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CHAPTER SEVEN

Science in the Courtroom

The Case against Intelligent Design

A Darwinist cannot invoke angels adding staples to [mouse] traps, because the angels are on *our* side.—Michael Behe, biochemist

I cannot persuade myself that a beneficent and omnipotent God would have designedly created parasitic wasps with the express intention of their feeding within the living bodies of caterpillars.—Charles Darwin

The evolution-creation controversy is one of those perennial issues that never seem to go away no matter how much scientists alternately ignore or confront them. Even more so than in the case of global warming that we just examined, there is no real controversy about this among scientists, who overwhelmingly accept the theory of evolution as by far the best available explanation of life's history and diversity. Indeed, unlike the case of global warming—which was, in fact, legitimately debatable until recently—such consensus about evolution developed almost a century ago, and has hardly changed since. Yet, similarly to what Al Gore pointed out for climate change, the American public is split down the middle with regard to evolution—a sharp contrast between what scientists think and what the laypeople perceive.

The evolution cultural wars make for a splendid case study in the quest for what distinguishes science (evolution) from pseudoscience (creationism). But this chapter will tackle the issue from a different perspective, examining in depth the outcome of a landmark trial in a court of law in

which a judge was asked to decide the very question that is at the center of this book: what is science, and what is pseudoscience?¹ Judge Jones in Dover, Pennsylvania, delivered a detailed opinion that includes a thorough examination of the history of the controversy, the science behind both evolution and intelligent design theory (ID, a form of creationism), and even the philosophy of the divide between science and nonscience.

But before delving into the fray, we need as usual to arm ourselves with a preliminary understanding of what evolutionary theory itself is all about. As in the case of the greenhouse effect considered earlier, the basic idea is not that difficult, though the details can be extremely complicated, especially in the mathematical version of the theory. The modern theory of evolution began with Charles Darwin and his 1859 book, *On the Origin of Species by Means of Natural Selection*. Darwin's book was, as he himself put it, "one long argument" to make essentially two points: first, all life on Earth is related by common descent; second, the major explanation of the diversity of life, and especially of the obvious adaptation of living organisms to their environment, is a process that he called natural selection.

The evidence that Darwin amassed in favor of his theory included an examination of the fossil record, with its traceable change in forms from simple to complex over long periods of time; the comparative anatomy of organisms such as vertebrates, clearly showing that they share similar structures (e.g., the forelimbs) that can be adapted to different functions (e.g., walking vs. flying); the study of animal breeding, demonstrating the rapid change in form that can be obtained even by unconscious selection (although breeders select directly, and therefore consciously, for certain characteristics, other traits change as an unconscious byproduct of this selection); the biogeography of both living and fossil forms, which can be used to trace the change of related species over time, as well as their adaptation to changing environments.

Modern biology has greatly expanded the same lines of evidence and added a wealth of information that was not available to Darwin from developmental biology (species that are considered to be closely related also share similar developmental systems) and molecular biology (the similarity in DNA sequences of different species matches the one predicted on the basis of anatomy and biogeography). To put it simply, the empirical evidence supporting Darwin's fundamental insight that living organisms changed over the course of Earth's history is as solid as the evidence in any open-and-shut murder case, or, more pertinently, as solid as any other

currently accepted mainstream scientific theory, such as Einstein's general relativity.

While many empirical and theoretical advances have been made in biology after Darwin, and while biologists today recognize a variety of evolutionary mechanisms besides natural selection, it is crucial to understand two ideas that are so often obfuscated within the context of the evolution-creation debate. First, common descent is a pattern (not a mechanism), which is explained by a variety of causes (mechanisms), the major one being that living organisms possess genetic material that they pass from one generation to another. Second, and most crucially, natural selection is not a random process. The latter misconception is so widespread, even among educated people, that it is worth restating the point unambiguously: natural selection is an evolutionary mechanism that is not random, and therefore one cannot reasonably say things like "evolutionists think that humans came about by chance." Nothing could be further from the truth.

Evolution by natural selection, at its core, works like this: living organisms are characterized by heritable variation for traits that affect their survival and reproductive abilities. This heritable variation originates from the (truly random) process of mutation at the level of DNA (although Darwin didn't know this, he observed that there was variation and noted that somehow it was heritable from one generation to the next). Natural selection then *is* the differential survival and reproduction of organisms that have (heritable) traits that allow them to do better in the struggle for life. That's it, but the concept is profound because the process of evolution turns out to be largely the result of two components: mutations (which are random) and natural selection (which, again, is not random). It is the joint outcome of these two processes that—according to evolutionary theory—explains not only the diversity of all organisms on Earth, but most crucially the fact that they are so well adapted to their environment: those that weren't did not survive the process. Indeed, many organisms do not survive or reproduce, with the result that more than 99 percent of the species that ever existed have by now gone extinct.

You may find it intuitively difficult to believe that two relatively simple natural processes can produce the complex order we observe in living organisms. But the beauty of science is that it so often shows our intuitions to be wrong. Moreover, there are other examples of order in nature arising from a mixture of random and deterministic forces, hurricanes being one. Even more simply, just think of the orderly distribution of pebbles on a rocky beach, with the small pebbles further up the shore and the largest

ones distributed near the water. What accounts for that? Did an intelligent designer come by and manually sort all the pebbles? No, the pattern was produced by the combination of two causes: the (random) action of waves, which pushes all pebbles toward the shore, and the (nonrandom, selective) effect of gravity, which makes it so that the lighter pebbles on average end up further away from the water.

One additional important concept follows from our simple discussion so far: evolution is *both* a theory and a fact, contrary to simplistic creationist views. How can this be? Evolution is a fact in the sense that it is beyond reasonable doubt that living organisms have changed over time throughout the history of the earth. It is a theory in the sense that biologists have proposed a variety of mechanisms (including, but not limited to, mutation and natural selection) to *explain* the fact of evolution. Similarly, in modern physics, gravity is both a fact (apples really do fall on people's heads when they become detached from their tree) and a theory (according to Einstein, gravity *is* a local deformation of space-time caused by physical objects with mass).

