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William H. Egberts examining trepanned skulls in the anthropology laboratory at the National Museum, 1926. Library of Congress LC-DIG-npcc-15637.

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FEATURE

My Niche in Human Evolution: 32 Teeth, Bony Eye Sockets, and No Tail!

Valerie First

I am a “street teacher”. That is my term for a teacher whose job involves talking with all people, every age, every level of education. Officially, I am a docent; but instead of walking around with a snake, for example, I introduce people to my collection of animal skulls from both living and extinct species native to our state of Florida when I set up shop at our local science center and at our zoo.

When I noticed no one was showing and discussing animal skulls at these locations, I asked if I could use my collection to help people explore animals from the past and present. People are attracted to my display by these bones, and in my discussions with them, I notice that most of them know little or nothing about any of these past animals.

I talk paleontology, touching on time, place, and anatomy. My basic talk starts with dinosaurs, and I emphasize that people were not around with the dinosaurs. Many people have no concept that dinosaurs have been gone for over 65 million years. They simply have so many misconceptions, and the lack of an accurate timeline is a key one.

Everybody loves to learn about dinosaurs, but they never lived in Florida because dinosaurs are land animals, and Florida was under water at that time. However, we did—and still do—have alligators, which are related to dinosaurs and go back to the time of dinosaurs (St John and others 2012). They are both fierce-looking diapsids, and I point out the two openings in the skull that they share (see a discussion of the anatomic and phylogenetic features of diapsids available from <http://www.ucmp.berkeley.edu/taxa/verts/diapsida.php>).

I move on to the mammals that lived right here in Florida until about 10 000 years ago—mastodons, saber-toothed cats, giant ground sloths, beavers, and dire wolves—and compare the single openings in the skulls of each mammal species (synapsida) to the two openings in the diapsid dinosaurs and alligators (see <http://www.ucmp.berkeley.edu/synapsids/synapsida.html>). The number and arrangements of these openings in the skull are two of the features that paleontologists use to trace common ancestry among the vertebrates, and we can see it right here in native Floridian species!

I point out that these species were here in Florida when there were people in this part of the world. Although most of these became extinct about 10 000 years ago, we do find these bones, these fossils, right here in Florida.

My collection of skulls includes past and present species of mammals. I also use shark teeth, to introduce the idea of the parts of the skeleton made up of cartilage. This is useful when the children ask why the animal skulls all seem to be missing part of their noses.

We compare these to a human skull, and they feel their own noses as we talk about that. Soon I am pointing out that all these animals share features: two eyes, a nose and a mouth ... just in different shapes.

Showing the features shared first by all vertebrates and then by all mammals, I point to a human skull and ask them to compare it with all the other animal skulls. Again, I repeat that they all have two eyes, a nose, and a mouth, but in slightly different shapes. I point to a bat skeleton and show how the skeleton resembles ours and those of the other vertebrates. I hear, “Oh, wow, cool!”

WHAT ABOUT HUMANS?

For a few years, I just talked vertebrate paleontology, without getting into human ancestors. Later, I was fortunate to be connected to someone who gave me a set of hominin skulls. Hm, I do remember hearing that it would probably not go over well to talk about evolution, being warned at least not to use the actual “e” word and definitely not to talk about humans in that context ... but the shared pattern of two eyes, a nose, a mouth, just different shapes were staring at me. I knew evolution—descent with modification—was the reason for this pattern.

Now, since it is the pattern of similarities and differences that gives us the details of evolution, I point out some things that humans have which none of the other mammals share. “We have 32 teeth as adults, and bony eye sockets. None of the other animals have bony eye sockets.” I point to all the animal orbits.

I pick up a monkey skull. “All true monkeys, from Asia and Africa, have bony eye sockets and 32 teeth.” I hear, “Wow, that is why they say we are related!” And then I say they have tails and I hear, “Oh.” When I show the skulls of the apes—gorillas, chimpanzees, orangutans, and gibbons—pointing out that they have bony eye sockets, 32 teeth, and no tails, I hear, “Oh, wow, really? I didn’t realize that. So that is why they say we are related.” Yes, we are related to *all* animals, but by various degrees of closeness.

Next I show several ancestral hominins—*Australopithecus afarensis*, *Australopithecus africanus*, *Homo habilis*, and *Homo erectus*—mentioning the earliest of these lived over 3.5 million years ago. They all have bony eye sockets, 32 teeth, no tail, and they all walk on two legs. As I am saying this, I point to the 10-cm toy models of each hominin species I have displayed. A smile comes across their faces as they say, “Wow, that is so cool! That is evolution! I understand it now! No one ever explained it like that before.” I have had people tell me they have been to museums with human origin exhibits and had courses in high school but said no one ever explained it like this so they could “get it”.

I keep it simple. I show these few similarities that are easily observed but are dramatic in their simplicity. I do show other characteristics and explain more as I respond to visitors’ interest or answer their questions. Sometimes I talk about other cranial and postcranial bones; sometimes the question is more like “so why do they have bony eye sockets?”

Of course, these species are not native to Florida. In this part of the world, we only have had *Homo sapiens*. Maybe that adds to the confusion. They have no idea that the australopithecines lived in Africa over 3 million years ago, and that all humans, including the

indigenous peoples that they know as “Indians” or Native Americans, migrated all over the world from those African populations.

LINGERING QUESTIONS

This is new information to many visitors: both the comparison of the anatomy of the skulls and the explanation of how this verifies an evolutionary pattern. A few are slow to accept it and tell me that they are confused, not sure. They may say that they believe in God so they think that is in conflict with evolution. I stop them there and say that many denominations find that faith and science—including evolution—are compatible and they address separate issues: how things work and how one conducts one’s life.

I field all sorts of questions, and I listen and respond. Most are just talking points that they have heard which they think challenge evolution: “Carbon-14 dating is not accurate.” Or “Why are there still monkeys?” I explore the question with them and provide a factual answer based on scientifically validated principles, and then they feel more confident in their understanding. I have answered questions that might have been restraining them from fully accepting evolution.

