guess is yes. Dembski's is no. And that is, I suppose, fine. He is entitled to his guess. But do not let him tell you that it follows ineluctably from some mathematical theorem, because it does not. The troubling thing is that the above scenario is not some contrived attempt to sidestep Dembski. It is the *standard* explanation of why organisms do not get permanently stuck on local peaks. For one brief moment Dembski seems to realize that changing environments might matter, pulling the rug out from

under his it-won't-go-anywhere argument. But the worry is quickly dispatched with a footnote: "More precisely, *f* needs to be an evolving fitness function indexed by time. My argument, however, remains intact." Unfortunately it does not.

IRREDUCIBLE COMPLEXITY: ONCE MORE WITH FEELING

In the last half of his book, Dembski gets specific. He turns to an example of biological structures that is allegedly inaccessible to Darwinism. It would be more accurate to say he *returns* to the example as it is one that has been worked to death in ID circles. The idea comes from Michael Behe, the ID biochemist and author of *Darwin's Black Box* (Behe 1996).

Behe's argument was that some structures are "irreducibly complex": remove any part and the whole thing stops working. His favorite example was the mousetrap. Take away any part — spring or hammer, say — and function collapses; the trap will not catch mice. Behe

claimed the biological cell is also loaded with irreducibly complex structures. His pet example, and one Dembski loves, was the bacterial flagellum, which sports a dizzying number of proteins that have to be arrayed in just the right way.

The importance of irreducibly complex structures is that they cannot, Behe assured us, be built by Darwinism. Darwinism demands that each step in the long walk to the present structure be functional. But that cannot be: since *all* parts are required for function, natural selection could not possibly have added them one at a time. Irreducible complexity is therefore a reliable marker of "intelligent design". This argument sold a lot of books and got tremendous media airplay.

Unfortunately it was all wrong. Behe's claim was refuted — and in at least two ways. Both showed how irreducibly complex systems could be reached via gradual, Darwinian paths. Dembski calls the first path "scaffolding." At each

Dembski's it-just-gets-simpler argument also relies on an erroneous assumption.

step, a part gets added that improves a structure's function. At some point, however, a substructure might appear that no longer needs the remaining parts. These useless parts could then fall away. The key point is that the substructure we are left with might be irreducibly complex. Remove any part *now* and all hell breaks loose.

The second path was one that I championed. Dembski calls it "incremental indispensability" Here's the argument:

An irreducibly complex system can be built gradually by adding parts that, while initially just advantageous, become — because of *later* changes — essential. The logic is very simple. Some part (A) initially does some job (and not very well, perhaps). Another part (B) later gets added because it helps A. This new part isn't essential, it merely improves things. But later on, A (or something else) may change in such a way that *B now becomes indispensable*. This process continues as further parts get folded into the system. And at the end of the day, many parts may *all* be required. (Orr 1996/1997; see also the exchange that followed in the February/March 1997 issue of *Boston Review*.)

Dembski more or less concedes that the above paths show that irreducibly complex machines can be built via Darwinism. (He says the "incremental indispensability objection is similar to the scaffolding and co-optation [which I skipped] objections in offering a narrative scheme for how an irreducibly complex system might conceivably have evolved by Darwinian means". And "[c]ertainly there is no logical impossibility that prevents such patchworks from forming irreducibly complex systems.") Despite this, however, he bizarrely concludes that "[t]he challenge of irreducible complexity to Darwinian evolution is real, and to claim that Behe's ideas have been refuted is false." I must admit that I re-read this sentence four or five times, searching for signs it

reflected multiple typos. But concluding that Dembski meant what he said, I tried to piece together why he still thinks irreducible complexity is a bone in the throat of Darwinism.

The answer is "causal specificity". The scaffolding and incremental indispensability arguments are not, Dembski says, causally specific. This means they have not, in any particular biological example, been fleshed out in sufficiently gory detail that Dembski can judge their validity. You might think scaffolding, say, can account for the bacterial flagellum, but no one has told Dembski just which protein came first and which second:

Indeed, there is no way to argue against a putative transmutation that seems plausible enough to our imaginations but has yet to be concretely specified. ... This is of course another way of saying that the scaffolding objection has yet to demonstrate causal specificity when applied to actual irreducibly complex biochemical systems. The absence of detailed models in the biological literature that employ scaffoldings to generate irreducibly complex biochemical systems is therefore reason to be skeptical of such models.

