

The University of New Hampshire Law Review

Volume 4

Number 2 *Pierce Law Review*

Article 6


June 2006

Does Changing the Definition of Science Solve the Establishment Clause Problem for Teaching Intelligent Design as Science in Public Schools? Doing an End-Run Around the Constitution

Ann Marie Lofaso

American University, Washington College of Law

Follow this and additional works at: https://scholars.unh.edu/unh_lr

 Part of the [Constitutional Law Commons](#), [Curriculum and Instruction Commons](#), [Education Law Commons](#), [Elementary and Middle and Secondary Education Administration Commons](#), [History of Science, Technology, and Medicine Commons](#), [Religion Commons](#), and the [Science and Mathematics Education Commons](#)

Repository Citation

Ann Marie Lofaso, *Does Changing the Definition of Science Solve the Establishment Clause Problem for Teaching Intelligent Design as Science in Public Schools? Doing an End-Run Around the Constitution*, 4 *Pierce L. Rev.* 219 (2006), available at http://scholars.unh.edu/unh_lr/vol4/iss2/6

This Article is brought to you for free and open access by the University of New Hampshire – School of Law at University of New Hampshire Scholars' Repository. It has been accepted for inclusion in The University of New Hampshire Law Review by an authorized editor of University of New Hampshire Scholars' Repository. For more information, please contact ellen.phillips@law.unh.edu.

Does Changing the Definition of Science Solve the Establishment Clause Problem for Teaching Intelligent Design as Science in Public Schools? Doing an End-Run Around the Constitution

ANNE MARIE LOFASO*

I. INTRODUCTION

When Charles Darwin published *On the Origin of Species By Means of Natural Selection* in 1859, it sparked some of the most contentious debates in American intellectual history, debates that continue to rage today. Although these debates have numerous political ramifications, the question posed in this paper is narrow: Does the Establishment Clause permit a particular assessment of current evolutionary theory – intelligent design (“ID”) – to be taught as science in American elementary and secondary public schools?¹ This article shows that it does not.²

To understand current disputes over whether and how to teach the origins of life – including human life – in the science classes of public schools, it is necessary to understand both the legal and the scientific frameworks. I describe those general frameworks below in Part II. There I also show that Darwin’s theory of evolution meets the definition of science, an important step in showing that teaching evolution has a bona fide secular purpose as required by the Constitution. I also explain the relation-

* Anne Marie Lofaso is an Adjunct Associate Professor at American University’s Washington College of Law. She has an A.B. from Harvard University, where she studied History and Science, focusing on the history of evolutionary theories. She also has a J.D. from the University of Pennsylvania and a D. Phil. in Law from Oxford University. The author wishes to thank Dr. Seth Karp, Assistant Professor, Harvard Medical School, for engaging in numerous conversations regarding the scientific method. The author also thanks Rev. Joseph Pilsner, a Thomistic Scholar and author of *The Specification of Human Actions in St. Thomas Aquinas* for engaging in numerous conversations regarding Christian theology, St. Thomas Aquinas and Aristotle. In addition to Dr. Karp and Father Pilsner, the author wishes to thank Professor Jeff Hirsch, Michael Goen, Susan R. Lamb, Meera Trehan, William Yeomans, Jason Walta and Jim Heiko for their invaluable comments on an earlier draft of this article. The author also wishes to thank the American Constitution Society for Law and Policy for distributing an earlier draft of this article to its membership. Of course, all errors and views are the author’s.

1. This article does not fully examine the free speech implications of teaching intelligent design in public schools. For an excellent, in-depth discussion of that debate read Jay D. Wexler, *Intelligent Design and the First Amendment: A Response*, 84 Wash. Univ. L.Q. ___, nn. 100-08, nn. 138-57 and accompanying text (forthcoming).

2. This article leaves open the important legal question whether the current interpretation of the Establishment Clause is sound and the policy question relating to the type of church-state relationship we as a society should adopt.

ship between Darwin's theory and other explanations for the origins of life, such as creationism and classical versions of the design inference. I show, in particular, that neither creationism nor the design inference meets the definition of science, but belong rather to the religious domain.

In Part III, I examine the origins of the conflict between evolutionary theory and creationism. That debate centered around two questions: May states constitutionally prohibit public schools from teaching evolution because its account of human origins is antithetical to the account set forth in the *Book of Genesis*? If not, does the Establishment Clause of the First Amendment permit a state to insist that its schools provide a balanced treatment of creationism and evolution when presenting human origins theories? Examining the historical development of the Establishment Clause in this context illuminates the question whether the current "teach the controversy" dispute is a historical product of the past controversies involving creationists. Answering that question helps determine whether efforts by ID proponents have a constitutionally impermissible religious purpose.

In Part IV, I examine the modern theory of ID to determine whether it meets the definition of science. Again, answering that question helps to determine whether current efforts by ID proponents to "teach the controversy" have a secular purpose. I conclude that they do not, by showing that ID not only fails to meet the definition of science, but it also is linked to such famous proofs for the existence of God as St. Thomas Aquinas' fifth proof, and Bishop Paley's design inference.

In Part V, I examine one school board's solution to the constitutional problem – to change the definition of science. I conclude that the school board's actions are unconstitutional to the extent they are attempting to inject proofs for the existence of God into public school science classes.

And in Part VI, I draw some broad conclusions regarding the compatibility of theistic and scientific responses to origins of life inquiry.

II. LEGAL AND SCIENTIFIC FRAMEWORKS FOR UNDERSTANDING THE ONGOING DEBATE BETWEEN EVOLUTION AND DESIGN

A. *Legal Framework: The Establishment Clause Mandates Government Neutrality between Religion and Religion, and between Religion and Nonreligion*

The question whether and how human origins theories may be taught in public school science classes sharply implicates rights under the Estab-

lishment Clause of the First Amendment. That clause forbids the enactment of any “law respecting an establishment of religion.”³ This “fundamental concept of liberty” embodied in the First Amendment applies to the states through the Fourteenth Amendment,⁴ which includes public elementary and secondary schools.⁵ In this context, the considerable discretion normally afforded to state and local school boards in operating these public schools “must be exercised in a manner that comports with the transcendent imperatives of the First Amendment.”⁶

The “First Amendment mandates governmental neutrality between religion and religion, and between religion and nonreligion.”⁷ In *Lemon v. Kurtzman*,⁸ the Supreme Court developed a three-pronged test to determine whether state action runs afoul of the Establishment Clause.⁹ First, the act must have a bona-fide secular purpose.¹⁰ Second, the act’s principal or primary effect must be one that neither advances nor inhibits religion.¹¹ Third, the act must not result in an excessive entanglement of government with religion.¹² State action violates the Establishment Clause if it fails to satisfy any of these prongs.¹³ For more than three decades, the *Lemon* test has been used to determine whether state action violates the Establishment Clause – most recently to strike down a display of the Ten Commandments established by the Kentucky legislature.¹⁴ But as the Supreme Court observed in *McCreary County v. ACLU*, “Establishment Clause doctrine lacks the comfort of categorical absolutes,”¹⁵ thereby making *Lemon* a highly fact-intensive inquiry into the purpose and effects of state action.¹⁶

In recent years, lower courts reviewing disputes involving public school teaching of evolution have also applied the endorsement test. That

3. U.S. Const. amend. I.

4. *Cantwell v. Conn.*, 310 U.S. 296, 303 (1940); accord *Santa Fe Indep. Sch. Dist. v. Doe*, 530 U.S. 290, 301 (2000).

5. *Edwards v. Aguillard*, 482 U.S. 578, 582-83 n. 3 (1987).

6. *Tinker v. Des Moines Indep. Community Sch. Dist.*, 393 U.S. 503, 507 (1969); see *Bethel Sch. Dist. No. 403 v. Fraser*, 478 U.S. 675, 683 (1986); *Bd. of Educ., Island Trees Union Free Sch. Dist. No. 26 v. Pico*, 457 U.S. 853, 864 (1982).

7. *Epperson v. Ark.*, 393 U.S. 97, 104 (1968); see also *Wallace v. Jaffree*, 472 U.S. 38, 53 (1985); *Everson v. Bd. of Educ. of Ewing*, 330 U.S. 1, 15-16 (1947).

8. 403 U.S. 602 (1971).

9. *Id.*

10. *Id.* at 612.

11. *Id.*

12. *Id.* at 613.

13. *Edwards*, 482 U.S. at 583.

14. *McCreary County v. ACLU*, 125 S. Ct. 2722 (2005).

15. *Id.* at 2733 n. 10 (citing *Everson*, 330 U.S. 1).

16. Compare *id.* at 2727-45 (striking down state legislature’s display of Ten Commandments), with *Van Orden v. Perry*, 125 S. Ct. 2854, 2858-59, 2868-71 (2005) (upholding long-standing public display of Ten Commandments) (Breyer, J., plurality).

test, first articulated by Justice O'Connor in *Lynch v. Connelly*,¹⁷ clarifies that *Lemon*'s purpose prong "asks whether government's actual purpose is to endorse or disapprove of religion."¹⁸ It further clarifies *Lemon*'s effect prong, asking "whether, irrespective of government's actual purpose, the practice under review in fact conveys a message of endorsement or disapproval."¹⁹ The Court, in *Allegheny v. ACLU*,²⁰ later adopted the endorsement test, commenting that "the [Establishment] Clause, at the very least, prohibits government from appearing to take a position on questions of religious belief or from 'making adherence to a religion relevant in any way to a person's standing in the political community.'"²¹

Considering that the Supreme Court only adopted the endorsement test in 1989, it stands to reason that the endorsement test does not fully figure into the analysis of the only two anti-evolution cases reviewed by the Supreme Court, both of which predate *Allegheny*.²² Post-*Allegheny* courts have had no trouble applying the endorsement test to public school policies regarding teaching evolution. For example, in *Freiler v. Tangipahoa Parish Board of Education*,²³ the United States Court of Appeals for the Fifth Circuit invalidated a disclaimer required to be read to students before teaching them evolution, because the disclaimer had the primary effect of endorsing a particular religious viewpoint.²⁴ In *Cobb v. Selman*,²⁵ the district court, applying *Lemon* and the endorsement test, concluded that the "primary effect" of a school board's requirement that a sticker, warning that evolution is not a fact, be posted in the front cover of the compulsory biology textbook, was to "endorse religion."²⁶ And most recently, in *Kitz-miller v. Dover*,²⁷ the district court, applying the endorsement test, permanently enjoined a Pennsylvania school board from maintaining a policy requiring its biology teachers from reading a lengthy statement disclaiming

17. 465 U.S. 668 (1984) (O'Connor, J., concurring).

18. *Id.* at 690.

19. *Id.*

20. 492 U.S. 573 (1989).

21. *Id.* at 493-94 (citing *Lynch*, 465 U.S. at 687 (O'Connor, J., concurring)).

22. See *Edwards*, 482 U.S. 578 (striking down anti-evolution law as having religious purpose); *Epperson*, 393 U.S. 97 (striking down balanced treatment law as serving no identified secular purpose and promoting religion). Even so, the *Edwards* Court did invoke the endorsement concept, stating that "[i]f the law was enacted for the purpose of endorsing religion, 'no consideration of the second or third criteria [of *Lemon*] is necessary.'" 482 U.S. at 585 (quoting *Wallace*, 472 U.S. at 56).

23. 185 F.3d 337 (5th Cir. 1999).

24. *Id.*

25. 390 F. Supp. 2d 1286, 1301-03 (N.D. Ga. 2005), *vacated on other grounds and remanded*, 2006 WL 1428822 (11th Cir. May 25, 2006).

26. *Id.* at 1312.

27. 400 F. Supp. 2d 707 (M.D. Pa. 2005).

Darwin's theory of evolution as "not a fact," while promoting ID as an alternative explanation to Darwin's theory.²⁸

Here, we are interested in public school policies over teaching human origins in science classrooms. Teaching science in the science classroom presumably passes *Lemon's* first prong, because such conduct would have a secular purpose. By contrast, teaching something other than science in the science classroom is suspect, because it begs the question why an educator would inject nonscientific analysis into a science curriculum.²⁹ When the educator's reason has a religious purpose or religious effects, or has the purpose or effect of endorsing religion, it violates the Establishment Clause. In this context, it is essential to understand what constitutes science and the scientific method. To show that the explanation to be taught meets that definition goes a long way towards showing that its educational value is secular.

B. Scientific Framework

1. Bacon's Rejection of Supernatural Causes Ushers in the Modern Scientific Era

Sir Francis Bacon (1561-1626), a Cambridge educated lawyer, is commonly credited as the father of modern science. His *Novum Organum*, which introduced the scientific method of inductive reasoning through careful observation, ushered in the era of modern science.³⁰ Bacon's philosophy of science was revolutionary. He rejected Aristotle's four epistemological causes or explanations (material, formal, efficient, final), as failing to advance scientific knowledge.³¹ He also rejected superstition and

28. *Id.* at 708-10, 714-46, 766.

29. *See Wallace*, 472 U.S. at 56 (to survive an Establishment Clause challenge, the government action must have a "clearly secular purpose").

30. Sir Francis Bacon, *Novum Organum* Book 1, ¶ 19, 108 (Ency. Britannica, Inc. 1952).

31. In his *Physics*, Aristotle defined four causes to explain reality. The formal cause of something is its form, essence or kind. Its material cause is the matter out of which it is made, and which can exist only with its essence or formal cause. Its efficient cause is the means by which it came into existence; what made it and what changes it. And its final cause is its purpose, goal, or function. Aristotle, *Aristotle's Physics* Book 2, § 3, 28-30 (Richard Hope trans., U. of Neb. Press 1961). In Aristotle's view, humanity's final cause or ultimate purpose is the state of happiness. Aristotle, *Nicomachean Ethics* Book I, ch. 10 (Martin Ostwald trans., Bobbs-Merrill Co., Inc. 1962). Aristotle would agree that a person's efficient cause is his or her parents.

Of importance for this paper is Christianity's adoption of the Aristotelean four-causes paradigm through St. Thomas Aquinas, and in particular, Thomas' argument from design. By design, Thomas explains that God in Being is not merely the efficient or creative cause of all life but the intelligent creator of the order of the universe. In other words, Thomas makes a direct link between an intelligent cause and the order of the universe. *See infra* nn. 257-59 and accompanying text (discussing Thomas' fifth proof of the existence of God). I am indebted to Father Joseph Pilsner for helping me to understand this point.

supernatural causes as being epistemologically irrelevant – again, as failing to advance knowledge of natural phenomena.³² In these respects, he replaced the Aristotelian four-causes-paradigm for describing phenomena with the inductive method of searching for naturalistic explanations for natural phenomena through experience.³³

Although Bacon's rejection of supernatural causes and his inductive method serve as the cornerstone for modern science, the philosophy of science has advanced considerably since his time.³⁴ Indeed, even contemporaries of Bacon, such as Copernicus, Galileo, Kepler, Newton, Descartes and Leibniz did not practice science solely by induction, but instead were already attempting to learn about the natural world by testing working hypotheses against reality.³⁵ For example, one need only briefly examine the works of Newton to see that Newtonian physics owes as much to theory and testing as it does to inductive reasoning and observation. Certainly by the nineteenth century – the period that witnessed the rise of biology as a science³⁶ – scientists and philosophers of science understood the value of facts and theory, reasoning by induction and reasoning by deduction.³⁷ Darwin himself remarked in 1861, “[h]ow odd it is that anyone should not see that all observation must be for or against some view if it is to be of any service.”³⁸ And today philosophers of science generally agree that “facts alone do not explain [and] even argue . . . over the question whether pure facts exist at all.”³⁹

2. *The Modern Definition of Science*

a. *What Is Science?*

Science is the systematic study of the material universe and how it works. Science explains natural phenomena by reference to natural processes. In other words, science rejects supernatural explanations for reality.

32. Bacon, *supra* n. 30, at Book 1, ¶ 65, 114.

33. *Id.* at Book 1, ¶ 70, 116-17.

34. Among the important philosophers of science in Darwin's time were William Whewell, John Hershel and John Stuart Mill. Among those important thinkers of the twentieth century are Karl Popper and Thomas Kuhn.

35. Ernst Mayr, *This is Biology: The Science of the Living World* 26-27 (Belknap Press of Harvard U. 1997) [hereinafter Mayr, *This is Biology*].

36. In 1802, the French scientist Jean-Baptiste Lamarck (1744-1829) coined the scientific term “biology,” meaning the study of life. Lamarck is often credited with being the first to develop a full-fledged theory of evolution.

37. A full-scale historical account that traces the development of the philosophy of science and the development of the scientific method is beyond the scope of this article.

38. Mayr, *This is Biology*, *supra* n. 35, at 25 (quoting Darwin).

39. *Id.*; see generally William Whewell, *The Philosophy of the Inductive Sciences* (2d prt., Routledge Thoemmes Press 1996).

Science makes predictions about the natural world, and those predictions are capable of being proven untrue – falsifiable – through repeated testing against nature. Scientific explanations are tentative and always subject to revision through the scientific method.⁴⁰

b. *The Building Blocks of Science: Facts, Hypotheses, Laws and Theories*

Science uses facts, hypotheses, laws and theories to construct its body of knowledge. Scientific definitions of these terms do not necessarily comport with lay definitions. This is significant because incorrect use of these scientific terms can cause confusion about the role science plays in modern society. Moreover, these definitions take on legal significance in cases where creationists have misused them (especially the fact-theory distinction) to disparage evolutionary theory. Accordingly, it is instructive to define these terms before analyzing the definition of science and its method.

Facts are confirmed observations. For example, that there are twenty-three pairs of chromosomes in the human cell is a scientific fact. To rise to the level of scientific fact, the observation must be repeatedly confirmed. After numerous observations, scientists will stop testing the observation and consider it a fact. Of course, the veracity of that fact depends on the accuracy of the instruments of observation and measurements taken. For example, scientists once believed that humans had only twenty-two pairs of chromosomes. By using better cell staining techniques, we now know there are twenty-three pairs – a fact that has been repeatedly confirmed for half a century.⁴¹

Hypotheses are testable statements about the natural world, often couched in the form of “if . . . then” statements, that tend to explain the

40. See generally *McLean v. Ark. Bd. of Educ.*, 529 F. Supp. 1255, 1267 (E.D. Ark. 1982); *Amicus Curiae Br. of 72 Nobel Laureates et al.* (available at 1986 WL 727658), *Edwards*, 482 U.S. 578; *Amicus Curiae Br. of Natl. Acad. of Sci.*, *Edwards*, 482 U.S. 578 (available at 1986 WL 727667); Stephen Hawking, *A Briefer History of Time* (Random House Inc. 2005); Eugenie C. Scott, *Evolution v. Creationism* (U. of Cal. Press 2005); James D. Watson, *The Double Helix: A Personal Account of the Discovery of the Structure of DNA* (Kingsport Press, Inc. 1968); Anne Marie Lofaso, *The Constitutional Debate over Teaching Intelligent Design as Science in Public Schools*, Am. Const. Soc. for L. & Policy, http://www.acslaw.org/pdf/Intelligent_Design_White_Paper.pdf (Dec. 2005) (summarizing various definitions of science found in case law and case briefs); PBS, *Online Course for Teachers: Teaching Evolution*, http://www.pbs.org/wgbh/evolution/educators/course/session1/explain_b.html (accessed May 22, 2006) [hereinafter *Online Course for Teachers*].

