

Reports of the National Center for Science Education

Reports of the National Center for Science Education is published by NCSE to promote the understanding of evolutionary sciences, of climate sciences, and of science as a way of knowing.

Vol 33, No 2 (2013)



Plato's Academy. First century BCE mosaic from the house of T. Siminius Stephanus, Pompeii. Now at the Museo Archeologico Nazionale, Naples. Photograph: Marie-Lan Nguyen / Wikimedia Commons.

Table of Contents

Features

Political Bias Meets Climate Bias: Overcoming Science Denial in a Politically Polarized World <i>Minda Berbeco</i>	3
Intelligently Designed Data: The Bogus Louisiana Teacher Survey <i>Barbara Forrest</i>	6
<i>Othniel Charles Marsh (1831–1899)</i> <i>Randy Moore</i>	14

Reviews

<i>The Philosophy of Human Evolution</i> • Michael Ruse <i>Matt Cartmill</i>	17
<i>Children of Time</i> • Anne H Weaver <i>Holly M Dunsworth</i>	20
<i>DNA USA</i> • Bryan Sykes <i>Anne D Holden</i>	23
<i>The Fossil Chronicles</i> • Dean Falk <i>Andrew Kramer</i>	26
<i>The Leakeys: A Biography</i> • Mary Bowman-Kruhm <i>Elizabeth J Lawlor</i>	29
<i>Sex, Genes, and Rock 'n' Roll</i> • Rob Brooks <i>J Michael Plavcan</i>	34

ISSN: 2159-9270



FEATURE

Political Bias Meets Climate Bias: Overcoming Science Denial in a Politically Polarized World

Minda Berbeco

In October 2012, the Pew Research Center released a poll on the American public's acceptance of climate change. The results were dismal: only 42% of Americans reported believing that the rise in the earth's temperature was mostly caused by human activity. A further breakdown revealed significantly more self-identified liberals than conservatives accepted the evidence that human activity is warming the earth.

Though the scientific consensus is clear, a significant segment of the American public still seems to be confused about climate change, and political affiliation appears to be a major factor. After years of unambiguous research results, public outreach initiatives, and educational programs, the science does not appear to be penetrating every community. So why don't all Americans understand the scientific consensus of human-caused climate change? Is there a better way to reach them? What else can be done?

Lawrence Hamilton, Professor of Sociology at the University of New Hampshire and Senior Fellow at the Carsey Institute, has been researching the public's relationship to environmental issues for more than thirty years. Over this time, Hamilton has worked to understand how people relate to conservation, how their political affiliations influence their decision making, and the role of education in making informed choices.

When looking at people's knowledge and their acceptance of the scientific consensus, Hamilton says, "I would separate out three things. One of them is years of education ... another is science literacy ... and third, specific climate knowledge." All three correlate with acceptance of the consensus, but not necessarily in the way one would think.

One might predict that more education, better science literacy, and greater climate knowledge would all be positively correlated with understanding and accepting human-caused climate change. The more you know in general, and about science in particular, the more you would believe what scientists are telling you. But this is not necessarily the case.

"If you are educated," Hamilton says, "if you are scientifically literate but also politically motivated, you can potentially be more efficient at acquiring facts that support the world views you already believe." In other words, more education makes you a better scavenger for information that supports your pre-existing views. For example, if I believe the moon landing was a hoax, I'll search the internet for articles and reports that claim to demonstrate this. My beliefs are then supported by my "research". How then does this play out with climate change?

Although just about any environmental question will show a strong partisan bias, according to Hamilton, “there is really no reason why your political party should tell you what to think about whether the ice is melting or not.” Instead, it’s the implications for climate change that drive much of the dissent: if the ice is melting, and people are causing it, then it could be argued that something should be done. “So if your ideology is that government is bad and it should do less regulation, then that [leads to] rejection of the problem’s existence because you find the solution ideologically unpalatable.”

An example of this is demonstrated by asking subjects whether humans or volcanoes have released more carbon dioxide in recent decades. Hamilton notes:

That is pretty well known in the science literature, but it is not a matter of public discussion and most people don’t know what the quantities look like People who don’t believe that humans are changing the climate are more likely to say that volcanoes are emitting more CO₂. Not because it’s true and not because they know that, but the idea fits better with their world view.

So rather than listening to the great majority of scientists or science organizations, a highly educated climate change denier might be an expert at finding blogs or other media that provide scientific-sounding arguments to support his or her worldview.

That’s not the whole story, though. The type of question asked in these surveys may also determine how people respond. “There are some facts I can ask, like ‘Has sea ice declined?’, where your beliefs about climate change may filter what you have heard or believed about sea ice. Even if you haven’t actually heard a word about sea ice, your beliefs about climate change may guide you what to guess.”

What if instead, you asked a question where politics could not lead you to an answer? Hamilton suggested the following as an example:

Which of these melting would add the most to sea level rise: Himalayan glaciers, Antarctic ice sheets, or Arctic Ocean ice?

For this question, you need information to guide you, not politics. “Your politics don’t give you any guidance which of those is right; you have to know something about geography.”

How you ask the question can have a large impact on your results. So how can researchers avoid triggering answers that demonstrate political affiliation rather than scientific knowledge? “Something I am really trying to do with the newer work,” says Hamilton, “is to write these carefully thought-out questions that are scientifically accurate with central issues on which there is no controversy.”

For example, a question as to whether or not polar ice caps have increased or decreased in recent years is rather imprecise, and might tap into people’s political, rather than scientific, knowledge. “Polar ice caps are at two poles, and are we talking about land ice or sea ice, and when it increases, are we talking about area or volume or both, and what season are we referring to?”

“When I went to write my own question about it, the wording was very precise: ‘What is the area of sea ice covering the Arctic Ocean in late summer now, compared with thirty years ago?’ It specifies the metric, it specifies the season, and it specifies the time frame.”

In his research, Hamilton has seen the effect of political affiliation on environmental surveys very clearly when subjects are asked about the Arctic. “The Arctic is where climate change is happening first and worst,” and though people seem to think they know quite a bit about the Arctic, his research has suggested they know very little.

There are certain things they pick up from the media that are widespread, for example the idea that polar bears are or are not endangered [People] who really don’t know about the actual physical reality, may become convinced that they do because they have some narrative that ties to their political beliefs.

So if politics are muddling scientific education, how can scientists and educators best communicate with the public?

Whether you are a grade school teacher or a local newspaper columnist or just having a discussion at the water cooler, you have to be aware that all of these counterarguments and counter-facts exist in the infosphere regarding just about any point you could make about climate change. I think education or communication could be more designed from the start with an awareness of what those counterarguments are.

So a discussion of Arctic change should start out with an explanation of how we know that what’s happening now is not a natural cycle.

“If people don’t already know the counter-arguments, they will hear them pretty soon anyway,” Hamilton said. In this case, when it comes to climate change denial, the best defense is a strong educational offense.

As we move into educating the entire public in coming years about human-caused climate change, we have to understand how political affiliation will influence their acceptance of the facts. Only by understanding our own reflexive biases can we find new ways to reach that audience, and help address an increasingly urgent problem.

ABOUT THE AUTHOR

Minda Berbeco received her PhD in biology from Tufts University in 2011 specializing in the effects of climate change on terrestrial systems. She joined NCSE in the fall of 2012 as a Programs and Policy Director in NCSE’s new global climate change program.

AUTHOR’S ADDRESS

Minda Berbeco
NCSE
PO Box 9477
Berkeley CA 94709-0477
berbeco@ncse.com



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FEATURE

Intelligently Designed Data: The Bogus Louisiana Teacher Survey

Barbara Forrest

On September 10, 2012, Central Community School System (CCSS) board member Jim Lloyd invoked a 2005 teacher survey in recommending the adoption of a stealth creationism policy by this small independent school district in the Baton Rouge suburb of Central, Louisiana (<http://lasciencecoalition.org/2012/12/28/creationist-conniving-in-central-part-two/>). He said that a Louisiana teacher organization, the Associated Professional Educators of Louisiana (A+PEL; <http://www.apeleducators.org/>), had “polled its members and learned that a large percentage of them welcomed guidance concerning how to better teach controversial science subjects” (http://lasciencecoalition.org/docs/Central_School_Board_9.10.12_Clip.mp3). The controversial subject is, of course, evolution.

A+PEL, established in part as an alternative to the state’s teacher unions, calls itself “the premier educators’ organization in Louisiana” (<http://www.apeleducators.org/displaycommon.cfm?an=1&subarticlenbr=175>). Its mission page says that the organization “is committed to advancing teachers as career professionals” so that through “teacher advocacy and excellence in education” they can “empower Louisiana’s youth for future success.” A+PEL’s description of its mission is at odds with its involvement in undermining public school science education by participating in this utterly worthless “survey,” which is being used publicly to promote creationist laws and policies.

In 2005, A+PEL teamed up with the Louisiana Family Forum (LFF; <http://www.lafamilyforum.org/>) to conduct an “Academic Freedom” teacher opinion survey, which is posted on the A+PEL website (<http://www.apeleducators.org/associations/3635/files/Academic%20Freedom%20Survey%20Aug%202005%20DDW%20.pdf>). The survey is bogus for two reasons: first, the questions are deliberately crafted to elicit biased responses; and second, although the survey addressed only science education, it was sent indiscriminately to all A+PEL members, regardless of teaching discipline or grade level.