This argument is more than a little annoying. Though Behe griped that evolutionists had not faced up to particular biochemical machines, his chief claim was that Darwinism just could not get here from there. He asked, "What type of biological system could not be formed by 'numerous, successive, slight modifications?'" and answered "a system that is irreducibly complex". He announced that "[i]rreducibly complex systems are nasty roadblocks for Darwinian evolution" and spoke of "unbridgeable chasms". *That's* what all the hoopla was about, *that's* why Behe got in *Newsweek*, and *that* turned out to be dead wrong. So now the argument shifts. Now the problem is historical concreteness. But to leave readers with the vague impression that nothing's changed, Dembski brands his point "causal

specificity". But this is a category mistake of the first magnitude. His point has nothing to do with *causation*. It's got to do with *historical narrative*. Which gene begat which protein in which order? Dembski's bait and switch here is transparent and puerile. If the ID community wishes to be taken seriously as honest intellectuals seeking truth (even if they are wrong; the two are not incompatible) they must plainly say: "Behe's chief claim was wrong. Irreducible complexity *is* accessible to Darwinism."

The causal specificity argument is also an exercise in nerve. We are, recall, trying to choose between two theories. One says bacterial flagella were built by mutation and selection and the other says they were built by an intelligent designer. And Dembski concludes the *first* theory lacks historical concreteness? *Darwinism* suffers a shortage of specificity? When, after all, did Dembski's designer come up with plans for flagella? Just how did he reach out and shape that flagellum? Which protein did he move first or did he touch them all at once? It is the height of hypocrisy for Dembski to complain that Darwinism lacks causal specificity when his own theory lacks *any* specificity, including one atom of historical concreteness. Dembski may not have much of an argument, but you have to admit he *has* got *chutzpah*.

Last, I cannot help but wonder why Dembski is so worked up about irreducible complexity in the first place. Irreducibly complex systems do show specified complexity, but so do *non*-irreducibly complex ones. METHINKS IT IS LIKE A WEASEL is specifically complex (at least if it were longer) but it is not irreducibly so. So why the special treatment? Dembski seems to imply that irreducible complexity is special because it shows some structures cannot be reached by smooth fitness functions. But this is refuted by scaffolding and incremental indispensability. The fact is that irreducible complexity plays no definable role in Dembski's view specifically and poses no challenge to Darwinism generally. The idea is dead and it is time the ID community gave it a proper burial.



ID'ING THE DESIGNER

Dembski devotes some time at the close of his book to what ID as a practicing "science" might look like. This is one of the more interesting parts of the book. Dembski knows a fair amount about the history and philosophy of science and his observations here are on the whole worth hearing. It is also here that we learn Dembski's thoughts not on design, but the *designer*. Dembski considers two questions that reside in the No Man's Land between science and theology: Is the designer embodied or unembodied? And is design front-loaded in the universe (for example, at the Big Bang and is now playing itself out) or periodically injected throughout cosmic history? (Dembski does not, though, consider another important question about the designer: What's gained by replacing a mysterious material order with an equally mysterious designer? This was one of Hume's objections to the argument from design. As Philo explains to Cleanthes in the *Dialogues Concerning Natural Religion*, "An ideal system, arranged of itself, without a precedent design, is not a whit more explicable than a material one which attains its order in a like manner; nor is there any more difficulty in the latter supposition than in the former." Cleanthes did not have much of a response. It would have been interesting to hear Dembski's.)

Dembski's treatment of the second question is the more interesting as it leaves him in an especially awkward position. To be fair, Dembski admits that there are no grounds for excluding either front-loading or intervention. But it is clear where his heart lies. He seems less than crazy about the former idea and perceptibly leans to the latter. At the very least he defends intervention with gusto (for a similar conclusion, see Pennock 2001a).