41. See Scott, *supra* n. 40, at 12 (discussing what constitutes scientific fact); Natl. Acad. of Sci., *Teaching About Evolution and the Nature of Science*, <http://newton.nap.edu/html/evolution98/evol1.html> (accessed May 22, 2006) [hereinafter *Teaching About Evolution*]; *Online Course for Teachers*, *supra* n. 40.

relationship among two or more things.⁴² For example, this statement – if high levels of lead in children’s blood are associated with poor IQ scores, then children who live in environments with high lead levels should have lower IQ scores – is a hypothesis.⁴³ Scientists use hypotheses to build more complex inferences and explanations about the world. They do that by either disconfirming (i.e., rejecting) or confirming (as opposed to proving) the hypothesis through repeated testing. Tested hypotheses thereby build scientific explanations by eliminating incorrect approaches and encouraging further testing of confirmed approaches. Hypotheses cannot be supplanted by “ad hoc” hypotheses – explanations that merely explain way the particular anomaly and therefore are “incapable of generating new information, or of being tested empirically” – because such hypotheses “cannot stimulate research or expand scientific understanding.”⁴⁴

Scientific laws represent the highest level of scientific generalization. “A law identifies a class of regularities in nature from which there has been no known deviation after many observations or trials. It is often expressed mathematically.”⁴⁵ “Laws are extremely useful empirical generalizations: they state what, under certain conditions, will happen.”⁴⁶ Accordingly, laws are greatly “valued for their predictive capacity.”⁴⁷ An example of such a law is Mendel’s second law of independent assortment, which “tells us that traits are passed to offspring independently of one another.”⁴⁸ “For example, pea flower color passes independently from stem length.”⁴⁹ Moreover, the probability that offspring will have certain parental traits can be expressed mathematically. Nevertheless, Mendel’s second law does not hold when the genes for two traits are closely associated on the same chromosome, because there the genes generally cannot physically sort independently of one another.⁵⁰ Thus, while laws are valuable as predictive, generalized descriptions of phenomena, they do not explain phenomena. That is the unique role of scientific theory.

42. See Scott, *supra* n. 40, at 12-13 (discussing what constitutes scientific hypothesis); *Teaching About Evolution*, *supra* n. 41; *Online Course for Teachers*, *supra* n. 40; see also *Amicus Curiae Br. of Natl. Acad. of Sci.* at 7, *Edwards*, 482 U.S. 578 (defining hypotheses as “newly formulated . . . possible explanations of particular observed phenomena and are used as guides for exploring those phenomena and for generating tests by which the accuracy of the hypotheses can be verified or falsified”).

43. Scott, *supra* n. 40, at 12.

44. *Amicus Curiae Br. of Natl. Acad. of Sci.* at 7, *Edwards*, 482 U.S. 578. An example of an ad hoc explanation is where faith healers justify their inability to perform miracles in the presence of skeptics, who adulterate the conditions necessary to perform the healing; such explanation can never be tested because the healer can always blame failure on the skeptic’s presence.

45. *Id.*

46. Scott, *supra* n. 40, at 13-14.

47. *Amicus Curiae Br. of Natl. Acad. of Sci.* at 7-8, *Edwards*, 482 U.S. 578.

48. Scott, *supra* n. 40, at 13.

49. *Id.*

50. *Id.*

A theory, like the theory of evolution, “is a well-substantiated, overarching explanation of some aspect of the natural world that can incorporate facts, laws, inferences and tested hypotheses.”⁵¹ Such theory, or scientific explanation, has “yielded significant advances in understanding, has enabled scientists to order and explore a range of related phenomena, has survived repeated opportunities for disproof in the course of exploring its predictions, and has been supported by the gathering of substantial observational or experimental data.”⁵² Scientists use theories as provisional models for “explaining the nature of, and relationships within, an entire set of related phenomena.”⁵³ A theory remains “subject to modification to improve its ‘fit’ to relevant empirical facts.”⁵⁴ Nevertheless, “a theory is held with a high degree of confidence and is unlikely to be abandoned unless superseded by another model with greater explanatory force, which is capable of ordering, explaining and predicting observed phenomena at least as well as the existing theory, but is capable of generating more fruitful research problems or approaches.”⁵⁵

c. Methodological Naturalism – Rejecting Supernatural Causes for Explaining Phenomena

Science is “a process for systematically collecting and recording data about the physical world, then categorizing and studying the collected data in an effort to infer the principles of nature that best explain the observed phenomena.”⁵⁶ By engaging in such process, scientists have “consciously limited . . . the scope of scientific inquiry . . . to the search for naturalistic principles.”⁵⁷ Science thus proceeds by methodological naturalism, the requirement that scientists use only natural explanations to explain natural phenomena.⁵⁸

The conscious decision to limit scientific inquiry to natural or material causes, and thus, to eliminate supernatural causes, by definition, is not an arbitrary one. As is shown below, science “is not equipped to evaluate the

51. *Online Course for Teachers*, *supra* n. 40; see also Jerry Coyne, *The Faith That Dare Not Speak Its Name*, Aug. 22 & 29 *New Republic* 21-33 (2005) (defining theory as “a convincing explanation for a diversity of data from nature”); Scott, *supra* n. 40, at 13 (Theories explain laws and facts).

52. *Amicus Curiae Br. of Natl. Acad. of Sci.* at 7, *Edwards*, 482 U.S. 578.

53. *Id.*

54. *Id.*

55. *Id.*

56. *Amicus Curiae Br. of 72 Nobel Laureates et al.* at 23, 23 n. 29, *Edwards*, 482 U.S. 578 (citing *IIT Research Inst. v. U.S.*, 9 Cl. Ct. 13 (1985) (defining “science” as “the process by which knowledge is systematized or classified through the use of observation, experimentation, or reasoning”).

57. *Id.* at 23.

58. Scott, *supra* n. 40, at 50.

supernatural explanations for our observations.”⁵⁹ By eliminating supernatural causes from consideration, science does not necessarily reject the existence of supernatural causes. Accordingly, methodological naturalism is not philosophical naturalism, which claims that only material causes exist – there is no supernatural causes, no God.⁶⁰

d. *Scientific Explanations Make Predictions about the Natural World, Which are Capable of Being Proven Untrue – Falsifiable – through Repeated Testing Against Nature; Scientific Explanations are Always Tentative*

Science, as distinguished from other fields dedicated to acquiring knowledge, “requires the testing of explanations of the natural world against nature itself, and discarding those explanations that do not work.”⁶¹ Scientists thereby devote themselves “to formulating and testing naturalistic explanations for natural phenomena.”⁶² These explanations:

[G]enerate predictions about related phenomena, about the outcome of future activities or events, or about past occurrences. The predictive capacity of scientific explanations enables scientists to generate new applications of existing explanations. These predictions yield opportunities to test the accuracy of the scientific explanation in question and may result in the falsification of the explanation.⁶³

In addition to observation and logic, science uses experiments to test proposed explanations about the world.⁶⁴ Experiments hold constant or control various causal factors to test the affect of a particular explanation for a natural phenomena. In some tests, the variables are controlled by direct manipulation; in others, the variables are controlled statistically; in still others, the variables may be controlled by the environment itself. Tests conducted under these circumstances are known as direct experimentation. By contrast, indirect experiments are used where it is not possible to directly control the variables and the phenomena cannot be directly observed.⁶⁵ For example, physicists study subatomic particles that are too

59. Amicus Curiae Br. of 72 Nobel Laureates et al. at 23, *Edwards*, 482 U.S. 578.

60. Scott, *supra* n. 40, at 50.

61. *Id.* at 3; *see also* Amicus Curiae Br. of 72 Nobel Laureates et al. at 23, *Edwards*, 482 U.S. 578; Amicus Curiae Br. of Natl. Acad. of Sci. at 6, *Edwards*, 482 U.S. 578 (science is “commit[ed] to the testing of proposed explanations by means of empirical observation and experimentation.”).

62. Amicus Curiae Br. of 72 Nobel Laureates et al. at 23, *Edwards*, 482 U.S. 578.

63. Amicus Curiae Br. of Natl. Acad. of Sci. at 6-7, *Edwards*, 482 U.S. 578.

64. Scott, *supra* n. 40, at 5-7.

65. This discussion of experimentation is taken from Scott, *supra* n. 40, at 6-7.

small to observe. But by “applying knowledge about how particles behave, they are able to create indirect experiments to test claims about the nature of particles.”⁶⁶

The hallmark of science then is that its theories are “capable of disproof, . . . subject to being falsified. . . . If no test can be conceived that could prove a proposition wrong, it is not a proposition of science.”⁶⁷ For example, Newton’s laws are laws of science because they were formulated from empiric observation and confirmed by countless experiments. As our observational technology improved, it became clear that certain observations, most importantly the precession of the perihelion of Mercury, could not be explained by Newton’s laws. And so the search was on for an explanation, finally provided in the context of Einstein’s general theory of relativity. Importantly, this theory represents a complete paradigm shift in how gravity is understood.⁶⁸

With these frameworks in mind, I now turn to the question of whether evolutionary theory meets the definition of science.

C. Darwin’s Theories of Evolution are Science

1. Darwin’s Theory is a Composite of Several Theories, Each of Which Makes Predictions and is Falsifiable

Darwin’s theory of evolution is not one but five theories. As the late Harvard Professor of Zoology, Ernst Mayr, once explained: “There is one particularly cogent reason why Darwinism cannot be a single, homogenous theory: Organic evolution consists of two eventually independent processes, transformation in time and diversification in (ecographic) space.”⁶⁹ Mayr succinctly described those five theories:

- (1) *Evolution as such*. This is the theory that the world . . . is steadily changing and that organisms are transformed in time.

66. *Id.* at 7.

67. Amicus Curiae Br. of Natl. Acad. of Sci. at 6, *Edwards*, 482 U.S. 578. In the twentieth century, philosopher of science, Sir Karl Popper, explored the concept of falsifiability, concluding that “the criterion of the scientific status of a theory is its falsifiability, or refutability, or testability.” Karl Popper, *Conjectures and Refutations: The Growth of Scientific Knowledge* (Routledge & Keagan Paul, 1963) (reprinted at http://www.stephenjaygould.org/ctrl/popper_falsification.html). For Popper, while it is easy to find verification of most theories, “[e]very genuine test of a theory is an attempt to falsify it, or to refute it.” *Id.*

68. I am indebted to Dr. Seth Karp for helping me to understand the paradigm shift from Newtonian to Einsteinian physics.

69. Ernst Mayr, *What Makes Biology Unique?* 99 (Cambridge U. Press 2004) [hereinafter Mayr, *Unique*].

(2) *Common descent*. This is the theory that every group of organisms descended from a common ancestor and that all groups of organisms, including animals, plants, and microorganisms, ultimately go back to a single origin of life on Earth.

(3) *Multiplication of species*. This theory explains the origin of the enormous organic diversity. It postulates that species multiply, either by splitting into daughter species or by “budding,” that is, by the establishment of geographically isolated founder populations that evolve into new species.

(4) *Gradualism*. According to this theory, evolutionary change takes place through the gradual change of populations and not by the sudden (saltational) production of new individuals that represent a new type.

(5) *Natural selection*. According to this theory, evolutionary change comes about through the abundant production of genetic variation in every generation. The relatively few individuals who survive, owing to a particularly well-adapted combination of inheritable characters, give rise to the next generation.⁷⁰

Darwin’s theories meet the modern definition of science. Each theory indisputably relies on natural explanations for natural phenomena. Each makes predictions as well. For example, the theory of evolution or descent with modification predicts succession of forms and genetic lineages from ancestors to descendants. Despite the fact that the fossil record is biased against the fossilization of soft forms, such as tissue, in favor of bones and teeth,⁷¹ the fossil record evidences such evolutionary sequences, including an evolutionary sequence of humanoid bipedal ancestors who over time evolved larger brains, smaller teeth, and greater bipedal efficiency.⁷²

The theory of common descent similarly predicts such intermediate forms or “missing links,” such as reptile-like mammals, birds, and fish.⁷³

70. Ernst Mayr, *One Long Argument: Charles Darwin and the Genesis of Modern Evolutionary Thought* 36-37 (Harvard U. Press 1991) [hereinafter Mayr, *Long Argument*]; see also Mayr, *Unique*, *supra* n. 69, at 100-12; Ernst Mayr, *Toward a New Philosophy of Biology* 198-211 (Harvard U. Press 1988) [hereinafter Mayr, *New Philosophy*]. Jerry Coyne also describes those theories in lay terms in Coyne, *supra* n. 51.

71. Richard Cowen, *History of Life* 16 (4th ed., Blackwell Publ. 2005).

72. Coyne, *supra* n. 51.

73. Ernst Mayr, *What Evolution Is* 13-19 (Basic Books 2001) [hereinafter Mayr, *Evolution*] (discussing the completeness of fossil lineages between reptiles and mammals); see also *id.* at 14 (noting the 1861 discovery of *Archaeopteryx*, a primitive fossil bird exhibiting reptilian characteristics, thereby confirming the prediction that birds descended from reptiles); *id.* at 22 (noting fossil findings showing, among other things, common ancestors between cats and dogs, dogs and bears, and even among all carnivores). For a discussion of the most recent missing link, a transitional form between fish and

For example, the discovery of an early ant, fossilized in mid-Cretaceous amber, confirmed predictions of evolutionary entomologists that ants evolved from wasp-like ancestors.⁷⁴ More controversially, common descent predicts that the deoxyribonucleic acid (“DNA”) between humans and chimps would be very similar, thereby reflecting a relatively recent common ancestor. In fact, 98-99 percent of human and chimp DNA is identical.⁷⁵

Natural selection predicts changes in the genetic make-up of special populations tailored to environmental circumstances. In fact, last century witnessed the rise of antibiotic-resistant bacteria, DDT-resistant insects, and drug resistant viruses.⁷⁶ And the theories in combination accounts for many natural phenomena. For example, many organisms have vestigial organs; humans possess an appendix, which no longer serves its function of an intestinal pouch used to digest the hard-to-digest diets of our ancestors and indeed is nonadvantageous.⁷⁷ Other organisms show signs of adapting older forms to some new purpose that renders some survival advantage. For example, the anterior extremity of a walking mammal, such as a dog, shows modification for digging (moles), climbing (monkeys), swimming (whales), and flying (bats).⁷⁸

Significantly, each of these models is falsifiable as well. For example, the theory of evolution could be disproved by finding a constant (non-changing) fossil record. Common descent could be disproved by finding non-DNA-based life. Gradualism could be disproved by the sudden production of a new species type.⁷⁹ Speciation could be disproved by finding that DNA is perfectly copied from generation to generation and that variation is not possible by errors in replication or from environmental mitogens. Natural selection as the main mechanism for change could be falsified by finding that acquired traits in any species can be inherited.⁸⁰ And

reptile, see Edward B. Daeschler et al., *A Devonian Tetrapod-like Fish and the Evolution of Tetrapod Body Plan*, 440 *Nature* 757 (2006).

74. Mayr, *Evolution*, *supra* n. 73, at 25. When life is preserved in amber, which is fossilized tree resin, many soft parts survive. Cowen, *supra* n. 71, at 16.

75. Scott, *supra* n. 40, at ix-xiii.

76. Jerry Coyne, *supra* n. 51.

77. *Id.*

78. Mayr, *Evolution*, *supra* n. 73, at 26.

79. The literally sudden appearance of new species is not to be confused with the theory of punctuated equilibrium, which argues that evolutionary change within a phyletic lineage fluctuates between extreme rapid and normal or slow change. Such rapid change may in fact take hundreds of thousands of years but is often referred to as geologically instantaneous because it may appear suddenly relative to the Earth’s age of approximately 5 billion years.

80. This inheritance of acquired traits is known as soft inheritance as opposed to inheritance through genes and genetic mutations, known as hard inheritance. See *infra* nn. 113-16 and accompanying text.

several theories are disproved by finding fossils in a time before or after their expected period, or in places that could not be explained.⁸¹

Darwin also employed the scientific method to come up with and test his theories. In particular, it is well-documented that Darwin devised his theories through careful observation over a number of decades.⁸² And, in fact, many of Darwin's theories arise from his rejection of other working theories. For example, Darwin entered his famous voyage on the H.M.S. Beagle in 1831 believing in the fixity of species. But his careful observation shook that belief and led him by July 1836 to "suspect [there] are varieties," that if true "would undermine the stability of species."⁸³ When in 1837 he showed some "varieties" of mockingbirds found on the Galapagos Islands (off South America) to a well-respected ornithologist, who insisted that the varieties were actually different species, Darwin came up with the idea of geographic speciation – the theory that a new species can develop when one population becomes geographically isolated from the rest of the population.⁸⁴ These mockingbirds also provided insight for his theory of common descent, because Darwin knew that the varieties were related to an ancestral species on the South American continent.⁸⁵ Significantly, Darwin's theories also grew out of his rejection of the design inference. And of equal importance is that Darwin and others further tested Darwin's theories even after Darwin settled on these theories for purposes of publication in 1859. As shown below, after Darwin's death in 1882, each of these theories continued to undergo extensive scientific testing and, in many cases, revision based on new evidence.

81. As easy as it is to imagine falsifying evolutionary theory it is difficult to imagine a theory that would falsify the existence of a supernatural creator of life. In particular, the omnipotence of the supernatural force easily accounts for any older-than-expected fossil finding. The proponent of the supernatural force need only state that the force willed the fossil record to be a certain way. If the force is powerful enough to create life, it is certainly powerful enough to create life at any particular time it wishes.

82. See e.g. Mayr, *Long Argument*, *supra* n. 70, at 1-34.

83. *Id.* at 5.

84. *Id.*

85. *Id.* at 21; Mayr, *Unique*, *supra* n. 69, at 100-02.

