Teaching the Origins Controversy: Science, Or Religion, Or Speech?

David K. DeWolf[*]
Stephen C. Meyer[**]
Mark Edward DeForrest[***]

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[*]Professor of Law, Gonzaga University School of Law, Spokane, WA. B.A., Stanford University, 1971; J.D., Yale Law School, 1979.

[**]Associate Professor of Philosophy, Whitworth College; Director, Center for the Renewal of Science and Culture, Discovery Institute, Seattle, WA. B.A., Whitworth College, 1980; Ph.D., Cambridge University, 1991.

[***]Instructor, Central Washington University. B.A., Western Washington University, 1992; J.D., Gonzaga University School of Law, 1997.

I. INTRODUCTION

One can hardly imagine a more contentious issue in the American culture wars than the debate over how biological origins should be taught in the public schools. On the one hand, the National Academy of Sciences, the National Center for Science Education, and the American Civil Liberties Union have insisted that any departure from a strictly Darwinian approach to the issue constitutes an attack on science itself, and even an unconstitutional intrusion of religion into the public school science curriculum. On the other hand, many parents and religious activists have long rebelled against what they perceive as a dogmatic attack on their religious beliefs. Beginning in the 1970s, such activists sought to promote a Bible-based curriculum—known as "scientific creationism"—as either a complement or an alternative to the standard Darwinist curriculum advocated by the National Academy of Sciences. And so the battle lines were drawn.

When confronted with a conflict between establishment science and religious fundamentalism, most lawyers have assumed that the law clearly favors the former. And indeed, although the creationists won some battles in state legislatures during the 1980s, they clearly lost the war in the courts. In *McLean v. Arkansas Board of Educ.*[1] and *Edwards v. Aguillard*,[2] the courts ruled that teaching "scientific creationism" or "creation-science" would have resulted in an unconstitutional advancement of religion. Media reports have

[1]529 F. Supp. 1255 (E.D. Ark. 1982).
[2]482 U.S. 578 (1987).

portrayed all subsequent local controversies as reruns of these earlier battles—some even invoking imagery from the *Scopes* trial from the 1920s.[3]

Such reports have, unfortunately, served to obscure rather than illuminate the legal issues that school boards and their lawyers now increasingly face. Not only are the legal issues surrounding the *Edwards* decision more complex than often reported, but the challenge to the Darwinian curriculum in public education has now changed. Indeed, as the new century begins, a school board lawyer is far less likely to confront a religion-based challenge to the current biology curriculum than he is to face a situation resembling the one portrayed in the following hypothetical:

> John Spokes has been teaching biology for several years at a public high school in Middletown, Anystate. In previous years, Spokes has spent several class periods discussing Darwin's theory of evolution, providing students with a clear overview of the standard evidence and arguments for contemporary Darwinian[4] theory, as well as key concepts such as natural selection, random mutation, and descent with modification that students need in order to understand the theory. In addition to describing how biological evolution explains the origin of new living forms from existing forms, he also has discussed how the theory of chemical evolution explains the origin of the first life starting from simple chemicals.
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> In his discussion of these theories, Spokes provided a standard textbook treatment, never departing from the strictly naturalistic or materialistic renderings of these theories that textbooks present. Thus, he explained that the evolutionary process is "random and undirected" and that it occurs "without either plan or purpose" as some textbooks phrase it.[5] He has also explained that Darwin's theory explains the appearance of design in living organisms by the "impersonal" mechanism of natural selection, and thus envisions no role for a "guiding hand" or "intelligent designer" in the origin of new life forms.[6] Following Ayala, and other prominent biologists and biology

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[3]*See* John Gibeaut, *Evolution of a Controversy*, A.B.A. J., Nov. 1999, at 50, 50–55.

[4]Throughout this article we will refer to this view as "Darwinian" or "Darwinist." Although in this article we sometimes carefully distinguish between classical Darwinian, contemporary neo-Darwinian and chemical evolutionary theories, we also use the term "Darwinian" or "Darwinist" to refer to all purely naturalistic theories of evolution—indeed, those that deny any role for a designing intelligence in the history of life. As will be discussed in greater detail below, the central feature of a Darwinist theory is that it regards the apparent design of living things as merely apparent. Moreover, the term "creationism" is misleading because it suggests that those who are opposed to Darwinism base their opposition on a literal reading of the Book of Genesis. *See* discussion *infra* Part V.A.

[5]KENNETH R. MILLER & JOSEPH LEVINE, BIOLOGY 658 (4th ed. 1998).

