

Evolution / Évolution

# The evolution of creationists in the United States: Where are they now, and where are they going?

Kevin Padian

*Department of Integrative Biology and Museum of Paleontology, University of California, Berkeley 94720-3140, USA*

Accepted after revision 12 July 2008

Available online 26 November 2008

Presented by Claude Combes

## Abstract

The history of anti-evolutionism in the United States begins only in the early decades of the 20th century but has evolved considerably since then. Various versions of the movement (“equal time” for creationism, “creation science”, “intelligent design”) have developed over time, but they have made few positive contributions to serious discourse about science and religion. Their main goal has been to try to stop the teaching of evolution. The most recent version of creationism, “intelligent design” (ID), has little in common with William Paley’s 18th-century version: ID posits an interventionist Deity who regularly interferes in natural processes to produce complex biological structures and functions. The 2005 “intelligent design” trial in Dover, Pennsylvania, destroyed any pretensions that the movement had to scientific integrity. However, anti-evolutionists continue to foment discord at local levels, where opposition to the teaching of evolution can be presented without strong resistance. Scientists can best demonstrate their concern by becoming involved in federal, state, and local administrative processes that determine curricula and develop and adopt textbooks and other instructional materials. **To cite this article: K. Padian, C. R. Biologies 332 (2009).**

© 2008 Académie des sciences. Published by Elsevier Masson SAS. All rights reserved.

*Keywords:* Evolution; Anti-evolutionism; School curricula

## 1. Introduction

In fall 2005, the United States witnessed an extraordinary trial played out against the green rolling hills of central Pennsylvania [1–3]. The previous year, several school board members in the small town of Dover had managed to convince their colleagues on the board, by various tactics of persuasion and bullying, that the topic of evolution in high school biology was scientifically suspicious and religiously offensive. Although they knew that evolution is regarded by scientists and

educators as good science without scientific alternatives, these board members attempted to weaken the teaching of evolution by introducing doubts about it into the curriculum and by offering students a supposed alternative to mainstream evolutionary theory, “intelligent design” (ID).

To many in their community, and to many outside it, the action of the Dover school board was innocent enough. During many months of negotiations with Dover science teachers, board members had failed in their attempt to pressure the teachers to replace the standard high-school biology text with a creationist book, *Of Pandas and People* [4]; the teachers had refused to

*E-mail address:* [kpadian@berkeley.edu](mailto:kpadian@berkeley.edu).

use it even as a supplementary text. They also refused to follow the board's directive to read a statement in class saying that there are many "gaps" in the theory of evolution and that students should consult *Pandas* for an alternative view of "origins". Consequently, the board instructed school administrators to go into the classrooms to read the policy; however, no discussion and no questions about the policy would be entertained. As soon as the policy was read to their children, eleven parents in the school district filed the first lawsuit involving ID, *Kitzmiller et al. v. Dover Area School District*. They received legal assistance from the American Civil Liberties Union of Pennsylvania, the Philadelphia law firm of Pepper Hamilton LLP, and Americans United for Separation of Church and State, a Washington, DC, religious liberties organization. The National Center for Science Education, a non-profit organization dedicated to defending the teaching of evolution and to the clarification of science for the public, provided scientific expertise and strategy advice [1–3].

The trial lasted six weeks, during which a parade of scientists and other experts, ID proponents, school board members, teachers, and citizens who had complained about the board's action testified before Judge John E. Jones III, an appointee of President George W. Bush. The judge's decision [5], which ran to nearly 140 pages, offered no comfort either to the school board or to ID proponents. Judge Jones accepted the view of the scientific community that ID is not science, but thinly disguised fundamentalist Christian polemics. He ruled that ID may neither be taught in public school science classes nor referred to as an acceptable alternative to evolution, and that false "criticisms" of evolution cannot be promulgated in the classrooms of the Middle District of Pennsylvania. In the most memorable phrase of the trial, the judge characterized as "breathtaking inanity" the actions of a school board that rejected all advice from science teachers, their own lawyers, and outside scientific experts, as well as complaints from many parents, choosing instead to waste time and money pushing their own sectarian religious beliefs on others. (They were held responsible for paying damages of \$2.5 million, voluntarily reduced by the plaintiffs' lawyers to \$1 million.) The judge was visibly infuriated when courtroom testimony revealed to him the outright lies by some of the "Christian" school board members, both in court and in pre-trial depositions.

Judge Jones's decision is only the latest in a lengthening series of legal defeats for American creationists, dating back to the 1960s [6]. In successive cases, federal courts have decided, first, that the teaching of evolution

may not be prohibited; second, that evolution must not be balanced with religious doctrine; third, that "creation-science" (an attempt to portray Bible stories as scientific phenomena) is not science but disguised sectarian religion, and cannot be introduced in public science classrooms to "balance" the teaching of evolution; and finally, in *Kitzmiller*, that "intelligent design" is creationism, therefore a religious belief, and may not be taught as science [6].