There are undoubtedly some fine teachers in A+PEL’s rank-and-file membership. But the reality is that this organization partnered with the LFF, a Focus on the Family affiliate, to produce this bogus teacher opinion survey that LFF and the Discovery Institute (DI) have used to promote creationist laws in Louisiana and Tennessee, and creationist policies in the Ouachita Parish and CCSS school districts. The September 2012 release of the “findings” also raises other questions. Why, seven years after the survey was done, was Lloyd bringing it up now? What was its relevance to the CCSS policy? What is this “teacher organization”? Who are its members, and what is its objective? And who are the partner organizations that support and collaborate with this group? Like the moral in Aesop’s fable

“The ass and his purchaser,” we can learn much about people—and organizations—by the associates they choose.

THE A+PEL 2005 ACADEMIC FREEDOM SURVEY, AUGUST 2005

For convenience, we will call the survey the “A+PEL/LFF survey,” since the LFF considered it so important that they listed it in their 2005 IRS 990 form as one of their signal accomplishments that year (http://lasciencecoalition.org/docs/LFF_IRS_990_2005.pdf, p 17). Posted on A+PEL’s website under “Resources” (<http://www.apeleducators.org/displaycommon.cfm?an=1&subarticlenbr=16>), this survey was first used by the Ouachita Parish (OP) School Board to justify the “Academic Freedom Policy” that it adopted on November 29, 2006 (<http://www.opsb.net/CAPS/Policies/IAA-07.htm>; see news report at <http://www.ouachitacitizen.com/news.php?id=530>). DI has also used it to defend creationist “academic freedom” laws in Louisiana and Tennessee, and they will no doubt pull it out again in their next forays into state lawmaking.

THE FIRST APPEARANCE OF A+PEL/LFF SURVEY: OUACHITA PARISH

In early 2006, after the 2005 *Kitzmiller v Dover* case shredded its credibility, DI needed a new vehicle for promoting its brand of creationism. In other words, the “intelligent design” creationists had to re-design “intelligent design.” So DI reverted to the time-honored creationist tactic of promoting “academic freedom” (see, for example, the stated purpose of Louisiana’s 1981 “Balanced Treatment Act,” <http://www.legis.state.la.us/lss/lss.asp?doc=80459>). DI’s Winter 2006 newsletter announced that “academic freedom” would be its “new front in the debate over intelligent design” (<http://www.discovery.org/scripts/viewDB/filesDB-download.php?command=download&id=695>, p 2).

Later the same year, on November 29, 2006, the OP school board adopted its “Ouachita Parish Science Curriculum Policy,” subtitled “RESOLUTION ON TEACHER ACADEMIC FREEDOM TO TEACH SCIENTIFIC EVIDENCE REGARDING CONTROVERSIAL SCIENTIFIC SUBJECTS” (capitalization in original; <http://www.opsb.net/downloads-file-166.html>). Two days later, DI staffer Casey Luskin sang the praises of the OP decision in a post on DI’s Evolution News & Views blog:

We’re very happy to see [the Ouachita Parish School Board] take a stand protecting the academic freedom of teachers to answer student questions and discuss scientific issues in the classroom. ... There is a disturbing trend of teachers, students and scientists coming under attack for questioning evolution. (http://www.evolutionnews.org/2006/12/local_louisiana_school_board_p002907.html)

In what looks like a veiled reference to the A+PEL/LFF teacher survey, Luskin also stated, “the policy was passed after teachers expressed a desire for clarification of their rights.”

The OP academic freedom policy was the proverbial camel’s nose under the door of the science class, and it laid the foundation for the Louisiana Science Education Act (LSEA) two years later (<http://www.legis.state.la.us/lss/lss.asp?doc=631000>).

The *Ouachita Citizen* gave this milestone a favorable write-up, highlighting the involvement of LFF “consultant” (and co-founder) Darrell D White:

Retired Judge Darrell White of Baton Rouge, consultant with Louisiana Family Fo-

rum's Education Resource Council, commended the [OP] school board for setting a precedent he hopes other school systems will follow.

Ouachita Parish is the first school system in the state to adopt such a measure that will give its teachers academic freedom.

"This has been a long fight," White said, but added the fight to implement quality science education guidelines in all schools has just begun. (<http://www.ouachitacitizen.com/news.php?id=530>)

Although nothing about the A+PEL/LFF survey appeared in newspaper coverage of the OP policy, an attendee at the school board meeting reported to the Louisiana Coalition for Science that an "academic freedom survey" was used as part of the rationale for its adoption. That report signaled the first use of the A+PEL/LFF survey. Shortly thereafter, the survey was posted on A+PEL's web site. White's involvement was integral to the adoption of the OP policy and, apparently, to the survey, since A+PEL's URL for the survey notably incorporates his initials, "DDW": <http://www.apeleducators.org/associations/3635/files/Academic%20Freedom%20Survey%20Aug%202005%20DDW%20.pdf>.

DARRELL WHITE'S RELATIONSHIP WITH A+PEL

Anyone familiar with his constant promotion of the LFF's Religious Right agenda will recognize the introductory paragraph of the A+PEL/LFF survey as vintage White:

The issue of teachers' freedom to teach controversial subject matter has recently been discussed in the public square. For example, there is debate surrounding the teaching of sex education classes, teaching the Bible as history and literature classes as a part of our national heritage, and in teaching the full range of scientific views regarding Darwin's evolution model. Some teachers confess that they are fearful of introducing such topics.

Promoting "the full range of scientific views" about evolution—which is DI's "Santorum Amendment" code language for teaching "intelligent design" (<http://www.discovery.org/a/2103>)—has become one of the signature marks of White's promotion of creationism in Louisiana (<http://lasciencecoalition.org/2012/12/12/creationist-conniving-in-central-part-one/>). He is a lifetime member of Answers in Genesis's infamous Creation Museum (<http://blogs.answersingenesis.org/blogs/ken-ham/2009/11/24/a-judges-judgment/>). Promoting the Bible as a history textbook for public schools is also one of his pet projects, as evidenced by his membership on the advisory board of the National Council on Bible Curriculum in Public Schools (<http://www.bibleinschools.net/About-Us/Board-of-Directors-and-Advisors>).

White also has a relationship with A+PEL. Somehow, for some reason, someone at A+PEL got the idea that he has expertise that must be communicated to teachers for transmission to children. He has been included among "notable authorities" that A+PEL has invited to give presentations to social studies teachers at A+PEL's "American Studies Institute":

With an emphasis on traditional principles and historical accuracy, seminars are offered throughout the year to help classroom teachers and others gain additional information and insight which will strengthen and enhance social studies classes in

elementary and secondary schools throughout Louisiana. (<http://www.apeleducators.org/displaycommon.cfm?an=1&subarticlenbr=22>)

Moreover, even though A+PEL's American Studies Institute emphasizes "historical accuracy," it does not seem bothered by White's association with David Barton, the pseudohistorian who helped distort the Texas social studies education standards in 2009 (<http://www.tfn.org/site/News2?page=NewsArticle&id=5778>). Barton's book, *The Jefferson Lies: Exposing the Myths You've Always Believed About Thomas Jefferson*, was pulled from bookstores by his own publisher, Thomas Nelson, with the explanation that "basic truths just were not there." (<http://www.npr.org/blogs/thetwo-way/2012/08/09/158510648/publisher-pulls-controversial-thomas-jefferson-book-citing-loss-of-confidence>).

DISCOVERY INSTITUTE "DISCOVERS" THE A+PEL/LFF SURVEY

Casey Luskin seems to have been referring indirectly to the 2005 A+PEL/LFF survey when he defended an academic freedom bill that was introduced in New Mexico in 2007: "In our present climate, many teachers are intimidated ... into teaching a biased, incomplete view of the biological evidence about neo-Darwinian evolution" (http://www.evolutionnews.org/2007/01/academic_freedom_bill_introduc003112.html).

The survey asked teachers, "Do you feel intimidated regarding the teaching of the controversy surrounding origins?" (<http://www.apeleducators.org/associations/3635/files/Academic%20Freedom%20Survey%20Aug%202005%20DDW%20.pdf>, p 3).

In April 2012, Luskin referred more directly to a "survey of Louisiana teachers" in defending Tennessee HB 368 (http://www.evolutionnews.org/2012/04/governor_of_ten058451.html) which Governor Bill Haslam allowed to become law without his signature (<http://ncse.com/news/2012/04/monkey-bill-enacted-tennessee-007299>). DI partnered with the Family Action Council (FAC) of Tennessee to write and promote HB 368 (<http://factn.org/portfolio/education-6/gallery/legislation-bill-tracking-state-legislature/>), just as it did with the LFF to write and promote the LSEA.