2. *Although Darwin's Theories Challenge Long-held Ideologies, the Scientific Community Quickly Comes to Accept Those Theories on the Strength of Their Explanatory Power*

a. *Overview – Darwin's Theory Challenges Traditional Christian and Entrenched Philosophical Views*

Darwin's theories seriously challenged long-held religious ideologies. The Darwinian paradigm – which views the world in constant flux and posits that all living creatures have a common ancestor – challenges the belief in a constant world created by a wise and benign Creator, who made humans in His image and with a soul, something animals do not possess.⁸⁶ If animals and humans have a common ancestor, why don't animals have a soul? If, according to *Genesis*, God separately created all the living plants on day 3, fish and birds on day 5, terrestrial animals and humans on day 6, then how can all living creatures gradually have evolved from a common ancestor? These and other questions pose problems for the creationist who believes in a literal interpretation of *Genesis*, which defines God the Creator – the ultimate efficient cause of life. The Darwinian paradigm also challenges the nature of that Creator, by replacing humanity's purpose-driven, final cause – God – with a non-teleological mechanism for change – natural selection.⁸⁷

The Darwinian paradigm also challenged entrenched nineteenth century philosophical ideologies of essentialism, physicalism, and vitalism. Intellectual thinkers of Darwin's time, including his own Cambridge tutors, believed that all matter had a constant, ideal essence (essentialism) or Platonic type.⁸⁸ In biological terms, this translated into the idea of the fixity of species, "according to which each species is characterized by its unchanging essence (*eidos*) and separated from all other species by a sharp discontinuity."⁸⁹ Darwin's theory, by contrast, depends on individual variation on which natural selection worked to effect change. For Darwin, there are no ideal types – only groups of unique individuals comprising populations of species.⁹⁰

86. Mayr, *Long Argument*, *supra* n. 70, at 38-39. Mayr separates this into the following four beliefs: (1) belief in a constant world; (2) belief in a created world; (3) belief in a world designed by a wise and benevolent Creator; and (4) belief in the unique position of humans in creation. *Id.*

87. *Id.* at 39.

88. Mayr, *Evolution*, *supra* n. 73, at 74. For further explication of type theory, see Plato's Cave Allegory in *The Republic*, Book VII.

89. Ernst Mayr, *The Growth of Biological Thought: Diversity, Evolution, and Inheritance* 255-56 (Belknap Press of Harvard U. Press 1982).

90. Mayr, *Long Argument*, *supra* n. 70, at 40-42.

Darwin's theories also challenged the prevailing ideas of the physical scientists of Darwin's time. Physicalists, as they were known, believed that life could be described in mechanistic terms so precise that all life could be captured by natural laws described in exact mathematical equations.⁹¹ In fact, the most extreme form of physicalism, captured in Julien Offray de La Mettrie's (1709-1751) *L'homme machine* (1749), translated "man a machine," essentially describes humans in purely material and mechanistic terms. Insofar as Darwin's theories rely on natural causes to explain natural phenomenon, they are compatible with the materialistic world view of the physicalists. Darwin's theories, nevertheless, challenged the physicalists' emphasis on describing the world in terms of nineteenth century mathematics. In particular, Darwin's theory of natural selection on populations of unique individuals introduced such alien mathematical concepts as chance and probability theory to biology.⁹² Although the mathematical concepts of chance and probability can explain phenomena with great predictive power, those concepts (nascent in the late nineteenth century) were difficult for turn-of-the-century thinker to grasp.⁹³

Most obviously, the Darwinian paradigm challenged that time's prevailing opposition to physicalism, known as vitalism. By contrast with physicalists, who had a mechanistic view of human behavior, vitalists claimed that there exists a teleological vital or life force that makes living organisms uniquely different from inorganic matter.⁹⁴ Vitalists, with their emphasis on a teleological life force, opposed Darwin's theory of evolution by natural selection, which was mechanistic and nonteleological.⁹⁵

b. Darwin's Theories Also Respond to Defects Found in Paley's Argument from Design

Perhaps the most drastic paradigm shift for nineteenth century theologians and philosophers then was the shift from a teleological to a non-teleological world view. Nineteenth century thinkers believed in the existence of God the Creator or efficient cause of life. For Christians, that cause was also a final cause – God, who designed the world and all living things for humanity's purpose. The Christian God in particular is a final cause for human beings, who in Christian tradition have a special relation-

91. For a brief history of the development of physicalism, see Mayr, *This is Biology*, *supra* n. 35, at 3-8.

92. Mayr, *Long Argument*, *supra* n. 70, at 48-59.

93. Mayr, *Unique*, *supra* n. 69, at 112-13.

94. For a brief history of the development of vitalism, see Mayr, *This is Biology*, *supra* n. 35, at 8-16.

95. *Id.* at 12.

ship with God and who find their ultimate perfection in God.⁹⁶ Darwin described the world without the need to resort to a Creator (or efficient cause), and without resort to a final cause. For Darwin, natural selection acted on random variation to transform species, one branch of which evolved into modern-day humans. In other words, Darwin's theory implied a world not necessarily envisioned or planned by God.

By contrast, the design inference contends that the world and all reality (seen and unseen) is the product of an intelligent designer, which can be inferred by observing nature: Design is observable in nature. Design implies a designer. That designer must be God. Bishop William Paley (1743-1805), the Cambridge educated Anglican priest and one of the best known proponents of design, famously articulated a teleological version of the argument – that naturally observable design implies an intelligent designer with purpose:

There cannot be design without a designer; contrivance without a contriver; order without choice; arrangement without anything capable of arranging; subservience and relation to a purpose without that which could intend a purpose; means suitable to an end, and executing their office in accomplishing that end without ever having been contemplated or the means accommodated to it. Arrangement, disposition of parts, subservience of means to an end, relation of instruments to a use imply the presence of intelligence and mind.⁹⁷

Bishop Paley used the analogy of God the watchmaker to explore the central premise of his argument – that the nature of God could be understood by observing His creation, the natural world:

When we come to inspect the watch, we perceive . . . that its several parts are framed and put together for a purpose, e.g., that they are so formed and adjusted as to produce motion, and that motion so regulated as to point out the hour of the day; that if the different parts had been differently shaped from what they are, or placed after any other manner or in any other order than that in which they are placed, either no motion at all would have been carried on in the machine, or none which would have answered the use that is now served by it. . . . the inference we think is inevitable, that the

96. St. Thomas Aquinas, *Summa Theologica* I-II, Q. 2, art. 8; I-II, Q. 6, art. 2; II-II, Q. 23, art. 1 (Paul E. Sigmund ed. & trans., 1988) (translation also available online at <http://www.ccel.org/a/aquinas/summa/FP/FP002.html#FPQ2A3THEP1>)

97. William Paley, *Natural Theology* ch. 2, 11 (1802) (available at <http://www.hti.umich.edu/cgi/pd-modeng/pd-modeng-idx?type=HTML&rgn=TEI.2&byte=53049319>).

watch must have had a maker – that there must have existed, at some time and at some place or other, an artificer or artificers who formed it for the purpose which we find it actually to answer, who comprehended its construction and designed its use.⁹⁸

Bishop Paley's design argument, like all design arguments, patently depends on the truth of the initial postulate – that design, or at least order, exists. If his observation – design exists – is untrue, then Paley's argument fails. But most if not all biologists, including Darwin, agree at a minimum that order in the natural world exists. Indeed, order is measurable and subject to scientific inquiry.

More importantly, design theory also hinges on the argument that design implies a particular designer. As Bishop Paley stated, once design is discerned in nature, “the inference . . . is inevitable, that the watch must have had a maker.” But that argument fails as a scientific matter if the inference itself is untrue or even unknowable. Accordingly, the interesting question for those interested in the origins of life is not whether order exists, but whether such order implies a designer and whether that inference is observable, testable, and falsifiable through the scientific method.

Darwin's doubts about design lie in the inference of design, not in the observable fact of natural order. Darwin was trained at Cambridge in natural theology, a school of thought committed to design theory. Darwin was also a keen observer of nature. During his famous voyage, Darwin observed anomalies in “God's design,” which led him to abandon teleological thinking by the 1850s in favor of non-purpose driven natural selection.⁹⁹ Darwin's meticulous observations led him to discover increasingly more evidence that cast doubt on design theory, thereby emancipating him from the design ideology. For example, all the evidence Darwin found in favor of common descent cast doubt on design. Darwin also considered the existence of vestigial organs and extinction – both “anomalies” in a designed universe.¹⁰⁰

Darwin's theory of natural selection, coupled with his consideration of the many anomalous data that cast doubt on the design inference, enabled him to abandon design¹⁰¹ – not because he had falsified it, but because he

98. *Id.* at ch. 1, 2.

99. Mayr, *Long Argument*, *supra* n. 70, at 58-59; Mayr, *New Philosophy*, *supra* n. 70, at 237. Although Darwin's conception of natural selection was non-purpose-driven, natural selection is not an inherently nonteleological concept. For example, Asa Gray believed that natural selection was guided by God, a concept Darwin himself outright rejected. Mayr, *Long Argument*, *supra* n. 70, at 59. And T.H. Huxley, one of Darwin's greatest defenders, described Darwin's theory as teleological. *Id.*

100. Mayr, *New Philosophy*, *supra* n. 70, at 239.

101. *Id.* at 239 (citing Charles Darwin, *The Autobiography of Charles Darwin, 1809-1882* (1887)).

no longer had faith in the inference.¹⁰² Darwin's theory of natural selection is essentially a rejection of supernatural causes for life's origins, thereby bringing the study of life's origins within the domain of modern science. Before Darwin, that question simply was not a question for modern science. As Professor Mayr, expressing the thoughts of one nineteenth century scientist, explained:

To postulate teleological forces . . . is in conflict with the basic principle of science, not to invoke occult forces, as long as one can interpret things by known forces. 'For what else is science but the attempt to determine the causal mechanisms by which the phenomena of the world are caused.'¹⁰³

In essence, Darwin's theories posed problems for those nineteenth century thinkers, perhaps especially Christians, who tended to view the world in terms of Aristotle's four causes. By rejecting all supernatural causes, Darwin's *On the Origin of Species* turned the well-accepted world view on its head overnight.¹⁰⁴

c. *The Scientific Community Accepts Darwin's Theories*

As explained above, Darwin's theories challenged the main philosophical traditions of his time and culture – essentialism, physicalism, and vitalism. Nevertheless, biologists were relatively quick to accept the basic ideas behind Darwin's theories. As Professor Mayr points out, “[w]ithin fifteen years of the publication of the *Origins* hardly a qualified biologist was left who had not become an evolutionist.”¹⁰⁵

Darwin's theoretical framework for biology ushered in a new philosophy of biology that replaced the ideas of physicalism and vitalism with the philosophy of organicism. Holists or organicists came to agree that “no system can be exhaustively explained by the properties of its isolated components;” rather the unique characteristics of living organisms resulted primarily from their organization.¹⁰⁶ Holists also came to agree that physicochemical mechanisms, which could explain molecular process, played an insignificant role at higher levels of integration, and replaced instead by

102. For a modern account of the evidence against design, see Kenneth R. Miller, *Finding Darwin's God: A Scientist's Search for Common Ground between God and Evolution* 57-128 (HarperCollins Publishers 1999); see generally Richard Dawkins, *The Blind Watchmaker: Why the Evidence of Evolution Reveals a Universe without Design* (W.W. Norton & Co. 1996).

103. Mayr, *New Philosophy*, *supra* n. 70, at 242.

104. See *supra* n. 32 and accompanying text.

105. Mayr, *New Philosophy*, *supra* n. 70, at 21; Mayr, *Unique*, *supra* n. 69, at 112.

106. See Mayr, *This is Biology*, *supra* n. 35, at 19 (quoting Alex Novikoff (1947)).

the emerging characteristics of the organized system.¹⁰⁷ As such, organicists rejected reductionism, whereby physicalists sought to explain nature in terms of its smallest components.¹⁰⁸ And by rejecting reductionism, the holist no longer regarded “living organisms as machines made of a multitude of discrete parts (physico-chemical units), removable like pistons of an engine and capable of description without regard to the system from which they are removed.”¹⁰⁹ Organicism also rejects vitalism by adhering to the idea that the system is not “mysteriously closed to analysis but that it should be studied and analyzed by choosing the right level of analysis.”¹¹⁰ Organicism later incorporated the concept of “emergence – that in a structured system, new properties emerge at higher levels of integration which could not have been predicted from a knowledge of the lower-level components.”¹¹¹

Organicism, with its rejection of reductionism and emphasis on emergent evolution, thus paved the way for the modern conception of evolution, known as the Modern Synthesis, a grand theory that integrates Darwin’s theories, especially natural selection, with Mendelian genetics and population mathematics.¹¹² Professor Mayr, one of the most important scientists involved in the Modern Synthesis, described it as a

period . . . not . . . of great innovations but rather of mutual education. Naturalists who had not known it before learned from the geneticists that inheritance is always ‘hard,’ never soft. There could be no heritable influence of the environment, no inheritance of acquired characteristics.¹¹³

Naturalists also learned that genetics was Mendelian in character, following Mendel’s law, rather than a blending of characteristics.¹¹⁴ Acceptance of Mendelian genetics paved the way toward rejecting the three competing

107. *See id.* at 16.

108. *See id.* at 17.

109. *See id.* at 18 (quoting Alex Novikoff (1947)).

110. *See id.* at 20.

111. *See id.* at 19.

112. General acceptance of Darwin’s theories, known as the Modern Synthesis, came in two phases. First is the synthesis of Darwin’s theories with Mendelian genetics to a core discipline of population genetics. Second is the linking of several traditional subdisciplines in biology. While a thorough examination of the Modern Synthesis is beyond the scope of this paper, an excellent account of it can be found in Stephen Jay Gould, *The Structure of Evolutionary Theory* 503-91 (Belknap Press of Harvard U. Press 2002). For a user-friendly explanation of the evidence supporting the evolutionary theories, including an analysis of the fossil record and a modern explanation of the debate surrounding gradualism, *see* Miller, *supra* n. 102, at 57-164.

113. Mayr, *New Philosophy*, *supra* n. 70, at 525-26. August Weismann is credited with refuting the neo-Lamarckian theory of acquired characteristics by establishing that inheritance is “hard” and with invalidating blending inheritance by establishing particulate inheritance. *Id.* at 491-524.

114. *Id.* at 525-26.

theories to Darwinian evolution: (1) neo-Lamarckian theories of acquired traits; (2) autogenetic theories based on a belief in a built in drive toward evolutionary progress; and (3) saltation theories, which posited the sudden appearance of radical new life forms.¹¹⁵ By rejecting these theories, the Synthesis reaffirmed natural selection as the main mechanism for adaptive evolutionary change.¹¹⁶

For the Modern Synthesis to gain acceptance, not only did naturalists have to learn genetics, but geneticist had to learn from naturalists about population thinking, the role of geographic isolation, and the individual as the unit of selection. Accordingly, the Synthesis is not merely the application of Mendelian genetics to Darwin's theory of evolution. Rather, naturalists brought geographical thinking into the Synthesis, which helped to explain speciation, the multiplication of species through geographic isolation or some other isolating mechanism.¹¹⁷ Naturalists also displaced the strictly reductionist view of most geneticists with the more holistic view that evolution is not merely a change in gene frequency but a process that acts on individuals within a population.¹¹⁸

D. Summary

In sum, Darwin's theories of evolution – evolution, common descent, gradualism, multiplication of species, and natural selection – are now commonly accepted by the scientific community, because they have withstood 150 years of repeated challenges. Evolution and common descent were quickly accepted. By contrast, gradualism (which depends on population thinking, a concept foreign to nineteenth century scientists) was and remains difficult for most scientists to grasp.¹¹⁹ Indeed, an understanding of population thinking remains at the core of the debate surrounding punctuated equilibrium. Today, speciation is accepted, but the mechanisms for speciation remains controversial.¹²⁰ Finally, natural selection is firmly accepted by today's scientists, who assign a greater role to chance than Darwin did. For the modern biologist, “[c]hance plays a role not only during the first step of natural selection, the production of new, genetically unique individuals, but also during the probabilistic process of the determination of reproductive success of these individuals.”¹²¹

115. *Id.* at 526.

116. *Id.* at 527.

117. *Id.* at 529.

118. *Id.* at 530.

119. Mayr, *Unique*, *supra* n. 69, at 112-13.

120. *Id.* at 113; Mayr, *New Philosophy*, *supra* n. 70, at 211-12.

121. Mayr, *New Philosophy*, *supra* n. 70, at 212.

Darwin's theories also challenged the main religious views of his time and culture – Christianity. I discuss how that conflict played out in the United States in the following section.

III. THE INITIAL CONFLICT BETWEEN EVOLUTION AND RELIGION
DEFINED: DEVELOPMENT OF ESTABLISHMENT CLAUSE JURISPRUDENCE
CONCERNING THE QUESTION WHETHER AND HOW HUMAN EVOLUTION
MAY BE TAUGHT IN PUBLIC SCHOOLS

A. *Overview: Defining the Conflict between the Scientific Theories of Evolution and Religious Beliefs*

*[While] it is the job of science to explain the material contents of the universe and how it works, and the task of religion to explore the spiritual and moral side of human existence, it nonetheless remains as true today as it was in the nineteenth century that a literal reading of Genesis (with its two and a half non-identical accounts of the origin of the Earth, life, and human beings) does not readily match up with the scientific account.*¹²²

There is no inherent conflict between the pursuit of knowledge through the study of science and the pursuit of knowledge through the study of religion because these two fields of knowledge occupy different realms. Pope John Paul II himself seemed to recognize this when, in the context of discussing whether scientific conclusions regarding human origins seem to contradict the *revealed truth*, he said, “truth cannot contradict truth.”¹²³

Exclusivity between the scientific and religious realms is more readily apparent when examined from the lens of scientists, who have expressly and intentionally limited their field to the study of the material universe (matter, energy and their interaction), by using natural explanations for elucidating the universal structure and how it functions.¹²⁴ In this way, scientists study only material phenomena that can be directly or indirectly observed.¹²⁵ Scientists also employ the scientific method, which overtly eliminates from consideration supernatural explanations for observable

122. Niles Eldredge, *Foreward: The Unmetabolized Darwin*, in Scott, *supra* n. 40, at x.

123. Pope John Paul II, *Truth Cannot Contradict Truth: Address of Pope John Paul II to the Pontifical Academy of Sciences* ¶ 2, http://www.newadvent.org/library/docs_jp02tc.htm (Oct. 22, 1996) (citing Leo XIII, encyclical *Providentissimus Deus*).

124. Scott, *supra* n. 40, at 3.

125. For example, scientists may not be able to directly observe the behavior of certain subatomic particles but they can observe the effects of such particles, and thereby making them an appropriate subject of scientific inquiry. *See also id.* at 50.

phenomena, thereby leaving supernatural explanations to the realm of religion. As discussed above, this method for exploring the world is known as methodological naturalism. Moreover, scientific conclusion can be said never to contradict any religious explanation; after all, science expressly declares that its conclusions are tentative and subject to revision.

By contrast with science, which concerns itself solely with natural explanations for the natural world, theologians, at least Christian theologians, concern themselves with not only the material world, but with “all things visible and invisible.”¹²⁶ Moreover, unlike scientists, who always view their conclusions as tentative and subject to revision, theologians view their conclusions as final – the truth.¹²⁷ Despite assurances from scientists that scientific knowledge is always tentative, theologians are more likely to view scientific knowledge that does not readily square with scripture as threatening. Conflict becomes inevitable.