Despite these court decisions, opposition to the teaching of evolution in America is as strong as ever. Historically, since the 1960s, creationists have entirely failed in the federal courts (although with its current Bush-appointed profile, pro-science forces are wary about the issue reaching the U. S. Supreme Court). When their legislative and legal ventures fail, the anti-evolutionists cry foul, lick their wounds, and redouble their efforts at the local, grassroots level. At the local level, it is much easier for them to harass individual schoolteachers, administrators, and school boards; they work "under the radar" where it is difficult to detect their actions. Ultimately, most of them do not care whether "creation science" or "intelligent design" is taught in public schools; their aim is to drive evolution out.

## 2. Evolution, creation, and the American psyche

What element of the American political psyche makes the United States so susceptible to assaults of this sort on science and science education?

This is an appropriate question to ask as we approach the milestone celebrations of Darwin's birth and the publication of *The Origin of Species* [7]. A French commentator actually put his finger on the problem long ago. The United States is founded on two separate and philosophically irreconcilable traditions. One is Jeffersonian democracy, crafted from ideas born of the Enlightenment, which held that reason and rationality provide the solutions to the problems of the empirical and political worlds. The other tradition is that of the Puritans, who came to America to escape religious persecution in their former land, but who, on arriving, began to persecute everyone else who did not agree with them.

Now we are in the early years of the 21st century, America's third century as a nation. If we continue along our present course, we will replay — at the federal level, in 50 state governments, and in a vast number of local school districts and classrooms — the same farce that has been played out since the famous Scopes trial in Tennessee in 1925.

### 3. Christianity and evolution in the United States

In America today, creationists often say that Christians cannot “believe in” evolution, because it contradicts the word of the Bible as revealed in the first verses of Genesis. This is incorrect, of course [8,9], even setting aside the false premise that scientific hypotheses are matters of belief rather than of empirical evidence and testing. In the first place, there are two versions of creation in Genesis, and their events occur in different orders [9]. In the second place, almost no Christian theologians think that the Bible should be literally interpreted, either as an explication of natural science or as a theological document [10]. There is, of course, no right and wrong in theology when it comes to statements about the “nature” of deities; there is only scholarship, and biblical scholarship clearly tells us that the authors of the Old Testament did not have as their primary purpose the explanation of the literal genesis of the natural world. Indeed, many of the Hebrews’ historical traditions are mythological, either having no support in archaeological history (such as their enslavement and Exodus from Egypt), or having been adopted from older traditions (such as the Babylonian myth of Gilgamesh, appropriated wholesale as the story of Noah) [9].

Of course, the view that Christians cannot “believe in” evolution is promulgated in America mostly by fundamentalist preachers [11–13]. These preachers are generally poorly versed in both theology and philosophy; they are not biblical scholars, nor do most of them seem able to read the Bible in its original orthographs or to understand the subtle ambiguities and connotations of ancient languages and dialects. Traditionally, these preachers reject scholarship in favor of blind faith. They reject any ambiguity in historical and archaeological reconstructions of the ancient Mideast. They reject the universal conclusion of reputable biblical scholars that over the centuries the Scriptures have been miscopied, added to and subtracted from, edited, marginally commented upon, and altered like a bacterial DNA strand [10]. They persist in the misguided notion that any normal human being with sufficient faith can correctly and inerrantly interpret the true meaning of the Scriptures. They insist that evolution is a lie that leads to atheism, Nazism, communism, abortion, homosexuality, stem cell research, same-sex marriage, and the abridgment of all our natural freedoms [6,14].

The rise of Christian fundamentalism in America is comparatively recent [12]. Until the early 1900s, Christian denominations had few or no problems with the discoveries of science. Whereas a variety of opinions pervaded most denominations, their official positions

were on the side of science. It was widely recognized that scientific discoveries that seemed to challenge literal interpretations of the Bible were in fact made by religious people who had no interest in destroying the teachings of any church. Decades of impartial research had pointed to the inescapable conclusion that the Earth was very old, that faunas and floras had changed through time, that organisms found as fossils were not found in the living world (and vice versa), and that the life forms of the past were very different from those of the present [6,9,15]. As for the accounts in Genesis, a common explanation was the “day-age theory” or “God of the gaps”. That is to say, what was regarded as a “day” in the Bible (etymologically not a single, 24-hour period but an “indeterminate period of time”) could have encompassed vast ages in terms of how we measure natural events in the real world. God could have intervened to close the evolutionary gaps between the events of the successive days in biblical chronology [12].