[6]*See* CHARLES DARWIN, THE ORIGIN OF SPECIES 130, 130–72 (Penguin Books 1968).

textbook writers, Spokes has described "Darwin's greatest accomplishment" as precisely his ability to explain the apparent design of living systems "without resort to a Creator or other external agent."[7]

Despite regular assurances to his students that evolutionary theory does not conflict with religious belief, Spokes has encountered increasing criticism of his teaching methods over several years. True, some parents (and students) complain that his lessons conflict with the Bible. Yet others have begun to complain that his lectures make "a selective presentation of the scientific evidence." This disturbs Spokes. After one conversation with several parents, including a local physician and geneticist, Spokes agrees to read several books and articles that they say will provide a specifically scientific critique of contemporary Darwinian and chemical evolutionary theory.

To his surprise, Spokes finds himself impressed with much of what he reads. Articles from the *American Biology Teacher*, for example, document rather egregious errors in textbooks presentations—errors which have the effect of overstating the evidential case for neo-Darwinian and chemical evolutionary theory.[8] Spokes is disturbed to find that many of the "icons" of evolution found in his textbook, such as Haeckel's falsified embryological drawings, the peppered moths, and the Miller-Urey experiment, are seriously misleading.[9]

Other scientific articles suggest that textbooks commit many errors of omission—errors that understate the evidential difficulties with neo-Darwinian claims. In his reading, Spokes learns about the so-called "Cambrian explosion," a term describing the sudden appearance of most of the major animal "phyla" (or "body plans") in the Cambrian period (530 mya), in clear contradiction to Darwinian expectations about the fossil record. Spokes also notices that scientists writing in technical journals openly discuss the challenge that these data pose to the neo-Darwinian prediction of gradual step-by-step change.[10] Yet Spokes knows that most basal biology texts do not even mention the Cambrian explosion, let alone that it might challenge contemporary Darwinism.

Spokes's reading on the Cambrian explosion sensitizes him to another issue—one of definition. Spokes begins to suspect that textbooks have created confusion by using the term "evolution" as though it were a unitary concept, even though it can refer to everything

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[7]Francisco J. Ayala, *Darwin's Revolution, in* CREATIVE EVOLUTION 1, 4–5 (John H. Campbell & J. William Schopf eds. 1994).

[8]*See* Jonathan Wells, *Haeckel's Embryos & Evolution: Setting the Record Straight*, 61 AM. BIOLOGY TCHR. 345, 345–49 (1999); Gordon C. Mills et al., *Origin of Life & Evolution in Biology Textbooks—A Critique*, 55 AM. BIOLOGY TCHR. 78, 78–83 (1993).

[9]JONATHAN WELLS, ICONS OF EVOLUTION (2000).

[10]*See infra* note 73 and accompanying text.

from the universal common ancestry thesis, to small-scale change, to large-scale innovation *via* a strictly mindless material mechanism.[11] Moreover, technical literature suggests that while Darwin's mechanism of natural selection acting on random variations explains small-scale "micro-evolutionary" changes (such as the beak size and shape of the Galapagos finches), it fails to explain the large scale "macro-evolutionary" transformations required to build novel organs, body plans, and morphological structures.[12] It now seems to Spokes that the equivocal use of terminology has led, again, to overstating the scientific consensus about the sufficiency of neo-Darwinism. The failure to define terms also seems to have created an "all or nothing approach" to the subject of evolution that has prevented careful consideration of separate propositions and a variety of possible views.

For example, by now Spokes has read about a number of scientists who accept "evolution" in one or more of the senses described above, but who do not accept the classical Darwinian explanation of *apparent* design. Indeed, he notices that many scientists now question whether natural selection (and other similarly naturalistic mechanisms) can explain away all instances of "apparent design," as classical Darwinism and modern neo-Darwinism assert. Some of these scientists argue that certain features of living systems such as "irreducibly complex" molecular machines in cells, or the "information content of the DNA molecule," suggest *real* design by a purposeful or intelligent agent. Spokes finds these ideas provocative and fascinating, though not altogether congenial to his own way of thinking. Nevertheless, he admits that the scientists advancing these ideas have excellent credentials and appeal to scientific evidence not religious authority. He finds a book by biochemist Michael Behe, *Darwin's Black Box*,[13] particularly impressive in this regard.

After two summers of reading such materials, Spokes finds himself in a quandary. Spokes is not entirely sure how to incorporate what he has read into the way he teaches his high school students. For one thing, he is not politically naive. He has read statements issued by the

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[11]*See* Keith Stewart Thomson, *Marginalia: The Meanings of Evolution*, AM. SCIENTIST, Sept.-Oct. 1982, at 529, 529–31.

[12]Indeed, he finds that many distinguished biologists (e.g., Stuart Kauffman, Rudolf Raff, George Miklos, James Valentine) openly acknowledge that small-scale "micro-evolutionary" changes cannot be extrapolated to explain large-scale "macro-evolutionary" innovation. As one group of scientists put it, natural selection can explain "the *survival*, but not the *arrival*, of the fittest." Scott Gilbert et al., *Resynthesizing Evolutionary and Developmental Biology*, 173 DEVELOPMENTAL BIOLOGY 357, 361 (1996).