TN HB 368, nicknamed "The Monkey Bill", is merely a slightly tweaked version of SB 561, the "Louisiana Academic Freedom Act" (the initial draft of the LSEA). Like SB 561, it includes the "strengths and weaknesses of evolution" code language. Interested readers who want to take the time can compare the Tennessee Monkey Bill and Louisiana SB 561 side by side. It will be difficult to tell them apart:

- LA SB 561, 2008
(<http://www.legis.la.gov/Legis/ViewDocument.aspx?d=472973&n=SB561%20Original>)
- TN HB 368, 2012
(<http://www.capitol.tn.gov/Bills/107/Bill/HB0368.pdf>)

Luskin stressed that legislation such as the Tennessee Monkey Bill is needed because DI has discovered that teachers all over the country are being intimidated:

Working with teachers nationwide, we have long observed a pattern where teachers commonly feel intimidated into silence when covering controversial scientific topics. (http://www.evolutionnews.org/2012/04/governor_of_ten058451.html)

He documented not a single case of intimidation, and he didn't identify the survey of Louisiana teachers that he invoked. Nonetheless, he very prominently cited specific data—which just *happened* to be from the A+PEL/LFF survey—in reference to the LSEA:

Indeed, before Louisiana passed its academic freedom law in 2008, a survey of Louisiana teachers showed:

- 48% of teachers were afraid that “teaching controversial material could affect [their] ... tenure, salary, promotions, or job security.”
- 50% did not feel free to critique evolution.
- 55% felt “intimidated regarding the teaching of the controversy surrounding origins.” (http://www.evolutionnews.org/2012/04/governor_of_ten058451.html)

Luskin then warned that “just because state science standards officially encourage critical thinking, that doesn't mean a climate of academic freedom exists where teachers feel free to teach about different scientific views on topics like evolution” (http://www.evolutionnews.org/2012/04/governor_of_ten058451.html).

This really looks bad, doesn't it? With results like these, Louisianians should be extremely concerned about teacher intimidation in their public schools.

AH, BUT NOW FOR THE CRITICAL THINKING ...

When the A+PEL/LFF survey became available on A+PEL's website, the Statistical Research Center of the American Institute of Physics (AIP; <http://www.aip.org/statistics/about.html>) kindly offered to do a formal analysis of it (see the report at http://lasciencecoalition.org/docs/AIP_APEL_Survey_Analysis_Jan07_Updated_2012.pdf). Since the LFF and DI, especially Luskin, profess to be so concerned about critical thinking in public schools, they shouldn't mind that the AIP did some critical thinking about the survey that Luskin has been using to defend DI's academic freedom bills. AIP's analysis showed that this “survey” is pure hogwash. Moreover, Luskin reported the results incorrectly. Even a cursory inspection of the A+PEL/LFF survey very quickly reveals its flaws. The thing is skewed from the get-go. The questions are written so as to direct respondents toward the answers that the LFF wanted. The question below, with the responses included, is an example:

2. Which of the following two statements come[s] closest to your own opinion?
 - A. Biology teachers should teach only Darwin's model of evolution, and the scientific evidence that supports it. (21; 7%)
 - B. Biology teachers should teach Darwin's model of evolution, but also the scientific evidence against it. (173; 62%)
 - C. Neither (49; 17%)
 - D. Not sure (32; 11%)
 - E. Blank/No Answer (8; 3%)

Answer B, which the majority of respondents selected, assumes that there actually is scientific evidence against evolution. For the umpteenth time, there isn't any such evidence. But including that answer as a choice in the survey makes a subtle appeal to the respondent's desire to appear fair and impartial. The fact that 62% of the respondents chose answer B is consistent with the results of earlier, similarly biased surveys that DI purchased from Zogby International to support its promotion of "intelligent design" (<http://prospect.org/article/john-zogbys-creative-polls>).

As the AIP's analysis shows, the A+PEL/LFF survey doesn't get any better. Here are the first two items from the analysis.

1. *Poor response rate.* 6000 surveys were sent out, and only 277 returned. This is a response rate of 5%. How many of the other 95% chose not to answer because of the wording of the questions and the wording of the answer options that were provided?
2. *Potentially biased respondents.* The data were sent to the 6000 members of A+PEL. No teachers in Ouachita Parish who are not members of A+PEL were surveyed, and not all teachers in Ouachita are A+PEL members.

In addition to the low response rate, A+PEL provides no evidence that the survey is even representative of its own membership. There is a great deal more in the AIP analysis that shows the uselessness of this survey for any meaningful understanding of the work climate for teachers who must present evolutionary science in their classrooms.

However, question #6 in particular stands out: "Do you feel intimidated regarding the teaching of the controversy surrounding origins?" Since this item appears to be the specific source for Luskin's claim that Louisiana teachers are "intimidated into silence when covering controversial scientific topics," readers will understand its importance to his defense of DI's "academic freedom" laws. This survey question includes a pie chart, so we have reproduced the graphic here (Figure 1).

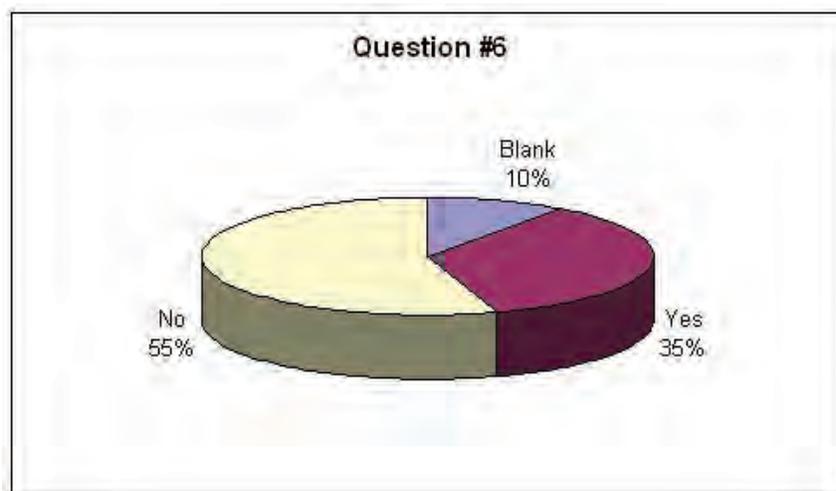


FIGURE 1. Redrawn from Figure 6 from the Academic Freedom Survey; <http://www.apeleeducators.org/associations/3635/files/Academic%20Freedom%20Survey%20Aug%202005%20DDW%20.pdf>.

A comparison of this presentation of the survey data with the figures Luskin cites from the unidentified “survey of Louisiana teachers”—the part where he claims that the survey reveals a “pattern” of intimidation “regarding the teaching of the controversy surrounding origins”—yields a disturbing fact: Luskin has reversed the survey results.

When asked whether they felt intimidated “regarding the teaching of the controversy surrounding origins,” only 35%—96 teachers in real numbers—answered “Yes.” The number Luskin cites—55%, or 174 in real numbers—represents the teachers who answered “No.” So the majority of the tiny minority of the A+PEL teachers who responded to the survey don’t actually feel intimidated at all. And over 10% (29) of the teachers responding to the survey didn’t even bother to answer that question.

This is an easy mistake to make, of course, but also a very easy one to correct. And the crux of the matter is this: Luskin—a DI staffer who, as his DI bio informs us, is also “an attorney with graduate degrees in both science and law” (<http://www.discovery.org/p/188>)—has incorrectly cited misleading statistics from a seven-year-old, defective teacher opinion survey to support the need for the creationist academic freedom laws that DI is promoting around the country.

The 277 respondents to the A+PEL/LFF survey comprise roughly 5% of the 6000 A+PEL teachers to whom the survey form was mailed. Putting this in an even broader context, the 277 teachers who responded represent roughly one-half of one percent (0.6%) of the roughly 48 000 public school teachers in Louisiana (http://nces.ed.gov/surveys/sass/tables/sass0708_043_t1s.asp). The 96 teachers who claimed to feel intimidated represent a mere 1.6% of the 6000 polled and only 0.2% of the public school teachers in the entire state. So, a critical analysis of the data that Luskin presented in support of the “intimidation hypothesis” not only fails to support his claims, but unequivocally refutes it.

What is more critical is that the recently adopted CCSS policy—which will now influence the science instruction of public school students throughout the Central school district—is based on this farce of a “survey.” So, to readers in states where the next round of “academic freedom” bills crop up (as they already have in six states in 2013; <http://ncse.com/creationism/general/chronology-academic-freedom-bills>): Store this information in your memory banks, and feel free to distribute both the A+PEL/LFF survey and the AIP analysis far and wide. If any organization or individual tries to use this teacher “survey” to convince your legislators (or governor) that teachers are intimidated and need an “academic freedom” law in order to teach your kids to think critically about evolution, you have a nice example of real critical thinking to show them.

ABOUT THE AUTHOR

A member of NCSE’s board of directors, Barbara Forrest is a professor of philosophy at Southeastern Louisiana University and a co-founder of the Louisiana Coalition for Science, on whose blog a version of this article originally appeared: <http://lasciencecoalition.org/2013/01/14/bogus-apel-lff-teacher-survey/>.