Given the absolutist position that Christianity takes regarding truth, conflict arises when members of the religious community view a scientific explanation for a material reality as challenging an established religious explanation for the same reality.¹²⁸ The famous conflict between Pope Paul V and Galileo Galilei (1564-1642) is illustrative. Throughout the Middle Ages, the Church held to a geocentric (Earth-centered) view of the universal structure. That view was grounded in the astronomy of Aristotle and Greek mathematician Claudius Ptolemy (85-165 CE born in Egypt).¹²⁹ The geocentric theory remained unchallenged for about 1400 years, when in 1543 Nicolaus Copernicus (1473-1543) presented the heliocentric (sun-centered) theory, published on his deathbed.¹³⁰ When Galileo, using his powers of observation, newly magnified by technological advances, declared that the planets orbit the sun – not the Earth – he thereby presented confirming evidence of Nicolaus Copernicus’ heliocentric theory. More importantly to members of the Roman Catholic Church, Galileo’s evidence also challenged the established Christian view of a geocentric universe. The Pope declared Galileo’s theory heresy, because it challenged the established Christian view.

126. See Antiochian Orthodox Church, *The Nicene-Constantinopolitan Creed*, <http://www.antiochian.org/674> (accessed May 22, 2006).

127. For example, many religions and religious denominations take the position that the fullness of truth can only be found in their own theological tradition.

128. The reason for this is obvious – science, by definition, rejects a supernatural explanation for a natural phenomenon. For this reason, a survey of the history of science reveals many “religious” scientists maintaining their faith, even when persecuted by their own established religion.

129. Ptolemy presented his theories in the *Almagest* (published around 150 CE).

130. Nicolaus Copernicus, *De Revolutionibus Orbium Coelestium (On the Revolutions of the Heavenly Spheres)* (1543) (available at <http://webexhibits.org/calendars/year-text-Copernicus.html>).

Applying this view to the particular question of human evolution, it should become clear that, although there is no inherent conflict between the scientific and the religious explanations, conflict would be inevitable. The Judeo-Christian explanation for human origins – that God created the Earth and every living thing on the Earth – is not a scientific theory, law, hypothesis, or fact. Rather, it is a supernatural explanation for the observable phenomena that the Earth exists and that diverse life on Earth exists. No scientific theory, law, hypothesis, or fact – not even Darwin's theory of evolution by natural selection – contradicts that explanation. Nor does any scientific theory, law, hypothesis, or fact support that explanation. At most, we can say that a scientific theory, law, hypothesis, or fact is consistent with the monotheistic world of the Judeo-Christian tradition or even the polytheistic world of the ancient world.

Similarly, there is no necessary conflict between common descent and creationism or the Christian tradition, more broadly. Although common descent appears to refute the idea that humans are unique because they were separately created by God, common descent says nothing, for example, about ensoulment – the entry of the soul into the body. And if evolutionary theory is silent on ensoulment, then it cannot speak authoritatively on human uniqueness, at least in that regard.

Some conflict does arise, however, in the details. For example, the Christian view of creation was at some point based on certain views about the Earth's age that eighteenth century geology as well as Darwin's theory of evolution contradicted. In the mid-seventeenth century, two Christian clergymen calculated that God created the Earth on October 23, 4004 BCE.¹³¹ These calculations were claimed to be based on strict interpretation of scripture as revealed in the Bible. When scientists, such as British geologist Charles Lyell (1797-1875), uncovered evidence that contradicted the strict creationist view that the Earth was created about 6,000 years ago, conflict over that particular fact became inevitable. Darwin, based on the thinking of geologists such as Lyell, posited that life on Earth was several billion years old, a theory consistent with the established scientifically tested age of the Earth.¹³² Assuming the clergymen properly calculated the Earth's age, the scientifically calculated Earth's age (and Darwin's theory, which estimated the age of organic life) at most jeopardizes a literal inter-

131. In his book *Annales Veteris Testamenti, a Prima Mundi Origine Deducti* ("Annals of the Old Testament, Deduced from the First Origins of the World"), published in 1650, Bishop James Ussher, Archbishop of Armagh, Primate of All Ireland, and Vice-Chancellor of Trinity College in Dublin, calculated that God created the Earth on October 23, 4004, BCE. Dr. John Lightfoot, an Anglican clergyman, rabbinical scholar, and Vice-Chancellor of the University of Cambridge, made a similar calculation.

132. Mayr, *New Philosophy*, *supra* n. 70, at 193. For an excellent, user-friendly summary of the geological evidence against young Earth creation-science, see Miller, *supra* n. 102, at 57-80.

pretation of Judeo-Christian scripture, a view only a minority of contemporary believers actually take.

A seemingly deeper philosophical conflict is also present between evolution and a strictly literal interpretation of the Bible. The Christian view of creation was based on certain views about the nature of life's diversity, in particular, that God created diverse life in its present form. As explained above, Darwin's theory of evolution directly contradicts that view, breaking with the ancient philosophy of essentialism and the fixity of species. Again, there is no necessary conflict between evolution and creationism. After all, God could have created the world in such a way that life would evolve. And indeed, faced with overwhelming evidence of evolved life, many modern creationists (including, as we shall see, many proponents of the modern ID movement) willingly concede that at least some evolution of life occurs and that the scientific explanation for, say, antibiotic-resistant bacteria, casts no doubt on their belief in God the Creator.¹³³

But the theories of evolution (in particular, natural selection and common descent) posed several greater challenges for creationists. For example, even if a creationist accepted the idea that evolution and creation could co-exist by positing that God created an evolving world, evolution still challenged the deeply entrenched Christian views that God created the world for humanity's purpose and that God created people in God's image. In other words, evolution's non-teleological basis, grounded primarily in natural selection as its mechanism for change, conflicts with the teleological Christian view. This conflict is not readily resolvable. And indeed, it remains a common complaint of modern ID proponents.

Accordingly, the conflict between evolution and creationism was not inevitable, even if it was foreseeable. And so, as shown below, the theory of evolution spawned one famous trial and two cases ultimately decided by the United States Supreme Court. Careful examination of these cases ultimately shows that the ID movement's current attacks on evolutionary theories are historically connected to those earlier creation-science attacks, and serve, as a constitutional matter, to taint the ID movement.¹³⁴

133. The literature often distinguishes between microevolution, the theory that a particular species may change in response to environmental factors, but remain essentially the same; and macroevolution, the theory that life can transform from one species to another over time. Good examples of microevolution are the ever-evolving antibiotic resistant bacteria, and the domestication or breeding of subspecies of animals. Both are also good examples of intelligent design, as an intelligent force, namely people, direct the changes over time through breeding.

134. See generally Wexler, *supra* n. 1, at nn. 51-69 and accompanying text.

B. *Anti-Evolution Laws, Which Forbid Teaching Any Theory Antithetical to the Biblical Creation Story, Are Eventually Declared Unconstitutional*

1. *Scopes: Tennessee Supreme Court Declares Anti-Evolution Act Constitutional Under the Establishment Clause Because, in Its View, the Act is Religiously Neutral and Has No Religious Purpose*

Fundamentalism, a nineteenth-century religious movement that grew out of evangelical Protestantism, viewed Darwin's theory of evolution as responsible for a perceived decline in traditional moral values following World War I.¹³⁵ The central common premise of Fundamentalism has been a belief in the literal interpretation of the Bible and the infallibility of biblical scriptures. Fundamentalist efforts, particularly in the South, focused on promoting statutes prohibiting the teaching of evolution in public schools.¹³⁶

In 1925, John Scopes, a biology teacher working in the Tennessee public school system, was tried and convicted of violating the Tennessee Anti-Evolution Act.¹³⁷ The Anti-Evolution Act made it unlawful for Tennessee public schools teachers "to teach any theory that denies the story of the divine creation of man as taught in the Bible, and to teach instead that man descended from a lower order of animals."¹³⁸ Any teacher convicted of violating the Act's terms was guilty of a misdemeanor and would be fined between \$100 and \$500.¹³⁹ Scopes appealed his conviction, raising several questions concerning the Act's constitutionality. On appeal, the Tennessee Supreme Court upheld the Anti-Evolution Act, and found that the jury properly found Scopes guilty of teaching a "theory that denied the story of the divine creation of man, as taught in the Bible, and did teach instead . . . that man had descended from a lower order of animals."¹⁴⁰ In particular,

135. The link between a perceived decline in morality and teaching evolution is still prevalent today. For example, then House Republican Majority Whip Tom DeLay, explaining the school violence in Littleton, Colorado, a few years ago, stated: "Our school systems teach the children that they are nothing but glorified apes who have evolutionized out of some primordial soup of mud." Remarks reprinted in Chet Raymo, *Darwin's Dangerous De-Evolution*, Boston Globe (Sept. 6, 1999) (available at <http://www.boston.com/globe/search/stories/reprints/darwin100199.htm>). See also Phillip E. Johnson, *Darwin on Trial* (2d ed., InterVarsity Press 1993).

136. These background facts can be found in *McLean*, 529 F. Supp. at 1259.

137. 1925 Tenn. Pub. Acts ch. 27 (codified at Tenn. Code Ann. § 49-1922). The Act passed in March 1925, and took effect immediately, "the public welfare requiring it." *Id.* at § 3.

138. *Id.* at § 1.

139. *Id.* at § 2.

140. *Scopes v. State*, 289 S.W. 363, 363-64 (Tenn. 1927). In limiting the definition of evolution theory to any theory that "men descended from a lower order of animals," the court concluded that the statute was sufficiently certain in meaning to avoid constitutional infirmity. *Id.* at 364. One justice

the court rejected Scopes' contention that the Anti-Evolution Act violated the Establishment Clause on grounds that the Act did not give a preference to any particular religious establishment.¹⁴¹ The court explained:

We are not able to see how the prohibition of teaching the theory that man has descended from a lower order of animals gives preference to any religious establishment or mode of worship. . . . [T]here is no religious establishment or organized body that has in its creed or confession of faith any article denying or affirming such a theory. . . . [T]he denial or affirmation of such a theory does not enter into any recognized mode of worship. . . . Belief or unbelief in the theory of evolution is no more a characteristic of any religious establishment or mode of worship than is belief or unbelief in the wisdom of the prohibition laws.¹⁴²

The court found no conflict in its Establishment Clause jurisprudence, which permitted a legislative mandate requiring ten verses from the Bible be read each day at the opening of every public school, while forbidding the teaching of evolution.¹⁴³ The court added that, if a public school feels so "hampered" by the Anti-Evolution Act in "the teaching of the science of biology . . . as to render such an effort no longer desirable, this course of study may be entirely omitted from the curriculum of our schools."¹⁴⁴ Finally, the court rejected arguments concerning the motives of the legislators who enacted the Anti-Evolution Act, explaining that "the validity of a statute must be determined by its natural and legal effect, rather than proclaimed motives."¹⁴⁵

Notwithstanding its analysis upholding the Anti-Evolution Act, the Tennessee Supreme Court overturned Scopes' conviction on a technicality. It found that the trial judge, by fining Scopes, improperly usurped the jury's state constitutional role of assessing the amount of any fine in excess

dissented on grounds that the statute was constitutionally vague in violation of due process. *See id.* at 370 (McKinney, J., dissenting).

141. *Id.* at 367 (majority). The court rejected Scopes' other constitutional challenges as well. *See id.* at 364 (rejecting challenges based on the privileges and immunities clauses of the state and federal constitutions on grounds that Scopes, an employee of the state under state contract, "had no right or privilege to serve the state except upon such terms as the state prescribed"). *See also id.* at 366 (rejecting contention that the law violates the government's duty under the state constitution to "to cherish literature and science" on grounds that the constitutional provision is "too vague to be enforced by any court).

142. *Id.* at 367.

143. *Id.* (discussing 1915 Tenn. Pub. Acts ch. 102). The United States Supreme Court later found unconstitutional a similar statute requiring bible readings in public schools. *Sch. Dist. of Abington Township v. Schempp*, 374 U.S. 203, 205 (1963).

144. *Scopes*, 289 S.W. at 367.

145. *Id.* (citing, *inter alia*, *Lochner v. N.Y.*, 198 U.S. 45 (1905)).

of \$50.¹⁴⁶ In the court's view, the "trial judge exceeded his jurisdiction in levying this fine, and we are without power to correct his error" because the Anti-Evolution Act "does not permit the imposition of a smaller fine than \$100."¹⁴⁷ Because John Scopes was no longer working for the state at the time of the appeal, the court did not remand the case, finding "nothing to be gained by prolonging the life of this bizarre case. On the contrary, we think the peace and dignity of the state, which all criminal prosecutions are brought to redress, will be the better conserved by the entry of a *nolle prosequi* herein."¹⁴⁸

The concurrence found the Act constitutional for one additional reason. In that justice's view, the Act prohibited teaching only that theory of evolution that "denies the divine creation of man, without regard to details of religious belief, or differing interpretations of the story as taught in the Bible."¹⁴⁹ The concurrence based its view on the assumption that there were two well-recognized views of "organic evolution" – the theistic view, which is consistent with the Biblical creation story, and the materialistic, which denies that Biblical story of creation.¹⁵⁰ The concurrence concluded that the Anti-Evolution Act prohibited only the materialistic theory as inconsistent not only with "the common belief . . . of every 'religious establishment,'" but also with the philosophical foundations of this country's government, including the Constitution, the Declaration of Independence, and the Articles of Confederation.¹⁵¹

2. *Forty-three Years Later, the Supreme Court in Epperson Strikes Down an Anti-Evolution Law Because It Has a Religious Purpose: to Protect the Fundamental Sectarian Christian Belief That the Book of Genesis Is the Exclusive Source of Doctrine Concerning Human Origins*

During the 1920s, twenty state legislatures introduced anti-evolution bills. By the mid-1960s, only three states, Tennessee, Arkansas, and Mississippi, still maintained anti-evolution statutes.¹⁵² A constitutional chal-

146. *Id.* (citing Tenn. Const. art. 6, § 14).

147. *Id.*

148. *Id.*

149. *Id.* at 370 (Chambliss, J., concurring).

150. *Id.* at 368.

151. *Id.*

152. Tennessee's Anti-Evolution Act was not repealed until 1967. See 1967 Tenn. Pub. Acts ch. 237; see also 1929 Ark. Acts 1; Ark. Code Ann. §§ 80-1627, 80-1628 (1960 Repl. Vol.); Miss. Code Ann. §§ 6798, 6799 (1942); The Pew Forum, *From Dawin to Dover: An Overview of Important Cases in the Evolution Debate* 2, <http://pewforum.org/docs/?DocID=116> (Sept. 22, 2005) (explaining that legislatures or school boards in many states, including California, Florida, North Carolina, Tennessee, and

lenge to one of those statutes – the Arkansas anti-evolution law – only reached the United States Supreme Court in 1968. The Arkansas law,¹⁵³ modeled after the Tennessee Anti-Evolution Act at issue in *Scopes v. State*, made it unlawful to teach in a state school “the theory or doctrine that mankind ascended or descended from a lower order of animals,” or “to adopt or use in any such institution a textbook that teaches this theory.” Violation is a misdemeanor and subjects the teacher to dismissal.¹⁵⁴ Notwithstanding the force of this law, in 1965, the Little Rock school administration, on the recommendation of the biology teachers, adopted a textbook containing a chapter setting forth “the theory about the origin . . . of man from a lower form of animal.”¹⁵⁵ Susan Epperson, a graduate of the Arkansas school system with an advanced degree in zoology from the University of Illinois, was employed by the Little Rock school system in the fall of 1964 to teach tenth grade biology. Faced with the possibility of criminal prosecution and dismissal for teaching human evolution, Epperson filed a complaint, seeking a declaration that the Arkansas statute is void and enjoining the Little Rock school officials from dismissing her for violating the statute. The trial court rejected the view, adopted by the Tennessee Supreme Court in *Scopes*, that the law was merely a directive by the state, as employer, to its employees.¹⁵⁶ Instead, it found the Arkansas law to be an unconstitutional restraint on free speech. The Arkansas Supreme Court reversed, rejecting the constitutional challenge and noting primarily that the Arkansas law “is a valid exercise of the state’s power to specify the curriculum in its public schools.”¹⁵⁷

In *Epperson v. Arkansas*,¹⁵⁸ the United States Supreme Court unanimously reversed the state’s highest court and found the Arkansas’ anti-evolution statute unconstitutional, because it had a religious purpose.¹⁵⁹ Side-stepping the vagueness argument, the Court explained that, whether the statute prohibits teachers from even making students aware that there exists a theory of evolution or whether it prohibits the actual teaching of human evolution, the statute violates the Establishment Clause, because the Arkansas law “selects from the body of knowledge a particular segment

Texas, passed laws or rules requiring the teaching of creationism either along side or in place of evolution).

153. Ark. Code Ann. §§ 80-1627, 80-1628 (1960 Repl. Vol.) (cited in *Epperson*, 393 U.S. at 99 n. 3.); 1929 Ark, Acts 1.

154. *Epperson*, 393 U.S. at 98-99.

155. *Id.* at 99.

156. *Supra* n. 141.

157. These facts are taken from *Epperson*, 393 U.S. at 100-01 nn. 5-7.

158. 393 U.S. 97.

159. *Id.* at 106. Although the Arkansas statute, like the Tennessee statute in *Scopes*, was challenged on grounds of vagueness in violation of due process, the Court did not rest its constitutional finding on those grounds. *Id.* at 103, 105-06.

which it proscribes for the sole reason that it is deemed to conflict with a particular religious doctrine; that is, with a particular interpretation of the *Book of Genesis* by a particular religious group.”¹⁶⁰

The Court rested its conclusion on the principle that the state and federal governments “must be neutral in matters of religious theory, doctrine, and practice.”¹⁶¹ As the Court famously put it – the “First Amendment mandates governmental neutrality between religion and religion, and between religion and nonreligion.”¹⁶² The Court acknowledged that American public education is largely committed to state and local authorities with power to prescribe state curriculum; based on that power, courts generally “cannot intervene in the resolution of conflicts which arise in the daily operation of school systems.”¹⁶³ But where those conflicts “directly and sharply implicate basic constitutional values” courts must intervene because “[t]he vigilant protection of constitutional freedoms is nowhere more vital than in the community of American schools.”¹⁶⁴ In the Court’s words, “the First Amendment ‘does not tolerate laws that cast a pall of orthodoxy over the classroom.’”¹⁶⁵

The Court recognized that not all religious instruction in public school violates the Establishment or Free Exercise Clauses. For example, the Court explained that “[w]hile study of religions and of the Bible from a literary and historic viewpoint, presented objectively as part of a secular program of education, need not collide with the First Amendment’s prohibition, the State may not adopt programs or practices in its public schools or colleges which “aid or oppose” any religion.”¹⁶⁶ Nevertheless, if the “purpose” or the “primary effect” of the enactment is to advance or inhibit religion, then “the enactment exceeds the scope of legislative power as circumscribed by the Constitution.”¹⁶⁷

Applying those principles, the Court found that the “[s]tate’s undoubted right to prescribe the curriculum for its public schools does not carry with it the right to prohibit, on pain of criminal penalty, the teaching of a scientific theory or doctrine where that prohibition is based upon rea-

160. *Id.* at 103.