We now have the basic tools to follow the bizarre story that unfolded in Dover, Pennsylvania, and culminated in one of the best examples of how science and philosophy of science can play a surprising and fundamental role in our courtrooms, helping to decide what should and should not be taught in our public schools by way of an analysis of the distinction between science and pseudoscience.²

The Simple Statement That Led to a Storm

On 18 October 2004, the Dover School Board passed the following resolution: "Students will be made aware of gaps/problems in Darwin's theory and of other theories of evolution, including, but not limited to, intelligent design. Note: Origins of Life is not taught." That decision came after almost three years of intense political maneuvering on the part of several members of the board, and it eventually led to a historical trial in which proponents of intelligent design were handed a devastating defeat by a conservative judge appointed by President George W. Bush. The 139-page decision by Judge John E. Jones III is worth reading in its entirety, and I will discuss it in some detail because it will guide us through a fascinating tour of human deception worthy of a mystery novel, all the while teaching us something about the nature of science and the difference between

science and pseudoscience. It truly is a case study destined to become a classic in the cultural wars.

The story, as Judge Jones tells it,³ began in January 2002, when Alan Bonsell, president of the Dover School Board, publicly declared that his two main goals for board action were to push the teaching of creationism in the district's schools and to reinstate public prayer. Both goals, of course, violate the constitutional separation of church and state and should have therefore never been on the agenda at Dover, but it is the ignorance and bigotry of local officials that often causes trouble where there should have been none.

The legal side of things is rather simple. The so-called establishment clause of the First Amendment to the U.S. Constitution (passed in 1791) reads: "Congress shall make no law respecting an establishment of religion, or prohibiting the free exercise thereof." The Fourteenth Amendment, passed in 1868 (i.e., after the Civil War), applies federal law to the states. There is very little room for interpretation of the establishment clause: it is made of two subclauses, the first of which prohibits the government from favoring or forcing religion—any religion—on the citizenry; the second prohibits the state from impeding in any way on the free (but private) exercise of religion. It is hard to imagine how anyone could therefore seriously argue that teaching creationism (which the Supreme Court had determined in 1987 is not science, but religion) or officially sponsoring prayer in schools (as opposed to students privately praying while on recess at school, which is of course perfectly legal) would not violate the First Amendment. And yet, failing to understand this represented the beginning of trouble for the Dover School District.

Bonsell eventually confronted teachers in the district in person about the teaching of evolution in the fall of 2003, an unprecedented administrative step that sent a chilling message to the teachers: stay away from the controversy if you don't want to trigger the ire of the board. This had an immediate effect on one of the teachers who testified at the Dover trial, Robert Linker.⁴ Before the meeting with Bonsell, Linker used to tell his students that creationism is based on "religion and Biblical writings," which made it illegal as a subject matter in public schools. After the meeting with Bonsell, Linker dropped any mention of the controversy to his students and even stopped using helpful teaching material to aid students in making the distinction between science and religion. It was the first round of an escalating confrontation that would eventually completely vindicate the teachers and cast a serious cloud of misconduct on the administrators.

Enter another shadowy character: William Buckingham, whom Bonsell had appointed chair of the board's Curriculum Committee. In early 2004, Buckingham contacted the Discovery Institute, a Seattle-based "think tank" devoted to the promotion of intelligent design in public schools. The institute sent Buckingham a video entitled *Icons of Evolution* (from the title of a popular ID book by author Jonathan Wells), which he arranged to be shown to the teachers to "educate" them about the real nature of ID.⁵ Interestingly, two lawyers from the Discovery Institute also made a presentation to the board, obviously a prelude to the sure legal challenge that would ensue if the board kept pursuing this clear breach of church-state separation.

Between the summer of 2003 and that of 2004, the board shifted to a delay tactic to force the teachers' hand, refusing to approve the purchase of a standard textbook, *Biology* by Kenneth Miller and Joseph Levine (Miller later testified as an expert for the plaintiffs at the trial). Despite the fact that the book had been approved by teachers (i.e., those people who actually know something about biology) and by the administration, Buckingham felt that it covered evolution too thoroughly and did not give creationism a fair shake.⁶ This is like complaining that a textbook in astronomy is too focused on the Copernican theory of the structure of the solar system and unfairly neglects the possibility that the Flying Spaghetti Monster is really pulling each planet's strings, unseen by the deluded scientists.

In June 2004, some members of the board went even more clearly on the offensive, with Buckingham stating that *Biology* was "laced with Darwinism," a comment that followed another one made previously by the same character (as reported in the trial's decision) to the effect that the separation of church and state is "a myth" and, at any rate, something that he, Buckingham, personally doesn't support. One has to wonder at the size of the egos of these people who would readily put their own ideological opinions above the constitutional guarantees of an entire nation. But such is the nature of the evolution-creation debate. And speaking of church-state separation, it turns out that at the same board meeting, Buckingham's wife gave a long speech⁷ (beyond the standard allotted time) during which she said that "evolution teaches nothing but lies" and asked the audience how one could teach anything but the Bible to their kids, ending up with exhorting people to become born-again Christians. Her husband came to her aid by challenging the onlookers to trace their ancestry to monkeys (nothing could be easier, as a matter of scientific fact), accusing judges in previous trials against creationism of "taking away the rights of

Christians,” and ending with a call to stand up for Jesus. The point here, of course, is not that Mr. or Mrs. Buckingham or anyone else doesn't have the right to their religious opinions, or that they cannot express them in public (though a school board meeting hardly seems like the most appropriate venue). But all of this made it into the official documents of the trial because it established a crucial point for the judge: the clear religious motivations of the board in passing its resolution, and therefore the untenability of the board's legal position that its actions were meant in a secular spirit to further education and critical thinking among local students.

Of course, Buckingham himself was never concerned with respecting either other people's opinions or upholding minimum educational standards. The court proceedings relate an earlier episode, in 2002, when a mural about evolution (put up by students as a class project) was taken down and burned. When Buckingham was asked, two years later, if he knew anything about the episode, he replied, “I gleefully watched it burn.”⁸ This has nothing to do with Christianity or religion; it is simply the ugly face of ideological bigotry.

But let's proceed with some further background before we get to the actual trial. During the summer of 2004, Buckingham found out about the existence of an ID book called *Of Pandas and People*, produced by the ironically named Foundation for Thought and Ethics, an organization classified by the Internal Revenue Service as a public charity, but which describes itself as religious in nature in its articles of incorporation and tax returns. This book was revealed at trial to be nothing but blunt creationist propaganda, and a witness for the plaintiffs, philosopher Barbara Forrest, was able to show Judge Jones that previous drafts of the book included the word “creationism” in all the places where now it had “design.” Moreover, the changes were made around 1987, immediately after the Supreme Court established that creationism is not science, but religion, and therefore cannot be taught in public schools. Coincidence or (mischievous) intelligent design?