With the reawakening of religious fervor in America during the early decades of the 20th century, things began to change. A reaction against liberal theology prompted a religious conference that produced *The Fundamentals*, a series of pamphlets explicating Christian doctrine that heavily influenced the spread of emphasis on literal interpretation of the Bible. Of course, this reactionary tradition was opposed to evolution in all its forms and with all its presumed implications. Thus the current tradition of biblical fundamentalism was born in America. Laws were passed in several states forbidding the teaching of evolution; in 1925, the young substitute biology teacher John Scopes was recruited as a defendant for a test case against such a law in Tennessee [1–3]. When Scopes lost his case because he admitted to teaching evolution, Tennessee was ridiculed in much of the country as backward and primitive. However, in another substantial segment of the American population, fundamentalist religious determination was strengthened. A measure of this strength is that the Tennessee law under which Scopes was convicted remained on the books until the 1960s, when the U. S. Supreme Court declared all such laws to be unconstitutional.

In the decades that followed, evolution was eliminated from both public school classrooms and textbooks throughout much of the country [6]. During the same time, the teaching of earth science was weakened, partly because Christian fundamentalists objected to being taught that the Earth was more than several thousand years old. This situation continued until 1957, when the Russians launched the satellite Sputnik. The American scientific and military establishments were shaken to their core, as was the political establishment. Poli-

cymakers realized, somewhat unconsciously, that they could no longer indulge the anti-scientific prejudices of a vocal minority and that science had to be taught straightforwardly and earnestly to the next generation of American voters and leaders.

For several decades, science was more strongly emphasized in American schools than it had been before; but if my own recollections are in any way representative, this meant simply that more details of cell biology, physics, and chemistry were pounded into the skulls of American students, with no noticeable increase in conceptual literacy. American students in 1965, like typical ones today, could not readily explain why the sky is blue, how the tides are controlled, or how plate tectonics works. But they would more likely be able to recite the five stages of chromosomal activity, the elements on the periodic table with a valence of  $-1$ , and the steps of the Krebs cycle. American children have been taught a jumble of scientific facts, but little or nothing about either the scientific methodology by which these facts came to be known or the overarching theories of a vast realm of scientific inquiry.

Ronald Reagan helped to reverse what progress had been made when he became president in 1980. During his campaign, Reagan had courted the Christian Right vote. Although he acknowledged that, legally, churches could not endorse him for president, he assured those who supported him that he endorsed their views and implied that if elected he would support their efforts at social “reform” [9]. Of course, like the current President Bush, who promised the same thing to the Christian Right, Reagan threw them only a few scraps when it came to federal legislation. But rhetorically and politically, his words counted for a great deal when he stated that evolution was “only a theory” and that it was strongly questioned by the scientific community. George W. Bush acted similarly in August 2005 in appearing to endorse the teaching of ID as an alternative to evolution by classrooms. In both cases, these presidents were pandering to an assured audience without actually taking steps to legalize their pronouncements. Nevertheless, a president can create an atmosphere of either tolerance or rejection, and there is no question about the kind of atmosphere that Reagan and the second President Bush created.

In 1994, Bill Clinton was in his second year as President of the United States. For reasons that need not be discussed or judged here, the midterm congressional elections resulted in the rejection of many long-term Democratic officeholders and the election of a great number of new, neo-conservative Republican members of Congress. The leader of this “Republican Revolu-

tion” was Representative Newt Gingrich of Georgia, who vowed to enact a “Contract with America” in the first hundred days of the new Congress. This program, he said, would end government waste and excess spending, and return America to its fundamental moral principles. The tawdry details of this political “revolution” are still being played out today by the current occupant of the White House and his administration, as well as by many members of Congress. What concerns us here is that the neoconservative revolution fostered a rejection of liberal education and encouraged grass-roots movements that hoped to eliminate the teaching of evolution in public schools. All across the nation, laws have been proposed to limit or “balance” the teaching of evolution, and conservative candidates for school boards (often without identifying themselves as such) have tried to stop the teaching of evolution in their local school districts. Without directly fomenting such activities, the neoconservative administration certainly encouraged them.

#### 4. Intelligent design: what is it?

This was the climate in which the “intelligent design” movement arose in America in the 1990s. Its principal architect was Phillip E. Johnson, a now-retired law professor at the University of California, Berkeley. Johnson had no expertise in science, but for him that was beside the point. He was on a campaign against “naturalism” and “materialism”, by which he meant the modern world’s reliance on scientific, i.e., naturalistic, evidence of the material world and the failure of Americans to live their everyday lives according to conservative Christian precepts. He wanted nothing less than to restore to American institutions what he regards as their original Christian values and to make Christianity the foundation of public policy. For him, evolutionary theory was the scientific equivalent of moral nihilism. Its reliance on “random mutation and natural selection” appeared to deny the reality of any sort of spiritual or divine guidance, to deny that human life had a purpose or meaning, and even to deny the existence of God [16,17]. Johnson formed his impressions about evolution from reading Richard Dawkins’s *The Blind Watchmaker* [18] and New Zealand biochemist Michael Denton’s discredited book, *Evolution: A Theory in Crisis* [19]. As Johnson recounts it, he gathered some like-minded people and began to form a strategy and raise money. A small think tank in Seattle, the Discovery Institute, became the headquarters of most of this activity and in 1996 added a division called the Center for the Renewal of Science and Culture (later renamed the Center for Science and

Culture (CSC), presumably to avoid the fairly obvious religious connotations).