161. *Id.* at 103-04.

162. *Id.* at 104 n. 12.

163. *Id.* at 104.

164. *Id.* (quoting *Shelton v. Tucker*, 364 U.S. 479, 487 (1960)).

165. *Id.* at 105 (quoting *Keyishian v. Bd. of Regents*, 385 U.S. 589, 603 (1967)).

166. *Id.* at 106. In this context, the Court explained that the First Amendment’s “prohibition is absolute. It forbids alike the preference of a religious doctrine or the prohibition of theory which is deemed antagonistic to a particular dogma.” *Id.* at 106-07. The Court further explained that “the state has no legitimate interest in protecting any or all religions from views distasteful to them.” *Id.* at 107 (quoting *Joseph Burnstyn, Inc. v. Wilson*, 343 U.S. 495, 505 (1952)).

167. *Id.* (quoting *Schempp*, 374 U.S. at 222).

sons that violate the First Amendment.”¹⁶⁸ Those unconstitutional reasons are, of course, the religious purpose of Arkansas’ anti-evolution law. Relying in part on public appeals favoring the passage of the anti-evolution statute, which depicted those favoring the law as theists and those favoring teaching evolution as atheists, the Court found that Arkansas public officials sought to prevent their “teachers from discussing the theory of evolution because it is contrary to the belief of [fundamentalist sectarian Christians] that the *Book of Genesis* must be the exclusive source of doctrine as to the origin of man.”¹⁶⁹ The Court found irrelevant that the religious purpose of the Arkansas statute, unlike that of Tennessee, was not explicit.¹⁷⁰

C. Balanced-Treatment Laws, Which Forbid the Teaching of the Evolution in Public Schools Unless Accompanied by Instruction in “Creation Science,” Are Unconstitutional

1. The Constitutionality of Balanced-Treatment Laws is First Tested in 1982, Where a District Court, Applying the Lemon Test, Strikes Down Arkansas’ Law Because it has a Religious Purpose and Effects

About the same time that the constitutional challenge to anti-evolution statutes was percolating, groups of fundamentalist organizations attempted to give scientific legitimacy to the biblical story of human origins. At that time, “several Fundamentalist organizations were formed to promote the idea that the *Book of Genesis* was supported by scientific data.”¹⁷¹ These fundamentalist groups, which include ICR,¹⁷² CRS,¹⁷³ and CSRC,¹⁷⁴

168. *Id.*

169. *Id.*

170. *Id.* at 108-109 nn. 15-18.

171. *McLean*, 529 F. Supp. at 1259.

172. The Institute for Creation Research (est. 1970) “believe[s] God has raised up ICR to spearhead Biblical Christianity’s defense against the godless and compromising dogma of evolutionary humanism. Only by showing the scientific bankruptcy of evolution, while exalting Christ and the Bible, will Christians be successful in ‘the pulling down of strongholds; casting down imaginations, and every high thing that exalteth itself against the knowledge of God, and bringing into captivity every thought to the obedience of Christ’ (II Corinthians 10:4,5).” Institute for Creation Research, *Welcome – Institute for Creation Research*, <http://www.icr.org> (accessed May 22, 2006) (emphasis added).

173. The Creation Research Society (est. 1963) “is a professional organization of trained scientists and interested laypersons who are firmly committed to scientific special creation. The Society was organized in 1963 by a committee of ten like-minded scientists, and has grown into an organization with worldwide membership.” Creation Research Society, *About CRS*, http://www.creationresearch.org/about_crs.htm (accessed May 22, 2006). Its members believe “[a]ll basic types of living things, including man, were made by direct creative acts of God during the Creation Week described in *Genesis*. Whatever biological changes have occurred since Creation Week have accomplished only changes within the original created kinds.” Creation Research Society, *CRS – Statement of Belief*, http://www.creationresearch.org/stmnt_of_belief.htm (accessed May 22, 2006). They consider them-

adopted the term “creation science” to describe their study of creation and human origins.

Creation scientists generally pitted themselves directly against proponents of human evolution, by adopting the view (similar to the *Scopes* concurrence) that “there are only two positions with respect to the origins of the Earth and life: belief in the inerrancy of the *Genesis* story of creation and of a worldwide flood as fact, or belief in what they call evolution.”¹⁷⁵ The affiliated creationist organizations viewed introducing creation science into public school curriculum as part of their mission and published pamphlets suggesting methods for persuading school officials to add creation science to their curriculum.¹⁷⁶

The constitutionality of teaching creation science in public schools was first tested in 1982 in *McLean v. Arkansas*, where a federal district court judge issued a permanent injunction against enforcing Arkansas’ Balanced Treatment for Creation-Science and Evolution-Science Act, on grounds that the statute violated the Establishment Clause.¹⁷⁷ The Arkansas law required public schools to give balanced treatment to Creation-Science and Evolution-Science, as defined by the Act.¹⁷⁸ It defined “creation-science” as including the scientific evidence and inferences that indicate: “(1) Sudden creation of the universe, energy, and life from nothing; (2) The insufficiency of mutation and natural selection in bringing about development of all living kinds from a single organism; (3) Changes only within fixed limits of originally created kinds of plants and animals; (4) Separate ancestry for man and apes; (5) Explanation of the Earth’s geology by catastrophism, including the occurrence of a worldwide flood; and (6) A relatively recent inception of the Earth and living kinds.”¹⁷⁹

selves to be an “organization of Christian men and women of science who accept Jesus Christ as our Lord and Savior,” who believe that “[t]he *Bible* is the written Word of God,” and “the account of origins in *Genesis* is a factual presentation of simple historical truths.” *Id.*

174. The Creation-Science Research Center’s “primary objective has been to change the manner in which the public schools teach about evolutionary theories. The purpose is to protect the faith of Christian children from illegal offense against their faith in the God of Creation.” Creation-Science Research Center, *C-SRC Information*, <http://www.parentcompany.com/csrc/csrcinfo.htm> (accessed May 22, 2006). C-SRC was founded in 1970. *Id.*

175. *McLean*, 529 F. Supp. at 1260.

176. *Id.*

177. *Id.* at 1274. The court rejected the vagueness argument and side-stepped the academic freedom argument. *Id.* at 1273.

178. *Id.* at 1256, 1264.

179. 1981 Ark. Acts 590, § 4(a). By contrast, the Act defined evolution science to include:

- (1) Emergence by naturalistic processes of the universe from disordered matter and emergence of life from nonlife;
- (2) The sufficiency of mutation and natural selection in bringing about development of present living kinds from simple earlier kinds;

By that time, the Supreme Court in *Lemon* had formulated its now well-worn, three-pronged test for determining whether a state actor, like a public high school, violated the Establishment Clause.¹⁸⁰ Applying the *Lemon* test – whereby a challenged statute must have a bona-fide secular legislative purpose; its principal effect must not advance or inhibit religion; and it must not foster excessive governmental entanglement with religion – the *McLean* court decided that the Act failed on each prong.¹⁸¹ The district court concluded that the Act was passed with the specific purpose of advancing religion by introducing the Biblical version of creation into the public school curriculum.¹⁸² To support that conclusion, the court noted that the law’s supporters admitted they were motivated by their religious convictions and that the law was enacted without consulting educators or scientists.¹⁸³ The court also found significant Arkansas’ role in the history of the debate over whether evolution should be taught in public schools.¹⁸⁴

The court next concluded that a major effect of the Act was to advance particular religious beliefs rather than advancing legitimate educational or scientific goals.¹⁸⁵ To support that conclusion, the court first pointed to the statutory definition of creation science as inspired by a literal interpretation of the *Book of Genesis* and as necessarily entailing a supernatural being unique to the Western concept of God.¹⁸⁶ The court next observed that the Act’s structure – pitting creationist as theist against evolutionist as atheist – was a “contrived dualism which has no scientific factual basis or legitimate educational purpose.”¹⁸⁷ The court pointed out that the extent of this dualism is so stark that evidence critical of one theory is irrationally taken as evidence supporting the other theory.¹⁸⁸ The court further noted that the Act’s dual model approach was the approach espoused by fundamentalist organizations, such as ICR, and lacked educational value because creation

(3) Emergence by mutation and natural selection of present living kinds from simple earlier kinds;

(4) Emergence of man from a common ancestor with apes;

(5) Explanation of the Earth’s geology and the evolutionary sequence by uniformitarianism; and

(6) An inception several billion years ago of the Earth and somewhat later of life.

Id. at § 4(b).

180. 403 U.S. at 612-13.

181. 529 F. Supp. at 1272.

182. *Id.* at 1264.

183. *Id.* at 1259-64.

184. *Id.* at 1263 (citing *Epperson*, 393 U.S. 97).

185. *Id.* at 1266.

186. *Id.* at 1264 n. 19 to 1266 n. 21.

187. *Id.* at 1266.

188. *Id.* at 1267.

science was not science.¹⁸⁹ The court also observed that the “methodology employed by creationists . . . indicat[es] that their work is not science. A scientific theory must be tentative and always subject to revision or abandonment in light of facts that are inconsistent with, or falsify, the theory. A theory that is by its own terms dogmatic, absolutist and never subject to revision is not a scientific theory.”¹⁹⁰ The court added: “creationists’ methods do not take data, weigh it against the opposing scientific data, and thereafter reach the[ir] conclusions. . . . Instead, they take the literal wording of the *Book of Genesis* and attempt to find scientific support for it.”¹⁹¹ Finally, the court concluded that “the pervasive nature of religious concepts in creation science texts amply demonstrate why State entanglement with religion is inevitable under [the Balanced Treatment Act.]”¹⁹²

The district court rejected the defense argument that evolution is a religion that, if taught, infringes on the free exercise rights of nonbelievers and creates an Establishment Clause problem that can be redressed only by giving balanced treatment to creation science.¹⁹³ The court explained that “if creation science is, in fact, science and not religion . . . it is difficult to see how the teaching of such a science could ‘neutralize’ the religious nature of evolution.”¹⁹⁴ The remedy instead would be to stop teaching evolution rather than combating it with more religion.¹⁹⁵ But the court added that the basic assumption underlying that argument is, in any event, false.¹⁹⁶ Evolution is science; thus, teaching evolution does not violate the Establishment Clause.¹⁹⁷ The court concluded by acknowledging evidence suggesting that a majority of Americans favor balanced treatment, but observed that such evidence was irrelevant to the question whether balanced treatment violates the First Amendment.¹⁹⁸ “No group, no matter how large or small, may use the organs of government, of which the public schools are the most conspicuous and influential, to foist its religious beliefs on others.”¹⁹⁹

189. *Id.* at 1267 n. 25, 1268 n. 27. The court defined the essential characteristics of science as being: (1) guided by natural law; (2) explanatory by reference to natural law; (3) testable against the empirical world; (4) tentative as to its conclusions; and (5) falsifiable. *Id.* at 1267.

190. *Id.* at 1268-69.

191. *Id.* at 1269.

192. *Id.* at 1272.

193. *Id.* at 1273-74.

194. *Id.* at 1274.

195. *Id.*

196. *Id.*

197. *Id.* (citing *Epperson*, 393 U.S. 97).

198. *Id.*

199. *Id.*

2. *In Edwards v. Agulliard, the Supreme Court Strikes Down Louisiana's Balanced-Treatment Law, Because it Serves No Identified Secular Purpose and Promotes a Particular Religious Belief*

The question whether balanced treatment acts violate the Establishment Clause ultimately reached the United States Supreme Court in 1987. In *Edwards v. Aguillard*, the Supreme Court held unconstitutional Louisiana's Balanced Treatment Act, because it served no identified secular purpose and had as its primary purpose the promotion of a particular religious belief.²⁰⁰ Acknowledging that the Act's stated purpose was to protect academic freedom, the Court concluded that the Act was not designed to further that purpose, but in fact restricts academic freedom by putting conditions on the teaching of evolution.²⁰¹ The Court observed: "Even if 'academic freedom' is read to mean 'teaching all of the evidence' with respect to the origin of human beings, the Act does not further this purpose. The goal of providing a more comprehensive science curriculum is not furthered either by outlawing the teaching of evolution or by requiring the teaching of creation science."²⁰² Rather, the Act "has the distinctly different purpose of discrediting 'evolution by counterbalancing its teaching at every turn with the teaching of creationism.'"²⁰³

The Court also concluded that the Act was unconstitutional because it had a religious purpose: "to advance the religious viewpoint that a supernatural being created humankind."²⁰⁴ The Court found that the statute's historical context²⁰⁵ and its legislative history, including statements by the law's proponents, supported its conclusion.²⁰⁶ Reviewing the evidence, the Court concluded that the purpose of the Act was "to restructure the science curriculum to conform with a particular religious viewpoint. Out of many possible science subjects taught in the public schools, the legislature chose to affect the teaching of the one scientific theory that historically has been opposed by certain religious sects."²⁰⁷ In that way, the Court likened the Balanced Treatment Act – designed either to promote creationism or inhibit the teaching of a theory hostile to young Earth creationists – to the anti-evolution statute struck down in *Epperson* – designed to proscribe the

200. 482 U.S. at 596-97.

201. *Id.* at 586 n. 6.

202. *Id.* at 586.

203. *Id.* at 589 (quoting *Aguillard v. Edwards*, 765 F.2d 1251, 1257 (5th Cir. 1985)).

204. *Id.* at 591.

205. The Court referred to the "historic and contemporaneous link between the teachings of certain religious denominations and the teaching of evolution," noting that it was this link that concerned the Court in *Epperson*. *Id.* at 590.

206. *Id.* at 591 n. 12 to 593 n. 14.

207. *Id.* at 593.

teaching of a theory hostile to a particular religious viewpoint.²⁰⁸ Summarizing its views, the Court explained that the Establishment Clause “forbids *alike* the preference of a religious doctrine *or* the prohibition of theory which is deemed antagonistic to a particular dogma.”²⁰⁹

D. Framework for Analyzing the Constitutionality of Legislative Attempts to Regulate How Evolution Should be Taught in Public Schools

The United States Supreme Court’s detailed discussion of the Arkansas anti-evolution law in *Epperson* and Louisiana’s Balanced Treatment Act in *Edwards* gives many clues for how it might analyze future disputes over teaching evolution in public school science classes. As Boston University Law Professor Jay Wexler points out, the *Edwards* Court found relevant: (1) statements from the legislative history indicating an intent to promote religion; (2) the poor fit between the statute and goal of promoting academic freedom; (3) and singling out evolution from among all possible reform measures; and (4) the historic link between religion and critiques of evolution.²¹⁰

Regarding legislative history, in evaluating a particular statute, the Supreme Court has announced that it will examine the plain meaning of the statutory language, the legislative history, the statute’s interpretation by the responsible administrative agency, and the statute’s historical context.²¹¹ In the public school setting, this means that the Court would continue to scrutinize not only the statutory language regulating how life’s origins is to be taught, but also the statements of school board members and legislative sponsors, the debates over the law’s enactment, and the historical context of the debate, among other things.²¹²

The Supreme Court’s search for a valid, bona fide secular purpose also suggests the conclusion that the concurrence in *Edwards* in fact draws: “If no valid secular purpose can be identified, then the statute violates the Establishment Clause.”²¹³ In this context, the search for the bone fide secular purpose would entail a close examination of the “fit between the means of the statute and its ends.”²¹⁴ A “poor fit” between the two tends to discredit

208. *Id.*

209. *Id.* (quoting *Epperson*, 393 U.S. at 106-07) (emphasis added in *Edwards*).

210. Wexler, *supra* n. 1, at 10-11 (interpreting *Edwards* as using legislative history to determine whether there was an intent to promote religion).

211. *Edwards*, 482 U.S. at 594-95 (citing *Wallace*, 472 U.S. at 56-61, 74; *Stone v. Graham*, 449 U.S. 39, 41-42 (1980); *Arlington Heights v. Metro. Hous. Dev. Corp.*, 429 U.S. 252 (1977); *Epperson*, 393 U.S. at 103-09; *Richards v. U.S.*, 369 U.S. 1, 9 (1962); *Jay v. Boyd*, 351 U.S. 345, 357 (1956)).

212. Wexler, *supra* n. 1, at 10-11 (interpreting *Edwards* as using legislative history to determine whether there was an intent to promote religion).

213. 482 U.S. at 597 (Powell & O’Connor, JJ., concurring).

214. Wexler, *supra* n. 1, at 10.

the validity of the secular purpose advanced.²¹⁵ Examination of the advanced secular purpose would also entail close examination of the proposed alternatives to evolution, including the question whether the alternative constitutes a valid scientific theory. Valid scientific critiques of any scientific doctrine would likely pass *Lemon's* purpose prong. But nonscientific critiques, especially those that imply a supernatural explanation, lend themselves to question the validity of the regulation's secular purpose and are likely to be viewed as transgressing the Establishment Clause. Similarly, singling out evolution also tends to belie a secular motive, especially where the secular motive is couched in more general terms such as academic freedom, free speech, or fairness.

Take fairness, for example. Creationists often speak in terms of fairness when giving reasons that their side should be taught along-side evolution. That argument, while rhetorically powerful because it appeals to the American free-market-of-ideas-paradigm, is constitutionally specious for at least two reasons. First, it assumes, without showing, that there are in fact two sides to the debate. Recall that creationists want to teach creationism in *science* class. Accordingly, they must first meet the definition of science to lay fair claim to a *scientific* debate that should be taught in that venue. Second, that argument is often incorrectly linked to a purported educational purpose – that students should be given the full story so they can understand the debate. Once again, the educational purpose is belied by the facts. Science and the scientific method are taught in science class. By injecting religious beliefs, with no scientific support, into the science curriculum, state educators cast doubt on the scientific efficacy of evolution – something only other scientific theories should do. Scientifically unsupported attacks on evolution that are taught as scientific attacks on evolution also confuse students about how science is practiced. Accordingly, the fairness argument is essentially an argument to entangle religion into the science curriculum.

Of course, the historic link between religion and critiques of evolution remains a constant. Although it has been suggested that such historic link is merely between creation science and critiques of evolution, one purpose of this article is to show otherwise. ID is an integral part of the over 150-year debate between creationists and evolutions. And while a particular critique of evolution may be able to de-link itself from this history, it could only do so by meeting the definition of science. In other words, valid scientific critiques would be presumptively immune from Establishment Clause challenges, even if the critique were to overthrow the Darwinian paradigm.