Buckingham had the brilliant idea of forcing the Dover school system to adopt *Pandas* as a reference book, but how could he convince the teachers to go along? Simple: by blackmail. He held the approval of *Biology* hostage, clearly stating that he would allow the latter book to be purchased by the school system only if *Pandas* were adopted as well. This isn't something made up by the liberal press: Buckingham openly stated at the trial that “if I didn't get this book, the district would not get the biology book.”⁹ Thoughtful and ethical indeed.

All of this was not happening without some resistance and great discussion in the community. In fact, in August 2004, the board solicitor warned the Dover School Board of the possible legal consequences of their actions, stating that “my main concern at the moment, is that even if use of the text [*Pandas*] is purely voluntary, this may still make it very difficult to win a case.”¹⁰ Those words revealed themselves to be prophetic on 20 December 2005, when Judge Jones handed out an unquestioningly negative verdict for the school board.

Of course, humans being what they are, the board forged ahead, eventually forcing the purchase of *Pandas* on the teachers despite strong opposition by the latter. And yet the strangeness of the case certainly doesn't end here. In October 2004, sixty copies of *Pandas* were mysteriously donated to the school system, and at trial it emerged that both Bonsell and Buckingham had attempted to hide the source of funding, which turned out to be a call for donations that Buckingham himself did at Harmony Grove Community Church, where he attended Sunday services. The judge noticed that this meant that both these questionable characters actually lied under oath at a deposition they made on 3 January 2005, in preparation for trial, when they denied having any knowledge of the source of funding for the purchase of the sixty copies of *Pandas*.¹¹ I guess a lie doesn't send you to Hell if it is for the Good Cause (as Martin Luther himself famously said).

Also in October 2004, the Curriculum Committee drafted the statement that eventually led to the lawsuit. There were several irregularities and rather unusual happenings in the way the board acted on the recommendation of the committee, including the fact that the teachers—that is, those who actually know about biology—were simply not called to comment on various drafts of the resolution. Even more irritatingly, several board members who voted for the resolution, beginning with Buckingham, later frankly admitted that they had no idea what intelligent design theory actually says, nor were they in any position to knowledgeably comment on the adoption of *Pandas* as a reference book. As Judge Jones points out in the final decision for the trial,¹² it also didn't occur to anybody on the board to consult serious scientific or educational organizations, such as the National Academy of Science or the National Association of Biology Teachers. Only the ID think tank the Discovery Institute was asked for an opinion.

Here is the complete statement that the board decided should be read by teachers to students of the Dover district:

The Pennsylvania Academic Standards require students to learn about Darwin's Theory of Evolution and eventually to take a standardized test of which evolution is a part.

Because Darwin's Theory is a theory, it continues to be tested as new evidence is discovered. The Theory is not a fact. Gaps in the Theory exist for which there is no evidence. A theory is defined as a well-tested explanation that unifies a broad range of observations.

Intelligent Design is an explanation of the origin of life that differs from Darwin's view. The reference book, *Of Pandas and People*, is available for students who might be interested in gaining an understanding of what Intelligent Design actually involves.

With respect to any theory, students are encouraged to keep an open mind. The school leaves the discussion of the Origins of Life to individual students and their families. As a Standards-driven district, class instruction focuses upon preparing students to achieve proficiency on Standards-based assessments.¹³

Before we proceed further, let us pause for a moment and take a closer look at this statement. The first paragraph singles out the theory of evolution for particular attention by the students. This is an inappropriate signal that there may be something especially wrong with this and no other scientific theory. Surely the Pennsylvania Academic Standards establish a variety of benchmarks for the students of that state in order to demonstrate academic proficiency, but the board clearly wanted to set evolution aside for special consideration. Since evolutionary theory is taken (by scientists) to be as good a scientific theory as, say, continental drift or quantum mechanics, this decision by the board was obviously motivated by religious views, which is one of the several reasons that led Judge Jones to rule against the school board in the end.

The second paragraph is beautiful because it is at once largely correct and deeply misleading. First, as I mentioned at the onset of this chapter, it is certainly true that "Darwin's theory is a theory," in the same way that it is true that my chair is a chair, that is, by definition (notice, incidentally, that just like modern mechanical physics is not "Newton's theory," the modern theory of evolution is not "Darwin's theory," but a more advanced and sophisticated theory known as the Modern Synthesis). Second, the theory

is not a fact, again, by definition. Scientific theories are just what the board states they are: explanations meant to unify a broad range of observations. Facts are observations that the theory attempts to make sense of, which is why the standard creationist refrain that “evolution is a theory, not a fact” is at the same time (almost) correct and yet entirely irrelevant. Moreover, the business about gaps in the theory “for which there is no evidence” betrays a profound misunderstanding of the nature of scientific theories: every theory has “gaps,” meaning sets of facts that are not (currently) explained by the theory or, conversely, makes hypothetical statements that are not (currently) supported by empirical evidence. This is true for evolution, quantum mechanics, general relativity, or whatever. Theories are human constructs meant to guide our understanding of nature, and as such have always been and will always be “incomplete.” Once one realizes that this is a normal condition of science, it will not come as a surprise that the theory of evolution has “gaps.” Furthermore, there is no reason for students to focus on those particular gaps in contrast to any other lacuna of any other scientific theory.

The third paragraph contrasts intelligent design with “Darwin’s view” (again, the proper contrast should be with the modern theory of evolution, not with Darwin’s original views—science makes progress with time). It states that ID is an alternative explanation and that students can find more about it in the “reference text” *Of Pandas and People*. But, in fact, ID is not a scientific theory at all because there is no empirical observation that can possibly contradict it. Anything we observe in nature could, in principle, be attributed to an unspecified intelligent designer who works in mysterious ways. As long as we do not venture to make hypotheses about who the designer is and why and how she operates, there are no empirical constraints on the “theory” at all. Anything goes, and therefore nothing holds, because a theory that “explains” everything really explains nothing.

Let me elaborate on this point, because it is crucial to our discussion. ID proponents such as William Dembski are fond of drawing a parallel between their position and the sort of conclusion one would reach while looking at Mount Rushmore in South Dakota. This mountain, as is well known, was carved between 1927 and 1941 (before the modern environmental preservation movement took hold) with the facial features of four American presidents: Washington, Jefferson, Theodore Roosevelt, and Lincoln. Now, ID proponents say, it doesn’t take a rocket scientist (or, apparently, an evolutionary biologist) to figure out that the faces were

intelligently designed and were not the result of a natural process. They pompously call this the “design inference.”