The CSC's mission is explained in a 1998 document entitled "The Wedge", which was circulated privately among its proponents and friends in the mid to late 1990s [16]. The wedge metaphor signals the ID movement's intention to drive a wedge into the public understanding of science as naturalistic, thus undermining what they regard as the damage that scientific materialism has done to American culture. The Wedge Document describes a three-phase program of "scientific research", "publicity", and "cultural confrontation and renewal" to be driven by the work of the CSC's fellows and supporters. Its 20-year plan includes the writing of articles and books presenting ID "research", attempts to influence state and national science curricula as well as influential congressmen and state officials, and the writing of op-ed pieces, along with appearances on television and radio talk shows.

Initially, the movement had great success. It received favorable press coverage in newspapers and magazines. Fellows of the Discovery Institute appeared before a number of state school boards to promote ID in their curricula, and behind the scenes they provided text, resources, and talking points for supporters in these processes. They wrote many op-ed pieces in prominent national magazines and newspapers, and were characterized in many interviews as the new, up-and-coming face of science. Meanwhile, the scientific community waited to see what these people had in mind scientifically.

And what exactly were ID proponents saying? That was not immediately clear, at least to most observers. The original concept of "intelligent design" is attributed to William Paley, a late 18th-century, middlebrow English cleric and author (among many other works) of *Natural Theology* (last edition 1802) [20]. Paley used a famous analogy to support belief in a Creator. In short, he said that just as a watch is so obviously designed and specifically functional as to imply the existence of a watchmaker (because it never could have been assembled by random forces), so the beautiful adaptations and intricate workings of living organisms imply the existence of a Creator. Paley's books were very popular, and they became standard reading at Cambridge and other universities during Darwin's time and for a century afterward. Darwin, in fact, used Paley's device of a "grand analogy" when he suggested that the artificial selection practiced by farmers and breeders to preserve slight variations in their domesticated species could easily be extrapolated to natural selection, given natural

variations in wild populations during the great expanse of time that could allow Nature to do its work [7,21].

When Americans were asked in the 1990s whether they believed in "intelligent design", most responded in the affirmative, and this is no less true today (<http://www.pollingreport.com/science.htm>). After all, most Americans believe in a Creator, and most believe that organisms are well fit for their environments. Darwin would have agreed: he could not conceive how the universe could have been the result merely of "blind chance and necessity"; as he wrote in his *Autobiography*, all this must have had a "First Cause" with "an intelligent mind in some degree analogous to that of man".

But this is not at all what ID proponents at the Discovery Institute have been saying [22–25]. For them, as for other creationists, most scientific discoveries and the natural processes that they reflect are unobjectionable. However, they maintain that in some cases, natural processes are insufficient by themselves to produce certain natural phenomena. In these cases, they conclude, one must accept the intervention of a Designer. It is probably not coincidental that every such case that ID proponents have so far identified is biological, not chemical, physical, or geological, and that each one applies to the action of evolutionary processes.

There are more than a few problems with this approach. In the first place, what standards will be used to judge whether a given natural phenomenon was impossible to achieve by natural means? Second, if one were to draw such an inference of a Designer today, but ten years later natural evidence were found that supports natural mechanisms in the same case, would that falsify the existence of a Designer? Third, the assertion that natural mechanisms cannot account for certain natural phenomena is a "science stopper": it cuts off scientific investigation and essentially abandons rational inquiry. Fourth, ID proponents provide no guidelines for investigating the nature of the Designer itself: they do not claim that the inference to a Designer will provide any knowledge at all about the Designer or its actions. And of course, they provide no guidelines on how this hypothesis would ever be falsified.

There are problems for theology as well in this poorly conceived repackaging of "intelligent design". First, the notion of an interventionist deity is old-fashioned, predating the Enlightenment's influence on Christian theology. Second, it raises the age-old question of theodicy: if the Deity can intervene to influence the development of even the most insignificant life forms, why does it not do so more often to relieve pain and suffering? And third, of what use, then, is prayer? ID proponents wave away these questions

as mere trivialities to be worked out later. In fact, under Phillip Johnson's "big tent" approach, the Wedge Strategy has included a specific and concerted effort to unite a highly disparate group of creationists, including Old Earth Creationists, Young Earth Creationists, various evangelicals, and fundamentalists: once they defeat naturalism and materialism, Johnson claimed, they can start to work out their respective doctrinal differences [16].