[13]MICHAEL J. BEHE, DARWIN'S BLACK BOX (1996).

National Academy of Sciences,[14] the National Association of Biology Teachers,[15] and the American Association for the Advancement of Science,[16] which urge him to ignore any criticism of Darwinism as unscientific and religiously motivated. He realizes that he may be accused of "attacking science," or "teaching creationism," or even "bringing religion into the science classroom." Still, he finds it troubling that his students learn nothing of important differences of opinion among scientists, and he is confident that, regardless of anyone else's motivation, *his* motivation is only to "teach the controversy"[17] and to discuss scientific evidence and how scientists interpret it differently.

Spokes decides that at a minimum he must modify his presentation to reflect the additional information and diversity of scientific opinion that he has encountered in his study. In addition to presenting evidence and arguments for the standard biological and chemical evolutionary theory as he has done before, he plans four changes in his pedagogy. First, he wants to correct the blatant factual errors in his textbook that overstate the evidential case for neo-Darwinian and chemical

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[14]*See* NATIONAL ACADEMY OF SCIENCE, TEACHING ABOUT EVOLUTION AND THE NATURE OF SCIENCE 4 (1998):

> Those who oppose the teaching of evolution in public schools sometimes ask that teachers present "the evidence against evolution." However, there is no debate within the scientific community over whether evolution occurred, and there is no evidence that evolution has not occurred. Some of the details of how evolution occurs are still being investigated. But scientists continue to debate only the particular mechanisms that result in evolution, not the overall accuracy of evolution as the explanation of life's history.

[15]The National Association of Biology Teachers issued the following statement on teaching evolution:

> The same examination, pondering and possible revision have firmly established evolution as an important natural process explained by valid scientific principles, and clearly differentiate and separate science from various kinds of nonscientific ways of knowing, including those with a supernatural basis such as creationism. Whether called "creation science," "scientific creationism," "intelligent-design theory," "young-earth theory" or some other synonym, creation beliefs have no place in the science classroom. Explanations employing non naturalistic or supernatural events, whether or not explicit reference is made to a supernatural being, are outside the realm of science and not part of a valid science curriculum. Evolutionary theory, indeed all of science, is necessarily silent on religion and neither refutes nor supports the existence of a deity or deities.

Id. app. C. at 129.

[16]*See id.* ("The Commission on Science Education of the American Association for the Advancement of Science, is vigorously opposed to attempts by some boards of education, and other groups to require that religious accounts of creation be taught in science classes.").

[17]John Angus Campbell, *Intelligent Design, Darwinism, and the Philosophy of Public Education*, 1 RHETORIC & PUB. AFF. 469, 487 (1998).

> evolutionary theory. Second, he intends to tell students about the evidential challenges to these theories that current textbooks fail to mention. Third, he wants to define the term "evolution" without equivocation and to distinguish clearly between those senses of the term that enjoy widespread support among scientists and those that remain controversial, even if only among a minority of scientists. Finally, he wants to tell his students that a growing minority of scientists do see evidence of real, not just apparent, design in biological systems.
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> Wisely, Spokes decides to bring his plan to his principal, and ultimately to the school board, to be sure he is on safe ground. Is he?

Although this portrait of Spokes is hypothetical,[18] the issues it raises are not. Indeed, an increasing number of teachers around the country have begun to implement very similar changes to their own biology curriculum, often, though not always, creating controversy.[19] School boards, fearing both ideological strife and costly litigation, have often not known how to react to such teachers. On the one hand, forbidding any dissent from Darwinian theory smacks of censorship. On the other, even school board members sympathetic to such changes assume that federal law forbids science educators to deviate from an exclusively Darwinian curriculum. In short, many school boards do not know what the law allows.

This article will attempt to clarify what the law does allow teachers to teach in their biology classrooms. In the process, it will answer three key questions necessary to deciding the legal status of Spokes's proposed curriculum. These are:

- *Is It Science?* Are Spokes's intended changes in his biology curriculum scientific? Is his plan to correct and critique textbook presentations of neo-Darwinism scientific? Are the alternative

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[18]A recent article describes one such case. *See* Gibeaut, *supra* note 3, at 50–55. For an additional case, see Daniel J. Pinchot, *Moon Mulls Biblical Biology Three Years After Suit, Board Wants to Get Creation in Classes*, PITTSBURGH POST-GAZETTE, Aug. 29, 1997, at B-1. More recently, a biology teacher was reassigned because he taught intelligent design as part of his treatment of the origins issue. *See* Marjorie Coeyman, *Evolution Gets Dismissed from Some Classes*, CHRISTIAN SCI. MONITOR, August 16, 1999, at 1.