Indeed, to deny the validity of such an inference would be ludicrous. But the reason such a conclusion is inescapable is because we know a lot about the intelligent designers themselves: we know that they are human, how they managed to carve the mountain, and why they did it. It is not (just) the complexity or the features of the faces that allow the design inference, it is the fact that the inference is a hypothesis made testable by our additional knowledge concerning human monuments. We have absolutely no such information in the case of the alleged intelligent designer of biological organisms; moreover, while there is no alternative, non-natural explanation available for the faces on Mount Rushmore,¹⁴ there is a perfectly viable scientific theory that tells us how living organisms change over time: through a series of mechanisms that involve the generation of random mutations and nonrandom survival and reproduction of those organisms that happen to be better adapted to the local environmental conditions. There is much more to the modern scientific theory of evolution, but the contrast between the two is sufficient to make clear that ID is not, in any meaningful sense of the word, a theory of anything.

The last paragraph in the board’s statement is a masterpiece of deception. To begin with, no scientist or educator would ever argue against teaching critical thinking to students, and therefore naturally we would like students to “keep an open mind” about anything. But, again, why was the theory of evolution singled out, if not for religious purposes? Should Dover’s students not be equally open minded about, say, general relativity or the germ theory or, for that matter, astrology (or even religion)? Open-mindedness means that one does not accept a certain conclusion as dogma, but only tentatively and in proportion to the available evidence. By that standard, the scientific theory of evolution is what an open mind *should* accept, since it is overwhelmingly supported by the available empirical evidence. Could it be that the theory will be superseded by another one in the future? Yes, and in fact that is what happens to most scientific theories because science is a progressive enterprise (in the sense that it improves its own products) and it is part of the job description of a scientist to keep an open mind and be willing to abandon a theory that no longer works. This has happened already to several other theories of evolution (for example the one advanced before Darwin by the French biologist Jean-Baptiste de Lamarck) as well as to Newtonian mechanics and even the early version of the Copernican theory (Coper-

nicus was right that it is the earth that rotates around the sun and not vice versa, but he was wrong in thinking that such an orbit was circular; it is elliptical).

Finally, the statement about the fact that students will not be taught about the origin of life is downright puzzling. The origin of life is a scientific question and as such should be discussed in science classes. Of course students are free to also discuss it with their families, especially when it comes to its perceived metaphysical and religious implications. But the role of education is to provide students with both the best available understanding of a given problem to date and the reasoning tools to think independently about the problem itself. Not teaching a subject—no matter how controversial—is not good education; it is simply subordinating education to an ideological agenda. Which is exactly what got a minority of board members and the teachers' body to publicly distance themselves from the board's peculiar decisions and *modus operandi*.

Let us now resume our chronicle of the bizarre events at Dover, as reported in the trial proceedings, to help us reflect on the comprehensive picture—not to mention its ugly emotional underpinning—of the so-called evolution-creation controversy that emerges from them. After the board passed its inane resolution, opposition became more vocal, beginning with some of the board members themselves. For example, Casey Brown wrote a letter of resignation from the board that, in part, states: "Our opinions [on the board] are no longer valued or listened to. . . . I myself have been twice asked within the past year if I was 'born again.' No one has, or should have the right, to ask that of a fellow board member."¹⁵ Indeed, and note that this statement does not come from an avowed atheist (although if it did it shouldn't make any difference), but from someone who simply happened to believe in the separation of church and state. No matter: Buckingham called Brown an atheist, and Bonsell told her—according to the trial's documents¹⁶—that she would go to hell. So much for Christian compassion and open mindedness.

This was not an isolated incident either. The trial proceedings show that the second board member to resign, Noel Wenrich, explained in a letter to the board that "I was referred to as unpatriotic, and my religious beliefs were questioned,"¹⁷ even though Wenrich actually served in the U.S. armed forces for eleven years and is, in fact, a Christian. This is not a matter of religion versus science or even versus atheism; it is a simple matter of religious bigotry and intolerance on the part of a particular group of Christian fundamentalists.

Despite all of this, the board approved the disclaimer about evolution that teachers were supposed to read to their students, except that the teachers refused to cooperate. They sent a letter to the board that said that the board's request "violates our responsibilities as professional educators" and that "to refer the students to *Of Pandas and People* as if it is a scientific resource breaches [the teachers'] ethical obligation to provide them with scientific knowledge that is supported by recognized scientific proof or theory."¹⁸ Strong stuff, which clearly set the stage for the ultimate confrontation in court.

Things were not much calmer in the surrounding community either. Judge Jones actually admitted as evidence at trial all the letters to the editor on the matter sent to two local newspapers, the *York Dispatch* and the *York Daily Record*, as well as editorials about the board's actions published in the same papers. The numbers are staggering: from 1 June 2004 to 1 September 2005 a total of 62 editorials and 225 letters appeared in the *Dispatch* and the *Record*! This was relevant, as Judge Jones explained,¹⁹ not to establish the validity of either position, but rather to confirm that a reasonable member of the community would have been justified in perceiving the actions of the board as an attempt to impose a particular religious perspective in a public school, in violation of the First Amendment. The statistics speak for themselves: of 139 letters published by the *Record*, 86 clearly framed the issue in religious terms (pro or against); similarly for 28 of the 43 editorials published by that paper. In the case of the *Dispatch*, the analogous figures are 60 out of 86 letters, and 17 out of 19 editorials. Can there be any reasonable doubt that this is not a matter of teaching science, but a straightforward infringement of the establishment clause?

Predictably, the community was bitterly divided by the board's stance, as was testified by Joel Leib, a local resident with multigenerational ties to the area: "[the Board's actions have] driven a wedge where there hasn't been a wedge before. People are afraid to talk to people for fear . . . They're afraid to talk to me because I'm on the wrong side of the fence." Yet, as we have already seen, and despite all the obvious evidence to the contrary, the defendants at the Dover trial had the audacity to present their motivations as "secular" and their actions as aimed only at furthering the education and critical thinking of the students. As Judge Jones (again, remember, a conservative judge appointed by the second President Bush) aptly put it: "To assert a secular purpose against this backdrop is ludicrous."²⁰

A Long History of Legal Battles and Shifting Strategies

The Dover trial is just one of the most recent (though historically crucial) examples of the ongoing legal war between religious zealots and defenders of church-state separation in the United States. Judge Jones himself pointed out in his decision at Dover that such history is relevant to the understanding of the controversy because it clearly shows the shifting tactics employed by creationists, thereby plainly exposing their nonsecular, and not really well-hidden, motives.