What is odd about this is that Dembski goes out of his way here to make the slightest whiff of design maximally unpalatable to scientists. Plenty of scientists have, after all, been attracted to the notion that natural laws reflect (in some way that's necessarily poorly

articulated) an intelligence or aesthetic sensibility. This is the religion of Einstein, who spoke of "the grandeur of reason incarnate in existence" and of the scientist's "religious feeling [that] takes the form of a rapturous amazement at the harmony of natural law." (This or something like it is also the religion of the young Chesterton with whom I began this essay.) This mild mysticism is fairly common among scientists, especially physicists and mathematicians. What is attractive about this view — which is of course thoroughly religious, not scientific — is that it at least requires no violation of methodological naturalism. The miraculous is not some alleged departure from natural law but the law itself.

Given that Dembski pays lip service to Duhem's claim that questions of coherence with existing theory invariably enter when choosing between views that explain the data equally well, you would guess that he would rush to embrace Einsteinian front-loading. History shows it lives peaceably with science's remaining intellectual commitments. So why doesn't he? Why does Dembski work so hard to prop up interventionism?

I can only guess but the guess seems plain: Dembski's defense of interventionism reveals, I suspect, both the ID's movement's ideological roots and its political agenda. The movement emerged, after all, out of a Judaeo-Christian tradition that demands, or at least historically favors, an interventionist deity. But more important, I suspect Dembski and much of the ID community are turned off by the fact that the Einsteinian view demands no change, much less revolution, in our practice of science. The Einsteinian view is insufficiently radical — too tame, too palatable, and too inconsequential for Dembski and his fellow travelers. It is one thing to stand in awe before the harmony of natural law. It is quite another to topple methodological naturalism, puncture materialism, and rewrite the textbooks of Ohio and Texas. I can guess which Dembski prefers.

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DEMBSKI VERSUS ORR

After the publication of "The return of intelligent design" (see p 41) in the summer 2002 issue of the *Boston Review*, Dembski and Orr crossed swords in the October/November 2002 issue. The exchange is available on-line at <<http://bostonreview.net/BR27.5/exchange.html>>; a longer version of Dembski's response to Orr appears on his personal web site at <http://www.designinference.com/documents/2002.12.Unfettered_Resp_to_Orr.htm>.

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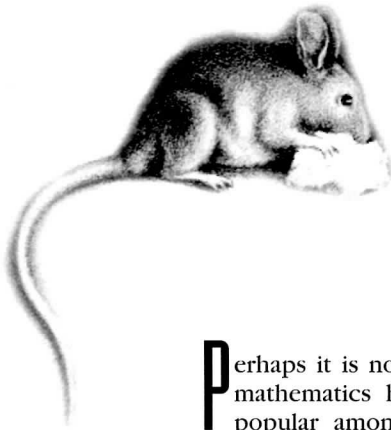
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Probability, Optimization Theory, and Evolution



NO FREE LUNCH: WHY SPECIFIED COMPLEXITY CANNOT BE PURCHASED WITHOUT INTELLIGENCE

by William A Dembski
Lanham (MD): Rowman & Littlefield, 2002. 404 pages

Reviewed by Jason Rosenhouse, James Madison University

Perhaps it is not surprising that mathematics has always been popular among anti-evolutionists. Math is unique in its ability to bamboozle a lay audience, making it well-suited to their purposes. William Dembski represents the cutting edge in anti-Darwinian mathematics. His bailiwick is probability and information theory, which he fashions into a formidable, but ultimately unsuccessful, weapon.

For years the Holy Grail of optimization theory was the production of an algorithm that would outperform blind search independent of the particular problem to be solved. The “No Free Lunch” (NFL) of Dembski’s title refers to a collection of theorems establishing the nonexistence of such an algorithm (Wolpert and Macready 1996). Specifically, the average performance of any algorithm over the class of all optimization problems is no better than blind search. It follows that an algorithm is assured of success only when information about the problem is in some way built into it.