[19]*See Creationist Book to Be Used in Burlington—Biology Teacher Questions Evolutionary Theory*, SEATTLE TIMES, June 14, 1999, at B3; Barbara Galloway, *Group Asks Alternative to Theory of Evolution; Louisville Activists Say Darwin Camp Has Monopoly*, AKRON BEACON J., February 13, 1995, at A1; Laurie Goodstein, *Scientists Take New Look at Creationism*, HOUSTON CHRON., January 10, 1998, at 1; Jennifer Juarez Robles & Matt Helms, *Schools Consider Creationism*, DETROIT FREE PRESS, November 11, 1997, at 1B; Andrea Schoellkopf, *Proposed Science Curriculum Would Allow Creationism*, ALBUQUERQUE J., October 29, 1997, at 1.

theories that Spokes wants to present (including the theory of intelligent design) scientific?

- ! *Is It Religion?* Does Spokes's plan to correct and critique textbook presentations of neo-Darwinism constitute an establishment of religion? Does Spokes's plan to expose his students to evidence of design and design theory qualify as teaching religion? Does the First Amendment prevent the presentation of this point of view?
- ! *Is It Speech?* Do Spokes's plans to correct and critique textbook presentations of neo-Darwinism, and to expose students to the alternative theory of intelligent design, enjoy protection under the First Amendment, either in the prohibition of viewpoint discrimination, or as an exercise of academic freedom?

Before addressing these questions, however, we must first place them in a broader historical context.

II. A BRIEF HISTORY OF THE ORIGINS CONTROVERSY

A. Classical Science-Based Design Arguments

Prior to the publication of *The Origin of Species* by Charles Darwin in 1859, many Western thinkers, for over two thousand years, had answered the question "how did life arise?" by invoking the activity of a purposeful designer or creator. Design arguments based upon observations of the natural world were made by Greek and Roman philosophers such as Plato[20] and Cicero,[21] by Jewish philosophers such as Maimonides, and by Christian thinkers such as Thomas Aquinas.[22]

The idea of design also figured centrally in the modern scientific revolution (1500-1700).[23] As historians of science have often pointed out, many of the founders of early modern science assumed that the natural world was intelligible precisely because they also assumed that it had been designed by a rational mind. In addition, many individual scientists—Johannes Kepler in astronomy,[24] John Ray (1627-1705) in biology,[25] Robert Boyle (1627-

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[20]*See* PLATO, THE LAWS 279 (A.E. Taylor trans., 1969).

[21]*See* CICERO, DE NATURA DEORUM 217 (H. Rackham trans., Harvard Univ. Press 1933).

[22]Aquinas used the argument from design as one of his proofs for the existence of God. *See* JOHN HICK, ARGUMENTS FOR THE EXISTENCE OF GOD 1 (1971).

[23]*See* Neal C. Gillespie, *Natural History, Natural Theology, and Social Order: John Ray and the Newtonian Ideology*, 20 J. HIST. BIOLOGY 1, *passim* (1987).

[24]*See* JOHANNES KEPLER, HARMONIES OF THE WORLD 170, 240 (Charles Glen Wallis trans., Prometheus Books 1995) (1619); JOHANNES KEPLER, MYSTERIUM COSMOGRAPHICUM [THE SECRET OF THE UNIVERSE] 93–103 (A.M. Duncan trans., Arabis Books, Inc. 1981)

1691) in chemistry[26]—made specific design arguments based upon empirical discoveries in their respective fields. This tradition attained an almost majestic rhetorical quality in the writing of Sir Isaac Newton, who made both elegant and sophisticated design arguments based upon biological, physical, and astronomical discoveries. Writing in the General Scholium to the *Principia*, Newton suggested that the stability of the planetary system depended not only upon the regular action of universal gravitation, but also upon the very precise initial positioning of the planets and comets in relation to the sun. As he explained:

> [T]hough these bodies may, indeed, continue in their orbits by the mere laws of gravity, yet they could by no means have at first derived the regular position of the orbits themselves from those laws . . . [Thus] [t]his most beautiful system of the sun, planets, and comets, could only proceed from the counsel and dominion of an intelligent and powerful Being.[27]

Or as he wrote in the *Opticks*:

> How came the Bodies of Animals to be contrived with so much Art, and for what ends were their several parts? Was the Eye contrived without Skill in Opticks, and the Ear without Knowledge of Sounds? . . . And these things being rightly dispatch'd, does it not appear from Phænomena that there is a Being incorporeal, living, intelligent, omnipresent . . . .[28]

Despite the objections of some enlightenment philosophers, notably David Hume, science-based design arguments continued well into the early nineteenth century, especially in biology. William Paley's (1743-1805)

(1596); . Kepler's belief that the work of God is evident in nature is illustrated by his statement in the Harmonies of the World that God "by the light of nature promote[s] in us the desire for the light of grace, that by its means [God] mayest transport us into the light of glory." KEPLER, HARMONIES OF THE WORLD, at 240. *See also* MORRIS KLINE, MATHEMATICS: THE LOSS OF CERTAINTY 39 (1980) ('The strength of Copernicus's and Kepler's conviction that God must have designed the world harmoniously and simply can be judged by the objections with which they had to contend.").