AUTHOR'S ADDRESS

Barbara Forrest
Department of History and Political Science
SLU 10484
Hammond LA 70402
bforrest@selu.edu



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FEATURE

People and Places: Othniel Charles Marsh (1831–1899)

Randy Moore



FIGURE 1. *Othniel Charles Marsh (date unknown). Library of Congress LC-USZ62-63539.*

Othniel Charles Marsh was born on October 29, 1831, in Lockport, New York. After graduating from Yale, he studied geology, mineralogy, and other topics in Germany. Marsh returned to the United States in 1866 to be an unpaid professor at Yale, and by the 1870s he had discovered fossils of ancient horses and fossil birds with teeth and other reptilian features. While in school, Marsh met Louis Agassiz, who became interested in Marsh's discoveries. Marsh, who served as president of the National Academy of Sciences for 12 years, claimed to be "a man of great wisdom" and a friend of Buffalo Bill.

In 1868, Marsh discovered bones of a small horse *Equus parvulus* (now *Protobippus*). Marsh, the first professor of vertebrate paleontology in the United States, teamed with Thomas Henry Huxley to describe the evolution of modern horses from a four-toed ancestor and, in the process, provided crucial evidence for how species evolve over time. Marsh and Huxley predicted that a more ancient, five-toed animal probably existed. Several months later, fossils of *Eobippus* ("the dawn horse")—just such an animal—were discovered. Marsh became a fierce rival of paleontologist Edward Drinker Cope, and their highly publicized rivalry was dubbed "The Bone Wars." Marsh spent \$200 000 of his own money (and Cope \$70 000 of his) on fossil-hunting expeditions associated with their competition (Plate 1964). In one such expedition, Marsh found 50 specimens of *Triceratops*, each weighing an average of a ton in life (the largest weighed 3.5 tons).

In 1878, Marsh named *Diplodocus*, and casts of this dinosaur were distributed throughout the world by Andrew Carnegie. The following year, Marsh named *Brontosaurus*. However, in 1903 (four years after Marsh's death), Elmer Riggs of Chicago's Field Museum determined that Marsh's *Brontosaurus* belonged to the same genus as *Apatosaurus*. According to the rules of scientific nomenclature, the name *Brontosaurus* was retired, although it continues to be used by the public.

As part of an 1868 peace treaty, the Great Sioux Nation was given all of western South Dakota and the sacred Black Hills. However, when gold was discovered in the Black Hills three years later, prospectors flooded into the Black Hills; George Armstrong Custer's (1839–1876) expedition there for gold in 1874 helped produce the lawless town of Deadwood, South Dakota. Although prospectors were violating the peace treaty, the Army protected the prospectors, which infuriated the Sioux. Marsh negotiated a peace treaty with Sioux Chief Red Cloud, promising that he would take Red Cloud's grievances to government officials if Red Cloud would allow Marsh to gather fossils. Red Cloud agreed, and Marsh and his crew took away two tons of fossils.

When Marsh investigated Red Cloud's complaints, he was shocked at the treatment that the Sioux had received. Marsh took his concerns to various government officials and, when he did not get a satisfactory response, took his story to newspapers. The resulting "Red Cloud Affair" rocked Ulysses Grant's presidency, and Secretary of the Interior Christopher Delano resigned. Marsh remained friends with Red Cloud, who referred to Marsh as "the best white man I ever saw".

Marsh's discoveries convinced many people of the validity of Darwin's theory, and made Marsh one of the most famous paleontologists of his era. In 1871, Marsh found the first American pterosaur fossils. Charles Darwin wanted to see Marsh's specimens, but he never made the trip. In 1866, Marsh's uncle George Peabody endowed \$150 000 for the Peabody

Museum; many of the dinosaur fossils in that and many other museums can be traced to Marsh and Cope.

Marsh, who discovered and described hundreds of vertebrate fossils, died on March 18, 1899, and is buried in the Grove Street Cemetery in New Haven, Connecticut. Marsh left his estate and specimens to Yale.

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ABOUT THE AUTHOR

Randy Moore is the HT Morse–Alumni Distinguished Professor of Biology at the University of Minnesota. His most recent book (with coauthor Sehoya Cotner) is *Understanding Galápagos: What You'll See and What It Means* (New York: McGraw-Hill, 2003).

AUTHOR'S ADDRESS

Randy Moore
University of Minnesota, MCB 3-104
420 Washington Avenue SE
Minneapolis MN 55455
rmoore@umn.edu



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REVIEW

The Philosophy of Human Evolution

by Michael Ruse

Cambridge: Cambridge University Press, 2012. 282 pages

reviewed by **Matt Cartmill**

From the beginning, the relationships between Darwin and philosophers of science have been uneasy. To please the philosophers of his day, Darwin labored to make his theory fit the approved Newtonian model of physical science, with less than perfect success. CS Peirce regarded Darwinism as both scientifically dubious and morally disgusting (Russell 1976:64). Karl Popper thought that the neo-Darwinian synthesis was not so much a scientific theory as a “metaphysical research program.” (He changed his mind later.) And postmodernist *philosophes* who insist that nature is a human construction have never been happy with a theory that depicts humans as emerging over geological time from an independent natural order.

Michael Ruse’s new book *The Philosophy of Human Evolution* is a historical and critical survey of the ways in which Darwinian thinking has clashed and interacted with the concerns of philosophers. Intended for a general audience, the book showcases Ruse’s manifold skills as a writer. His prose is lucid, straightforward, and colloquial. Each paragraph leads into the next with elegant coherence and no complicated impediments to the smooth flow of ideas. As might be expected from so brief and readable a book, there are no profound or subtle new ideas here; but most readers will bring away new facts and insights from this thoughtful little page-turner.

The beginning and end of the book deal with the history of ideas. They set forth Ruse’s incisive critiques of a huge array of questionable notions in evolutionary thought, including spandrels, constraints, memes, complexity, eugenics, evolutionary medicine, evolutionary psychology, and biological progress. The philosophy proper comes mainly in the middle of the book, beginning on page 66 with the question: is Darwinian theory real science? There are two main grounds for doubt. First, it seems trivially true to say that the fittest genes or organisms out-reproduce the others, because that’s what “fittest” means. Second, if explaining something scientifically means showing that it obeys a law of nature, then you can’t explain unique events (Hume 1748 [XI], 1825 [2]: 149–50); and many or most evolutionary events are unique. Ruse dispatches the first problem handily, but I thought he waved away the second too easily, by pointing to the astrophysicists’ supposed success in “explaining” the Big Bang. This confuses explanation with description. I’m inclined to stick with Hume on this one.

Ever since Plato, philosophers have been debating the meaning of the True, the Good, and the Beautiful. Ruse devotes his central chapters to trying to shed some Darwinian light on the first two. His chapter on “Knowledge” begins with some generally kind words for two related notions: the ideas that science progresses by a process analogous to natural selec-

tion, and that a lot of our intuitive “knowledge” (for example, our unshakable conviction that everything has a cause) is itself the product of natural selection. This latter idea is essentially Kant’s reply to Hume’s attack on induction, simplified and given a Darwinian spin. This move, however, runs into an objection urged by theists like Alvin Plantinga and CS Lewis: if our faculty of reason was bestowed on us by an age-long baby-making contest rather than by God, there are no grounds for assuming that it works to ensure true conclusions—only larger numbers of babies. Ruse evades the dilemma by invoking a pragmatic theory of truth (truth is whatever works), but he ultimately ends this chapter with a question mark.

Ruse begins his next chapter, “Morality,” by recounting the ideas of Darwin and his successors about the origins of altruism in animal and human societies. He has some properly scathing things to say about the sorry history of Social Darwinism, from Herbert Spencer down through the National Socialists. He reports happily that Social Darwinism evaporated after World War II and is, “one can say with some relief, no longer fashionable” (p 165). I would imagine that Ruse wrote those comforting words before the 2012 Presidential election campaign got into full swing. Unfortunately, the notion that the undeserving poor must not be succored lest they drag down the successful is alive and vital in American politics.

Ruse has little patience with evolutionary ethicists who define virtuous impulses as those favored by natural selection. Probably most philosophers today would agree that David Hume slammed the door in 1740 on all such attempts to reason from “is” to “ought”—from the way things are to the way we ought to behave. But then how *can* we determine how we ought to behave? Ruse thinks that Darwin and Hume can be reconciled to yield an answer. As Hume wrote, “Our sense of duty always follows the common and natural course of our passions” (Hume 1740:2[1]:484). Thanks to Darwin, we now know that those passions—our instinctive sense of justice and fair play, our love for our families, our bodily perceptions of pleasure and pain—are part of our biology and the product of evolution, and our sense of duty arises from them naturally.

Fine: but where is the “ought” in all this? It won’t do to say, as Ruse wants to say, that we just naturally avoid acting wickedly because we are not psychopaths. (No doubt we ought to, but in fact people exhibit an impressive capacity for unrepentant wickedness.) Something more is needed to lend moral force to our shared natural preferences. I think the “something more” here is logic. Ultimately, moral reasoning has to incorporate something like the Golden Rule—the principle that you should act towards others as you would like them to act toward you—as a self-evident premise. I suggest that this axiom of moral reasoning derives at least partly from the operations of syntax, which allows us to put ourselves in another’s place by switching the pronouns around (Cartmill 2006).