The opening salvo, as is well known, was the infamous Scopes trial of 1925, which took place in Dayton, Tennessee.²¹ John Scopes, a substitute biology teacher, was arrested on the grounds that he was teaching the illegal doctrine of evolution (it is not clear whether he actually did or just pretended to so that the trial could take place and the town of Dayton could be “put on the map,” as local community leaders were hoping). Scopes was convicted—the only time creationists actually won a major legal challenge—despite the participation in the trial of renowned defense lawyer Clarence Darrow and of the American Civil Liberties Union (then a fledgling organization at one of its first high-profile cases) on the side of Scopes. On the prosecution side was three-time Democratic presidential candidate William Jennings Bryan, after whom the local Bryan College is still named.

The Scopes trial was the stuff of Hollywood movies, and in fact one was made in 1960, followed by three more movies made for TV. The 1960 version features Spencer Tracy playing Darrow, Fredric March in the role of Bryan, and an unusual dramatic role for Gene Kelly, playing a journalist reminiscent of *Baltimore Sun*'s H. L. Mencken, who in real life filed scathing commentaries on the trial and the local culture for the *Philadelphia Inquirer* (the movie, and the play from which it was adapted, *Inherit the Wind*, was actually meant as a criticism of the abuses of the McCarthy era, which occurred several decades after the Dayton trial). Scopes's conviction was overturned on a technicality, and the state of Tennessee did not dare retry the ill-conceived case, fearful of even more bad publicity and Mencken-style barbs (a classic example of which is “It is hard for the ape to believe he descended from man”). The result, however, was that the law prohibiting the teaching of evolution in Tennessee actually stayed on the books for decades until it was finally repealed in 1967.

But why did the Scopes trial occur in 1925, almost seventy years after

the publication of Darwin's *Origin of Species*? Partly because the early twentieth century had seen a religious revival in the United States with the publication of a series of books called "The Fundamentals" (from which the word "fundamentalism" derives), published to bring people back to the "original" word of the Bible (of course, there is no longer such a thing as the original manuscript of the Bible, and we have to rely on the earliest surviving manuscripts in Hebrew and Aramaic, together with an influential translation in ancient Greek). Indeed, Bryan was a populist politician who was profoundly disturbed not by the scientific theory of Darwin itself (about which, arguably, he understood little) but by decidedly unscientific "social Darwinism" ideas, used by some scientists and politicians to advocate inhumane treatment of the poor based on a cynical misunderstanding of the science of evolution.

The approach used by fundamentalists during the early stages of their legal war was simply to attempt to prohibit the teaching of evolution. That tactic came to an abrupt end in 1968, when the Supreme Court struck down an Arkansas statute that aimed at making the teaching of evolution illegal. The Supreme Court is the last appeal in legal matters in the United States, so once it declares something unconstitutional, there is no other possible recourse—except waiting for the makeup of the court to change in a favorable manner, or changing the Constitution itself. The 1968 decision marked the first major shift in tactics on the part of creationists: since banning the teaching of evolution was no longer feasible, creationists came up with the idea of a "balanced treatment," that is, of teaching both evolution and creationism in the name of presenting students with a choice about competing "theories."

That shift in tactics, however, proved in turn to be short-lived: in 1987 the Supreme Court again intervened in the controversy, this time declaring any "balanced treatment" approach, and indeed the very teaching of creationism, in violation of the First Amendment to the U.S. Constitution. Understandably, this caused significant disarray among creationists, who were seemingly left with nowhere to go—until they invented intelligent design theory. It is not by chance that the ID movement got off the ground in the early 1990s, largely as a result of the public advocacy of retired Berkeley law professor Phillip Johnson. If creationism didn't make it under the pretentious name of "creation science," then perhaps it would under the more ambiguous term "intelligent design theory." It is this continuously shifting series of tactics in the single-minded pursuit of state establishment

of religion that led philosopher Barbara Forrest and biologist Paul Gross to entitle their book on intelligent design *Creationism's Trojan Horse*.²²

This is also why Judge Jones's decision is so important: although it does not carry the weight of a Supreme Court decision (and, in fact, we can fully expect creationists to push the issue again within the next few years, until it does reach the highest court in the land), it marks the beginning of the end for the third round of creationist legal strategies. It seems like they are truly running out of options now, and pathetic attempts to rename ID along the lines of "sudden emergence theory" (a bizarre term that has surfaced here and there in the aftermath of Dover) surely are not going to cut it.

This complex legal history is why we need to understand the criteria applied by Judge Jones to reach his decision at Dover: the endorsement test and the so-called Lemon test of the First Amendment²³ (after the case of *Lemon v. Kurtzman* [1971], not the fruit). The endorsement test was explained by the Supreme Court: "School sponsorship of a religious message is impermissible because it sends the ancillary message to members of the audience who are nonadherents that they are outsiders, not full members of the political community, and an accompanying message to adherents that they are insiders, favored members of the political community."²⁴ Judge Jones clearly concluded that this was indeed the case at Dover, and it is hard to find a more blatant example of it than the above-mentioned accusation of atheism and lack of patriotism hurled by board members to the dissenting minority. One has to remember, of course, that the establishment clause works in both directions: it not only prohibits the state from endorsing (any) religion, it also forbids the state interference with religious practice. Consequently, Mr. Bonsell and Mr. Buckingham are perfectly free to advocate any view they may hold on the origin of life and its history, both in their churches and in the public square, but they are barred from doing so in their capacity as public officers.

Let us now turn to the Lemon test. First, this has been considered necessary by the courts only if the endorsement test fails: that is, if one can convincingly show that a statute or action directly endorses a particular religious viewpoint, this is sufficient to rule against such statute or action, and no Lemon test is necessary. The latter becomes relevant in cases where a breach of the First Amendment could not be reasonably demonstrated under the endorsement test alone. Lemon hinges on precise standards regarding the purpose and the effect of the statute or action

being challenged. Judge Jones summarized the Lemon (as articulated by the Supreme Court) in this way: “under the Lemon test, a government-sponsored message violates the Establishment Clause of the First Amendment if: 1) it does not have a secular purpose; 2) its principal or primary effect advances or inhibits religion; or 3) it creates an excessive entanglement of government with religion.”²⁵ Notice that the first point regards the purpose, the second and third, the effect of a given statute or action by the government.

It is the Lemon test that explains, for example, why Judge Jones was interested in the newspaper editorials and letters published about the controversy: they clearly revealed that the actions of the board were not motivated by secular aims, fulfilling the “purpose” component of the Lemon test. The same literature, as well as the letters of resignation written by some minority members of the board, and especially the letter written by the teachers to the board, all make clear that the board’s maneuvers did create an excessive entanglement of government and religion and that the primary result of such maneuvers was, in fact, to advance a religious viewpoint. This equally clearly fulfilled the “effect” part of the Lemon test.