## 5. The Dover decision

It would seem that Judge Jones put the Wedge Strategy to rest with his landmark decision in the Dover case [5]. In fact, even in the months before the trial began, the Discovery Institute's honeymoon with the press had ended. As the trial neared, reporters began to ask inconvenient questions. Why hadn't Discovery Institute "scientists" produced any peer-reviewed research supporting or even testing the proposition of intelligent design? Why had so many scientific organizations and academies issued statements rejecting ID as science and identifying it as religion? Why were there so few scientists who supported ID, and why did those who supported it not have degrees in the sciences relevant to their attacks on evolution? Reporters found that the previously cooperative and talkative ID proponents were now sullen, uncommunicative, and testy. Reporters were accustomed to scientists' giving them straight answers. Now they were facing avoidance, belligerence, and stonewalling. They sensed that something was wrong.

Something was indeed wrong. For years, the Discovery Institute had been trying to find a local school district in which to foment a legal test case that they could use to validate the teaching of ID, either alongside evolution or in place of it. They were hoping for a case that they themselves would initiate and control, especially with respect to the terminology in which school policy proposals would be worded. The Discovery Institute had begun to shy away from explicit references to "intelligent design", preferring that ID-friendly curriculum policies be written in code language that permitted, for example, teaching the "strengths and weaknesses" of evolution. With such language, they hoped to bypass the legal constraints against teaching creationism. However, the Discovery Institute did not instigate the Dover policy. Rather, this policy was the product of their aggressive, nationwide promotion of ID, and they found themselves unable to control the local initiative in Dover that such promotion had unleashed. In trying to pressure the Dover school board to settle the case and abandon

its policy, the Discovery Institute realized quickly that the board was not going to play by their rules. A conservative Catholic legal organization, the Thomas More Law Center (TMLC), had also been looking for an ID test case and found willing accomplices on the Dover school board. Moreover, the TMLC was less cautious than the Discovery Institute: its representatives urged the school board to craft a policy that explicitly advocated "intelligent design". And so, while the Discovery Institute tried to persuade the board to withdraw a policy that would surely provoke a legal challenge, the TMLC, hired as the board's legal defense team, encouraged the adoption of just such a policy. This strategy turned out to be disastrous for the defense, however. They were depending on the Discovery Institute to provide scientific "expertise", and several CSC fellows, including Dembski, agreed to serve as expert witnesses. But the TMLC watched in dismay as one after another of the Discovery Institute "experts" withdrew from the case, fearing personal embarrassment and a huge defeat [1–3].

Nonetheless, because there was no question of a settlement, the case proceeded to trial. The strategy of the plaintiffs was to show: (1) that ID is in no way accepted by the scientific community as science and does not qualify as such; (2) that ID is actually creationism, thus a religious belief, making the teaching of it in a public school a violation of the U. S. Constitution; (3) that the Dover school board had acted with religious motivations in attempting to insert ID into the school curriculum; and (4) that the alleged "criticisms of evolution" that formed virtually the entire basis of ID (as exemplified in the *Pandas* book that the school board intended for student use) were unsubstantiated and had been thoroughly refuted. The defense strategy was to allege that ID was not religious but was instead a nascent, brilliant, new scientific advance that merely needed time to be developed fully, and that it was being unfairly dismissed and discriminated against, just as other brilliant scientific advances had been at their outsets.

Of course, the defense had difficulty defending the proposition that ID was not religious inasmuch as its proponents had explicitly attempted to change the definition of science so as to admit the possibility of supernatural intervention in the natural order. The defense witnesses admitted on cross-examination, however, that this attempt to change the way science is now understood was unlikely to succeed; centuries of scientific discoveries throughout the Renaissance and the Enlightenment had shown scientists that supernatural influences must be excluded from the practical methodology of science.

But presenting much more difficulty was the task of defending in court the two principal bulwarks of the ID movement (apart from the standard creationist allegations about the “weaknesses” of evolutionary theory [26]): “irreducible complexity” and “specified complexity”. The main proponent of the first bulwark is biochemist Michael Behe of Lehigh University, who maintains that if removing one or more working parts from a complex structure leaves that structure unable to perform its function, it is irreducibly complex and must have been designed [27]. Behe uses as his two main examples the bacterial flagellum and certain features of the vertebrate immune system. However, the plaintiffs’ lawyers and expert witnesses had little trouble showing that other, living organisms have flagella with related functions and that manifest the intermediate evolutionary stages that produced the bacterial flagellum; Behe simply refuses to accept the well-known, basic evolutionary phenomenon of exaptation that explains how these supposedly irreducibly complex systems could evolve.