Dembski presumes to use NFL as the foundation of an argument against the explanatory sufficiency of natural selection. In the first three chapters of the book he argues that complex specified information (CSI) is a reliable indicator of design. For Dembski this is a technical term in probability theory. Mathematically speaking, infor-

mation content is something possessed by an event in a probability space. “Complex” then indicates an event of low probability, while “specified” notes the event’s conformity to some independently describable pattern. He then argues that biological systems are replete with CSI and that NFL precludes selection’s ability to create such information without pre-existing CSI to act upon.

Dembski urges CSI as a tool for separating the products of “intelligent design” from those of chance and natural causes. He attempts to apply this tool to biological systems, believing he can thereby prove the intervention of an intelligent agent in the course of natural history. It is a drum he has been pounding for many years, through two earlier books and countless essays. His work devotes considerable effort to persuading the reader that his definition of CSI is both mathematically rigorous and practically applicable. Every aspect of this work has been strongly criticized by numerous philosophers and scientists (Fitelson and others 1999; Wilkins and Elsberry 2001; Godfrey-Smith 2001). Here I will address the primary flaws in his arguments as they apply specifically to evolutionary biology.

Assessing natural selection’s creative abilities requires that we evaluate the efficacy of a particular algorithm acting on a given problem. NFL addresses only *average performance* over all possible problems. It therefore offers no reason to believe that selection cannot construct complex adapta-

tions. On the other hand, NFL does suggest that selection’s ability to ascend the fitness landscapes it actually confronts implies its inability to scale the different landscapes that no doubt exist in some alternate reality. Mutation and recombination, viewed as algorithms for searching genotype space, will be effective only when the landscapes they confront obey certain properties. This makes it reasonable to ask why nature presents us with just the sorts of landscapes that are searched effectively by these mechanisms (Kauffman 2000). The answer, at least in part, is that fitness landscapes co-evolve with organisms. This is a bedrock principle of modern ecology.

Dembski draws a different conclusion, claiming that natural selection acts effectively only because CSI was front-loaded into the biosphere. This information is encoded in the fundamental constants of the universe. He writes:

For starters, [the collection of DNA-based self-replicating cellular organisms] had better be nonempty, and that presupposes raw materials like carbon, hydrogen, and oxygen. Such raw materials, however, presuppose star formation, and star formation in turn presupposes the fine-tuning of cosmological constants. Thus, for f to be the type of fitness function that allows Darwin’s theory to flourish presupposes all the anthropic principles and cosmological fine-tuning that lead many

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physicists to see design in the universe (p 210).

Most of us did not need difficult mathematical theorems to realize that Darwinism is viable only when nature satisfies certain axioms, and it is not a defect in evolutionary theory that it takes these axioms for granted. Determining why the universe has just the properties it does is hardly a problem within biology's domain. If Dembski wishes to claim that cosmological "fine-tuning" represents CSI then, following the requirements of his theory, he should perform a probability calculation to demonstrate that fact. Since there is no empirical basis for such a calculation, it is understandable that Dembski prefers simply to make assertions and be done with it.

And how are we to show the human genome possesses CSI? Within Dembski's framework, we must show that the probability of formation by natural selection of a particular gene sequence falls below some universal lower bound. Dembski offers 10^{-150} for this purpose, based on certain computations involving the Planck time and the number of fundamental particles in the observable universe. How do we measure this probability?

The classic creationist argument in this regard asserts that the chance formation of a gene sequence n bases long has probability 4^{-n} . The gene is modeled as an n -tuple in which each slot can be filled in any of 4 equiprobable ways. This argument is absurd for many reasons — its failure to consider selection's role in the process being the most prominent. Dembski attempts to circumvent this blunder while maintaining the computational tractability of the creationist version.

To do this he invokes the irreducible complexity (IC) of certain biochemical machines. This was the brainchild of biochemist Michael Behe, who introduced the idea in 1996. A machine composed of several well-matched, indispensable parts is IC. Such machines are said to pose an insurmountable challenge to Darwinian mechanisms because they entail some minimal complexity that could not

THREE ON-LINE CRITIQUES OF NO FREE LUNCH

1. Mark Perakh's "A free lunch in a mousetrap" appeared on the Talk.Reason web site in February 2002 (<http://www.talkreason.org/articles/dem_nfl.cfm>). Perakh writes:

[C]onfusing statements, contradictory definitions, and even elementary errors as well as unnecessary mathematical exercises, abound in this book. ... new elements are mostly characterized by the same penchant for using self-coined terms, pretentious claims of important insights or discoveries without a proper substantiation, and too-obvious a subordination of the discourse to preconceived beliefs.