For some reason, Darwinians (including Ruse) are reluctant to admit the compulsions of logic as an independent influence on human behavior. Logic, Darwinians like to think, has to be what it is for some practical reason grounded in natural selection. But Ruse admits that this is a tough proposition to swallow when it comes to the self-evident truths of mathematics—for example, Euler’s famous equation $e^{i\pi} = -1$, which he considers “one of the most beautiful things ever encountered by humankind” (p 182). It’s hard to see this equation as a fact about human genes.

Whatever you think of Ruse's conclusions about the Good and the True, he has done a wonderful job of covering and evaluating a huge range of important ideas about the political, ideological, and philosophical implications of Darwinian thought in this short, easily read book. His errors of fact are few and minor. I wish he had gone on to deal with the Beautiful—Darwinians have never had anything very plausible to say about esthetics—but you can't have everything. This book gives us more than we have any right to expect in its brief span of 245 pages of text.

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ABOUT THE AUTHOR

Matt Cartmill has published more than a hundred scholarly and popular works on the evolution and functional anatomy of people and other animals, and on the history and philosophy of evolutionary biology. His writings include the award-winning book *A View to a Death in the Morning* (Cambridge [MA]: Harvard University Press, 1996), a history of Western ideas about hunting and human origins. The recipient of numerous awards for his research, writing, and teaching, Cartmill is a Fellow of the American Association for the Advancement of Science, a 1985 JS Guggenheim Fellow, the former President of the American Association of Physical Anthropologists, a founding editor of the *International Journal of Primatology*, and the former editor-in-chief of the *American Journal of Physical Anthropology*. His research interests include primate origins and phylogeny, systematics, cranial morphology, and the functional anatomy and evolution of bipedal and quadrupedal locomotion.

AUTHOR'S ADDRESS

Matt Cartmill
Department of Anthropology
Boston University
232 Bay State Rd
Boston MA 02215
cartmill@bu.edu



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REVIEW

Children of Time: Evolution and the Human Story

by Anne H Weaver, illustrated by Matt Celeskey

Albuquerque (NM): University of New Mexico Press, 2012. 192 pages

reviewed by **Holly M Dunsworth**

Fossils are kid business, fickle forgotten by grown-ups who've glommed on to money, wine, and weed-whackers. So, if you're a grown-up who's wondering why someone who's (a) not a kid and (b) not a kid's book author is reviewing a kid's book, then please consider what I do as a paleoanthropologist. Anne Weaver's *Children of Time* just happens to be the first material I've professionally reviewed that's honest about whom the scientific study of human origins and evolution is actually *for*: the kids and the kids-at-heart of the world. And this book nails it. You should read it. But because I can't submit a mere paragraph to the editor, and because many of you may want to know *why* I recommend the book, then I'll offer up my evidence.

Each of the six chapters of *Children of Time* can stand alone as its own short story in which we're playing, eating, nesting, socializing, learning, creating, inventing, and navigating right alongside a young hominin at a particular time and place in our evolutionary history. The first chapter follows a present-day boy's archaeological work at a Clovis site in the American Southwest. In it, Weaver cleverly builds interest for the rest of the chapters by establishing how we learn about past humans, and other ancient creatures, through the clues they leave behind. Chapters 2–6 are arranged in chronological order—from 2.5 million years ago to 26 000 years ago—but can just as easily be read in any order.

The first fossil hominin story, chapter 2, is set in South Africa and is all about a few days in the life of the “Taung Child”—the first *Australopithecus* fossil ever discovered and one that's still famous because the face and brain cast are beautifully preserved. Then in chapter 3 we're sucked into the life of a *Homo habilis* kid known as “Jonny's Child” or Olduvai Hominin 7, who belongs to the first species to which paleoanthropologists confidently attribute stone tool manufacture. These first two hominin stories have little or no dialogue, so they're just begging to be animated—acted out in a classroom or reading group with a narrator directing the characters' actions.

In chapter 4, we join the Nariokotome (or “Turkana”) Boy as he plays with friends and forages, and we listen as he speaks with a primitive language that's quite appropriate for *Homo erectus*. Following that, in chapter 5, we're wrapped up in a story about Neanderthals, based mostly on finds from Amud, Israel, and it's followed in chapter 6 by a culturally rich and engrossing tale about modern humans, based mainly on finds at Dolní Věstonice in the Czech Republic.

Children of Time is appropriate for all ages except perhaps the youngest readers. Beginners will need to be read to, and one chapter is a good length for one sitting. Somewhere

around third or fourth grade, youngsters may be able to handle this book on their own. The vocabulary is challenging but not unconquerable for amateurs. There's a glossary, but it's restricted to the paleoanthropological terms. Each chapter is concluded by a few pages called "The science behind the story" where the physical evidence that inspired Weaver and Celeskey's imagination is explained. These digests are well-researched, thorough, and engaging, considering the tough (fictional) acts that they follow.

Reading this book does bring to mind a significant problem with how human evolution is portrayed. It's a systemic issue that's not at all fairly blamed on a single representation such as this high-quality book, but we do need more depictions of human evolution to include dark-skinned *Homo sapiens*. Too many of these journeys through hominin evolutionary history cap a long sequence of dark-skinned primitive hominins living in Africa with "modern" light-skinned people living in Europe. It's an understandable bias based in the biased fossil and archaeological records—we have more well-preserved and exciting Later Stone Age (Upper Paleolithic) sites in Europe than anywhere else—but this habit has got to be supporting the misconception that racism is inherent in human evolution.

Certainly a refreshing achievement of *Children of Time* is the lack of anthropomorphization with the earliest hominins (*Australopithecus* and early *Homo*). Weaver and Celeskey created alien yet familiar creatures—deftly drawing on ape and human behaviors and traits—which are captivating to the bone. So even without their "full" humanity it's difficult when those creatures die. Yes, parents and teachers beware: Young hominins actually die in this book. Now, I've read more macabre children's books than this (such as Maurice Sendak's *Outside Over There* [1981]), but none in which kids die. To Weaver's credit, it's terribly hard, and actually deceitful, to avoid death when you're dealing with fossils. That's how they got that way! Kids who are turned on to paleontology, the ancient past, and evolution in general are probably primed already. The rest of us softies could probably use a firm, "Madame, all stories, if continued far enough, end in death, and he is no true-story teller who would keep that from you" (Ernest Hemingway, in Phillips 1984:26).

At the root of every book review is the question, is it a good book? One way to find out is to see if it transports you to a new universe that's mapped out in some fresh corner of your mind in ever-increasing detail and depth as you turn each page. With colors, textures, odors, and myriad sounds, Weaver guides the reader through this new universe. No film, television program, museum exhibit, "grown-up" pop science book, novel, and not even my own imagination while I lurked inside a spectacularly painted Paleolithic French cave has conjured living dying laughing crying hominins like *Children of Time* does. Adult-oriented science writers are adopting similar use of "narrative, scene and storytelling to engage and inform readers" (as a recent NSF-supported science writing program describes it: <http://thinkwritepublish.org/>), and after reading *Children of Time* it's clear that this strategy is a good one.

Fossils are a child's gateway to science. For that quality alone *Children of Time* is a significant contribution. But fossils are more than makers of science-mindedness and scientists. Hominin fossils embody our connectedness to past organisms and, by extension, to all those we share the planet with presently. If you don't read Weaver's book to experience a vivid hominin fantasy, if you don't read it to share our evolutionary history with kids, then

just read it for the same reason you read others': It's a window into one human's view of humanity and sharing those perspectives, those stories, is the essence of being human.

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ABOUT THE AUTHOR

Holly M Dunsworth is Assistant Professor of Anthropology at the University of Rhode Island. She studies monkey, ape, and human evolution through fossil, anatomical, and metabolic evidence.

AUTHOR'S ADDRESS

Holly M Dunsworth
Department of Sociology and Anthropology
University of Rhode Island
507 Chafee Building
10 Chafee Road
Kingston RI 02881
holly_dunsworth@mail.uri.edu



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REVIEW

DNA USA: A Genetic Biography of America

by Bryan Sykes

New York: WW Norton, 2012. 320 pages

reviewed by **Anne D Holden**

Bryan Sykes has spent his career weaving together the story of human history with DNA. His many works—beginning with his 2001 bestseller, *The Seven Daughters of Eve*—have introduced readers to the history of our humanity hidden within the human genome. And while he has largely focused his efforts on Europe, Sykes crosses the Atlantic this time around, putting together what he calls “a genetic biography of America” in *DNA USA*.

The past three decades have been witness to a fundamental change in how scientists study human origins. In 1982 a team of geneticists found that DNA extracted from people alive today could be used to trace the origins of our species. They focused on a type of DNA called mitochondrial DNA. Unlike the 23 pairs of chromosomes that we inherit from both our parents, mitochondrial DNA is only passed down from a mother to her children. The scientists reasoned that they could compare small genetic differences—called mutations—in the mitochondrial DNA of people worldwide and use those to construct a “family” tree of our species.