The second bulwark, “specified complexity”, is the hobbyhorse of one William Dembski [28], who has degrees in philosophy, mathematics and divinity but no credentials in science, and has held various positions at religious colleges. “Specified complexity” is actually a gambit that originated in the old “creation science” movement, but it has been resuscitated by the ID creationists. It holds that if the assembly of a structure cannot be attributed to natural selection or chance by statistical means, it must have been designed by a higher intelligence. Unfortunately for Dembski, he has no actual examples; his notion has been heavily criticized by mathematical and statistical experts, and, like Behe’s “irreducible complexity”, has never been published in a peer-reviewed journal. Dembski balked at testifying in court, allegedly because he could not be represented by his own personal counsel. His withdrawal from the case left Behe to do all the heavy work defending ID. (In fact, of the defense witnesses scheduled to testify, two other Discovery Institute witnesses also withdrew before their depositions, leaving the defense scrambling; the defense withdrew two additional witnesses without explanation after the trial began.) During the trial, Behe was pleasant enough, but his testimony was variously obtuse, repetitive, and desultory. And he did himself no good when plaintiffs’ attorney Eric Rothschild got him to admit during cross-examination that under his definition of a scientific theory, astrology would qualify as science [1–3].

The two remaining defense witnesses ranged from incompetent to irrelevant. Meanwhile, the six expert

witnesses for the plaintiffs had systematically shown that the bulwarks of ID have no scientific support, that ID’s philosophical foundations are entirely religious, and that the ID movement’s principal documents, such as the *Pandas* textbook, had “evolved” directly from “creation science” books and documents. In fact, early drafts of the book that eventually became *Of Pandas and People*, subpoenaed by the plaintiffs’ attorneys, showed that the terms “creationist” or “creationism” had simply been replaced by “intelligent design” and related ID terms in nearly 200 instances, without any change in the substance of the discussion — shortly after a U. S. Supreme Court decision determined that “creation science” was not admissible as science [1–3]. Creationism evolves!

## 6. The aftermath

The judge’s decision was unambiguous [5]. Delivered on 20 December 2005, it was immediately hailed by scientists, teachers, and most rational citizens. It was excoriated by the usual right-wing extremists, many of whom had been certain only months before that the Republican, Bush-appointed judge would surely rule in ID’s favor. The Discovery Institute put out endless press releases and complaints criticizing the judge’s decision, often in strongly *ad hominem* terms; but they had nothing to complain about. They had been given their day in court, and they failed miserably. Moreover, it was abundantly clear from the cases made by both the plaintiffs and the defense that ID would be unlikely to fare better in masquerading as science in any court in the nation. In fact, Judge Jones explained that part of the reason he wrote such a long, comprehensive decision was to prevent the need for another school district to go through the same miserable process again [5].

It is almost unbelievable that ID proponents continue to insist that they have a case. In order to do this, they must continually and deliberately ignore the court rulings, the statements of scientific societies and academies, their own lack of any peer-reviewed papers presenting original scientific data, the meager scientific credentials of their “experts”, and an educational community that has become increasingly skeptical of their blandishments. However, they are religious zealots, and they do not think they can fail. Welcome to 21st-century America, where Christian fundamentalists deny the advances of the Enlightenment and behave no differently than fundamentalists in other countries who threaten universal human freedoms and values. Jefferson, Franklin, and Paine are surely turning in their graves.

## 7. What's next?

What can scientists do to help? Before I offer suggestions, it is first necessary to explain that, in America, the criticism of personal beliefs based on religion is not a successful tactic, no matter how ridiculous some of those beliefs or their implications may seem. America is founded on the principle of religious liberty, although there is also an explicit constitutional separation between church and state. An individual's religious beliefs must be generally seen as strongly harmful to the general populace before they can be sanctioned or suppressed. So to pit science against religion is to work at cross-purposes.

A more successful approach, which was taken by the plaintiffs' expert witnesses in the Dover case, is to explain clearly what is understood about evolution by the scientific community, what is in doubt and what is not, and what is and is not science. Rather than criticizing belief systems, it is more effective to focus concern on the misrepresentation of science to children in classrooms, stressing that this wastes time and tax money, and to furthermore point out that representing only the non-scientific beliefs of one segment of the population is deeply unfair. This argument turns the tables on the "fairness" ploy often used by creationists to demand "equal time" for their views. Using tax dollars to advance a single sectarian religious viewpoint is unfair.

Scientists can also act on their concern by participating in the national, state, and local administrative procedures by which science curricula are developed and established. Over the years, these documents have come to be developed mostly by classroom teachers and science education administrators, who are typically much less familiar with science than the scientists themselves. On the other hand, they are much better acquainted with approaches to successful teaching and with age-specific concepts and sequences by which scientific knowledge should be taught. If both of these groups who have a stake in good science education listen to each other, great progress can be and often has been made.