The material in "A free lunch in a mousetrap" appears also in chapter 1 of Perakh's *Unintelligent Design* (Amherst [NY]: Prometheus Books, 2003), which will be reviewed in a future issue of *RNCSE*.

2. Richard Wein's "Not a free lunch but a box of chocolates" appeared on the Talk.Origins Archive in April 2002 (<<http://www.talkorigins.org/design/faqs/nfl/>>). Wein writes:

No Free Lunch consists of a collection of tired old anti-evolutionist arguments: god-of-the-gaps, irreducible complexity, tornado in a junkyard, and cosmological fine-tuning. ... the book is best regarded as pseudoscientific rhetoric aimed at an unwary public which may mistake Dembski's mathematical mumbo jumbo for academic erudition.

Dembski's response, entitled "Obsessively criticized but scarcely refuted" (<http://www.designinference.com/documents/05.02.resp_to_wein.htm>), appeared in May 2002. Wein's reply, entitled "Response? What response?" (<<http://www.talkorigins.org/design/faqs/nfl/>

<http://www.designinference.com/documents/2002.06.WeinsFantasy.htm>>), appeared in June 2002.

3. Howard J Van Till's "*E coli* at the *No Free Lunch*room: Bacterial flagella and Dembski's case for intelligent design" was posted on-line in July 2002 on the web page of the American Association for the Advancement of Science's Dialogue on Science, Ethics, and Religion (<<http://www.aaas.org/spp/dser/evolution/perspectives/vantillecoli.pdf>>). Van Till writes:

Dembski presents the bacterial flagellum as the premier example of a biological system that, because he judges it to be both complex and specified, must have been actualized by the form-conferring action of an unembodied intelligent agent. However, a critical examination of Dembski's case reveals that 1) it is built on unorthodox and inconsistently applied definitions of both "complex" and "specified", 2) it employs a concept of the flagellum's assembly that is radically out of touch with contemporary genetics and developmental biology, and 3) it fails to demonstrate that the flagellum is either "complex" or "specified" in the manner required to make his case. If the bacterial flagellum is supposed to demonstrate ID, then ID is a failure.

Dembski's response, entitled "Naturalism's argument from invincible ignorance" (<<http://www.discovery.org/viewDB/index.php3?program=CRSC%20Responses&command=view&id=1256>>), appeared in September 2002. Van Till's untitled reply (<<http://www.aaas.org/spp/dser/evolution/perspectives/vantillresponse.pdf>>) appeared in October 2002.

emerge from a small change in a simpler, precursor system.

Dembski performs a breathtaking calculation that purports to measure the complexity of a bac-

terial flagellum. The flagellum is irreducibly complex, you see, implying it can be treated as a "discrete combinatorial object". Dembski writes:



All About Steve

Glenn Branch and Skip Evans, NCSE

In their ceaseless effort to convince the public that evolution is problematic, creationists are fond of compiling lists of scientists who deny evolution. Introducing its list, the Institute for Creation Research declares that “[c]reation scientists can now be found in literally every discipline of science, and their numbers are increasing rapidly.” The creationist ministry Answers in Genesis supplements its list with a list of “creationist scientists” of the past, including some who are warily described as “old-earth compromisers” because they, unlike AIG, accepted that the earth is over 10 000 years old.

And in 2001, the Discovery Institute, the institutional home of “intelligent design” creationism, placed advertisements in *The New Republic*, *The Weekly Standard*, and *The New York Review of*

Books, signed by a number of scientists who “are skeptical of the claims for the ability of random mutation and natural selection to account for the complexity of life” and who believe that “[c]areful examination of the evidence for Darwinian theory should be encouraged” (see *RNCSE* 2001 Sep-Dec; 21 [5-6]: 22-3). Innocuous as these sentiments are, the DI’s list, like the ICR’s and AiG’s, is nevertheless brandished by those trying to show that evolution is a “theory in crisis”.