[25]*See* JOHN RAY, THE WISDOM OF GOD MANIFESTED IN THE WORKS OF THE CREATION (3d ed. 1701).

[26]*See* ROBERT BOYLE, SELECTED PHILOSOPHICAL PAPERS OF ROBERT BOYLE 172 (M.A. Stewart ed. 1979).

[27]NEWTON'S PRINCIPIA MOTTE'S TRANSLATION REVISED 543–44 (Andrew Motte trans. & Florian Cajori rev. 1934) (1686).

[28]SIR ISAAC NEWTON, OPTICKS 369–70 (Dover Publications 1952).

Natural Theology, published in 1803 (several years after Hume's criticism of the design argument), is the most notable example. Paley's work catalogued a host of biological systems that suggested the work of a superintending intelligence. He argued that the astonishing complexity and superb adaptation of means to ends in such systems could not originate strictly through the blind forces of nature, any more than could a complex machine such as a pocket watch.[29]

B. Darwin and the Eclipse of Design

Acceptance of the design argument finally began to abate during the late nineteenth century with the emergence of increasingly powerful materialistic explanations of apparent design, particularly Charles Darwin's theory of evolution by natural selection.[30] Darwin argued in 1859 that living organisms only *appeared* to be designed. To make this case, he proposed a concrete mechanism, natural selection acting on random variations, that could explain the adaptation of organisms to their environment (and other evidences of apparent design) without actually invoking an intelligent or directing agency. Darwin saw that natural forces would accomplish the work of a human breeder, and thus that blind nature could come to mimic, over time, the action of a selecting intelligence—a designer. If the origin of biological organisms could be explained naturalistically,[31] as Darwin argued, then explanations invoking an intelligent designer were unnecessary and even vacuous.[32]

Even so, natural selection as a causal mechanism had a mixed reception in the immediate post-Darwinian period. As the historian of biology Peter Bowler has noted, classical Darwinism entered a period of eclipse, in part because Darwin lacked a theory of the origin and transmission of new heritable variation.[33] By the late 1930s and 1940s, however, natural selection

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[29]*See* WILLIAM PALEY, NATURAL THEOLOGY *passim* (1803).

[30]For a discussion of this methodological shift, see NEIL C. GILLESPIE, CHARLES DARWIN AND THE PROBLEM OF CREATION *passim* (1979).

[31]The effort to explain biological organisms was reinforced by a trend in science to provide fully naturalistic accounts for other phenomena such as the precise configuration of the planets in the solar system (Laplace) and the origin of geological features (Lyell and Hutton). It was also reinforced (and in large part made possible) by an emerging positivistic tradition in science that increasingly sought to exclude appeals to supernatural or intelligent causes from science *by definition*. *See id.*

[32]*See* CHARLES DARWIN, ON THE ORIGIN OF SPECIES 481–82 (Harvard Univ. Press 1964).

[33]*See* PETER J. BOWLER, THEORIES OF HUMAN EVOLUTION: A CENTURY OF DEBATE, 1844-1944, at 44–50 (1986). Natural selection, as Darwin well understood, could accomplish nothing without a steady supply of genetic variation, the ultimate source of new

was revived as the main engine of evolutionary change as developments in a number of fields helped to clarify the nature of genetic variation.[34] The resuscitation of the variation/natural selection mechanism by modern genetics and population genetics became known as the neo-Darwinian synthesis. According to the new synthetic theory of evolution, the mechanism of natural selection acting upon random variations (especially including small-scale mutations) sufficed to account for the origin of novel biological forms and structures. Small-scale "microevolutionary" changes could be extrapolated indefinitely to account for large-scale "macroevolutionary" development. With the revival of natural selection, the neo-Darwinists would assert, like Darwinists before them, that they had found a "designer substitute" that could explain the appearance of design in biology as a result of the action of a wholly natural mechanism.[35] As Harvard evolutionary biologist Ernst Mayr has explained, "[T]he real core of Darwinism . . . is the theory of natural selection. This theory is so important for the Darwinian because it permits the explanation of adaptation, the 'design' of the natural theologian, by natural means."[36]

C. Problems with the Neo-Darwinian Synthesis and the Re-emergence of Design

Since the late 1960s, the modern synthesis that emerged during the 1930s and 40s has begun to unravel in the face of new developments in paleontology, systematics, molecular biology, genetics, and developmental biology. Since then a series of technical articles and books—including such recent titles as *Evolution a Theory in Crisis* (1986) by Michael Denton, *Darwinism: The Refutation of a Myth* (1987) by Soren Lovtrup, *The Origins of Order* (1993) by Stuart A. Kauffman, *How The Leopard Changed Its Spots* (1994) by Brian C. Goodwin, *Reinventing Darwin* (1995) by Niles

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biological structure. Nevertheless, both the blending theory of inheritance that Darwin had assumed and the classical Mendelian genetics that soon replaced it, implied limitations on the amount of genetic variability available to natural selection. This in turn implied limits on the amount of novel structure that natural selection could produce.