So, Judge Jones—unmistakably conscious of the importance of the Dover case—played it particularly safe and made sure that his decision was based on both the establishment test as well as on the purpose and effect aspects of the Lemon test. The defendants failed on all counts, leaving no doubt that this was as clear a case of violation of church-state separation as one is likely to find in the annals of jurisdiction.

But Is It Science?

While we have learned much about creationism and intelligent design from a careful analysis of the Dover proceedings, the crucial question as far as this book is concerned is rather more direct: is ID science, under any reasonable definition of the term? Just because an idea has strong religious underpinnings, it doesn’t necessarily make it scientifically unsound, and one ought to pursue the two questions (infringement of state-church separation and scientific nature of the claim) separately. This is, in a sense, what Judge Jones did, and the central part of his decision, entitled “Whether ID is science,”²⁶ should be a must-read in any discussion of science and religion. Interestingly, Judge Jones relied not only on the ex-

pert testimony of ID proponents and of their scientific critics, but also on a usually neglected category of experts: philosophers of science. His account is an enduring testimony to how a person with no technical background, a religious believer, and a political conservative, can form a solid opinion—based on considerate understanding of expert testimony—of matters that are both intellectually sophisticated and full of emotional and political implications.

Jones clearly stated in his discussion that he does not take any position as to the truthfulness of ID itself. This is also what most scientists do: intelligent design, or other forms of creationism, may be true (although it is hard to imagine how one could ascertain it), but the controversy hinges upon the twin questions of whether ID is religion (it is) and whether it is science (it isn't). Nonscientific claims may be true and still not qualify as science. For example, it is true that I am writing this while in a hotel in Vienna during a work-related trip; moreover, it is a truth that is empirically ascertainable, since there is a record in terms of eyewitnesses (the colleagues to whom I gave a talk last night), hotel bills, airline tickets, and credit card receipts. However, this particular truth is not “scientific” in any meaningful sense of the term because it isn't part of any general theory of how the natural world works.

Judge Jones concluded that ID fails as a science on three grounds: “(1) ID violates the centuries-old ground rules of science by invoking and permitting supernatural causation; (2) the argument of irreducible complexity, central to ID, employs the same flawed and illogical contrived dualism that doomed creation science in the 1980's; and (3) ID's negative attacks on evolution have been refuted by the scientific community.”²⁷ It is crucial to understand these three points because they apply to the creation-evolution controversy in general and because they represent an excellent example of the distinction between science and pseudoscience.

First, then, let us examine what Jones meant when he said that ID (and, in fact, any form of creationism) violates the ground rules of science. As we shall see in the next chapter, one can trace elements of the scientific approach to ancient Greece, and in particular to Aristotle, although it is generally agreed that modern science really begins with Francis Bacon and his articulation of the inductive method. But even back in Aristotle's time, a fundamental assumption of doing things scientifically is that the supernatural is out: no explanations that invoke non-natural causes are allowed. It is not difficult to find clear statements to such effect in the

ancient literature. For example, Epicurus (341–270 BCE), who was nineteen when Aristotle died, wrote in a letter to his friend Pythocles: “The divine should not be introduced in any way into these considerations [theories about nature] . . . If this is not done, all speculation [i.e., theorizing] on the causes of heavenly phenomena will be in vain.”²⁸

But wait, is scientific practice then based on unquestioned assumptions? How can it be scientific to rule something out (or in) a priori, without empirical evidence? The answer is that this aspect of the scientific method is not, in fact, scientific: it is a philosophical position. As Robert Pennock and Barbara Forrest—two philosophers of science who testified at Dover—have explained, this assumption is known as “methodological naturalism.” It is worth bearing with me a little here, because the common misunderstanding of this point is a major reason why so many people consider ID the “reasonable” compromise that it most certainly is not. Bill Dembski, a leading proponent of ID, has repeatedly claimed that he is trying to broaden the current concept of science, to get science to move beyond naturalism to take into account the possibility of supernatural explanations. The debate hinges upon three crucial terms: “naturalism,” and two adjectives that can be attached to it: “methodological” and “philosophical.”

Naturalism, in this context, is simply the idea that the world works according to natural laws and processes, but it comes in two varieties: methodological and philosophical. A philosophical naturalist is, essentially, an atheist, or someone who believes—as a result of philosophical (not scientific) considerations—that there really is no supernatural at all. This is a minority (though perfectly reasonable) position in the population at large, and many scientists do not espouse it either. But how can one be a scientist and reject philosophical naturalism? By being a methodological naturalist, of course! Methodological naturalism is at the core of science because it doesn’t commit a scientist to atheism; it simply says that—since science cannot possibly investigate the supernatural—the supernatural, if it exists, cannot factor into scientific explanations of how the world works. This is not at all the same as saying that the supernatural doesn’t exist; it is simply, in a sense, to admit the limitations of science in being able to deal only with natural causes and empirical evidence. At the same time, it frees science from any close tie with religion and allows scientists to pursue their work independently of their private religious beliefs.

Now, this is not a particularly strange position, contrary to what Dembski and company would argue. Indeed, almost everyone is a methodological naturalist at heart, regardless of his religious creed, and all of us certainly

behave that way in everyday life. Consider what might happen the next time your car doesn't start. Very likely your first thought isn't going to be that some supernatural agent wishes to interfere with your plan to get to the grocery store. Instead, you will look at the gas gauge to make sure that there is enough fuel in the tank. If that checks out, you'll proceed with a series of additional controls, such as making sure the battery is operating normally, and so on. In other words, you are assuming—without any direct evidence—that there is a natural explanation for why your car is not running. Let us push the analogy a bit further and suppose that you go through all the standard checks and still can't find anything wrong with the car. Again, I bet you will not take out your cell phone (most definitely not a supernatural device, though clearly intelligently designed!) and call your pastor, rabbi, or imam. You will call your mechanic, sticking with your methodologically naturalistic assumption about cars in general. Moreover, suppose your mechanic calls you back a week later and says that he couldn't identify the cause of the malfunction and that the car still won't run. Most likely you will persist (despite the complete lack of evidence) in assuming that there must be a mechanical (i.e., natural) explanation and that your mechanic either isn't competent enough or had insufficient information to find it. You may shrug your shoulders and go to the nearest car dealer to buy another car. Even if you are a religious believer, throughout this process you behaved just like a scientist, and for the same exact reason: the only explanation you can possibly act upon is a natural one. If God truly didn't want your car to start, then there is nothing you could do about it anyway, and no way you could prove (or disprove) it either.