Discussing the propaganda value of such lists, the evolution education advocates associated with the TalkDesign web site (<<http://www.talkdesign.org>>) started to play with the idea of a response. But compiling a list of the hundreds of thousands of scientists who accept evolution would be not only tedious but also heavy-handed: it would look as if

the scientific establishment was out to squash creationism by sheer weight of numbers. Someone suggested that it would be just as compelling and quite a bit funnier to compile a list of scientists named Dave, say, or Chris, who accept evolution. Matt Inlay, then a graduate student in biology at the University of California, San Diego, suggested that in honor of the late Stephen Jay Gould, a better choice of name would be Steve. Thus Project Steve was born.

The National Center for Science Education undertook to sponsor Project Steve. We drafted a statement reading:

Evolution is a vital, well-supported, unifying principle of the biological sciences, and the scientific evidence is overwhelmingly in favor of the idea that all living things share

Such objects are invariably composed of building blocks. Moreover, these building blocks need to converge on some location. Finally, once at this location the building blocks need to be configured to form the object. It follows that the probability of obtaining an irreducibly complex system is [the product of these three probabilities] (p 290).

The subsequent 10 pages represent a valiant attempt to assign values to the terms of this product. The text soon becomes a dazzling congeries of binomial coefficients, perturbation probabilities, and sundry mathematical notation, all in the service of a computation that may as well have been written

in Klingon for all the connection it has to reality. Modeling the formation of complex structures via a 3-part process of atomization, convergence, and assembly is terribly unrealistic.

Further, IC machines cannot be treated as discrete combinatorial objects. Since the publication of Behe’s book (1996), numerous biologists have undertaken the thankless task of stating the obvious: irreducible complexity in the present tells us nothing about functional precursors in the past. This has been demonstrated in two ways: (1) By describing general schemata whereby an IC machine could arise gradually (Thornhill and Ussery 2000). (2) By outlining hypothetical scenarios to explain specific biochemical machines. Structures so explained

include the blood clotting cascade (Miller 1999) and the flagellum (Rizzotti 2000), among many others. The theoretical plausibility of such scenarios renders IC useless as a device for carrying out computations, and Dembski’s argument is no improvement over the creationists’.

Dembski’s casual approach to probability calculations is fatal to his enterprise. His assertion that CSI reliably indicates design is moot given his inability to establish its presence in biological systems. For example, he accuses Manfred Eigen of making a category error for writing, in reference to understanding the origin of life, “Our task is to find an algorithm, a natural law that leads to the origin of information” (Eigen 1992). Dembski believes organisms pos-



a common ancestry. Although there are legitimate scientific debates about the patterns and processes of evolution, there is no serious scientific doubt that evolution occurred or that natural selection is a major mechanism of evolution. It is scientifically inappropriate and pedagogically irresponsible for creationist pseudoscience, including but not limited to "intelligent design", to be introduced into the science curricula of the public schools.

We circulated the statement to selected Steves, Stevens, Stephens, and Stephanies with PhDs in the sciences. (We were also willing to take Estebans, Etiennes, and Istvans.) Relying on data from the Census Bureau, we calculated that approximately 1% of the United States population possesses a qualifying name, so every signatory represents about 100 scientists.

The first few days of Project Steve were hectic. NCSE member Stephen Burnett, a biologist at Clayton College and State University in Georgia, was the first to sign. After about ten days, the Steveometer was at 100, the initial

target, and 100% of the eligible Nobel laureates — Steven Weinberg and Stephen Chu — were on board, as were a number of other scientific luminaries, including the paleontologist Steven M Stanley of Johns Hopkins, the linguist Steven Pinker of MIT, and the geneticist Steve Jones of University College London. But responses were still pouring in. Shrugging our shoulders, we decided to shoot for 200.