Textbooks are another front in the struggle for good science education. For a long time in America, science textbooks used in the public schools have included very few contributions from real scientists. Instead, they have been developed and written by the staffs of textbook publishers who have little or no actual experience in science; the various textbooks of different publishers look very much alike and cover much the same ground — with similar incompetence. The publishers are not entirely at fault; they have to please myriad state and local school districts with quite different local standards and

requirements. However, on balance, these books and standards reinforce each other, creating an endless cycle of incompetence and misrepresentation of what is important and what is known in much of science. This situation is reflected, if surveys are any indication, in the fact that American students lag behind nearly all other developed countries, and some underdeveloped countries, in scientific understanding.

Scientists can offer their expertise to publishing houses and are in fact frequently asked to review individual chapters of textbooks; however, publishers have no obligation to accept their recommendations. Furthermore, if a scientist's advice seems to counter the publisher's status quo, the publisher will probably discount it. A more effective tactic is to provide reviews and testimony to state and local education officials about the scientific quality of textbooks when they are proposed for adoption. When scientists publicly express concern about the quality of textbooks proposed for their children, it is difficult for officials to ignore.

However, scientists can be even more effective at the college and university level, where they themselves are the consumers and adopters (and even the writers) of their own textbooks. I have recently undertaken a study of the presentation of macroevolution — specifically how major new adaptations arise — in college texts in general biology, vertebrate paleontology, comparative vertebrate morphology, and evolution. Surprisingly, many of these books present virtually nothing on the subject; some present cladograms but do not link them to morphological and functional change; some present comparative anatomy but do not provide an evolutionary connection. It cannot be assumed either that students will draw these connections or that many textbook writers have the knowledge to explain them properly.

Accordingly, the University of California Museum of Paleontology and the National Center for Science Education have begun a project to provide instructional approaches and examples of macroevolutionary change to textbook publishers, teachers, and the public. These examples will be housed on a website sponsored by the museum, which has long led the campaign to educate the public about science by means of the Internet. Visitors are invited to visit the site, <http://evolution.berkeley.edu>, and to monitor it for future developments.

## 8. Conclusion

The forces of anti-evolution in the United States will not rest simply because they lose court decisions. Although, two years after the *Kitzmiller* trial in Pennsylvania, there have been no new legal challenges that involve



the teaching of ID as science, there have been numerous attempts to introduce ID in other ways, or to otherwise weaken the teaching of evolution. One strategy that has been used for some years is “teach the controversy” about evolution. When scientists respond that there is no controversy, the anti-evolutionists say “Aha! You see? That’s the controversy!”

A second strategy is “academic freedom” for students to hear all points of view, and for teachers (in this case, those with creationist backgrounds) to present “both sides” of the evolution-creation issue. In America, “academic freedom” is a concept that strictly applies to the freedom for researchers at the University level to pursue responsible research where it leads them, unfettered by political, ideological or religious opposition. It does not apply to high school teachers, who are required to teach what is mandated in their state curricula and not to subvert or ignore it. Moreover, there is no “right” of students to hear “all points of view”, or else schools would allow equal time for those who deny that the Holocaust took place.

A third anti-evolutionist strategy is “critical thinking”, by which is meant not the time-honored teaching practice of weighing arguments and rhetoric judiciously, but rather introducing a set of criticisms about evolution without considering the actual scientific evidence. In other words, “critical thinking” for creationists is not inquiry as measured against philosophical and methodological standards of scientific work; rather, it is one-sided criticism of the “dogma” of evolution as they see it. These criticisms have been the stock in trade of creationists for decades and they have been refuted many times. Indeed, Judge Jones in the Dover trial specifically prohibited the introduction of these false claims into classrooms, but this will not stop the practice outside his district.

To this tactic is added the notion of “viewpoint discrimination”, which implies that ID proponents are being denied a fair hearing in classrooms (a complaint that ignores the overwhelming consensus of the scientific community in favor of evolution, to which they do not like to draw attention). Americans historically regard themselves as very fair-minded (a fact that explains why they were initially open to the possibility of ID as science). “Why not teach both”? is hence a common slogan of anti-evolutionists who want some variation of anti-evolution presented to students. It is difficult to argue against fairness, so scientists have a difficult road when creationists use this approach. The proper response, which must be conveyed to the public, is to agree that *valid* scientific hypotheses should be compared and contrasted, but that ID has been ruled un-

scientific in a court of law and is not accepted by any segment of the scientific community.

As evolutionary biology in all its forms continues to bring forth amazing new insights from the origin of whales to the evolution of microbial resistance, one would think that the anti-evolutionists would have less to cling to each year, and that they would give up their arguments as disproven misapprehensions. They will not, despite recent victories against ID as science and the lunacy of “creation science”. Creationists reject the notion of a rational universe because they believe that evolution depends upon the dominance of “random processes” that allow no divine direction or teleological goal. This is the core of the resistance to evolution in America, and it will not go away anytime soon.