Of course there are visitors who will not be persuaded, and their questions are not really an effort to understand evolution. I will talk with them if they will talk with me but my main effort is devoted to the bulk of the people who have no understanding of evolution and deep time. Part of my success in promoting evolution is that I listen to the visitors’ questions and use them to focus my explanations. New encounters bring new questions that I can use to build better explanations in the future.

And so this is the niche I have built: to use visitors’ interest in extinct animals and draw them to my collection of skulls to present evolution in a way that it is “discovered” by the audience. The discovery leads to more questions, and I have additional materials on various aspects of evolutionary change: neoteny, epigenetics, homology, evo-devo, genetics, embryology, and more. The interaction with the visitors is “organic” and is shaped by their interests and questions as they explore the raw material that helps us to understand evolution. My presentation is informal and non-threatening, and the responses I receive are rewarding and positive.

The situation may be unique, but the niche exists in many places around the country. I hope that others will find this niche and use it, and that it will be a way to strengthen science education and scientific literacy more generally.

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Valerie First shares her vertebrate skull collection at the Central Florida Zoo and Botanical Gardens, in Sanford, Florida, and the Orlando Science Center. She earned her BA degree from the University of Florida and is a member of the Florida Fossil Hunters, Tampa Bay Fossil Hunters, the Florida Paleontological Society, and the Society of Vertebrate Paleontology.

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FEATURE

People and Places: Carl Akeley (1864–1926)

Randy Moore

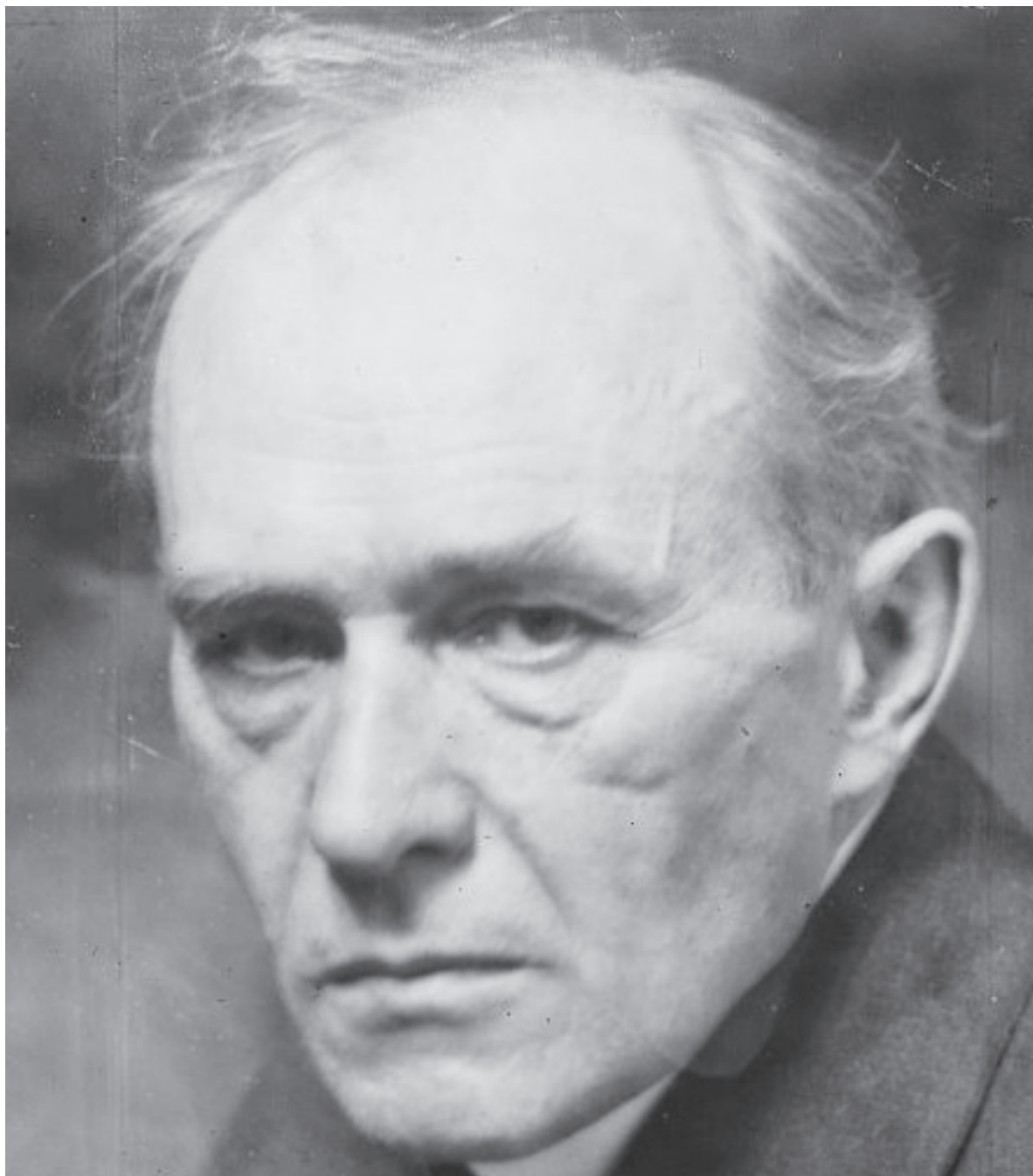


FIGURE 1. *Carl Akeley. Undated; Library of Congress LC-DIG-ggbain-37036.*

Carl Ethan Akeley (Figure 1) was born on May 19, 1864, in Clarendon, New York. He attended school for only three years, but became famous for inventing a new type of taxidermy to preserve and display animals. Whereas taxidermists before Akeley stuffed skins with cotton and straw, Akeley built carefully measured models, over which he stretched the animal's skin. The so-called "Akeley Method" revolutionized exhibits at museums, and brought distant, unimagined animals to life for the viewing public.