The signatories were gratifyingly enthusiastic: "thrilled to participate" and "honored to be listed", calling it "quite good fun" and a "great concept". Steven Semken, a geologist at Diné College in Tsaile, Arizona, suggested that we add a reference to the importance of evolution to the geological sciences to the statement. Unfortunately, by then the statement was so widely circulated that it would have been difficult to rectify our oversight. When we announced Project Steve on the NCSE web site, we explained that "NCSE's position is that evolution is vital to the geological sciences too; we confidently expect that the signatories would agree if asked, but we unfortunately failed to ask."

With the Steveometer at 200, we decided to unveil Project Steve at the American Association for the Advancement of Science annual

convention in Denver, Colorado. Lawrence Krauss, a physicist at Case Western Reserve University, who was speaking on "Scientific ignorance as a way of life", kindly announced Project Steve and referred reporters to Eugenie C Scott, NCSE's executive director, who was sitting in the front row of his audience. The Steveometer was then — on February 16, 2003 — at 220. Perhaps the most famous addition since then was the 300th Steve, the physicist Stephen W Hawking of Cambridge University, who, as we remarked in our April 21 update on Project Steve, "shares a unique distinction with Stephen Jay Gould: that of appearing on *The Simpsons*". There are now over 400 Steves on the list.

Even before the addition of Hawking, the whimsical nature of Project Steve caught the attention of the media. Stories appeared in the *Washington Times*, in the *Oakland Tribune*, and on the Australian Broadcasting Corporation's *The Science Show*, which went so far as to arrange for a male chorus to sing, "Steve, Steve, Steve, Steve", in the style of Monty Python's "Spam, Spam, Spam, Spam". Numerous articles appeared in local and college newspapers, accompanied by photographs of Steves wearing their official Project Steve t-shirts. The

sess CSI, which natural laws are fundamentally incapable of producing. But Eigen's whole point is that genetic information is not complex in the sense Dembski requires. It arises with high probability as soon as certain initial conditions are met.

The line between pure and applied mathematics is often blurry, but it is real. Dembski's arguments fail because the elaborate abstract models he constructs do not adequately capture the full richness of the natural world. Alas, such nuances will not deter the anti-evolution propagandists who will use Dembski's book as mathematical vindication for their arguments.

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scientific media were responsive, too. Steve Mirsky wrote "Bringing in the Steves" (alluding to the hymn "Bringing in the sheaves") for *The Scientist*. And Project Steve was even mentioned in the Random Samples column of *Science*.

Perhaps the most rewarding mention of Project Steve in the media, however, was in the *Greenville News* on May 1, 2003. Discussing a state senator's proposal to form a committee to decide "whether alternatives to evolution as the origin of species should be offered in schools" in South Carolina (see *RNCSE* 2003 Mar/Apr; 23 [2]: 12-4, 2003 May-Aug; 23 [3-4]: 5-10), the reporter referred to the Discovery Institute's list of "dissenters from Darwinism" and then immediately added, "To show how small a minority those scientists are, the National Center for Science Education put out a statement debunking Intelligent Design that was signed by 200 scientists — all of whose first name is 'Steve'". And we didn't even urge him to do so!

Project Steve is of course a parody of the lists used by creationists to try to convince the public that evolution is shaky. But there is a serious side to it, too: to remind the public that scientific questions are not answered by acclamation but by scientific research, which, of course, overwhelmingly supports evolution. But don't take our word for it. Just ask Stephen Abedon, or Stephen Addison, or Stephen Adler, or Stephen Aley, or ...

[For information about Project Steve, see <<http://www.ncseweb.org/article.asp?category=18>>.]

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ERRATUM

The donors thanked in *RNCSE* 2003 May-Aug; 23 (34): 54-5 made their donations between July and December 2002, not between January and June 2002.

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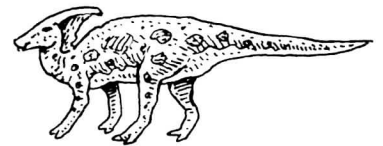
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OUR FAMILY TREE: AN EVOLUTION STORY

by Lisa Westberg Peters
New York: Harcourt, 2003. 48 pages

Reviewed by Lisa M Blank, University of Montana

Parents and teachers struggling for an intellectually honest and yet engaging approach for answering young children's questions about how life began should consider sharing *Our Family Tree: An Evolution Story*. This children's picture book by Lisa Westberg Peters carefully chronicles the complexities of evolution in easy-to-read language, while illustrator Lauren Stringer's bold colors and playful depictions help visualize historical events as a child of today might experience them.