Creationists are fond of pointing out that scientists *assume* that there must have been a natural cause to, say, the origin of life, without really knowing that this is indeed the case. It should be clear now in what sense scientists make this assumption and why this is in fact a valid and reasonable way to go about things. The assumption is not philosophical, it is methodological: scientists do not *conclude* that there was a natural cause for life's origin and then go home satisfied. They work under the provisional contention that there had to be a natural cause because, just like in the case of your mechanic, that's the only way they can hope to find an explanation. They may succeed or fail, but neither outcome will actually say anything at all about the existence or workings of God.

All of this is also why when Dembski and other ID proponents say that they wish for a "broadened" and more complete science, they are talking nonsense. Supernatural explanations aren't explanations at all, because

one doesn't know why and how God decided to do what he decided to do (after all, he is God!),²⁹ which means that any so-called explanation that invokes the supernatural turns out to be nothing more than an elaborate admission of ignorance: instead of simply saying that we have no clue about why or how something happened (the car isn't working) we increase our self-importance by concluding that God personally got involved into the matter.

Judge Jones, therefore, rightly concluded that ID would change the very definition of science and that this change is unwarranted. Defense witness Scott Minnich, a microbiologist, admitted: "for ID to be considered science, the ground rules of science have to be broadened to allow consideration of supernatural forces,"³⁰ thereby violating methodological naturalism. Perhaps worst of all for the defense, plaintiff attorney Eric Rothschild got biochemist Michael Behe (a prominent ID supporter) to state that his "broadened definition of science . . . would also embrace astrology."³¹ In fact, an argument can be made that astrology is not quite as bad as ID because the former only postulates natural forces unknown to science, not necessarily supernatural ones, but the comparison is damaging enough that Behe will regret having made it on record for the rest of his life.

Let us now consider the second major conclusion reached by Jones: that ID's central argument, known as "irreducible complexity," is simply an example of the same "contrived dualism" that the courts found in the 1980s was a fatal flaw of standard creationism. We need therefore to understand both what irreducible complexity is supposed to be and why contrived dualism is a logical fallacy.

"Irreducible complexity" is a term introduced by the above-mentioned Behe in his influential *Darwin's Black Box* and expanded and elaborated upon by Dembski in several books and articles.³² However, as Behe himself admitted at Dover, the basic idea goes back to the writings of Rev. William Paley and his *Natural Theology* of 1802.³³ Paley is famous for having proposed the analogy between the intelligent designer and a watchmaker as the major justification for inferring intelligent design in nature. He asked his readers to imagine themselves walking on a beach and looking at scattered pebbles. Surely they would not be surprised to find them, and they would rightly assume that natural processes are the cause of the pebbles' sizes and shapes. However, Paley says, imagine then that you stumble upon a watch. You immediately realize that this is not a natural object, that it

could not possibly have been the result of a natural process. You (correctly) infer that it must have been “intelligently designed” by a watchmaker.

If this sounds familiar, it is because Paley’s example is exactly analogous to Dembski’s “design inference”³⁴ applied to the figures sculpted on Mount Rushmore: in both cases we do in fact conclude that there was an intelligent agency, and not a natural process, at work. But why? The real answer should now be obvious to the reader: because we know lots of things about watches and sculptures, and in particular about watchmakers and sculptors. We know how they work and why, which is how we can recognize the products of their handiwork. But this, clearly, won’t do for proponents of intelligent design because they don’t want to admit anything about the designer and why or how she works (otherwise it would be obvious that they are talking about God). Hence Behe’s subterfuge of introducing the rather ambiguous concept of irreducible complexity.³⁵

Behe says that what watches, the faces on Mount Rushmore, and some biological structures have in common is that they could not possibly have come about by natural processes because they are made of a high number of parts that are supposed (designed) to work together: take any component out, and the whole falls apart. His favorite example of an irreducibly complex structure is the mouse trap³⁶ (hence the quote at the beginning of this chapter): exclude any part, and the trap stops working. Of course, the problem with the analogy is that mouse traps *are* unquestionably intelligently designed, and—again—we know much about the designers, their methods, and their intentions. (Moreover, and rather amusingly, John McDonald at the University of Delaware has actually produced a video showing that mouse traps are not, in fact, irreducibly complex, as one can obtain simpler and simpler mouse traps by taking out one part at a time while the trap continues to work—all the way down to just one component.³⁷ The only problem is that they become increasingly inefficient at catching mice!)

Now, since nature does not have forethought, then the only way to get irreducible complexity, according to Behe, is by intelligent design. To put it another way: just as half a watch isn’t any good at telling time, half an eye (Paley’s original parallel between manmade artifacts and biological structures) is not good either. Except, of course, that it is. It turns out that biologists have figured out, over the last several decades, how complex eyes can and did evolve: we now have evidence from the fossil record, from currently living organisms, and even from mathematical models³⁸

that half an eye is, well, half as good, but still a heck of a lot better than not seeing at all!

Behe knows about research on the evolution of the eye, which is why he doesn't use that old workhorse of Paley-style intelligent design. Instead, Behe retreats to the molecular level, which is more esoteric and much less familiar to the general public, suggesting that complex molecular structures and processes, from the bacterial flagellum to the blood-clotting biochemical cascade to the immune system, cannot possibly be explained by evolutionary theory. More on these examples in a moment, when we will take up Judge Jones's third and last conclusion about ID.

First, however, it is important to realize why the basic logic of irreducible complexity is flawed, regardless of specific examples. Essentially, Behe's and Dembski's idea is to prove a negative (evolution cannot produce a complex structure, particularly by means of natural selection) by arguing that there could not have been simpler intermediate structures (because of the "irreducibility" attribute). Since any naturalistic theory of evolution requires that complexity emerges gradually through intermediate, less complex steps, then pronto, we have "demonstrated" that evolution couldn't possibly happen, from which conclusion we then embrace the only other choice: (supernatural) intelligent design. Not so fast, says Judge Jones.

The judge pointed out that this sort of "reasoning" (to be very charitable) is the same "contrived dualism" that standard creationism suffers from. Contrived dualism is a logical fallacy wherein one is forced to make a choice between two alternatives, while in fact there are other possibilities that are being conveniently ignored. For example, a real estate agent who wants to sell you a particular house may try to present you with an "either you buy this one (because it is such an incredibly good deal) or you will not be able to find anything else" sort of argument. But of course in reality you do have the choice of looking at other houses in the same neighborhood or even of going to a different area of town (or of changing real estate agents). Analogously, the argument from irreducible complexity sets up a false dichotomy: either evolutionary theory can explain everything or ID is true. But a moment's reflection shows that there are several other possibilities: since all scientific theories are incomplete, any one of them may be unable to explain something at any given point in time, but not necessarily in the future. Or maybe the scientific theory in question really will be discarded eventually (many theories have suffered that fate

in the past), but a better theory will be produced without having to accept ID as the default alternative.