Akeley's career started with stuffing his neighbors' pets. However, in 1883, he began working at Ward's Natural Science Establishment (a biological supply company) in Rochester, New York, where he helped mount PT Barnum's famous elephant Jumbo, which had died in a circus train accident. (Akeley's model of Jumbo went to Tufts University, where it was the school's mascot until it burned in 1975; Jumbo's bones remain in the American Museum of Natural History.) Akeley then worked at the Milwaukee Public Museum, where in 1890 he helped to create the museum's first habitat diorama. At Chicago's Field Museum, Akeley further developed his new taxidermy techniques. His method soon became the standard at most major museums.

Later in his life, Akeley later turned his attention to saving wild gorillas and was the first to film gorillas in the wild. Today, Akeley's work is displayed in the Akeley Hall of African Mammals at the American Museum of Natural History, an exhibit considered to be among the world's greatest museum displays.

In 1924, Akeley sculpted *The Chrysalis*, a bronze sculpture that depicted a human emerging from the cracked-open skin of a gorilla. The sculpture depicted his feelings of kinship with animals; he knew that humans had not literally sprung from gorillas, but understood that they shared a common ancestor (Bodry-Sanders 1998). *The Chrysalis*, in which humans' ascent replaced a primal fall, was commissioned for New York's West Side Unitarian Church, and its display there outraged many creationists.

Akeley died of dysentery in the Congo while collecting for the American Museum of Natural History on November 17, 1926, ten years before the completion of the Akeley Hall of African Mammals. He was buried in a place depicted in the Hall's famous Gorilla Diorama. During 1979's hostilities between gorilla poachers and Dian Fossey, Akeley's grave was vandalized and his bones removed. Some were later recovered, and his memorial was later repaired by Penelope Bodry-Sanders, Akeley's biographer. The Carl Akeley Award is given annually to the world's top taxidermists.

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REVIEW

Marketing Intelligent Design: Law and the Creationist Agenda

by Frank S Ravitch

New York: Cambridge University Press, 2011. 360 pages

reviewed by **Tim Beazley**

In this very informative book, legal scholar Frank S Ravitch argues that the “intelligent design” movement (IDM) is not really a serious attempt to advance a scientific alternative to evolutionary science, but rather a slick marketing plan designed to evade the judicial interpretations of the First Amendment’s Establishment Clause that prohibit religious proselytizing in public elementary, middle, and high school science classes.

Judicial decisions interpreting the Establishment Clause are all over the map, so evaluating the constitutionality of the IDM’s various approaches is fraught with peril, but as Ravitch points out, there are at least some reasonably well-established judicial guidelines that can get one started in the analysis. Ravitch describes some of the most important tests that courts use in deciding Establishment Clause cases, including the three prongs in the Lemon test requiring that government enactments have a secular purpose, have a primary effect that is secular, and avoid excessive entanglement with religion, and two important, post-Lemon refinements: the endorsement test, which prohibits enactments signaling that adherents of religion are insiders, that is, favored members of the political community, and that non-adherents are outsiders; and the coercion test, which prohibits enactments directing the performance of religious exercises, such as prayers at high school graduations, where even persons who object to the exercises are effectively compelled to participate.

In detailed analyses applying those judicial guidelines to various IDM proposals, including affirmatively teaching ID in science classes, using disclaimers to denigrate evolution in science classes or textbooks, teaching so-called “weaknesses of evolution”, and “teaching the controversy”, Ravitch concludes that probably none of the proposals passes constitutional muster, though “teaching the controversy” may be a somewhat closer call.

Besides its religious implications, the IDM’s proselytizing may also raise free speech issues, such as equal access to public forums and funding, viewpoint discrimination, and academic freedom. Ravitch shows that analyzing those issues requires careful consideration of the facts, because radically different results can follow from seemingly small differences in the facts, such as whether the issue arises at the high school, college, or graduate school level. Ravitch discusses the IDM’s frequent claims of discrimination, judging them to be highly effective marketing ploys despite generally being substantively void.

Constitutional analysis frequently includes historical and philosophical matters. Ravitch briefly sketches the history of creationism from earlier times, when the existence of a cre-

ator did not need to be proved but was simply assumed and openly admitted, to *Edwards v Aguillard*, the 1987 Supreme Court case which effectively barred theories assuming the existence of supernatural creators from being taught in public high school science classes, and thus motivated the modern IDM's claim that the existence of a designer, whose identity is widely known but seldom openly admitted, can be proven scientifically. Ravitch argues that making the move from religious assumption to scientific conclusion requires ID to play the "proof game," a game for which ID is poorly equipped.

Establishment Clause cases in this area require courts to distinguish science from religion. ID proponents argue that unfavorable court rulings here are misguided, because philosophers of science indicate that making such distinctions is impossible, but Ravitch responds that philosophers and courts are not really addressing the same problem. In effect, ID proponents are confusing philosophical apples with judicial oranges.

Ravitch also argues that the IDM's attempt to change the definition of science to include ID relies on concepts of relativism that are radically inconsistent with the IDM's core views about absolute truth. Of course, marketing ploys need not be consistent.

Ravitch thinks that ID feeds on the entirely erroneous belief that evolution is inherently incompatible with religion. The existence of theistic evolution exposes the error in that belief, and yet the belief is reinforced, ironically enough, by some of evolution's most prominent advocates, who also happen to be proselytizing atheists. If only atheistic and theistic evolutionists would join forces on "mere evolution" just as young-earth and old-earth creationists have joined forces on "mere creation"!

Overall the book is excellent, but I have some minor complaints. Many citations are to secondary sources, and many citations to books don't include page references, making it difficult to check sources or do additional research. Ravitch also expresses some possible sympathy for Guillermo Gonzalez but cites no sources for the alleged factual basis for that sympathy. Finally, Ravitch suggests it might be unfair to accuse ID proponents of dishonesty even though many of their claims are demonstrably misleading, because ID proponents may feel that their deceptions serve a higher purpose. That's a remarkably tolerant position. Staying with Ravitch's marketing theme, false advertising is still an actionable offense. And school children deserve better than ID's version of Joe Isuzu in any case.