Peters begins by inviting the reader to walk with her along a sandy beach as she carves scenes in the sand from the family album of life. She deliberately uses a first-person narrative to convey a sense of comfort; reminding us that no one walks the path of life alone — each of us is constantly surrounded by our ancestors. As “we” begin the journey, a cadence of inside and outside characteristics of life connects each page or life form represented. “On the outside we were so small ... but on the inside, we had the same kind of spiraling genetic code for life we have today. ... on the outside we were small and furry ... on the inside we made milk for our babies the way we do now.” The repetition of this theme encourages children to compare outsides and insides as they travel through the nine stages of the family tree: single cells, worm-like vertebrates, lobe-finned fish, amphibians, reptiles, mammals, reptiles, primates, hominins, and *Homo sapiens*.

Interspersed with each life form are concurrent events on earth:

“As the seas rose and fell our family changed again.” This juxtaposition is important to Peters because it emphasizes to young readers that they are connected to the planet as much as they are connected to other life forms. She hopes to leave the reader with a sense that even though evolution is unpredictable and “we may not be able to predict our ultimate fate”, the “choices that we make ... will affect the quality of our lives.”

What Peters does not explain is the mechanism producing the changes highlighted in each page. Some young readers may intuit from this story that changes in life forms over time were purposeful changes. For example Peters writes, “We had scales to protect us and fins to swim against strong currents. ... When families of green plants and insects began living on the land, we followed them.” Here, added discussion is important. Adult readers and teachers must make clear that the changes shown on each page occur in populations, not individuals, and that these changes are due to differential reproduction rates among populations, not individual, purposeful changes in response to environmental conditions. To follow up this discussion, young readers could be challenged to recreate Stringer's illustrations to depict these understandings more accurately.

Time between events exists in the story as millions of years and generation after generation, a helpful analogy for young readers, but for them time more likely transpires as a mere flip of a page. Constructing a mental model of a family album that stretches back millions of years is difficult for young and adult readers alike, and reading *Our Family Tree* alone will not suffice. Readers will find that Peters has considered this and provides a timeline and glossary at the

back of the book to illustrate further the sequence of events, although the timeline is not to scale.

Again, Peters is aware of this and a visit to her personal web site (<<http://www.lisawestbergpeters.com/>>) is well worth the time. Here she includes a series of lessons for both elementary and secondary students. The 8-lesson unit for young children is rich with ideas, sensitive to the prevalence of alternative conceptions concerning origin of life and change over time, and adept in providing concrete models for difficult concepts such as time and scale. For secondary teachers, the curriculum is equally engaging, although I predict older students may find the reading of a picture book as the foundational learning experience a bit curious.

Near the end of Peters's journey, the entire family tree is laid out in the sand as a mother completes the final entry — an outline of her son's body. Peters writes, “On the outside we are all people.” And on the inside we all wonder, “who we are, where we came from, and where we're going next ... we carry with us reminders of each step of our past.” These parting statements provide valuable ideas for fruitful future discussions. Not only is the reader challenged to locate and research vestigial organs, but we are reminded that all humans wonder about their origins.

Peters first conceptualized a children's book on evolution after hearing an excerpt from the work of Stephen Jay Gould. Thirteen years of research later, pen was finally put to paper to write *Our Family Tree*, a book that she hoped would initiate a child's sense of the wonder about what it means to be human. As I read the book with my 3-year old, we traced the backbone of the early fish and giggled as we bounced along her backbone, assured that Peters did indeed do just that.

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AUTHORS' INFORMATION

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

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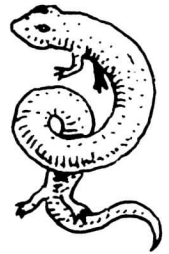
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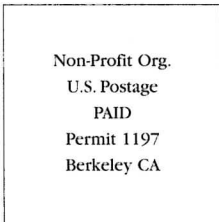
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