### Acknowledgements

I am very grateful to Prof. Barbara Forrest and Prof. Robert Pennock for their careful readings of an earlier draft of this paper; to Prof. Hervé LeGuyader for his invitation to participate; and to Prof. Armand de Ricqlès for introducing me to Prof. Dominique Lecourt’s excellent book *L’Amérique entre la Bible et Darwin* (2nd ed., Quadrige/Presses Universitaires de France, Paris, 2007), a superb summary for French readers of the history and substance of this problem. This is UCMP Contribution No. 1971.

### References

- [1] M. Chapman, *Intelligent Design, God, OxyContin® and Other Oddities on Trial in Pennsylvania*, HarperCollins, New York, 2007.
- [2] E. Humes, *Monkey Girl: Evolution, Education, Religion, and the Battle for America’s Soul*, Ecco, New York, 2007.
- [3] G. Slack, *The Battle Over the Meaning of Everything: Evolution, Intelligent Design, and a School Board in Dover, PA*. Jossey-Bass, New York, 2007.
- [4] P.W. Davis, D.H. Kenyon, *Of Pandas and People*, 2nd ed., Foundation for Thought and Ethics, Richardson (TX), 1993.
- [5] J.E. Jones, *Decision in the case of Kitzmiller et al. vs. Dover Area School Board: 2005*; [http://www.pamd.uscourts.gov/kitzmiller/kitzmiller\\_342.pdf](http://www.pamd.uscourts.gov/kitzmiller/kitzmiller_342.pdf).
- [6] E.C. Scott, *Evolution vs. Creationism*, University of California Press, Berkeley, 2005.
- [7] C. Darwin, *The Origin of Species by Means of Natural Selection*, John Murray, London, 1859.
- [8] J.L. Kugel, *How to Read the Bible: A Guide to Scripture, Then and Now*, Free Press, New York, 2007.
- [9] D.R. Prothero, *Evolution: What the Fossils Say and Why it Matters*, Columbia University Press, New York, 2007.
- [10] B.D. Ehrman, *Misquoting Jesus*, Harper, San Francisco, 2005.
- [11] K.R. Miller, *Finding Darwin’s God*, HarperCollins, New York, 1999.

- [12] R. Numbers, *The Creationists: From Scientific Creationism to Intelligent Design*, expanded ed., University of Chicago Press, Chicago, 2006.
- [13] J. Wallis, *God's Politics: Why the Right Gets it Wrong and the Left Doesn't Get It*, Harper, San Francisco, 2005.
- [14] M. Isaak, *The Counter-Creationism Handbook*, University of California Press, Berkeley, 2007.
- [15] M. Pigliucci, *Denying Evolution: Creation, Scientism, and the Nature of Science*, Sinauer, Sunderland (MA), 2002.
- [16] B. Forrest, P.R. Gross, *Creationism's Trojan Horse: The Wedge of Intelligent Design*, Oxford University Press, 2007.
- [17] P.E. Johnson, *Darwin on Trial*, Regnery, Gateway, Washington, 1991.
- [18] R. Dawkins, *The Blind Watchmaker*, Oxford University Press, Oxford, 1976.
- [19] M. Denton, *Evolution: A Theory in Crisis*, Adler & Adler, Sydney (Australia), 1986.
- [20] W. Paley, *Natural Theology*, various editions, 1802.
- [21] C. Darwin, in: N. Barlow (Ed.), *The Autobiography of Charles Darwin*, Norton, New York, 1958.
- [22] K. Padian, Testimony in the trial of Kitzmiller et al. vs. Dover Area School Board, 2005; [http://www.sciohost.org/ncse/kvd/Padian/Padian\\_transcript.html](http://www.sciohost.org/ncse/kvd/Padian/Padian_transcript.html).
- [23] R.T. Pennock (Ed.), *Intelligent Design Creationism and its Critics*, MIT Press, Cambridge (MA), 2001.
- [24] N. Shanks, *God, The Devil, and Darwin: A Critique of Intelligent Design Theory*, Oxford University Press, Oxford, 2004.
- [25] M. Young, T. Edis (Eds.), *Why Intelligent Design Fails: A Scientific Critique of the new Creationism*, Rutgers University Press, Piscataway (NJ, USA), 2004.
- [26] J. Wells, *Icons of Evolution: Science or Myth?* Regnery Publishing, Washington, 2000.
- [27] M.J. Behe, *Darwin's Black Box*, Free Press, New York, 1996.
- [28] W.A. Dembski, *The Design Inference: Eliminating Chance Through Small Probabilities*, Cambridge University Press, Cambridge, 1998.