Quibbles notwithstanding, however, anyone interested in the constitutional issues that the IDM raises would find this book very helpful.

ABOUT THE AUTHOR

Tim Beazley is a retired lawyer. He worked for the US Army for eighteen years, mostly in Europe, in a variety of fields, including administrative law, criminal law, legal assistance, and torts.

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REVIEW

Evolution, Creationism, and the Battle to Control America's Classrooms

by Michael Berkman and Eric Plutzer

Cambridge: Cambridge University Press, 2010. 304 pages

reviewed by **George F Bishop**

Who should decide what students are taught about the theory of evolution and its so-called alternatives in American public schools? This is the normative political question that sets the foundation for the two big research questions that Berkman and Plutzer address in this innovative investigation: (1) How is education policy made in each of the fifty states? and (2) How is policy actually implemented in each of the thousands of individual classrooms? Anyone who wants to know or ought to know the answers—especially legislators, members of local school boards, public administrators, school superintendents, principals, and biology teachers—should read what is easily the most comprehensive and definitive study to date of what goes on behind those closed classroom doors. Yes, there have been other studies of what is being taught about evolution in public school science classrooms, but none of them was conducted at a national level. Berkman's and Plutzer's NSF-funded inquiry is the first national survey of its kind, based on a scientifically representative sample of over 900 public high school biology teachers in the spring of 2007. So their results can be generalized, nationwide, with a high degree of statistical confidence. How often do we get to say that about the views and behavior of American biology teachers? Virtually never.

So what's in it for the reader? What follows is intended to provide a little flavor of the chapters in the book.

Chapter 1 takes on the basic normative question: Who should decide what children are taught? Our democratic political culture, as Berkman and Plutzer put it, tells us "... *the people* should decide what shall be taught in publicly funded schools" (p 8, emphasis in original). That's what William Jennings Bryan argued in the Scopes Trial, and that principle of majority rule is still very much with us today. But as Berkman and Plutzer remind the reader, there are sound alternatives to this simplistic majority rule principle. To begin with, the First Amendment of the US Constitution safeguards our civil liberties against arbitrary majoritarianism and prohibits the making of any law "respecting the establishment of religion." Another alternative to simple-minded popular sovereignty is to recognize, as the authors note, that school teachers are professionals who should have the *academic freedom* to use their best judgment about what needs to be taught regarding the theory of evolution. With this perspective as background, the authors discuss the creationism/evolution culture wars today and how they have evolved over time, tracing them from the days of the Scopes trial to *Epperson v Arkansas* to *Edwards v Aguillard* to *Kitzmiller v Dover*. They tell the reader, too, how the "standards and assessment movement" in American education has now opened the door for advocates of "intelligent design" (ID) and other

forms of creationism to smuggle their wares into the classroom under the guise of “equal time” and the like. But the courts, as Berkman and Plutzer point out, have greatly limited such unconstitutional maneuvers, so much so that they contend “there is not a single state in which the official state policy, as reflected in state science standards, fully reflects the wishes of the majority of citizens” (p 27). This leads them to conclude that there is a significant gap between public opinion (what the people want) and public policy (what the people get). There, I part company with them, but more on that in a bit.

In chapter 2, the authors’ comprehensive analysis of public opinion polls on teaching evolution and creationism lead them to conclude that the public wants to “teach both”:

... there can be no doubt that the large majority of Americans want creationism taught in the public schools. A large plurality of this group wants creationism taught *as science and in science classes*, whereas others apparently would be satisfied to see some ideas of creationism validated by their discussion as a religious perspective or belief. But current legal decisions rule out *all* such possibilities. (p 62, emphasis in original)

So, they contend, there is a gross gap between public opinion and the public policies that are in place in *all* fifty of the United States! Or so it seems.

Elsewhere, my colleagues and I (Bishop and others forthcoming) have analyzed the same public opinion data and reached rather different conclusions about what these polls actually show, to wit: (1) that the evidence clearly indicates the American public is profoundly ignorant about and unfamiliar with the so-called alternatives to the theory of evolution, creationism and intelligent design, and that their acquaintance with evolution is crude and superficial at best, (2) that their responses to questions about teaching evolution and “alternatives” to it reflect not so much informed, substantive policy preferences as a tendency to answer a complex question about largely unfamiliar abstract concepts in what superficially seems like a fair way, and (3) that many respondents who oppose the teaching of evolution in public schools and say they support teaching the alternatives to it, or the evidence against it, are just giving gut-level, emotional reactions to a word or idea—evolution—which has become associated with being “descended from apes” and with atheism. So, at best, the jury is out on what the public really wants. Furthermore, I would argue that treating the results of public opinion polls on the teaching of evolution and its “alternatives” at face value may unwittingly give aid and comfort to those who continue to pose challenges to the theory of evolution, by telling them that public opinion is on their side.

The third chapter deepens Berkman and Plutzer’s analysis of public opinion by showing how opposition to the theory of human evolution and its teaching in public schools varies significantly across various religious, educational, and geographic subgroups. It may come as no surprise to learn that support for creationism is concentrated not only among doctrinally conservative Protestant traditions, but also among fundamentalist black Protestants, among the less well-educated, in the South, and in less urbanized areas. But at the same time, the authors find that opposition to evolution has only a weak relationship with measures of scientific literacy or cognitive ability. So anti-evolutionists appear, as they say, to “*choose to ignore scientific arguments demonstrating evolution, or express skepticism ... as a hedge between what they have been taught in school and seen in museums on the one hand, and what they may have heard in church, on the other*” (p 78, emphasis in

original). More importantly, the authors are able to statistically aggregate multiple public opinion surveys and US Census data—for all fifty states—and demonstrate that just two key variables—the percentage of the state’s population holding master’s or doctoral degrees and the percentage affiliated with doctrinally conservative Protestant churches—are highly predictive of support for, or opposition to, the teaching of evolution.