These revolutionary techniques began to transform the fields of anthropology and archaeology. Many scientists shifted their focus from the field to the lab. And Oxford geneticist Bryan Sykes was smack dab in the middle of it. He spent the final decades of the 20th century exploring the genetic history of humans through their maternal ancestry.

But your maternal ancestry—as viewed through the lens of mitochondrial DNA—is just one branch of your family tree. And the last ten years have seen major advances in technology that allow us to examine the entire human genome for clues into genealogy. Prompted by these advances, Sykes ventures across the Atlantic to piece together the complex genetic history of America.

DNA USA begins with an examination of the various ethnicities that make up America, including American Indians, Eastern European Jews, and African Americans, among others. His discussion of each group is accompanied by a review of previous research—archaeological, historical, and genetic—that has helped to shape our understanding of its genetic and cultural makeup. Spaced throughout this examination are chapters that explain the science behind genetic ancestry, as well as the growing popularity of using genetics to trace one’s more immediate ancestors, a field known as “genetic genealogy.”

This is where Sykes excels. His chapter on the earliest arrival of humans to North America—whose descendants would come to be known as American Indians or Native Americans—is compelling, as Sykes brings to life these hardy people who made the trek—by

boat or by land or a combination of both—into North America. His descriptions of the genetic histories of both Eastern European, or Ashkenazi, Jews, and African Americans are equally thoughtful and heartfelt. And while there are some scientific inaccuracies (a curious diagram of a maternal genetic tree of Africa is taken from a scientific paper that is woefully out of date), Sykes has an uncanny ability to take facts that would otherwise seem dull—a detailed history of the first stone tools to arrive in America—and make them shine.

The next section, however, is where the narrative begins to falter. Here, Sykes embarks upon a journey to collect DNA samples from a small group of Americans—each representing a distinct American region—to paint a complete genetic picture of modern-day America.

Sykes explains that this trip, unlike his previous research trips, would not be meticulously planned or data driven. Instead, he would let this one “be guided by chance events from the start.” Unfortunately for the reader, however, this translates to a rambling and somewhat confusing journey. Sykes dedicates so much time to his travel diary that one cannot help but wonder whether he is trying to channel the travel writer Bill Bryson.

Sykes planned to run his samples through a type of DNA analysis developed by the Mountain View, California-based genetic testing company 23andMe. Called an “ancestry painting,” the analysis examines all 23 pairs of chromosomes and puts different chromosome segments into three color-coded categories: African, Asian (which includes Native American), or European. Sykes’s hope is that he can then use this data to paint a complete genetic portrait of each individual tested.

Sykes begins his journey in Boston, collecting samples from members of the New England Historical Society. For reasons not clearly explained, Sykes lets each individual tested choose a celebrity pseudonym, such as Betty White, Clark Gable, and so on. This adds a layer of confusion to the project, as the ethnicity (and even the gender) of the individual does not necessarily match their celebrity pseudonym: the individual referred to as “Johnny Depp” is female, for example.

Sykes continues making his way across the country—Chicago, Wyoming, Utah—all the way to San Francisco. Among his stops is the genetic genealogy company Family Tree DNA in Houston, which sounds particularly interesting, but he never really explains the purpose of his visit there. And throughout his travels, his observations about America and Americans—including the current political landscape—seem juvenile and simplified, especially for an American audience.

In the final section, Sykes visits with each individual and shows them their test results. Are they surprised when they find something unexpected—such as a piece of DNA that traces back to Africa when their family tree is strictly European?

The answer is, unsurprisingly, yes. But here is where the reader is shortchanged. We are given no answers as to the reasons for these surprising results (a history of slave ownership? a family story that hinted at an interracial relationship?) But most significantly, the reader is not given any insight into what the test results mean in the larger context of the genetic biography of America. And given that “A Genetic Biography of America” is the book’s subtitle, this represents a severe oversight.

The second half of *DNA USA* is disappointing overall. The reader has just spent the last few hundred pages following along with Sykes's meandering—and somewhat confusing—journey, receiving no satisfaction of understanding the true genetic makeup of Americans. Sykes notes at the end of his last chapter, “my hope is that you will come away with feeling that you have glimpsed another world.” And indeed that is all the reader gets—just a glimpse. A disjointed, rambling glimpse into the genetic history of America.

ABOUT THE AUTHOR

Anne D Holden is a PhD-trained science writer with a background in genetic anthropology and human evolutionary biology. Now a Communications Officer at the Gladstone Institutes in San Francisco, she previously worked for NCSE and 23andMe.

AUTHOR'S ADDRESS

Anne D Holden
c/o NCSE
PO Box 9477
Berkeley CA 94709-0477
info@ncse.com



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REVIEW

The Fossil Chronicles: How Two Controversial Discoveries Changed Our View of Human Evolution

by Dean Falk

Berkeley (CA): University of California Press, 2011. 259 pages

reviewed by **Andrew Kramer**

This book, written by one of the field's leading authorities on hominid paleoneurology (the study of human brain evolution), offers a provocative inside look at the past and present "paleopolitics" surrounding two of the most significant fossil human discoveries made over the past century. The author's intent is to flesh out the personal dimensions of these controversies over human origins, to help the reader understand the nature of scientific disputes, and to convey the excitement of discovery in both the field and the lab. She succeeds admirably on all three fronts. The "stars" of her book are the "Taung baby," the first australopithecine ("ape-man") fossil discovered in South Africa in 1924, and the "Hobbit," representing a remarkably unexpected miniature human species discovered on the Indonesian island of Flores 80 years later. Falk's expertise in paleoneurology provided her entrée into conducting original research on both specimens' brain-casts, and these first-hand accounts provide credibility to her story-telling and interpretations that readers should find engaging and compelling.

The structure of the book is broadly chronological, with the first four chapters devoted to the history and interpretations of the Taung specimen, followed by five final chapters focused on the Hobbit. There are several themes that bind the narrative into a coherent story, despite the eight-decade gap between discoveries of the two principal fossils. First, Falk draws convincing parallels between the scientific establishment's resistance to the initial interpretations of the discoverers of the Taung baby and the Hobbit. Ultimately, however, Falk argues that the original ideas put forth by the scientists who announced these fossils to the world were vindicated by further research and discoveries. A second commonality of the two histories was the very strong reactions engendered by these fossils among anti-evolutionists, demonstrating that religious fundamentalist opposition to human evolution may have become more sophisticated in recent years, but has not lessened in its intensity over the past century. Finally, Falk's own research on the brain casts of these fossils revealed surprising and heretofore unpublicized similarities between the two, giving the reader a personalized insider's account of the controversies surrounding these fascinating hominid specimens.

Raymond Dart announced the Taung baby in the pages of *Nature* in 1925 and claimed that it was a human ancestor, but his interpretation was roundly rejected by the "powers that be" of the time. His recently deceased student Phillip Tobias (revered as the dean of South African paleoanthropology) provided four reasons why Dart's conclusions were not accepted: (1) Asia was thought to be the cradle of human origins (it isn't), (2) large brain size was

thought to have evolved first (the Taung baby's brain was ape-sized), (3) the fossil's human-like features were attributed to its immaturity (apes get more ape-like as they grow older), and 4) the Taung fossil was thought to be geologically too young (it's not). A fifth reason that both Falk and I consider at least as important as the other four was that the British scientific establishment already had a big-brained, more ancient (so they thought) English "fossil" (the Piltdown hoax) that they much preferred as an ancestor over Dart's more ape-like Taung baby from the hinterlands. A vocal minority of current paleoanthropologists echo the early-twentieth-century British naysayers by claiming that the Hobbits of Flores also contribute nothing to our understanding of hominid evolution. Ironically, even though the Hobbit's brain is similar in size to the Taung baby's, these scientists do not portray the Hobbit as an aberrant little ape, but rather as a pathological modern human afflicted with a number of possible congenital disorders (including microcephaly, Laron Syndrome, and cretinism). Falk recounts how subsequent discoveries of australopithecines in South and east Africa and the unveiling of Piltdown as a hoax ultimately proved Dart right. Similarly, the claims of pathology for the Hobbit have been rejected one by one by scientists working on the fossils (including Falk), and today most paleoanthropologists agree that the Flores hominids are a truly unprecedented new species (*Homo floresiensis*) that survived into modern times (as recently as 18 000 years ago) on that isolated southeast Asian island.

Falk ties the announcement of the Taung baby in February 1925 to one of the landmark events in the battle between evolution and creationism: the Scopes "Monkey Trial". She points to a New York news story that linked the discovery of the Taung baby to the hastened signing into law of Tennessee's anti-evolution bill in March of that year, followed by the infamous summer trial in Dayton. The worldwide multimedia blitz that broadcast the discovery of the Hobbit in 2004 once again galvanized the anti-evolution movement in the United States. Interestingly, these reactions either echoed those against the Taung specimen (claiming that the Hobbit was a member of a fossil ape species that has nothing to do with us) or agreed with the scientists promoting the pathology explanation (claiming that the Hobbit was a diseased modern human and so irrelevant to any claims that human evolution has occurred).