Moreover, evolutionary theory actually does have an explanation for apparently irreducibly complex structures: it involves the concept of “exaptation” (as opposed to adaptation), and it states that some structures evolve gradually at the same time as they are changing their function. Exaptation is a bit like reusing old stuff you have in your basement for new purposes, maybe while at the same time altering the object to better suit its new role (indeed, biologist and Nobel winner Francois Jacob made an analogy between evolution and “bricoleur,” the French word for tinkerer³⁹). For example, you may have an old TV stand with drawers, but you have now decided to spend more time reading books than watching TV. So you get rid of the television, and you are left with the stand; it occurs to you that it would actually serve as a decent chest of drawers for your bedroom, especially after you repaint it. Notice that the old structure (the TV stand) is not ideally suited to the new function (chest of drawers), but it will do well enough, and over time you can modify it to improve its new role (e.g., by painting it).

There are several documented examples of this type of process in biology, one of the most spectacular being the slow transition and modification of some bones from the jaw of ancient reptiles to the middle ear of their mammalian descendants. This sort of evolution is made possible by the fact that living organisms are redundantly complex, to use a term proposed by philosopher Niall Shanks and biologist K. H. Joplin.⁴⁰ Unlike irreducible complexity, redundant complexity is a situation in which many parts carry out many functions, and the system is messy enough (because it wasn't intelligently designed) that some parts can cease to function for a particular task and take on another one over time, without the system as a whole being disrupted in the process. This is what we would expect from complexity arising from a natural historical process, rather than originating from a superintelligent engineer.

We finally get to Judge Jones's last reason for why ID is not science: its negative attacks on evolution have actually successfully been rebutted by biologists, leaving ID with nothing to show for itself, either in the way of positive contributions to knowledge or as a serious critique of an accepted scientific theory. The trial transcripts provide fascinating in-depth discussions of each of the three major objections raised to the explanatory power of evolutionary theory by ID supporter Michael Behe: the bacterial

flagellum, the blood-clotting cascade, and the immune system. Behe's argument is that the structure of the flagellum (essentially a rotating whip used by some bacteria to move through fluids), the biochemical reactions of the blood-clotting cascade (which stop the bleeding after a skin cut in animals), and the details of the immune system's response are "textbook" examples of irreducible complexity and could not possibly have evolved through intermediate forms. Behe contends that a flagellum with some parts missing could not do its work at all, that skipping even one biochemical reaction in the blood-clotting cascade would lead to certain death, and that biologists have no idea of how the immune system could have originated from simple beginnings. How, then, could these systems possibly have evolved from earlier versions?

It turns out that Behe is simply wrong, and (possibly willfully) ignorant of the relevant literature. Plaintiff expert Kenneth Miller, a biochemist at Brown University (and the coauthor of the widely acclaimed biology textbook that the Dover School Board at one point refused to purchase), explained to the judge that there are, in fact, intermediate structures that preceded the evolution of the flagellum.⁴¹ For example, scientists have discovered that some bacteria use a subset of the same proteins in what is known as the type III secretion system. This structure is deployed by the bacterial cell not as a flagellum, but as an injection pump. The point is that here we have a precursor to the flagellum, parts of which could then have been used by bacteria to perform a different function, just like your former TV stand that becomes a chest of drawers.

Miller also explained in court about the blood-clotting cascade: in direct contradiction to Behe's assertions, the scientific literature shows that there are plenty of intermediates of the cascade.⁴² For example, dolphins and whales can clot despite missing an entire part of the biochemical mechanism found in other mammals. This is what the theory of evolution predicts we should observe, and it cannot be explained by ID.

Finally, Miller also brought to trial evidence from peer-reviewed scientific publications presenting hypotheses and empirical data on the evolution of the immune system.⁴³ A total of fifty-nine papers, nine books, and even several immunology textbooks were presented to Behe at trial in an attempt to make him admit that he was simply wrong about the alleged irreducible complexity of the immune system. His answer was that the evidence was "not good enough," though he did not elaborate on what could possibly be sufficient to make him acknowledge his mistake.

Behe was perhaps the most disastrous player for the ID camp at the Dover trial. Not only did he stubbornly refuse to admit that he was wrong when faced with overwhelming evidence of his own intellectual arrogance and ignorance of the literature; not only, as we saw earlier, has he admitted that by his criterion of science, intelligent design is on the same footing as astrology; but he made yet another monstrous blunder when questioned about design inference, the centerpiece of the ID position. As we have seen, this is the idea that when one observes certain artifacts—like a watch or the presidents' faces on Mount Rushmore—one can reasonably infer the existence of an intelligent designer who made those artifacts. As philosopher David Hume pointed out already in the eighteenth century, this argument won't cut it because of the same objections that Behe faced at Dover: human artifacts are not alive, do not reproduce, and are not subject to natural selection, so there is a disanalogy between human artifacts and living organisms. Behe's response to all of this was, and I quote, that the inference "still works in science fiction movies"!⁴⁴ What is really astounding is that these buffoons actually have gotten as far as having their day in court.

Our brief analysis of intelligent design shows that it is not science because it invokes the supernatural, in violation of the methodological naturalistic approach that has characterized science since Bacon, and in fact all the way back to Aristotle. ID also makes no positive prediction of its own, but relies instead only on negative arguments, implying that if an established scientific theory fails to explain a set of phenomena, then ID wins by default. But this, as we have seen, constitutes a gross logical fallacy. The conclusion is that intelligent design is simply a religious position, not substantially different from standard creationism, and it therefore should not be taught in public school science classes (*both* because it is religion *and* because it is bad science). All of this notwithstanding, let us remember once again that science does not and cannot pronounce itself on the truth of a metaphysical idea (such as the existence of God), something best left to philosophers and theologians; *there* lies the true distinction between science and religion.

We have so far explored the complex territory that encompasses solid science ("hard" or "soft" as it may be), quasi-science, and downright pseudoscience. In the final portion of the book we will deal with the so-called culture wars between science defenders and science critics, and will eventually arrive at exploring the questions of what makes one an expert and how can we tell whether we should trust her or not. Before that, however,

we need to take a detour and further solidify our understanding of science by looking at its origins and early developments, to be better equipped to grasp both its limits and potential. This is a story that began more than two and a half millennia ago and that has involved some of the most brilliant and largest intellectual egos humanity has ever produced. Someone should make a movie about it one of these days.