215. *Id.*

Given the importance of (1) establishing a true secular purpose and (2) the historic link between religion and critiques of evolution, it is instructive to evaluate the question whether current attacks on evolution constitute science and to examine those critiques and the debate they have generated in their historical context. An historical analysis of the ideas behind ID surfaces an astonishing continuity between ID and religious assaults on evolution. With that, I now turn to the modern debate between evolution and ID.

IV. THE MODERN CONFLICT BETWEEN EVOLUTION AND RELIGION: “TEACH THE CONTROVERSY”

A. Overview: *So What’s All the Fuss About?*

Both sides [evolution and design] ought to be properly taught . . . so people can understand what the debate is about. . . . Part of education is to expose people to different schools of thought. . . . You’re asking me whether or not people ought to be exposed to different ideas, and the answer is yes. – Remarks of President George W. Bush, spoken on August 1, 2005.²¹⁶

It is by now generally well-accepted that creation-science is religion, not science, and therefore that teaching creationism in science classrooms would be unconstitutional.²¹⁷ Creation-science has been discredited as a scientific theory.²¹⁸ So why, twenty years after *Edwards*, are we having this déjà vu experience? The answer lies in the strength of the ID movement.

216. Remarks of President George W. Bush, spoken on August 1, 2005. Peter Baker & Peter Slevin, *Bush Remarks on ‘Intelligent Design’ Theory Fuel Debate*, Washington Post A01 (Aug. 3, 2005).

217. See Kent Greenawalt, *Establishing Religious Ideas: Evolution, Creationism, and Intelligent Design*, 17 Notre Dame J.L. Ethics & Pub. Policy 321, 394 (2003) (“[T]eaching creation science is teaching religious ideas [and that] is unconstitutional.”).

218. Professor Greenawalt posits four grounds for disqualifying fundamentalist creationism from science:

First, creation science posits a Divine Creator, which is not a scientific concept. Second, it provides an explanation that is not according to natural laws. Third, its proponents are not open to contrary evidence, and the theory is, therefore, not revisable or falsifiable. Fourth, little scientific evidence favors it; its arguments against most aspects of evolutionary theory are unconvincing and, in any event, do not establish its own truth.

Id. at 370. Similarly, creationism fails to meet any of the terms of the definition of science posited in this article – it invokes a supernatural explanation; it makes no predictions; it is not falsifiable; it is not subject to revision; and it does not care about scientific data.

The modern ID movement began about the same time that *Edwards* was decided.²¹⁹ The ID movement, as defined in more detail below, is the response of a group of intellectuals, including lawyers, theologians, philosophers, and scientists, who draw on the design inference to discredit evolutionary theory. In their view, evolutionary theory is inadequate to explain certain natural complexities; it is therefore necessary to resort to an intelligent agent (an efficient and final cause) to more fully and adequately to explain life's origins. Since *Edwards*, proponents of ID have prolifically published books and articles in part to show that evolutionary theory does not withstand scientific scrutiny and in part to show that ID should be instated as science.²²⁰

Proponents of ID, like its creation-science predecessors, have made teaching evolution in public schools their legal battleground. ID is thought to have inspired at least nineteen states to consider challenging teaching evolution in its secondary schools.²²¹ The first of these, the Kansas Board of Education, eliminated macroevolution or speciation, along with the Big Bang theory, from the State's science education standards in August 1999.²²² The Board of Education reversed itself in 2001, without legal challenge.²²³ Most recently, the Kansas Board of Education approved new science standards, which cast doubt on Darwin's theory of evolution and redefine science to include exploration of supernatural causes.²²⁴

219. I am not suggesting that the idea of ID is new. In fact, as this paper explains, the modern ID inference is a repackaged version of Paley's argument from design. This paper later argues that ID is also a repackaged version of St. Thomas Aquinas' fifth proof for the existence of God. Jonathan Witt, Senior Fellow of the Discovery Institute, further suggests the design inference is traceable to the Ancient Greeks. Jonathan Witt, *The Origin of Intelligent Design: A Brief History of the Scientific Theory of Intelligent Design*, <http://www.discovery.org/scripts/viewDB/filesDB-download.php?command=download&id=526> (accessed May 22, 2006).

220. See e.g. Francis J. Beckwith, *Law, Darwinism, and Public Education: The Establishment Clause and the Challenge of Intelligent Design* (Rowman & Littlefield Publishers, Inc. 2003); Michael J. Behe, *Darwin's Black Box: The Biochemical Challenge to Evolution* (Free Press 1996) [hereinafter Behe, *Darwin's Black Box*]; William A. Dembski, *Intelligent Design: The Bridge Between Science and Theology* (InterVarsity Press 1999); Johnson, *supra* n. 135.

221. Michael Powell, *Doubting Rationalist: 'Intelligent Design' Proponent Philip Johnson, and How He Came To Be*, Washington Post D01 (May 15, 2005); see generally AAAS – AAAS Evolution Resources – Dialogue on Science, Ethics, and Religion, http://www.aaas.org/spp/dser/03_Areas/evolution/issues.shtml#SSES (accessed May 22, 2006) [hereinafter *Dialogue on Science, Ethics, and Religion*] (summarizing state responses).

222. James Carroll, *A Victory for Shallowness*, Boston Globe A15 (Sept. 7, 1999); Raymo, *supra* n. 135.

223. Mary Good et al., *NSTA Press Release – A Statement of Support for the Kansas Board of Education's Decision to Adopt New Science Standards for K-12 Students in Kansas (AAAS, NAS, NRC, NSTA) – Feb. 14 2001*, http://www.nsta.org/pressroom&news_story_ID=45632 (accessed May 22, 2006).

224. CNN, *Kansas School Board Redefines Science*, <http://www.cnn.com/2005/EDUCATION/11/08/evolution.debate.ap/index.html> (Nov. 8, 2005).

The movement grew in controversy and political strength when, in 2001, Senator Rick Santorum (R-Pa) introduced a nonbinding amendment to the No Child Left Behind Bill, stating that “where biological evolution is taught, the curriculum should help students to understand why this subject generates so much continuing controversy.”²²⁵ In Senator Santorum’s view, the nonbinding amendment “simply says there are disagreements in scientific theories out there that are continually tested. Our knowledge of science is not absolute, obviously. We continue to test theories. Over the centuries, there were theories that were once assumed to be true and have been proven, through further revelation of scientific investigation and testing, to be not true.”²²⁶ Senator Santorum never explained why the amendment singles out evolutionary theory. But he did read into the record the following statement of David DeWolf, Gonzaga Law Professor and Discovery Institute Senior Fellow,²²⁷ concerning the “benefits [that] will accrue from a more open discussion of biological origins in the science classroom”:

First, this approach will do a better job of teaching the issue itself, both because it presents more accurate information about the state of scientific thinking and evidence, and because it presents the subject in a more lively and less dogmatic way. Second, this approach gives students greater appreciation for how science is actually practiced. Science necessarily involves the interpretation of data; yet scientists often disagree about how to interpret their data. By presenting this scientific controversy realistically, students will learn how to evaluate competing interpretations in light of evidence – a skill they will need as citizens, whether they choose ca-

225. 147 Cong. Rec. S6147-S6148 (daily ed. June 13, 2001) [hereinafter *Santorum Amendment*]. The entire text is as follows:

It is the sense of the Senate that – (1) good science education should prepare students to distinguish the data or testable theories of science from philosophical or religious claims that are made in the name of science; and (2) where biological evolution is taught, the curriculum should help students to understand why this subject generates so much continuing controversy, and should prepare the students to be informed participants in public discussions regarding the subject.

Id. The bill, with amendment, passed the Senate 91-98. *Id.* at S6153. Although dubbed the “Santorum Amendment,” Phillip Johnson, Berkeley law professor and father of the modern Intelligent Design movement, has taken credit for authoring the Santorum Amendment. Scott Stephens, *Federal Law Ignites Evolution Debate*, Cleveland Plain Dealer (Sept. 16, 2002).

226. *Santorum Amendment*, *supra* n. 225, at S6148.

227. The Discovery Institute is one of the major think-tanks for the Intelligent Design Movement. See Discovery Institute – Center for Science and Culture, *A Scientific Dissent from Darwinism*, <http://www.dissentfromdarwin.org> (accessed May 22, 2006) (collecting scientific opposition to evolution).

reers in science or other fields. Third, this approach will model for students how to address differences of opinion through reasoned discussion within the context of a pluralistic society.²²⁸

Senator Santorum further claimed that the amendment favors “intellectual freedom” and “open and fair discussion of using science – not philosophy and religion within the context . . . of science but science – as the basis for this determination.”²²⁹

Congress ultimately enacted the bill into law without the Santorum amendment.²³⁰ Nevertheless, the Santorum amendment continued to generate intense controversy on both sides of the political spectrum. While many continued to embrace the spirit of the amendment, some refused to support the amendment as being an unlawful federal intrusion into state affairs.²³¹ Others, who originally supported the amendment, distanced themselves from it when proponents proclaimed that it sent a message to educators that Congress believes concepts that counter Darwinian evolution should be taught in science classes.²³² Remarkably, some politicians, including Senator Santorum, continued to adhere to the view that the amendment was actually law.²³³

Although Congress ultimately rejected the idea of encouraging teaching ID, the movement nevertheless grew in strength in many states. At least two states, Alabama and Maryland, have introduced bills that track the Santorum language of academic freedom.²³⁴ New York law makers have used Santorum’s faulty rationale to justify their bill, which if enacted would “require[] instruction on all aspects of the controversy surrounding

228. *Santorum Amendment*, *supra* n. 225, at S6148.

229. *Id.*

230. Pub. L. No. 107-110, 115 Stat. 1425 (2002).

231. State and local school boards are generally afforded considerable discretion in operating public schools, subject primarily to constitutional constraints. *Bethel Sch. Dist. No. 403 v. Fraser*, 478 U.S. at 683; *Tinker*, 393 U.S. at 507.

232. Stephens, *supra* n. 225.

233. Rick Santorum, *Illiberal Education in Ohio Schools*, *The Washington Times* (Mar. 14, 2002), (available at http://www.arn.org/docs/ohio/washtimes_santorum031402.htm). Professor Kenneth Miller provides a clear criticism of that view. Kenneth R. Miller, *A Law by Any other Name – The Truth About the “Santorum Amendment” Language on Evolution*, <http://www.millerandlevine.com/km/evol/santorum.html> (accessed May 22, 2006); Kenneth R. Miller, *Is There a Federal Mandate to Teach Intelligent Design Creationism?*, <http://www.ncseweb.org/resources/articles/ID-activists-guide-v1.pdf> (accessed May 22, 2006).

234. Two such bills have been introduced in Alabama. Ala. H. 106, 2006 Reg. Sess. (Jan. 10, 2006); Ala. Sen. 45, 2006 Reg. Sess. (Jan. 10, 2006). Both bills died on April 18, 2006, when the Alabama legislature adjourned. Natl. Ctr. for Sci. Educ., *Alabama Antievolution Bills Die*, http://www.ncseweb.org/resources/news/2006/AL/575_alabama_antievolution_bills_di_5_10_2006.asp (May 10, 2006). In February 2006, the Maryland legislature introduced a similar bill. Md. H. 1531, 421st Sess. (Feb. 16, 2006). That bill has died as well, when the Maryland legislature adjourned. Natl. Ctr. for Sci. Educ., *Both Antievolution Bills in Maryland Dead*, http://www.ncseweb.org/resources/news/2006/MD/831_both_antievolution_bills_in_ma_4_11_2006.asp (Apr. 11, 2006).

evolution and the origins of man.”²³⁵ Like Senator Santorum, proponents of the proposed New York legislation erroneously rely on the “fairness” argument to “assure that all aspects of the controversy regarding the origins of man, the universe and all it contains, are being offered to students in publicly funded schools.”²³⁶ As explained, to lay fair claim to fairness, the state must show that a scientific controversy exists – it does not. In a stunning public admission of their own ignorance about the scientific method, proponents of Bill 8036 also confuse the concepts of theory and hypothesis, by erroneously claiming that the “basic rule of science is to evaluate and examine all theories rather than to present just one. Teaching just one theory can inadvertently result in that theory being looked at as an absolute.”²³⁷ As this article explains, if the scientific method is taught correctly, there is no confusion in presenting evolution as the dominant scientific theory, and there would be no confusion that the evolutionary theories are anything but absolute – scientific theories are, by definition, tentative. To state otherwise is to explicitly confuse scientific explanations, which are tentative, with religious explanations, which are absolute.

Another state’s school board showed similar confusion about how science is practiced, by confusing the scientific terms “fact” and “theory.” In 2002, the Cobb County School Board in Georgia required that stickers be affixed to biology textbooks, disclaiming the veracity of evolution as “a theory, not a fact,” because “discussion of disputed views of academic subjects is a necessary element of providing a balanced education, including the study of the origin of the species.”²³⁸ Later that year, parents sued Cobb County to remove disclaimer stickers (undermining evolution as a scientific theory) from biology textbooks, alleging, among other things, that the sticker violated the Establishment Clause.²³⁹ The district court found the sticker unconstitutional, ordered removal, and permanently enjoined the School Board from disseminating the stickers.²⁴⁰ The United States Court of Appeals for the Eleventh Circuit vacated the district court’s decision, finding that that the court’s decision was not supported by the

235. N.Y. Assembly 8036, 229th Annual Leg. Sess. (May 3, 2005).

236. See Memo attached to N.Y. Assembly 8036, 229th Annual Leg. Sess. (discussing purpose of bill) (available at <http://assembly.state.ny.us/leg/?bn=A08036>).

237. *Id.* (discussing justification of bill).

238. *Dialogue on Science, Ethics, and Religion*, *supra* n. 221. The text of the School Board’s policy is available at http://www.aaas.org/spp/dser/03_Areas/evolution/issues.shtml#SSES (accessed May 22, 2006) or <http://archives.cnn.com/2002/EDUCATION/09/26/creationism.evolution> (accessed May 22, 2006).

239. *Selman*, 390 F. Supp. 2d at 1288. The sticker reads: “This textbook contains material on evolution. Evolution is a theory, not a fact, regarding the origin of living things. This material should be approached with an open mind, studied carefully, and critically considered.” *Id.* at 1292.

240. *Id.* at 1313; see generally Eugenie C. Scott et al., *Outside View: Creation Sticker Shock*, UPI (Jan. 18, 2005) (providing a brief history of these sticker controversies).

record on appeal, which contained “significant evidentiary gaps,” and remanded the case for further fact-finding proceedings.²⁴¹

Other states have resorted to more traditional means of introducing religious ideas into the science classroom. For example, in December 2003 the Missouri state legislature introduced a bill requiring that equal time be given to teaching evolution and ID in science classes.²⁴² That same month, Montana Baptist Minister Curtis Brickley handbilled residents of Darby, Montana, asking them to attend a town meeting to discuss teaching ID.²⁴³ Following that meeting, in February 2004, the Darby School Board approved (3-2) a policy encouraging teachers to teach criticisms of evolutionary theory.²⁴⁴ The School Board reversed itself later that year.²⁴⁵ Also in February 2004, the Ohio School Board voted 13-5 to adopt high school science class lesson plans that encourage teaching ID theory.²⁴⁶ In Febru-

241. *Selman v. Cobb County Sch. Dist.*, 2006 WL 1428822 at *1 (11th Cir. May 26, 2006). Given that context is significant in evaluating Establishment Clause cases, the Eleventh Circuit “decided the best thing to do is remand the case to the district court in order for it to conduct new evidentiary proceedings and enter a new set of findings based on evidence in a record that we will be able to review.” *Id.* As the court explained: “Mindful that in this area factual context is everything, we simply choose not to attempt to decide this case based on a less than a complete record on appeal or fewer than all the facts.” *Id.* at 18. In light of Georgia’s antievolution history as well as the historical link between religiously motivated individuals and their tactic of undermining evolution as a comprehensive scientific theory by confusing the scientific terminology, the plaintiffs here should be able to create a record that would satisfy the court.

242. The bill states:

If scientific theory concerning biological origin is taught, biological evolution and biological intelligent design shall be taught and given equal treatment. Other scientific theory or theories of biological origin may be taught and given equal treatment. If biological intelligent design is taught, any proposed identity of the intelligence responsible for Earth’s biology shall be verifiable by present-day observation or experimentation and teachers shall not question, survey, or otherwise influence student belief in a nonverifiable identity within a science course.

Missouri Standard Science Act, Mo. H. 911, 92nd Gen. Assembly § 170.018.3(4)(b) (Dec. 19, 2003). The following April, a slightly altered version of this equal treatment bill was introduced. See Mo. H. 1722, 92nd Gen. Assembly (Apr. 7, 2004). Both bills died in May 2004, when the legislative session ended. See Natl. Ctr. for Sci. Educ., *Antievolution Legislation in Missouri*, http://www.ncseweb.org/resources/news/2006/MO/365_antievolution_legislation_in_m_1_11_2006.asp (Jan. 11, 2006).

243. See e.g. Jenny Johnson, *Darby Meeting To Discuss Teaching Intelligent Design*, Ravalli Republic, <http://www.ravallinews.com/articles/2003/12/09/news/news02.txt> (Dec. 9, 2003).

244. See e.g. Associated Press, *State Education Chief: Darby School Policy Not Science*, Billings Gazette, <http://www.billingsgazette.com/index.php?id=1&display=rednews/2004/02/03/build/state/50-darby-evolution.inc> (Feb. 3, 2004).

245. See e.g. Johnson, *supra* n. 243.

246. Neil Relyea, *Ohio School Board Approves Evolution Lesson Plan*, <http://www.wcpo.com/news/2004/local/03/09/schoolboard.html> (Mar. 9, 2004); John Mangels, *State Board Studying Theories on Start of Life*, <http://www.ohioroundtable.org/library/articles/ed/boardstudy.html> (Mar. 12, 2002); Kenneth R. Miller, *Good-bye Columbus*, <http://www.millerandlevine.com/km/evol/debate.html> (accessed May 22, 2006).

ary 2006, the Ohio Board of Education reversed that decision in an 11-4 vote.²⁴⁷

Most famously, in June 2004, the Pennsylvania School Board, led by school board member William Buckingham, rejected a biology textbook that taught Darwinian evolution. Buckingham subsequently agreed to the textbook on the condition that the School Board approve *Of Pandas and People: The Central Question of Biological Origins*, as a supplemental textbook. *Of Pandas* advocates ID as a viable scientific alternative to the modern theory of evolution. Shortly thereafter, the Pennsylvania School Board adopted a resolution requiring that ID be taught.²⁴⁸ Parents sued the school board, asking for a declaratory judgment that the ID policy violates the Establishment Clause, and injunctive relief prohibiting the school board from implementing the policy.²⁴⁹ After this decision issued, even Senator Santorum criticized the ID movement as pushing a religious agenda.²⁵⁰

In the past few months, several states have either joined ranks or revived previously unsuccessful attempts to teach ID as science. For example, school boards in Indiana have various plans to teach ID in its public schools.²⁵¹ Missouri has revived its anti-evolution legislation, introducing a bill that would require public school science teachers to comply with a list of “best practices . . . to support the truthful identity of scientific information and minimize misrepresentation while promoting clarity, accuracy, and student understanding” and “to support the objective teaching of scientific information and minimize dogmatism while promoting student inquiry, healthy skepticism, and understanding.”²⁵² The bill singles out the theory of evolution: “If a theory or hypothesis of biological origins is taught, a critical analysis of such theory or hypothesis shall be taught in a substantive amount.”²⁵³ In another example, parents in California sued school officials, asking a federal court to enjoin the school from teaching an elective course called the Philosophy of Design. The complaint alleged

247. Lisa Anderson, *Challengers of Evolution Lose*, Chicago Tribune, <http://www.chicagotribune.com/news/nationworld/chi-0602150175feb15,1,7955081.story?ctrack=1&cset=true> (Feb. 22, 2006).