In chapter 4, the authors take a close look at science standards throughout the fifty states, showing not only that there is considerable variation in such standards, but more importantly that the rigor and quality of state science standards, in general, can be explained by the administrative capacity of the state’s bureaucracy responsible for developing science standards, and a state’s support for public education in general. Though the climate of public opinion on evolution in a given state does not appear to have any notable influence on standards for science curricula in general, it turns out to be the most significant predictor of standards for the content of the evolution curriculum in particular. Thus, they argue, public policy is indeed responsive to public opinion, despite the wishes of scientists and organizations such as NCSE who try to keep “the science curriculum buffered from politics and popular control.”

Chapter 5 takes the reader behind those closed classroom doors to find out what teachers are actually doing. Here we learn that “only 12%—roughly one in eight—public high school teachers are teaching evolution in a manner totally consistent with the recommendations of the most prominent national scientific organizations” (p 127) such as the National Academy of Sciences. Shockingly, perhaps, their national survey also shows that anywhere from one out of seven (14%) to one out of five (21%) biology teachers endorse creationism or “intelligent design” as “*valid scientific alternatives*” to evolution (p 138, emphasis in original). Though such teachers may not explicitly advocate these “alternatives” in the classroom, equating them with *science*—as Berkman and Plutzer acutely remind us—undermines “the legitimacy of science” (p 140).

Chapter 6 is where the rubber meets the road, where state standards meet the “street-level bureaucrats” on the frontline: the teachers who “ultimately decide the fate of national and state science standards” (Spillane and Callahan 2000:401–402, cited by Berkman and Plutzer, p 149). The news is not so good, in fact rather dismal. The authors’ analysis of the hours teachers actually devote to evolution, including human evolution, indicates that state standards have a minimal impact on what teachers actually do. So much for what the National Academy of Sciences might like to see happening. The authors spend the rest of the chapter trying to explain why state content standards on evolution have so little influence on what teachers actually do. Hint: It’s not about the money we pay teachers.

In chapter 7, we find out—not surprisingly, perhaps—that a teacher’s personal beliefs about human origins makes a significant difference in how many hours they devote to teaching evolution, their scientific emphasis, and whether they bring creationism into the curriculum. Young-earth believers, for example, behave just as one would predict. On the upside, we also learn that the stronger a teacher’s education in biological science, the more likely he or she is to spend more hours on teaching it and in a way consistent with national scientific standards. Particularly significant is whether he or she took a college-level course emphasizing evolution. So the quality of a teacher’s science education matters a lot, regardless of his or her personal beliefs about human origins.

Chapter 8 tells us how it all plays out in the communities in which teachers get hired and pressured in varying degrees by the sentiments of the local political culture. As expected, self-selection plays an important role: communities with a traditionalist religious bent tend to hire new teachers with less formal education in biology and less exposure to the theory of evolution, and vice versa in more cosmopolitan places. Response to community pressures, as well, plays a role. So teachers end up teaching pretty much what the local community wants them to teach about evolution and its “alternatives.”

The final chapter brings it all together in a wide-ranging discussion of the continuities of the creationism/evolution “culture wars” over the past ninety years or so, the enduring question of “Who decides?”, and the future of this continuing political controversy.

Natural scientists such as EO Wilson (2006, afterword) often react with disbelief and dismay when they read polls about how many Americans do not believe in human evolution and resist its teaching in public schools. They’re not sure what (if anything) can be done about it in our exceptionally religious-minded society. But it may take highly capable political scientists, such as Berkman and Plutzer, to pave the way to effective reform by telling us what goes on behind those classroom doors, and why. Required reading, I’d say, for everyone who truly wants to make a difference in the “Battle for America’s Classrooms.”

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REVIEW

The Neighborhood Project: Using Evolution to Improve My City One Block at a Time

by David Sloan Wilson

New York: Little, Brown, 2011. 448 pages

reviewed by **Richard F Firenze**

In Margaret Atwood's terrific dystopian novel *Oryx and Crake*, the antihero, Glenn (also known as Crake), explains to the novel's protagonist, Jimmy (also known as Snowman), how it is that he was successful in creating a perfect new hominid species where all previous attempts had failed. "When in doubt," he says, "read the directions. You've got to work with what's on the table." David Sloan Wilson's equally terrific—and monumentally ambitious—new book *The Neighborhood Project: Using Evolution to Improve My City One Block at a Time* seems to be following this lead. Wilson, a Distinguished Professor of Biology and Anthropology at the State University of New York at Binghamton (now usually called Binghamton University), is suggesting that by reading the directions, written in the language of evolution, and working with what's on the table, a species honed for survival and reproduction on the African savanna by what he calls the "hammer blows of natural selection," we can create not just a better city (his city being Binghamton, New York) but in fact a better world.

Wilson is best known in the academic community for reviving the concept of group selection as well as for being one of its leading proponents. Mind you, this is not your grandfather's *Wild Kingdom* "it's for the good of the species" view of group selection, but a much more sophisticated multi-level selection process. Wilson's work on group selection has been presented to, and hotly debated within, the scientific community. But as of late Wilson's efforts have been to expand the tendrils of evolutionary theory, including but not limited to group selection, into the role it can play in everyday life. His previous book was modestly titled *Evolution for Everyone: How Darwin's Theory Can Change the Way We Think about Our Lives* (2007). That pretty much says it all. Perhaps his new book could have been titled "Evolution for Everything," since myriad and seemingly disparate topics such as economics, early childhood education, and city planning are all skillfully brought under the umbrella of evolutionary theory. In fact, Wilson states that his goal is nothing less than to illustrate how using an *evolutionary paradigm* can "make the world a better place"—a goal I might add he achieves magnificently. For Wilson, the group (tribe, community, neighborhood, city, nation, and so on) is in fact an organism in itself, the adaptive unit, and thus can be viewed as a product of natural selection. Until we re-establish our ancestral human social environment, he argues, our group will never feel at home.