Falk's narrative is most effective and affecting in the descriptions of her individual and joint research on the brains of the two stars of her book. Discussing her work on the fossils and archival material, Falk reveals startling parallels between the brain-casts of the Taung and Hobbit specimens, the fascinating details of which I will leave for readers to discover on their own. Falk effectively conveys the excitement of being invited to describe and interpret the Hobbit's brain-cast, and her subsequent accounts of how she and her colleagues accomplished their research richly and accurately provide the reader with an appreciation of scientific discovery. The human foibles of scientists are also starkly portrayed in her descriptions of the recovery of the Hobbit fossils and subsequent contestations over their access and stewardship.

In sum, Dean Falk has written a book on human evolution intended for an educated lay audience that hits the mark. Although it isn't without faults (too much detail on brain anatomy may prompt the average reader to skim or skip ahead), I was pleasantly surprised as a professional paleoanthropologist to learn a number of things I didn't know before reading this book. It is up-to-date, factually accurate (as best as I can determine), and adequately illustrated. I recommend it for readers of *Reports of the NCSE* and for my colleagues as well.

ABOUT THE AUTHOR

Andrew Kramer is Professor and Head of the Department of Anthropology at the University of Tennessee. He is a paleoanthropologist who has directed human evolution field work in West Java, Indonesia.

AUTHOR'S ADDRESS

Andrew Kramer
Department of Anthropology
250 South Stadium Hall
University of Tennessee
Knoxville TN 37996-0720



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REVIEW

The Leakeys: A Biography

by Mary Bowman-Kruhm

Amherst (NY): Prometheus Books, 2010. 181 pages

reviewed by Elizabeth J Lawlor

Grandpa was born and raised in Kenya, came of age with his friends in a secret Kikuyu ceremony, and, like them, lived on his own by age 14 in a mud hut he built himself (p 22). Grandma, who smoked cigars and had ramrod posture into her seventies, was “the most famous woman archaeologist in the world” (Morell 1995:536) and the disciplined scientist of the couple. They and their descendents endured scorching African summers, political upheavals, marital infidelities, and professional feuds, and discovered the earliest ape fossil known and at least eleven highly significant fossil finds of human ancestry. Today their dynamic young granddaughter continues the work in Kenya, piloting a bush plane and raising her own children in the field.

How, then, is it possible to write a boring book about the Leakeys for middle-school students and their teachers?

Here’s how: start with generalities and don’t get into specifics until later; change topics mid-paragraph; frequently use the passive voice; precede quotations with the complete bibliographic citation; include plenty of peripheral details about history, and maintain a consistent, bland tone. This formula makes *The Leakeys: A Biography* read like the plodding anthologies used as textbooks in many American middle schools.

These stylistic problems prompted my resident middle-schooler, an avid reader, to hand it back to me in less than two minutes, saying, “The topic is interesting, but the book isn’t. This is a lost cause. There’s no way any kid I know would even care about reading an anthropology book. And some would want to burn it because it’s about evolution.” (Yes, he really did say all that, and made me read it back to him for accuracy.)

Surely it’s a daunting challenge to engage young readers long enough to make headway against their preconceptions. Bowman-Kruhm deserves applause for making the attempt. And perhaps a book doesn’t have to be engaging to be a valuable reference for a science teacher or have a place in a school library. But a valuable reference does not have serious errors or provide erroneous definitions in its glossary. *The Leakeys* does.

In case any *RNCSE* readers don’t know, the Leakey dynasty started with Louis Seymour Bazett Leakey, the son of British missionaries and inspired, dogged hunter of fossil human ancestors and their tools. Mary (Nicol) Leakey, his second wife, was even more dogged, and she was the one who found *Proconsul* (the earliest known ape), *Paranthropus boisei* (originally “Zinjanthropus”, a member of a side branch of hominins specialized for chew-

ing dense foods), a *Homo habilis* adult and child, and the iconic footprints at Laetoli generally attributed to *Australopithecus afarensis*.

Louis and Mary's work together at Olduvai Gorge in Tanzania made the phrase "Oldowan tools" part of the vocabulary of every introductory class in archaeology and human evolution. And, of course, Louis jump-started the careers of Jane Goodall, Dian Fossey, and Birute Galdikas, who contributed much to our understanding of (respectively) chimpanzees, gorillas, and orangutans.

As if that weren't enough of a legacy, their middle son, Richard Leakey, has had a series of significant careers including wildlife conservationist, museum director, and politician. As a paleoanthropologist, he led teams that found fossils generally known by their specimen numbers, including KNM-WT 17000 (*Paranthropus aethiopicus*); KNM-ER 1470 (*Homo rudolfensis*); the diseased partial skeleton KNM-ER 1808 (*Homo erectus*); the nearly complete KNM-WT 15000, "Turkana boy" (also *Homo erectus*); and Omo 2, the oldest modern human. Richard's legacy also includes the training and recognition of African researchers as equals.

The dynasty doesn't stop there. Meave (Epps) Leakey, Richard's second wife, was the one who pieced together the 300 pieces of KNM-ER 1470, resulting in a credible reconstruction of the earliest truly large-brained hominin. Later she led the teams that found *Australopithecus anamensis* and *Kenyanthropus platyops*, the latter with their daughter Louise, a University of London PhD who now heads the Koobi Fora project in Kenya.

Were these tremendous contributions due to some "Leakey luck"? As Bowman-Kruhm points out (p 105–106), each of these successful paleoanthropologists had either an advanced degree or decades of field experience starting in childhood—or both. And with increased money, she notes, came increased "luck": Louis and Mary both marveled at their increased productivity once they started getting grant support for a staff.

The subjects of this book, then, are inherently interesting, but the book itself does not do them justice. *The Leakeys* opens promisingly with a quotation from *Indiana Jones and the Last Crusade* but immediately loses the momentum with these opening lines:

How and when did humans evolve? In paleoanthropology, a first cousin of archaeology that asks this question, facts are found in fossils. ... What facts about human origins do these fossils reveal? Dr. Richard Warms, anthropology professor at Texas State University – San Marcos and coauthor of *Anthropological Theory: An Introductory History* (McGee & Warms, 1996), explains, "All the evidence points to human ancestor divergence from ape ancestors between six [to] eight million years ago." (p 15–16)

Yawn. That's when my son handed the book back to me—three paragraphs before a Leakey is mentioned.

Yet the author clearly intends this to be a textbook for young readers. It was first published in hardcover in 2005 by Greenwood Press, an imprint specializing in reference books in the humanities for secondary schools through colleges (ABC-CLIO 2012). Prometheus Press has reissued it in paperback with a new cover photo and promotion as a biography for the general reader. But Bowman-Kruhm's website notes that she has authored "over 30 books for children and teens ... many [of which were] nonfiction educational texts"

(Bowman-Kruhm 2004–2009). And she occasionally connects her narrative with kids' lives by comparing stratigraphic dating methods to the process of making a peanut butter and jelly sandwich (p 107) and noting that Richard and his brothers grew up in Olduvai Gorge “without electronic games or even television” (p 81).

If *The Leakeys* fails as a compelling introduction for young people, does it at least deserve space in a school library as a reference book? Not if the librarian values accuracy. To her credit, Bowman-Kruhm cites an extensive list of sources and correspondence with Louise Leakey, and even traveled to Kenya to see the research in action. But without (apparently) a science background, she mixes up fossils and even gives the wrong definitions in the glossary of terms as central as “anthropology”. A science editor would have caught these in the manuscript or sent it out for peer review, but science is out of Greenwood's bailiwick. Unfortunately, the result damages the reputations of both publishers.

Sometimes it's just a matter of clarity. An otherwise exemplary summary of natural selection begins with “Evolution is not a theory in the sense that it is open to speculation. Change happens. Evolution happens” (p 32). Here Bowman-Kruhm misses an opportunity to clarify in what sense evolution is a theory: that scientists reserve the word “theory” for explanations with a solid foundation in fact and a track record of accurately predicting new results, such as when the Leakeys choose field locations based on known geological features.

Some of the errors seem to show poor reading comprehension. For example, in the passage about the *Homo erectus* skeleton called Turkana boy (KNM-WT 15000), Bowman-Kruhm concludes that his diet

must have included meat ... Alan Walker, then at Johns Hopkins University, showed clinicians at Johns Hopkins Hospital a slide of a section of leg bone. The clinicians identified death from hypervitaminosis A, probably from eating carnivore livers that contain huge amounts of vitamin A. They were astonished that the bone used for their diagnosis was from a child who died almost two million years ago rather than a recent death (Leakey & Lewin, 1993, p. 61). (p 125)

In fact, Walker's specimen was not from Turkana boy but from another partial skeleton, as the cited page makes clear: “1808 gives us a glimpse into the last weeks of life of a *Homo erectus* individual, possibly a female, who lived about the same time as the Turkana boy, but on the other side of the lake” (Leakey and Lewin 1993:61). The story continues with the Johns Hopkins doctors being astonished that the bone was “a million and a half years old,” not “almost two million years ago” and does not say that the “patient” was a child.