248. Joseph Maldonado, *Biology Book Squeezed By*, York Daily Record, <http://www.aaas.org/spp/dser/evolution/issues/pennsylvania/8.4.04article.shtml> (Aug. 4, 2004).

249. *Kitzmiller v. Dover Sch. Dist.*, Docket No. 04-CV-2688 (W.D. Pa. 2005).

250. Carrie Budoff & Paul Nussbaum, *Santorum Now Critical of Dover Case*, Philadelphia Enquirer, <http://www.philly.com/mld/inquirer/news/local/states/pennsylvania/13461220.htm> (Dec. 22, 2005); Associated Press, *Santorum Breaks with Christian-Rights Law Center*, Washington Post A11 (Dec. 23, 2005).

251. See e.g. Mary Beth Schneider & Robert King, *GOP Lawmakers Want Schools To Teach 'Intelligent Design'*, <http://www.indystar.com/apps/pbcs.dll/article?AID=/20051103/NEWS02/511030467&SearchID=73225546268876> (Nov. 3, 2005) (discussing recent attempts in Indiana).

252. *Missouri Science Education Act*, Mo. H. 1266, 92nd Gen. Assembly § 170.025.3(1) (Jan. 9, 2006).

253. *Id.* at § 170.025.3(2)(b).

that the course, to be taught by the local minister's wife, is a "thinly veiled effort to teach to the students of Frazier Mountain High School intelligent design and young-Earth creationism" in violation of the Establishment Clause.²⁵⁴ That case was settled out of court. In January 2006, Utah's legislature passed a bill that would require public school teachers to stress the existence of scientific disagreement over which theory about the origin of life is correct.²⁵⁵ Oklahoma currently has four anti-evolution bills pending.²⁵⁶ Michigan had an anti-evolution bill pending, which eventually passed without the anti-evolution language.²⁵⁷

But what is the fuss about? At a policy level, the fuss is that these political measures are misleading. For example, the textbook sticker controversy misleads students by leaving them with the inaccurate impression that evolution is not to be respected because it is only a theory. As discussed above, however, scientific theories have particular meaning – a meaning that is confounded by the stickers, which in turn confuses students about how science is practiced. Political proponents of ID, like Senator Santorum, and more recently President Bush, have similarly confused the issue by couching the debate in terms of academic freedom. However,

254. The course description is:

The class will take a close look at evolution as a theory and will discuss the scientific, biological, and Biblical aspects that suggest why Darwin's philosophy is not rock solid. This class will discuss Intelligent Design as an alternative response to evolution. Topics that will be covered are the age of the Earth, a world wide flood, dinosaurs, pre-human fossils, dating methods, DNA, radioisotopes, and geological evidence. Physical and chemical evidence will be presented suggesting the Earth is thousands of years old, not billions. The class will include lecture discussions, guest speaker, and videos. The class grade will be based on a position paper in which students will support or refute the theory of evolution.

Complaint ¶¶ 22, 58, *Hurst v. Newman* (E.D. Cal. Jan. 10, 2006), (available at http://www.au.org/site/DocServer/Final_Complaint.pdf?docID=541).

255. Utah S. 96, 2006 Gen. Sess. (Jan. 23, 2006).

256. The most recent bill, introduced in February 2006, would encourage public school boards:

[T]o revise the recommended academic curriculum content standards in science to ensure that . . . all students can . . . [u]se . . . the scientific method to critically evaluate scientific theories including, but not limited to, the theory of evolution; and . . . [u]se relevant scientific data to assess the validity of those theories and to formulate arguments for and against those theories.

The other bills would require that "the full range of scientific views" be taught with regard to "biological or chemical origins of life;" authorize school districts to teach ID; and encourage presentation of "the full range of scientific views." See Natl. Ctr. for Sci. Educ., *A Fourth Antievolution Bill in Oklahoma*, http://www.ncseweb.org/resources/news/2006/OK/295_a_fourth_antievolution_bill_in_2_15_2006.asp (Feb. 15, 2006).

257. Compare 2006 Mich. Acts 123 (signed into law April 20, 2006), with Mich. H. 5606, 2006 Gen. Sess. (Jan. 24, 2006). The new law deletes the bill's reference to "using the scientific method to critically evaluate scientific theories and using relevant scientific data to assess the validity of those theories and formulate arguments for and against those theories."

academic freedom does not include the privilege to teach bad science. Nor is it sufficient to baldly state that one has a critique of a scientific theory and, therefore, that principles of academic freedom should entitle educators to teach the controversy that one's critique has generated. To advance scientific knowledge, there must be a legitimate scientific (as opposed to political or religious) controversy to teach. Otherwise, as explained above, teaching the controversy leads to confusion about the principles of science and the scientific method.

At the level of constitutional analysis, the fuss, according to the scientific community, is that ID is not science, and therefore should not be taught as science. Accordingly, it is imperative to determine whether ID is science. If not, there is no good reason for teaching it in science class. If ID is not science and has a religious purpose or religious effects, then not only is it bad policy to teach it in science class, but it is unconstitutional to do so. Below, I define ID and show that it is not a scientific theory. I then explain that those who argue that ID should be taught as science ultimately seek to turn back the scholarly clock. Their goal is to treat supernatural explanations for natural phenomena as science – to return to a pre-Baconian, perhaps even Aristotelean-scientific framework.²⁵⁸ In essence, the modern debate over whether or not to teach the controversy is really a debate about the nature of science.

B. *The Modern Intelligent Design Inference*

1. *Intelligent Design, As Defined by Its Proponents, is Not Science*

Proponents of ID have defined it as a movement, whose:

[M]ain thrust . . . is that intelligent agency, as an aspect of scientific theory-making, has more explanatory power in accounting for the specified, and sometimes irreducible, complexity of some physical systems, including biological entities, and/or the existence

258. Intelligent design proponents dispute that they are advocating that position. In criticizing the exclusion by science of final and formal causes, and in arguing for the return of the design inference to science, Dembski qualifies:

Now I don't want to give the impression that I'm advocating a return to Aristotle's theory of causation. There are problems with Aristotle's theory, and it needed to be replaced. My concern, however, is with what replaced it. By limiting scientific inquiry to material and efficient causes, Bacon fed into a mechanistic understanding of the universe that was soon to dominate science.

Dembski, *supra* n. 220, at 124.

of the universe as a whole, than the blind forces of unguided and everlasting matter.²⁵⁹

Professor Michael Behe, one of the stalwarts of the ID movement, defines design “simply as the purposeful arrangement of parts.”²⁶⁰ Professor Behe defines “irreducibly complex” to mean “a single system composed of several well-matched, interacting parts that contribute to the basic function, wherein the removal of any one of the parts causes the system to effectively cease functioning.”²⁶¹ For Behe, an “irreducibly complex system can not be produced directly by numerous, successive, slight modifications of a precursor system, because any precursor to an irreducibly complex system that is missing a party is by definition nonfunctional.”²⁶² According to this view, finding an irreducibly complex biological system would present a “powerful challenge to Darwinian evolution. Since natural selection can only choose systems that are already working, then if a biological system can not be produced gradually it would have to arise as an integrated unit, in one fell swoop, for natural selection to have anything to act on.”²⁶³ The existence of an irreducibly complex system is “better” explained by the act of some “unnamed intelligent agent,” who purposefully arranged parts together into the irreducibly complex system.²⁶⁴ Simply put, “life is too complex to have developed through evolution, implying a higher power must have had a hand.”²⁶⁵

As with Paley’s argument from design, ID hinges primarily on the veracity of an inference: that the complex order observed in nature powerfully suggests that such complex order must have been designed by an intelligent agent. ID also postulates that observable complex systems are so complex – irreducibly complex – that they could not have been brought into existence by natural selection.²⁶⁶

259. Francis J. Beckwith, *Public Education, Religious Establishment, and the Challenge of Intelligent Design*, 17 Notre Dame J. L. Ethics & Pub. Pol. 461, 462 (2003).

260. Behe, *Darwin’s Black Box*, *supra* n. 220, at 193. Most recently, Professor Behe defined *intelligent design* as “a scientific theory that proposes that some aspects of life are best explained as the result of design, and that the strong appearance of design in life is real and not just apparent.” Trial Transcript at 89, *Kitzmiller v. Dover Area Sch. Dist.*, No. 04-CV-2688 (M.D. Pa. 2005).

261. Behe, *Darwin’s Black Box*, *supra* n. 220, at 39.

262. Michael J. Behe, *Evidence for Intelligent Design from Biochemistry from a Speech Delivered at Discovery Institute’s God & Culture Conference*, www.arn.org/docs/behe/mb_idfrombiochemistry.htm (Aug. 10, 1996).

263. *Id.*

264. Lisa Anderson, *Evolution of Intelligent Design*, Chicago Tribune, <http://www.chicagotribune.com/news/nationworld/chi-0510300281oct30,1,1790111.story> (Oct. 30, 2005).

265. Ondrej Hejma, *‘Intelligent Design’ Supporters Gather*, Associated Press, <http://www.discovery.org/scripts/viewDB/index.php?command=view&program=CSC%20-%20Views%20and%20News&id=2974> (Oct. 24, 2005).

266. To bolster that argument, proponents of ID often rely on self-organizing principles – the theory, devised by Stuart Kauffman of the Santa Fe Institute, that complexity generates greater organization.

As the argument itself reveals, ID is simply not a scientific theory because it fails to meet the definition of science – it is not falsifiable and is not subject to revision by testing; it has no predictive value; and it relies on supernatural rather than natural explanations for the natural world.

ID is not falsifiable, in part because it is subject to ad hoc explanations.²⁶⁷ Indeed, ID's poster child for irreducibly complex systems, the bacterial flagellum, does not show that ID is falsifiable. It cannot therefore transform ID into a scientific theory. Professor Behe states that the bacterial flagellum is an irreducibly complex system; in other words, natural selection cannot create it. However, Behe argues that the flagellum shows that ID is falsifiable. If a flagellum or other irreducibly complex system were produced by placing a bacterial species lacking a flagellum under some selective pressure and then grow the bacteria for thousands of generations, Behe argues, ID would be disproven:

In fact, *intelligent design is open to direct experimental rebuttal*. Here is a thought experiment that makes the point clear. In *Darwin's Black Box* (Behe 1996) I claimed that the bacterial flagellum was irreducibly complex and so required deliberate intelligent design. The flip side of this claim is that the flagellum can't be produced by natural selection acting on random mutation, or any other unintelligent process. To falsify such a claim, a scientist could go into the laboratory, place a bacterial species lacking a flagellum under some selective pressure (for mobility, say), grow it for ten thousand generations, and see if a flagellum – or *any* equally complex system – was produced. If that happened, my claims would be neatly disproven.²⁶⁸

Behe is wrong. Even if his experiment, which interestingly enough is beyond the capacity of modern science, did produce the flagellum, proponents of ID could argue that the intelligent agent was merely acting in the

But, in fact, that theory is compatible with Darwin's theory of natural selection, and helps refute Behe's main criticism of Darwin's theory – that there exist irreducibly complex systems that cannot be explained by Darwin's theory of natural selection. See Stuart Kauffman, *At Home in the Universe: The Search for the Laws of Self-Organization and Complexity* (Oxford U. Press 1995). For a user-friendly critique of Behe's observation that irreducible complexity exists at the biochemical level, see Miller, *supra* n. 102, at 129-64. Miller explains that Behe incorrectly assumes that natural selection could not work on "irreducibly complex" systems because such systems would not function as normal if some part were missing. Miller points out several examples of intermediate forms that might function, possibly even in completely different ways, thereby allowing the force of natural selection to drive evolutionary change.

267. Dembski also takes issue with the significance of showing that intelligent design is not falsifiable. Dembski, *supra* n. 220, at 253-54 nn. 29, 39. Other proponents, such as Behe, have tried unsuccessfully to show that intelligent design is falsifiable.

268. Michael Behe, *Philosophical Objections to Intelligent Design: Response to Critics*, Discovery Institute, <http://www.trueorigin.org/behe06.asp#b1> (accessed May 22, 2006).

test tube. There is no way to tell, from this experiment, whether the intelligent agent was actually working inside the laboratory. Therefore, the test does not falsify the theory.²⁶⁹

Nor does ID make any predications. After all, who can predict what something that is so powerful as to create life would do in any particular instance. Along these lines, the design inference is tautological, because it assumes what it tries to prove – observable design must have a designer. Accordingly, the tautology actually has no explanatory power, in the sense that it cannot predict outcomes.

But even more fundamentally, ID is, by definition, an inference – not a theory – for the existence of a supernatural power. That supernatural power, whether it is the Judeo-Christian God, the gods of the ancient world, or some other supernatural force, is simply not within the domain of science for at least two reasons. First, that power is supernatural and thereby excluded from the scientific method. Second, that power is subject to ad hoc explanations during testing.

Nor is that aspect of the ID movement that criticizes Darwinian evolution a scientific theory. Simply stating that a theory is wrong is not a theory in itself. And simply stating that the inference “has more explanatory power” than the scientific theory of evolution, does not transform the inference into a theory. Simply put, to the extent the argument is based on any theory, the theory is not that order exists (after all, evolution depends on the same premise), but that an intelligent designer exists – an argument that, by definition, has no place in science, but whose true home is religion.²⁷⁰

To be sure, complexity and order are observable and measurable. But it is doubtful whether the concept of “irreducible complexity” itself is measurable precisely because it begs the question asked: A system is irreducibly complex only if natural selection cannot account for it.²⁷¹ Similarly, whether the existence of a system is so complex that natural selection cannot account for it, at most, casts doubt on the theory of natural selection as the mechanism for evolutionary change. In other words, it potentially falsifies natural selection.

269. Behe’s claim is also wrong as a matter of scientific method. Generally one single finding casts doubt on a particular theory, but does not invalidate it. The theory is generally not disproven until a new scientific theory supercedes it. For a good summary of why Behe’s flagellum argument is not falsifiable, see William Saletan, *Grow Some Testables: Intelligent Design Ducks the Rigors of Science*, Sept. 29, 2005, <http://www.slate.com/id/2127052> (accessed May 22, 2006).

270. For a user-friendly explanation of how natural selection explains natural order and complexity, see Dawkins, *supra* n. 102.

271. Dembski disputes that the lack of measurability removes intelligent design from science. He argues that many phenomena are not measurable but remain part of science. Dembski, *supra* n. 220, at 253-54 n. 28.

If ID is not falsifiable, makes no predictions, and is otherwise not scientific because it invokes an untestable, unobservable supernatural force as its causal agent, then what scientific controversy is there to teach in the science classroom? Simply put, ID is, by its own terms, a nonscientific inference that arrogates itself to science. And, in its haste to cast doubt on evolutionary theory, it ironically shows why one of its main targets, the theory of evolution by natural selection, is itself scientific.

2. Intelligent Design, As Defined by Its Proponents, is a Religious Inference for the Existence of God

*Christ is indispensable to any scientific theory, even if its practitioners don't have a clue about him. The pragmatics of a scientific theory can, to be sure, be pursued without recourse to Christ. But the conceptual soundness of the theory can in the end only be located in Christ. Christ, as the completion of our scientific theories, maintains the conceptual soundness of those theories even as the real numbers maintain the conceptual soundness of the applied mathematician's calculations. Christ has assumed the fullness of our humanity and entered every aspect of our reality. He thereby renders all our studies the study of himself.*²⁷²

As shown above, ID is a religious inference for the existence of God. ID postulates irreducible complexity, and from that it infers that an intelligent agent is the best explanation for the existence of that irreducible complexity – defined as “a single system composed of several well-matched, interacting parts that contribute to the basic function, where in the removal of any one of the parts causes the system to effectively cease functioning.”²⁷³ In essence, ID is an argument for the existence of God.

That argument is similar in most respects to the fifth of St. Thomas Aquinas' (1225-1274) five proofs for the existence of God. Aquinas wrote:

We see that things which lack intelligence, such as natural bodies, act for an end, and this is evident from their acting always, or nearly always, in the same way, so as to obtain the best result. Hence it is plain that not fortuitously, but designedly, do they achieve their end. Now whatever lacks intelligence cannot move towards an end, unless it be directed by some being endowed with knowledge and intelligence; as the arrow is shot to its mark by the

272. Dembski, *supra* n. 220, at 210.

273. Behe, *Darwin's Black Box*, *supra* n. 220, at 39.

archer. Therefore some intelligent being exists by whom all natural things are directed to their end; and this being we call God.²⁷⁴

The core of Aquinas' argument is that natural bodies cannot order themselves, because they themselves lack knowledge and intelligence. Accordingly, something with knowledge and intelligence must be acting on them.

It stands to reason that the ID argument would be appealing to theologians, who would view Behe's and Dembski's version of the design argument as giving scientific rigor to the design inference. After all, Behe attempts to explain, in biochemical terms, the enormous complexity hidden from the naked eye – complexity, he claims, that cannot be produced by natural forces. But, as explained above, the extent to which complexity is observable and measurable is not unique to ID. Darwin's theory of evolution also depends on observable order in the universe, even at the biochemical level.

Proponents of ID dispute that their argument is necessarily religious by disputing that the intelligent agent is necessarily God or the gods. When asked then what the intelligent agent is, if not God, the answer ID proponents most frequently set forth is Dr. Francis Crick's (1916-2004) and Dr. Leslie Orgel's panspermia argument – “the theory that organisms were deliberately transmitted to the Earth by intelligent beings on another planet.”²⁷⁵ But as is patently obvious from the definition of panspermia, that answer only begs the question: What intelligent agent created the intelligent beings that spread intelligent life to Earth?