Wilson claims that although cultural and psychological evolution differ from genetic evolution, we can still explain human behavioral diversity by using this evolutionary paradigm. He cogently argues that we can use evolution both to *understand* and to *improve* the hu-

man condition, and that evolutionary science can and will (if he has his way) deliver practical answers to the problems of everyday life. According to Wilson, one of the reasons it has taken so long to recognize the importance of evolution in improving the human condition is the association it has had with the tenets of social Darwinism. “Evolutionary science will eventually prove so useful on a daily basis that we will wonder how we survived without it” (p 143–144), says Wilson, and “one thing’s for sure: our future is bleak if we don’t turn our groups into organisms” (p 365). Strong words from a passionate advocate. But would you expect less from a man who calls himself a plumber who is offering to fix our collective clogged drains with his evolutionary tool kit?

Wilson skillfully steers a course between the Charybdis of genetic determinism and the Scylla of social constructivism by illustrating with numerous relevant examples that the true answer emerges when both nature and nurture are used to best understand the human condition. Social constructivists have their heart in the right place, says Wilson, but often arrive at the construction site without the necessary evolutionary toolbox, while genetic determinists may have the requisite tools but frequently fail to recognize the important role culture plays in determining human behavior.

Part memoir, part biography, part history of science, and part discourse on scientific methodology, the text is written in a relaxed conversational style that makes it accessible to both scientist and non-scientist alike. A superb chapter titled “Quantifying Halloween” wonderfully describes how Wilson and his students scientifically studied various aspects of the Halloween celebration by haunting the streets of Binghamton on October 31. Perhaps the most important chapter is on the complex issues of economics—cleverly titled “Economics”. There can be little doubt considering the local, national, and global economic situation we all now face that a new view of economic theory and human nature is greatly needed.

There is also little doubt that like Darwin’s tangled bank analogy, used throughout the book, *The Neighborhood Project* does seem to meander from topic to topic. The reader may initially wonder how the social behavior of wasps and the solitary behavior of water striders as well as the philosophy of the great French paleontologist (and Jesuit priest) Pierre Teilhard de Chardin will all shed light on how we can make a better city and a better planet. And there are those who may feel that the book is, at times, too anecdotal. But those who stick with it (easily done due to the casual and informative writing style) will be greatly rewarded throughout.

So who should read this book? The answer is simple. I would argue that anyone who has an interest in the future of our species—and wishes to experience a unique perspective on how we may solve the myriad problems we all now face—will be engaged, informed, and pleased by *The Neighborhood Project*.

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REVIEW

Creation: How Darwin Saw the World and Changed it Forever

directed by Jon Amiel
Santa Monica (CA): Lionsgate, 2009. 108 minutes

Darwin's Darkest Hour

directed by John Bradshaw
Washington (DC): National Geographic Television, 2009. 90 minutes

reviewed by Timothy H Goldsmith

These accounts of Darwin's life share some common threads. Both make a sustained effort to inform the viewer about how Darwin worked and his fundamental contributions to science. Both present a picture of Darwin's domestic life, his relationship with his wife, their contrasting religious beliefs, and their loss of children to infectious diseases for which the 19th century had no cure. Both address the crisis presented to Darwin by the letter from Alfred Russel Wallace in 1858, which revealed that Wallace had independently hit upon the central idea behind natural selection. Despite these similar themes, the films paint two starkly different pictures.

Creation is a screen adaptation of the book *Annie's Box: Charles Darwin, His Daughter and Human Evolution* by Randal Keynes, a great-great-grandson of Darwin. The "box" holds a collection of keepsakes of Annie, the Darwins' oldest daughter and their second child, who died at the age of 10; however, making the box and Annie so central to the story imposed some boundary conditions on the screenwriters. Perhaps because of these confines, I found *Creation* at best a narrow and at worst a distorted picture of Darwin (played by Paul Bettany). His chronic illness as an adult was manifest physically largely as a gastric disorder, but in *Creation* it melds into a hallucinatory psychosis so disabling that Darwin sees writhing creatures in his jars of pickled specimens and has to be literally dragged out of bed by his friend the botanist Joseph Hooker in order to write. The moral aspects of his dilemma about how to react to the preemption by Wallace of his life's work seem muted, and his immediate response to the letter from Wallace is bizarre laughter. Darwin then angers the local minister in a sharp exchange in the garden by pointing out that nature works in ways that are hard to reconcile with a loving God. In *Darwin's Darkest Hour*, the same exchange occurs in a quiet conversation with Emma.

The death of Annie was a great loss to both parents, but it occurred in 1851, seven years before Wallace's letter arrived. You would not know this in watching *Creation*, in which Annie's death and a rift with Emma seem to be at the heart of Darwin's problems in 1858. The central role of Annie in the film also underplays Darwin's involvement with his other children.

Almost from the outset *Creation* toys with history. In a story Darwin tells Annie, we get a distorted account of FitzRoy's motives in capturing several Fuegians, including two young children. What happened is both more complex and more interesting than Darwin's supposed telling to his young daughter. (FitzRoy did not, as suggested, buy Fuegian children for the purpose of taking them to England. He did capture four Fuegians over a period of time, two of whom were young children, but his motives were to recover a stolen boat. The decision to take them to England came later when he could not recover the boat. It may indeed have been a bad decision, but I don't think Darwin would have told the story the way it appears here.)

Creation is not successful in presenting the elegance and power of natural selection as a creative natural process. The comparison of artificial and natural selection is clear enough in scenes in Darwin's pigeon loft, but the message may be visually compromised for some viewers. Darwin's experimental efforts to remove the flesh from the skeletons of deceased birds by soaking them in corrosive solutions is shown dramatically while giving the viewer no information why this was being done. More importantly, Thomas Henry Huxley makes a brief and peppery appearance to argue that the importance of Darwin's work is in revealing the false nature of theological explanations of nature. This may be vintage Huxley, but the conversation frames the science in a confrontational manner that fuels the psychological drama portrayed in *Creation* while doing little to improve the viewer's understanding of the evidence for descent with modification and the process of natural selection.