[34]*See id. passim*.

[35] [T]he fact of evolution was not generally accepted until a theory had been put forward to suggest how evolution had occurred, and in particular how organisms could become adapted to their environment; in the absence of such a theory, adaptation suggested design, and so implied a creator. It was this need which Darwin's theory of natural selection satisfied.

JOHN MAYNARD SMITH, THE THEORY OF EVOLUTION 30 (Penguin Books 3d ed. 1975).

[36]Ernst Mayr, *Foreword* to MICHAEL RUSE, DARWINISM DEFENDED, xi-xii (1982).

Eldredge, *The Shape of Life* (1996) by Rudolf A. Raff, *Darwin's Black Box* (1996) by Michael Behe, *The Origin of Animal Body Plans* (1997) by Wallace Arthur, *Sudden Origins: Fossils, Genes, and the Emergence of Species* (1999) by Jeffrey H. Schwartz—have cast doubt on the creative power of neo-Darwinism's mutation/selection mechanism. As a result, a search for alternative naturalistic mechanisms of innovation has ensued with, as yet, no apparent success or consensus. So common are doubts about the creative capacity of the selection/mutation mechanism, neo-Darwinism's "designer substitute," that prominent spokesmen for evolutionary theory must now periodically assure the public that "just because we don't know *how* evolution occurred, does not justify doubt about *whether* it occurred."[37] As Niles Eldredge wrote as early as 1982: "most observers see the current situation in evolutionary theory—where the object is to explain how, not if, life evolves—as bordering on total chaos."[38] Or as Stephen Gould wrote in 1980, "the neo-Darwinism synthesis is effectively dead, despite its continued presence as textbook orthodoxy."[39]

Indeed, scientists writing in technical journals across the subdisciplines of biology have questioned neo-Darwinian theory on many evidential and theoretical grounds, including:

> (1) The neo-Darwinian mechanism of natural selection acting on random variations does not seem sufficient to produce:
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> (a) novel specified genetic information,[40]

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[37]"There is absolutely no disagreement among professional biologists on the fact that evolution has occurred. . . . But the *theory* of how evolution occurs is quite another matter, and is the subject of intense dispute." Douglas Futuyma, *Evolution as Fact and Theory*, 56 BIOS 3, 8 (1985). Of course, to admit that natural selection cannot explain the appearance of design is in effect to admit that it has failed to perform the role that is claimed for it as a "designer substitute."

[38]Niles Eldredge, *An Ode to Adaptive Transformation*, 296 NATURE 508 (1982).

[39]Stephen Jay Gould, *Is a New and General Theory of Evolution Emerging?* 6 PALEOBIOLOGY 119, 119–20 (1980).

[40]One of the most significant doubts about the creative power of the mutation/selection mechanism has followed directly from the elucidation of the nature of genetic information by molecular biologists in the 1950s and 60s. At first the discovery that the genetic information on DNA is stored as a linear array of precisely sequenced nucleotide bases (the A's, T's, G's and C's discussed above) helped to clarify the nature of many mutational processes. Nevertheless, it also soon suggested limitations in the amount of genetic novelty that random mutations could produce. Just as a sequence of letters in an English text might be altered either by changing individual letters one by one or combining and recombining whole sections of text, so too did it occur to biologists that different lengths of genetic text might combine and recombine in various ways at random. And, indeed, modern genetics has established various mechanisms of mutational change—duplications, insertions, inversions,

(b) "irreducibly complex," "functionally integrated" molecular machines and systems (such as bacterial motors, signal transduction circuits or the blood clotting system),[41]

(c) novel organs and morphological structures (such as wings, feathers, eyes, echo location, the amniotic egg, skin, nervous systems, and multicellularity),[42] or

(d) novel body plans.[43]

(2) Many significant mechanisms of evolutionary change do not involve random mutations as the neo-Darwinian mechanism requires, but instead seem to be directed by preprogrammed responses to environmental stimuli.[44]

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recombinations, deletions and point mutations—that involve the random alteration of the genetic text.