3. *Bringing Intelligent Design Ideology into Science Class Promotes the Bad Public Policy of Encouraging Bad Science, and is, Nevertheless, Unconstitutional*

Contrary to Senator Santorum's statement read into the congressional record,²⁷⁶ teaching ID in science class is bad public policy. Senator Santorum wrongly suggested that teaching this controversy as science will “do a better job of teaching the issue itself” in terms of presenting the scientific method and livening the debate; will give students a “greater appreciation for how science is actually practiced;” and will serve as a “model” for how students should address differences in opinion through reasoned discussion within a pluralistic society.²⁷⁷ As explained above, the controversy sur-

274. St. Thomas Aquinas, *Summa Theologica*, *supra* n. 96, at I, Q. 2, art. 3.

275. F.H.C. Crick & L.E. Orgel, *Directed Panspermia*, 19 ICARUS 341 (1973) (available at http://profiles.nlm.nih.gov/SC/B/C/C/P/_/scbccp.pdf).

276. See *supra* nn. 225-229 and accompanying text.

277. *Santorum Amendment*, *supra* n. 228, at S6148 (statement of Sen. Santorum).

rounding evolution is not a scientific controversy, but a political and religious debate, which should be confined to classes where such controversies are the subject matter. To be sure, were there a competing scientific model to evolution, it would be good public policy to teach that theory. Along those lines, if ID proponents want ID to be taught as science, they must present a falsifiable, predictive theory about the origins of life and then obtain scientific acceptance of the design inference.²⁷⁸ So far they have been unable to put forward a falsifiable, predictive theory in part because the ID inference is premised on the existence of a supernatural being. Moreover, they have been unable to gain widespread scientific acceptance because the ID inference is not science and is contrary to the scientific method. Thus, contrary to Senator Santorum's second reason for "teaching the controversy" – to "give[] students greater appreciation for how science is actually practiced"²⁷⁹ – teaching ID as an alternative to evolution actually confuses students about how science is actually practiced. Senator Santorum's objective to provide models for how students should explore differences in opinion through reasoned discussions can be better obtained by making debates on important political issues a part of the social studies curriculum. For all these reasons, teaching ID as science is bad public policy.²⁸⁰

Teaching ID as science is not only bad public policy – it is also unconstitutional. In particular, it violates the Establishment Clause because such teaching lacks a secular purpose and is in fact a religiously motivated attempt to bring proofs for the existence of God into science class. To be sure, analyzing any issue under the Establishment Clause is a highly fact-intensive inquiry into the purpose and effects of the state action.²⁸¹ But applying the principles set forth in *Lemon* and its progeny, in particular, as Establishment Clause jurisprudence development in the context of the debate over teaching creation-science in public schools, it is fair to say that ID has at least two hurdles to overcome. First, it must establish itself as science. Second, it must disentangle itself from religion. Considering ID's overtly theistic agenda and its historical link to both St. Thomas Aquinas' fifth proof for the existence of God and Bishop Paley's design inference for God, a finding of religious purpose, effects, endorsement, or entanglement is very likely. Similarly, considering ID's overt reliance on God to

278. See *Amicus Curiae Br. of Natl. Acad. of Sci.* at 15, *Edwards*, 482 U.S. 578 (discussing the importance of peer review that characterizes the scientific community).

279. See *supra* n. 228 and accompanying text.

280. For similar reasons, Mississippi's most recent education bill, which forbids public school officials from prohibiting its teachers "from discussing and answering questions from individual students on the origin of life," Miss. H. 214, 2006 Reg. Sess. § 3 (2006), is also bad public policy, to the extent it encourages teaching in science class anti-evolution ideas not grounded in science.

281. *McCreary County*, 125 S. Ct. at 2733 n. 10 (citing *Everson*, 330 U.S. 1).

explain natural phenomena, it is unlikely that its proponents will convince a court of law that ID is science, short of convincing the scientific community to change its definition of science. I now examine precisely that option.

4. *The Intelligent Design Movement's Attack on Methodological Naturalism*

ID proponents claim that science in general, and evolutionary theory in particular, has a philosophical bias in favor of methodological naturalism – the exclusion of supernatural explanations from the realm of science. By excluding supernatural causes from the domain of science, scientists a priori exclude ID from scientific consideration.²⁸² Accordingly, any argument that posits a supernatural cause as the explanation of the natural phenomenon will have a problem both meeting the definition of science and showing that it does not violate the Establishment Clause.²⁸³

To get around the Establishment Clause obstacle, proponents of ID have advocated a mission of redefining science so that ID comes within that definition. In particular, proponents of ID have advanced replacing methodological naturalism with theistic naturalism or theistic science. Theistic naturalism fundamentally alters the scientific method by allowing scientists to seek supernatural explanations for natural phenomena.²⁸⁴ This is precisely what the Kansas School Board did.²⁸⁵

Not surprisingly, the scientific community has been hostile to fundamentally altering a methodology that has advanced knowledge of the natural world. Thus, while proponents of ID view methodological naturalism as confining, the restriction by science of explanations to material causes in fact augments knowledge. Dr. Eugenie C. Scott explained: “By continuing to seek natural explanations for how the world works, we have been able to find them. If supernatural explanations are allowed, they will discourage – or at least delay – the discovery of natural explanations, and we will under-

282. Phillip E. Johnson, *Evolution as Dogma: The Establishment of Naturalism*, in William A. Demski, *Uncommon Dissent: Intellectuals who Find Darwinism Unconvincing* 23-40 (ISI Books 2004).

283. For one of the most famous critiques of methodological naturalism, see Alvin Plantinga, *Methodological Naturalism?, Parts 1&2, Origins and Design*, <http://www.arn.org/docs/odesign/od181/methnat181.htm> (accessed May 22, 2006) and <http://www.arn.org/docs/odesign/od182/methnat182.htm> (accessed May 22, 2006).

284. See e.g. Phillip E. Johnson, *The Wedge: Breaking the Modernist Monopoly on Science*, <http://www.touchstonemag.com/docs/issues/12.4docs/12-4pg18.html> (accessed May 22, 2006); Discovery Institute, *'The Wedge Document': So What?*, <http://www.discovery.org/scripts/viewDB/filesDB-download.php?id=349> (accessed May 22, 2006).

285. Associated Press, *Kansas School Board Redefines Science*, <http://www.cnn.com/2005/EDUCATION/11/08/evolution.debate.ap/index.html> (Nov. 8, 2005).

stand less about the universe.”²⁸⁶ Dr. Scott also pointed out that supernatural explanations do not allow for controlled experiments and therefore do not allow for proper testing against the natural world:

[W]ithout making a judgment on the existence or nonexistence of God, modern scientists carry out their tests of hypotheses as if only natural causes were operating. It’s a scientific analogue of Pascal’s wager: if an omnipotent power such as God exists, then we can’t control for its actions, so we’re stuck with methodological materialism. If God doesn’t exist, then of course methodological materialism is the best way to understand the natural world.²⁸⁷

V. THE CHANGING DEFINITION OF SCIENCE: A KANSAS CASE STUDY

Kansas has taken the most radical stance yet in the current debate between scientists and creationists over teaching evolution and the origins of life in public school science classes. On November 8, 2005, the Kansas Board of Education approved new science standards, which redefined science to include exploration of supernatural causes.²⁸⁸

Science is a systematic method of continuing investigation that uses observations, hypothesis testing, measurement, experimentation, logical argument and theory building to lead to more adequate explanations of natural phenomena. Science does so while maintaining strict empirical standards and healthy skepticism. Scientific explanations are built on observations, hypotheses, and theories. A hypothesis is a testable statement about the natural world that can be used to build more complex inferences and explanations. A theory is a well-substantiated explanation of some aspect of the natural world that can incorporate observations, inferences, and tested hypotheses.²⁸⁹

The definition seems harmless enough – except that it fails to exclude supernatural explanations for natural phenomena. As Kansas State Univer-

286. Eugenie C. Scott, ‘*Science and Religion*,’ ‘*Christian Scholarship*,’ and ‘*Theistic Science*’: *Some Comparisons*, http://www.ncseweb.org/resources/articles/6149_science_and_religion_chris_3_1_1998.asp (Mar. 1, 1998).

287. *Id.*

288. *Kansas School Board Redefines Science*, <http://www.cnn.com/2005/EDUCATION/11/08/evolution.debate.ap/> (Nov. 8, 2005).

289. Kan. St. Bd. of Educ., *Kansas Science Standards* ix, <http://www.ksde.org/outcomes/sciencestd.pdf> (accessed May 22, 2006).

sity Professor John Staver, on behalf of the American Academy for the Advancement of Science wrote, the Kansas redefinition:

[I]mplies that science is just one of many explanations of natural phenomena, including supernatural causes, and removes a defining principle of science which was present in the previous version of the standards – that science is restricted to *natural* explanations of the natural world. This restriction, which has been one of the cornerstones of scientific practice for more than three centuries, is one of the primary reasons that science has been fruitful in producing useful knowledge.²⁹⁰

The Kansas Board of Education flatly denies that the failure to exclude supernatural causes says anything about supernatural causes, stating that “[b]y describing science as an open-ended search for more adequate or reliable explanations using empirical methods, it implies nothing about the supernatural.”²⁹¹ But curiously, the Board affirmatively adds that “[t]his also makes the definition *areligious* – religiously neutral, a feature important to both science and public education.”²⁹²

It is curious that the Board would simultaneously claim that failing to exclude supernatural causes from the definition of science both “implies nothing about the supernatural” but does something significant to the definition of science by making it “areligious.”²⁹³ It has been the position of the scientific community (as well as that of reviewing courts) that the “areligious” definition of science excludes supernatural causes. In other words, explanations of natural phenomena that resort to supernatural causes are, by definition, religious. So, to fail to exclude supernatural causes from that definition, but then claim that such omission makes the definition “areligious,” must mean that Kansas is adopting a religious view of what constitutes science – one that includes supernatural causes. Indeed, this approach is so common among members of the religious community that it is known as theistic naturalism.

Proponents of theistic naturalism, such as Notre Dame Professor of Philosophy, Alvin Plantinga, take the view that the actual practice and content of science challenge the claim that science and religion are by nature epistemologically distinct, and therefore that science is neutral on religious

290. John Staver, *AAAS Statement on Changes to Kansas Science Education Standards*, <http://www.aaas.org/news/releases/2005/0913kansas.shtml> (Sept. 13, 2005).

291. Kan. St. Bd. of Educ., *FAQ's about Kansas Science Standards, Kansas Science Standards*, http://www.kansasscience2005.com/Kansas_Science_Standards%20FAQ.doc (Nov. 8, 2005).

292. *Id.*

293. *See also* Wexler, *supra* n. 1, at nn. 110-37 (arguing against the more general version of this argument posited by ID proponents that teaching ID is necessary to erase the perception that the government, by permitting evolution to be taught, is favoring a certain irreligious point of view).

matters.²⁹⁴ Not surprisingly, evolution is one of three examples Plantinga gives to show that science is not neutral on religious matters (the other two examples being the scientific explanation for human altruistic behavior and the big bang theory). Plantinga refers specifically to the Grand Evolutionary Myth, which he defines as the theory that “organic life somehow arose from non-living matter by way of purely natural means and by virtue of the workings of the fundamental regularities of physics and chemistry.”²⁹⁵ He argues that this myth:

[P]lays a certain kind of quasi-religious role in contemporary culture. It is a shared way of understanding ourselves at the deep level of religion, a deep interpretation of ourselves to ourselves, a way of telling us why we are here, where we come from, and where we are going.²⁹⁶

Defining religion in that way, he observes that the origins-of-life myth of the evolution religion does not necessarily conflict with the Judeo-Christian creation myth.²⁹⁷ He argues, however, that the naturalistic explanation for the diversity of life – the theory of common descent – does conflict with the Christian account of creation. From here, Plantinga argues that the Christian or theistic scientist is freer to follow the evidence where it leads because the theistic scientist “knows” that God created all things. That scientist, unlike the atheistic scientist, is not “committed to any particular way in which God did this.”²⁹⁸ Plantinga also quotes well-known, mostly atheistic pro-evolutionists, such as Dawkins and Gould, to show that his conclusion – evolution is anti-religious – is correct. Acknowledging the obvious – that such scientists’ musing on their field are philosophical, not scientific – Plantinga then rejects that distinction as significant: “Perhaps this is true, although it has become increasingly difficult to draw a sharp line between science and such other activities as philosophical reflection on science.”²⁹⁹

Plantinga next takes issue with the idea that science necessarily involves the rule of methodological naturalism. He rejects several arguments for methodological naturalism, but does not take on Dr. Eugenie Scott’s explanation of Pascal’s wager analogy. He ends with a reference to St.

294. See Alvin Plantinga, *Methodological Naturalism?, Part 1, Origins and Design*, <http://www.arm.org/docs/odesign/od181/methnat181.htm> (accessed May 22, 2006) [hereinafter Plantinga, *Methodological Naturalism?, Part 1*].

295. See *id.*

296. See *id.*

297. After all, *Genesis* proclaims that God created Adam out of inorganic material.

298. Plantinga, *Methodological Naturalism?, Part 1*, *supra* n. 294.

299. See *id.*

Augustine's explanation of the battle between the City of God and the City of Man:

[T]he task of the Christian academic community is to discern the limits and lineaments of this contest, to see how it plays out in intellectual life generally, and to pursue the various areas of intellectual life as citizens of the Civitas Dei. This naturally suggests pursuing science using all that we know: what we know about God as well as what we know about his creation, and what we know by faith as well as what we know in other ways. That natural suggestion is proscribed by the principle of Methodological Naturalism. Methodological naturalism, however, though widely accepted and indeed exalted, has little to be said for it; when examined coolly in the light of day, the arguments for it seem weak indeed. We should therefore reject it, taken in its full generality. Perhaps we should join others in Duhemian science; but we should also pursue our own Augustinian science.³⁰⁰

Kansas, like Plantinga, takes the theistic naturalism view. But changing the definition of science, in these circumstances, is unlikely to resolve the Establishment Clause problems faced by proponents of creation-science and ID, especially because this redefinition can be linked to theologians and proponents of theistic science, like Plantinga. It is, once again, an agenda for proving the existence of God and injecting religion into science class.

VI. FINAL THOUGHTS: THE DESTRUCTION OF SCIENCE AS WE KNOW IT?

As this paper shows, ID's criticism of the scientific method – that it a priori excludes supernatural explanations – is true, but so what? Why is it so important for proponents to teach ID as science? The answer to that question may lay in the religious belief of some that science in general, and evolutionary theory, in particular, is built on a philosophy of materialism that is destroying the core fundamental values upon which our country was founded.³⁰¹ As Richard Dawkins explained: "Darwin made it possible to be an intellectually fulfilled atheist."³⁰² But again, so what? So what if

300. Alvin Plantinga, *Methodological Naturalism?, Part 2, Origins and Design*, <http://www.arn.org/docs/odesign/od182/methnat182.htm> (accessed May 22, 2006).

301. As this article shows, Darwinian evolution actually rejects wholesale materialism. *Supra* nn. 105-118 and accompanying text. But a full-scale rebuttal of the argument that Darwinism is built on a materialistic philosophy that is destroying the core fundamental values of this country is beyond the scope of this paper.

302. Dawkins, *supra* n. 102, at 6.

Darwin's evolutionary theories are compatible with an atheistic universe? All scientific theories, by definition, are compatible with a universe without God. More importantly, Darwin's evolution is compatible with a theistic universe as well.

So then why not allow ID, or any theory that relies on supernatural causes, to be taught alongside evolution? The answer is simple. Reliance on supernatural causes, far from promoting academic freedom, stifles the pursuit of knowledge. Dr. Eugenie Scott put it well in describing the so-called scientific analogue of Pascal's wager: The best way to understand the natural world is to assume methodological naturalism because if God exists, we can't experimentally control for Him anyway.

The argument from design, in whatever form, historically has been a powerfully persuasive argument for the existence of God, but it is not a scientific theory. To be sure, modern ID proponents have added scientific rigor to their analysis by pointing to the great complexity of natural order at the biochemical level. But the answer – God did it – is both epistemologically unfulfilling and intellectually stifling. And indeed, their own examples show just that. Behe has given several examples of what he considers to be irreducibly complex systems, including the mechanisms for blood clotting and the structure of the bacterial flagellum. Yet, scientists have explained how both systems, although complex in much the way Behe describes, are not irreducibly complex but can be brought about by evolutionary forces.³⁰³ If left to Behe, the inquiry would have ended with his statement that these systems were too complex to come about by the mechanism of natural selection and that the better explanation for these systems is that God created them – end of story.

Science is the quest for knowledge about the natural world. For the atheist-scientist, that's all it may be. For the theist-scientist, perhaps science is the quest for understanding God's mind.³⁰⁴ As the Vatican's chief astronomer put it, the "universe as we know it today through science is one way to derive an analogical knowledge of God."³⁰⁵ Leading conservative philosopher Larry Arnhart similarly remarked, "Darwin employed the metaphor of God as speaking through two books – the Bible as His word and nature as His works – which was commonly used by Christians to

303. See Miller, *supra* n. 102, at 129-64.

304. See Larry Arnhart, *Darwinian Conservatism* (Imprint Academic 2005) (arguing that Darwinian evolution supports conservative values and is open to the argument that God is the First Cause of the evolutionary laws of nature); Stephen Barr, *The Miracle of Evolution, First Things* (Feb. 2006).

305. See George Coyne, *God's Chance Creation* <http://www.thetablet.co.uk/cgi-bin/register.cgi/tablet-01063> (Jun. 8, 2005).

justify the scientific study of nature as compatible with reverence for the revelation of Scripture.”³⁰⁶

For a more traditional Christian creationist, knowledge gained from such a quest may be forbidden fruit from the tree of the knowledge of good and evil. By refusing those fruits, we avoid the consequences arising from the misuse or abuse of such knowledge. But, by invoking God as the efficient and final cause, and ending our quest for knowledge, we also blind ourselves to God’s mind; we end progress; we strangle academic freedom.

By contrast, opposing such a stranglehold is not to say that religion and morality should not play a significant role in scientific debates. After all, according to Judeo-Christian tradition, God “put [Adam] in the garden of Eden to till it and keep it.”³⁰⁷ To paraphrase a recent statement by the Vatican: “We know where scientific reason can end up by itself: the atomic bomb and [other similar accomplishments] are fruit of a reason that wants to free itself of every ethical or religious link.”³⁰⁸ That is the debate we should be having – what are the appropriate uses of knowledge gained through science, and not whether we should end scientific inquiry.

306. See Larry Arnhart, commenting on Barr’s *The Miracle of Evolution*, <http://darwinianconservatism.blogspot.com/2006/01/stephen-barrs-miracle-of-evolution.html> (accessed May 22, 2006).

307. *Genesis* 2:15 (Revised Stand. Version, Catholic ed.).

308. Nicole Winfield, *Vatican: Faithful Should Listen to Science*, http://news.yahoo.com/s/ap/20051104/ap_on_sc/vatican_science;_ylt=AmddOpaPmxvLcl3sFIC309ys0NUE;_ylu=X3oDMTA3MzV0MTdmBHNIYwM3NTM (Nov. 4, 2005).