The illustration on the box containing the disk and the title *Creation* are misleading enticements. Darwin is seated on the floor with a young orangutan that was in the London Zoo at the time and was observed by Darwin. Their arms are extended, with index fingers almost touching, suggesting Michelangelo's ceiling in the Sistine Chapel. Whether the illustration was made to go with the title or the other way around is hard to say. The ape is a bit player, and the image a tease, symbolic of the film's cavalier approach to both history and science.

The contrast with *Darwin's Darkest Hour* (with Henry Ian Cusick in the title role) is striking. Here most of the story takes place in the two weeks between the arrival of Wallace's letter and the decision to proceed with a publication based on Darwin's decades of work. The viewer's understanding of Darwin's scientific contributions is greatly enriched with informative flashbacks. These occur during conversations with Emma, who is determined that her husband find an honorable solution to the problem of Wallace's letter without sacrificing his own priority. We learn much about Darwin's life before the voyage of the *Beagle* and many of the people with whom he interacted: his father, his uncle (Emma's father), Captain FitzRoy of the *Beagle*, the geologist Charles Lyell, the botanist (and Darwin's close friend) Joseph Hooker, and the ornithologist John Gould. The prod from the Scottish biologist Robert Grant, which occurred while Darwin was escaping from his medical studies at Edinburgh, provides an interesting and I believe accurate view of Darwin's thinking at that point in his life. Through these several lenses we see Darwin's maturing understanding of the power of geological forces, the influence of Malthus, the concept of natural selection and its analog in animal husbandry, the role of geographical isolation, the capacity of seeds to survive ocean rafting and still germinate, as well as the evidence that Darwin had shared a written summary of his conclusions with Hooker a dozen years before the arrival of Wallace's letter.

Darwin's chronic illness as well as his fond memories of Annie are handled without making either the center of the story, and there is a balance between Darwin's joy in interacting with his children and tragic loss of two of them. During the Wallace crisis, another daughter was dangerously ill, and the infant Charles died of scarlet fever. The difference with Emma over religion is presented respectfully and with the knowledge that it was an open difference from the time they were married. In both this film and (ultimately) in *Creation*, Darwin has Emma's support in publishing what they both know may be a source of trouble, but in *Darwin's Darkest Hour* the success of their marriage never seems to be in doubt.

To summarize, *Darwin's Darkest Hour* is not only far richer in the development of Darwin's thinking, but also—it seems to this viewer—built on more solid historical ground. It also offers a more elegant presentation of evolution by natural selection, often accompanied by stunning photography.

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Timothy H Goldsmith is Professor Emeritus of Molecular, Cellular, and Developmental Biology at Yale University. He is the author of *The Biological Roots of Human Nature* (New York: Oxford University Press, 1991) and, with William Zimmerman, *Biology, Evolution, and Human Nature* (New York: Wiley, 2000). He is a fellow of the American Academy of Arts and Sciences and a former chair of the board of Biological Sciences Curriculum Study.

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REVIEW

No Dinosaurs in Heaven

written, produced, and directed by Greta Schiller
New York: Jezebel Productions, 2011. 53 minutes

reviewed by **Brandon Haught**

Award-winning director Greta Schiller's newest documentary *No Dinosaurs in Heaven* addresses concerns about who is teaching students what in classrooms across America—a cultural conflict that has been flaring up off and on for decades. The film's central question: What can be done about teachers who teach biology or other related life sciences and yet don't accept the central tenet of the field, evolution?

Schiller explains early in the film that she had recently returned to school to earn a master's degree in science education. While taking a graduate course in biology, she was shocked to discover that the adjunct professor did not accept evolution. This motivated Schiller to pick up the camera once again to film this documentary.

Schiller takes viewers through two sometimes intermingling storylines. In one, Schiller and her crew travel on a rafting trip through the Grand Canyon hosted by the National Center for Science Education (NCSE). This is an annual excursion that takes participants on a journey through geological time as the hosts present both the modern scientific and Christian fundamentalist creationist explanations for how this natural wonder was formed.

The other storyline featured Schiller's former City College of New York biology professor, Femi Otulaja, and a few of Schiller's classmates from that class. Through interviews Schiller gives viewers a sense of the classmates' varying impressions of what had happened in the classroom. Otulaja was also given a good amount of screen time to explain his beliefs and approach to teaching biology and evolution.

Mixed in at key points of the film were short interviews with public school students and their teacher and parents while exploring the American Museum of Natural History, clips from an Answers in Genesis presentation featuring famous creationist Ken Ham, and a talk by NCSE's executive director Eugenie C Scott at a National Science Teachers Association conference.

The Grand Canyon trip yielded spectacular images and interesting information about geology and creationist beliefs. However, the trip participants were much more important to Schiller's film's central question than the scenery. One-on-one interviews and candid group conversations were the meat of this storyline. Geologists, a high school biology teacher, a minister, and even an editor of *Nature* magazine all offered insights into the teaching of evolution.

Unfortunately, those pieces that were so important to the film were nearly lost under a flood—excuse the pun—of field lectures about creationist beliefs. The creationist expla-

nations and accompanying scientific geology information were certainly interesting, but at the same time they softened the film's focus too much. If their inclusion was meant to bolster Schiller's more general theme of scientific literacy, they failed. While there are people who use the creationist arguments presented here, the much more prominent anti-evolution activists nowadays go to great lengths to distance themselves from the nonsense of Biblical flood geology. All such proponents have to do is say they don't advocate for this creationist view in order to dismiss the entirety of the film as irrelevant.

The college professor storyline provided a fascinating look into how a teacher with strong religious convictions tried to reconcile them with a profession that can run counter to those beliefs. Oftentimes, it looked like Otulaja was uncomfortable in front of the camera. He tended to stumble through his explanations, but that in itself offered an insight into the inner workings of his mind. It appeared that he was trying to balance being true to himself with defending himself against accusations raised by his students while also wanting to look reasonable and fair. These conflicting objectives were clear in his mixing up of words and his look of confidence one moment and look of insecurity the next.