This level of faulty paraphrase makes me wonder what errors I missed in *The Leakeys*. One area rich in errors I did not miss was the paltry, two-page glossary (p 164–165), which includes misapprehensions including:

ANTHROPOLOGY: The science made up of the fields of geology (rocks, soil, minerals, etc.), archaeology (ancient cultures), linguistics (language), and ethnology (comparison of cultures). [Geology is a different discipline, in the physical rather than the social sciences. Furthermore, this definition omits biological anthropology, *the very topic of the book.*]

APE: Primate; chimpanzee, gorilla, or orangutan. [True but incomplete. Apes are relatively large primates with no tails and proportionately larger brains and shorter, stiffer spines than the others. The definition omits bonobos and the gibbon/siamang group.]

PALEONTOLOGY: The study of how early humans lived based on fossil evidence. [False. This defines “paleoanthropology.” Paleontology is a much wider field, including the study of ancient plants, insects, and dinosaurs, and usually is part of a geology department, which, as noted above, is not part of anthropology.]

PRIMATE: A member of the mammal family that includes humans, apes, and monkeys. [The order Primates, a member of the mammal class, also includes prosimians (such as lemurs). Characteristics that define the order include forward-facing eyes, opposable thumbs and big toes, and nails and sensitive pads in place of claws.]

Sprinkled throughout the book are other mistakes, perhaps minor to a general reader, but inappropriate for a book intended, in part, as a reference for school libraries. These mistakes include confusion of the terms “hominid”, “hominin”, and “hominoid” (p 164) and misspellings such as “orangutang” (p 164) and “Australopithicus” (photo caption on unpaginated plates between p 88 and p 89).

In sum, *The Leakeys: A Biography* is a nearly adequate, somewhat untrustworthy summary with an error-ridden glossary. The back cover includes tepid blurbs from two of its subjects (Louise Leakey and Nasser Malit, a young Kenyan post-doctoral student who had worked for Louise, p 156). When the most enthusiastic phrases in the blurbs say a book “well describes the personal story,” and is “condensed, but comprehensive” and “effective,” a prospective reader should know not to expect a compelling page-turner.

For an accurate, compelling page-turner about the Leakeys, Prometheus Books would do well to put Virginia Morell’s (1995) *Ancestral Passions* back into print. The field is still wide open for an engaging young-adult treatment of the quest to know our origins.

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ABOUT THE AUTHOR

Elizabeth J Lawlor is Professor of Anthropology at Mount San Antonio College. Her websites include the interactive “Evolution Mosaic” and the skeptic site “Incredible Anthropology!”, both available from <http://instruction2.mtsac.edu/elawlor>.

AUTHOR'S ADDRESS

Elizabeth J Lawlor
Department of Biological Sciences
Mount San Antonio College
1100 N Grand Avenue
Walnut CA 91789



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REVIEW

Sex, Genes, and Rock 'n' Roll: How Evolution Has Shaped the Modern World

by Rob Brooks

Lebanon (NH): University of New Hampshire Press, 2012. 322 pages

reviewed by **J Michael Plavcan**

Rob Brooks, an evolutionary biologist from the University of New South Wales, has written *Sex, Genes, and Rock 'n' Roll* as a popular book explaining how our understanding of evolutionary biology helps us understand human behavior. The goal of the book is laudable, but in reviewing it, I am torn between my support for books that convey why understanding evolutionary biology matters to us, and my desire to have books about science actually reflect the complex tapestry of science, and not simply use selected scientific findings to weave an entertaining story. Bad science can do more damage than no science at all.

The book tackles the evolutionary basis of three phenomena—obesity, human mating systems, and rock and roll music. With regard to obesity, the primary message is that we are adapted to regulating protein in our diets, and to eating as much food as we can because food tends to be limited for non-agricultural or industrial folks (our ancestors). As a result, we tend to eat too many calories from sugars and starches both because we like to store calories when we can, and because many of the carbohydrate-rich foods that we eat (especially for the poor) are relatively rich in calories but poor in protein. The treatment is superficial but amusing and clearly organized and articulated. Brooks asserts that an understanding of human evolution helps us understand our dietary problems (I agree), but in the context of what Brooks wrote, I could alternatively note that most of what Brooks looks at is simply physiology. He refers to the diets of our ancestors, but the fact is that we only know the diets of our ancestors in vague terms. How vague? There is currently a hotly contested debate about whether the robust Australopithecines ate hard or tough food objects—note that the debate never specifies what those were (not meat, probably). Richard Wrangham and his colleagues have argued that cooking changed human evolution. There is no argument that cooking is critical in human evolution since about 400 000 years ago or so, but the exact manner is hard to tease apart, and many assertions about the impact of cooking on social behavior and physiology have not been well received in the scientific community. Meat was certainly important, as inferred from the fact that we find a lot of evidence for hunting. How important? We cannot answer how much or what proportion of the diet meat comprised, how it was shared (if at all), who needed it most, who benefited most, or how our physiology was specifically adapted to eating meat. Any assertion to the contrary is just that—assertion. Maybe it makes sense, but making sense does not constitute hard data that supports further arguments. Apart from that, most of what we infer about our ancestral diet comes from the presumption that what a lot of marginalized

hunter-gatherers eat represents our natural diet. Maybe yes; maybe no. Caution is in order, but I found little caution or sense of uncertainty in the text.

The second part of the book discusses how evolution helps us understand human mating systems and mating patterns. This is an enormously complex and important topic (at least I think so, given my research background), but I am not really sure of what, exactly, Brooks wanted to convey. Humans pair-bond. Resources are important for females. Humans tend to be polygynous when males can accumulate wealth. Humans show some promiscuity, but extra-pair copulations tend not to produce too many kids. Humans tend to be serially monogamous. Males show off for mating opportunities. And so on, most of it mostly true. But three chapters left me feeling blank, because so much information was omitted, and what was presented left me with the feeling that the author read a few books and papers and then started talking. The sweeping explanation of the ancestral human mating systems (chimpanzee-like promiscuity) was based on arguments that many people have made, but left out is the often intense debate, wide variety of opinions, conflicting data, and alternative models. True, it is a popularization, and you have to simplify. But why not stick to one aspect, like the short human interbirth interval and how cooperative breeding is necessary to raise human kids? Or how about the role of mate guarding and mate acquisition in human male violence? We could fill whole popular books with these things, but the confused jumble presented here bounces around from point to point with no clear direction. And as for diet, at no point did I feel that he made a clear case that evolutionary biology has given us any greater insight than sociology.

The third part is about the evolutionary basis of music. This is fascinating stuff, but sadly, Brooks does a poor job of making his case. The basic message is that rock and roll is all about sex, and mate choice and acquisition. That's an interesting idea and would be cool if it were true. The evidence that is put forward is that teenagers like it, it makes a big impact on social development, and it centers a lot on sex. All true, but what about alternative ideas? How about socialization? How about coalition formation and conformation? How about neuro-sensory reactions to stimuli (I like red, but is that because I evolved a predisposition to be attracted to the color of an aroused female vulva)? No alternatives are considered, and I felt at times that Brooks presented a series of observations that seemed contradictory to the sexual selection hypothesis, and simply asserted that they support it. Science is all about trying to falsify hypotheses, not simply gathering up observations to support them and ignoring those that don't.

The problem with this book is a problem that dogs evolutionary psychology as a discipline. There is no doubt that our current minds and bodies are the product of evolution. But the science of studying human minds and bodies as products of evolution is difficult and slow. It is complicated. Many ideas that seem great turn out to be wrong. Studying humans is tough because variation in human culture and behavior adds a plethora of confounding variables that are difficult to control, because manipulating humans scientifically is difficult, potentially unethical, and even illegal, and because modern humans have dramatically altered their lives and environment to the point where arguably there are no humans on the planet that are living in a "natural" state unimpacted by modern industrial society. But these difficulties aside, the most problematic issue in evolutionary psychology is story telling. Evolutionary psychology has produced some good, thought-provoking, and useful work. But it is also rife with story-telling, and this book is a prime example. If you're writ-

ing a book like *Sex, Genes, and Rock 'n' Roll*, you take an idea, then make up a story. You in effect go back in time and write a script for a human ancestor and then create a history based on assumptions and assertions. Then you explain modern human behavior on the basis of the assumed story, weaving a complex tapestry, drawing support for each assumption and idea from some selected literature, but failing to actually consider alternatives, and the actual basis for the assumptions. Doing this is easy. All you do is read a few papers and books, construct the story, and publish.

Rob Brooks is a good writer. He conveys enthusiasm for the topic, and mixes some wit and banter in with a relatively lucid prose (that occasionally gets repetitive, though) to make a fairly easy read. The book will probably be well-received by a general audience, and Brooks has certainly made efforts to promote it in the media. I cannot argue with the need for books like this. Unfortunately, I would like to see a talent come along who can convey the core truth of science to the public without constructing imaginative but ultimately sloppy stories that are more akin to apologetics than to science.

ABOUT THE AUTHOR

J Michael Plavcan is Professor of Anthropology at the University of Arkansas. His research centers on primate and human evolution, with a special emphasis on using comparative analyses of living species to understand the morphology and adaptations of extinct species.

AUTHOR'S ADDRESS

J Michael Plavcan
Department of Anthropology
Old Main 330, University of Arkansas
Fayetteville AR 72701



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