The difficulty for neo-Darwinism arises, not in establishing the occurrence of such mutations, but in explaining how such mutations could generate novel *specified* information. Imagine a computer "mutating" at random the text of the play *Hamlet* by duplicating, inverting, recombining and changing various sections. Would such a computer simulation have a realistic chance of generating Stephen Hawking's best-seller, *A Brief History of Time*, even granting multiple millions of undirected iterations? Beginning in the late 1960s, mathematicians and probability theorists who began to analyze this problem found themselves deeply skeptical about the efficacy of random mutation as a means of generating specified information in the time available to the evolutionary process. *See* Symposium, MATHEMATICAL CHALLENGES TO THE NEO-DARWINIAN INTERPRETATION OF EVOLUTION (Paul S. Moorhead & Martin M. Kaplan eds., 1967) (*see especially* papers and comments from M. Eden, M. Shutzenberger, S. M. Ulam, and P. Gavaudan).

[41]*See* BEHE, *supra* note 13 *passim*.

[42]*See* BERNARD JOHN & GEORGE L.GABOR MIKLOS, THE EUKARYOTE GENOME IN DEVELOPMENT AND EVOLUTION *passim* (1988); A.H. Brush, *On the Origin of Feathers*, 9 J. EVOLUTIONARY BIOLOGY 131, 131–42 (1996); H. Allen Orr & Jerry A. Coyne, *The Genetics of Adaptation: A Reassessment*, 140 AM. NATURALIST 725, 725–42 (1992).

[43]*See* K.S.W. Campbell & C.R. Marshall, *Rates of Evolution*, *in* RATES OF EVOLUTION 61, 66–100 (K.S.W. Campbell & M.F. Day eds., 1987); George L. Gabor Miklos, *Emergence of Organizational Complexities During Metazoan Evolution: Perspectives from Molecular Biology, Palaeontology and Neo-Darwinism*, 15 MEM. ASS. AUSTRALAS PALAEONTOLS. 7, 7–41 (1993); Scott F. Gilbert et al., *Resynthesizing Evolutionary and Developmental Biology*, 173 DEVELOPMENTAL BIOLOGY 357, 357–72 (1996).

[44]*See* James A. Shapiro, *Genome Organization, Natural Genetic Engineering and Adaptive Mutation*, 13 TRENDS IN GENETICS 98, 98–104 (1997); J.A. Shapiro, *Natural Genetic Engineering in Evolution*, 86 GENETICA 99, 99–111 (1992); Richard von Sternberg, *Genome Self-Modification and Cellular Control of Genome Reorganization*, 89 RIVISTA DI BIOLOGIA/BIOLOGY FORUM 423, 424–53 (1996).

(3) The pattern of sudden appearance, missing transitional forms,[45] and "stasis" in the fossil record—as seen in the "Cambrian explosion," the "marine Mesozoic revolution," and the "big bloom" of angiosperm plant life, for example—does not conform to neo-Darwinian expectations about the history of life.[46]

(4) Evidence from developmental biology suggests clear limits to the amount of evolutionary change that organisms can undergo, casting doubt on the Darwinian theory of common descent, and suggesting a reason for morphological stasis in the fossil record.[47]

(5) Many homologous structures (and even some proteins) derive from nonhomologous genes,[48] while many dissimilar structures derive from similar genes, in both cases contradicting neo-Darwinian expectations.[49]

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[45]According to Stephen Jay Gould, "[t]he extreme rarity of transitional forms in the fossil record persists as the trade secret of paleontology. The evolutionary trees that adorn our textbooks have data only at the tips and nodes of their branches; the rest is inference, however reasonable, not the evidence of fossils." Stephen Jay Gould, *Evolution's Erratic Pace*, NAT. HIST., May 1977, at 12, 14.

[46]The trilobite specialist Niles Eldredge, for instance, of the American Museum in New York, and one of the authors of the hypothesis of punctuated equilibria, describes commencing his work on the trilobite genus *Phacops*, sampling Middle Devonian strata across the United States, only to discover to his dismay that the trilobites were not varying smoothly and gradually between species, as theory predicted. *See* NILES ELDREDGE, REINVENTING DARWIN: THE GREAT DEBATE AT THE HIGH TABLE OF EVOLUTIONARY THEORY *passim* (1995). Indeed, the fossil record as a whole proved so disturbing to traditional Darwinism that Eldredge and Stephen Gould rejected the gradualist neo-Darwinism model of evolutionary change in favor of a theory known as "punctuated equilibrium." According to punctuated equilibrium, the fossil record shows long periods of stability "punctuated" by abrupt changes, resulting in entirely new organisms. Punctuated equilibrium reduces the conflict with the fossil record, but does so at the cost of abandoning a sufficient explanatory mechanism for the appearance of biological novelty—the very thing that made Darwin's theory initially so attractive as a designer substitute. *See* D. Raup, *Conflicts Between Darwin and Paleontology*, 50 FIELD MUSEUM NAT. HIST. BULL., Jan. 1979, at 22, 22–29; Jeffrey H. Schwartz, *Homeobox Genes, Fossils, and the Origin of Species*, 257 ANATOMICAL REC. [New Anat.] 15,15–31 (1999).