Schiller did a good job of including a variety of student voices in this storyline. Some clearly thought that Otulaja had done something wrong. Others gave him the benefit of the doubt and weren't quite sure what the fuss was all about.

The big flaw in this storyline, though, was Schiller's deep personal involvement. Her voiceover narrative gave the distinct impression that she had a vendetta against Otulaja. The film edged dangerously close to looking like a "hit piece" aimed right at her old professor. To avoid this, she could have taken a wider view of the situation by including mentions of cases similar to Otulaja's. There are plenty of studies, statistics, newspaper headlines, and court cases related to this type of situation.

Unfortunately, there were additional distracting flaws. NCSE and Scott were the stars of the film, so to speak; however, at no time was it ever explained what NCSE does. As such, the film's credibility might suffer a bit in the minds of any viewers who have never heard of the organization. But one area that nearly demolished the entire film was the use of a group of toy dinosaurs as stand-ins for students while a transcript of conversations from Otulaja's classroom were reenacted. These segments were truly cringeworthy. Even worse, they reinforced the perception that Schiller was personally attacking Otulaja. The whole film, which was good overall, suddenly looked amateurish as a result.

The bottom line is that this film certainly explores important concepts concerning science, education, religion, and science literacy. It would be useful in sparking conversations about these subjects that could possibly even find an answer to Schiller's main question. *No Dinosaurs in Heaven* is worth watching, but it would have benefited from another round of editing.

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REVIEW

Anarchy Evolution: Faith, Science, and Bad Religion in a World without God

by Greg Graffin and Steve Olson

New York: HarperCollins, 2010. 304 pages

reviewed by **Richard P Meisel**

Greg Graffin is the lead singer of Bad Religion, one of the seminal punk bands to come out of Los Angeles in the early 1980s. He also has a PhD in the biological sciences. This combination of punk rock star and scientist is surprisingly common (McCook 2011), but what makes Graffin unique is the way he disseminates his worldview. Like other lyricists, he allows his personal philosophy to permeate his songs. In addition to his songwriting, however, Graffin has turned to academic and popular writing to explore his personal brand of atheism, which he calls “naturalism”.

Graffin’s PhD dissertation described the religious beliefs of evolutionary biologists (Graffin 2003). In his new book, *Anarchy Evolution*, Graffin (along with science writer Steve Olson) presents his own naturalistic worldview in semi-autobiographical form. In addition to Graffin’s philosophy and biography, the authors also mix in brief introductions to evolutionary biology. Each component is compelling in its own right—Graffin has led a renaissance life, he has honestly reflected on his personal philosophy, and NCSE members would agree that evolution is a fascinating subject—but the connections among these elements often come off as contrived.

For much of his life, Graffin has divided his time between punk rock and science. Bad Religion was founded when Graffin was in high school. Unlike many other Los Angeles punks, however, Graffin managed to stay out of legal trouble and avoid drug abuse. After riding the late-1970s/early-1980s popularity of punk rock, Bad Religion’s productivity waned in the mid-1980s, in part because Graffin enrolled in college. After graduating from UCLA, Graffin took a job as an assistant preparator at the Los Angeles County Museum of Natural History. Bad Religion began recording albums again in the late 1980s, around the same time Graffin started his graduate training at UCLA. After earning his master’s degree in geology, Graffin started working toward a PhD at Cornell University. Meanwhile, Bad Religion became international rock stars.

Anarchy Evolution describes the parallel progression of Graffin’s musical and scientific careers. The fact that each is presented achronologically is not the least bit distracting, and Graffin’s experiences make for compelling stories. For example, the authors describe an expedition to the Amazon Basin where Graffin was responsible for shooting and trapping wildlife to document the local fauna. When he was sent on the expedition, Graffin had just finished college and had yet to do any serious fieldwork. The interactions between the various scientists were far from collegial, correcting the idealistic view of the process of

science that Graffin previously possessed. To add insult to injury, the expedition came to an end when a coup overthrew the Bolivian government, and Graffin escaped to Trinidad in a two-seat Cessna. He had to leave all of his specimens in South America, making the trip a scientific failure.

Portions of Graffin's biography are found in each chapter, and the parts about Graffin's musical career are equally enthralling as his scientific adventures. Unfortunately, the authors end the stories with clumsily constructed morals that are usually implicit in the stories themselves. These morals are often used to segue between the biographical components of the book and the more philosophical points, but such deliberate transitions are unnecessary. Instead, they have the effect of turning Graffin's biography into a series of fables, as though the authors do not trust the reader to extract the take-home messages on his or her own.

Graffin and Olson give a similar treatment to the portions of the book introducing evolutionary concepts. The introductions to evolutionary biology in *Anarchy Evolution* are by no means comprehensive; for that readers should turn to books by Richard Dawkins, Stephen Jay Gould, Sean B Carroll, or Carl Zimmer. And while some biologists may disagree with the details presented in *Anarchy Evolution* (such as possible overstatements of the importance of epigenetics), I found the authors' treatment of evolution to be solid for the most part. As with the biographical components, however, the authors insert forced connections between evolutionary biology and Graffin's personal philosophy that are more jarring interruptions than smooth transitions.

This brings up the question: for whom is *Anarchy Evolution* intended? I would recommend it to fans of Bad Religion (and Greg Graffin) who are not very familiar with evolutionary biology. Because the book is loaded with stories from Graffin's biography (including the founding of Bad Religion) and descriptions of Graffin's personal philosophy (with obvious connections to Bad Religion lyrics), it is likely to capture the interests of punk audiences. Once they are pulled in by these components, they will receive a few short lessons on evolution. Perhaps this introduction will inspire them to explore additional books that delve further into some of the evolutionary concepts discussed in *Anarchy Evolution*.

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