[47]*See* A.D. Bradshaw, *Genostasis and the Limits to Evolution*, 333 Series B TRANSACTIONS ROYAL SOC'Y LONDON 289, 289–305 (1991); Brian K. Hall, Baupläne, *Phylotypic Stages, and Constraint: Why There Are So Few Types of Animals*, 29 EVOLUTIONARY BIOLOGY 215, 215–61 (1996); Kazuo Kawano, *How Far Can the Neo-Darwinism Be Extended? A Consideration from the History of Higher Taxa in Coleoptera*, 91 RIVISTA DI BIOLOGIA / BIOLOGY FORUM 31, 31–52 (1998).

[48]*See* GAVIN DE BEER, HOMOLOGY: AN UNSOLVED PROBLEM *passim* (1971); MICHAEL DENTON, EVOLUTION: A THEORY IN CRISIS 142–156 (1986).

[49]*See* JOHN GERHART & MARC KIRSCHNER, CELLS, EMBRYOS, AND EVOLUTION 125–46 (1997); John A. Davison, *Semi-Meiosis As an Evolutionary Mechanism*, 111 J. THEORETICAL BIOLOGY 725, 725–35 (1984); W.J. Dickinson, *Molecules and Morphology:*

(6) The (inferred) developmental programs among the metazoan animals of the Cambrian period are strikingly dissimilar (or "not conserved"), contrary to neo-Darwinian expectations.[50]

(7) The genetic code has not proven to be "universal," contrary to neo-Darwinian expectations based upon the theory of universal common descent.[51]

Further, biochemists and origin-of-life researchers have challenged the standard Oparin/Miller chemical evolutionary theory for the origin of the first life for many reasons including:

(1) geochemists have failed to find evidence of the nitrogen-rich "prebiotic soup" required by the standard chemical evolutionary model.[52]

Where's the Homology?, 11 TRENDS IN GENETICS 119, 119–21 (1995); Stephen J. Gaunt, *Chick Limbs, Fly Wings and Homology at the Fringe*, 386 NATURE 324, 324–25 (1997); Gregory A. Wray & Ehab Abouheif, *When Is Homology Not Homology?*, 8 CURRENT OPINION GENETICS & DEV. 675, 675–80 (1998).

[50]*See* WALLACE ARTHUR, THE ORIGIN OF ANIMAL BODY PLANS: A STUDY IN EVOLUTIONARY DEVELOPMENTAL BIOLOGY *passim* (1997); RUDOLF A. RAFF, THE SHAPE OF LIFE *passim* (1996); César Arenas-Mena et al., *Expression of the* Hox *Gene Complex in the Indirect Development of a Sea Urchin*, 95 PROC. NAT'L ACAD. SCI. U.S.A. 13062, 13062–67 (1998); Barbara C. Boyer & Jonathan Q. Henry, *Evolutionary Modifications of the Spiralian Developmental Program*, 38 AM. ZOOLOGIST 621, 621–33 (1998); Graham E. Budd, *Does Evolution in Body Patterning Genes Drive Morphological Change—or Vice Versa?*, 21 BIOESSAYS 326, 326–32 (1999); Eric H. Davidson, *How Embryos Work: A Comparative View of Diverse Modes of Cell Fate Specification*, 108 DEVELOPMENT 365, 365–89 (1990); Gabriel Gellon & William McGinnis, *Shaping Animal Body Plans in Development and Evolution by Modulation of* Hox *Expression Patterns*, 20 BIOESSAYS 116, 116–25 (1998); Miodrag Grbic et al., *Development of Polyembryonic Insects: A Major Departure from Typical Insect Embryogenesis*, 208 DEV., GENES, & EVOLUTION 69, 69–81 (1998).

[51]*See* SYOZO OSAWA, EVOLUTION OF THE GENETIC CODE *passim* (1995); T. Jukes & S. Osawa, *Recent Evidence for Evolution of the Genetic Code*, *in* EVOLUTION OF LIFE 79, 79–95 (S. Osawa & T. Honjo eds., 1991); Syozo Osawa et al., *Recent Evidence for Evolution of the Genetic Code*, 56 MICROBIOLOGICAL REVIEWS 229, 229–64 (1992); Patrick J. Keeling & W. Ford Doolittle, *A Non-Canonical Genetic Code in an Early Diverging Eukaryotic Lineage*, 15 EMBO J. 2285, 2285–90 (1996); Patrick J. Keeling & W. Ford Doolittle, *Widespread and Ancient Distribution of a Noncanonical Genetic Code in Diplomonads*, 14 MOLECULAR BIOLOGY & EVOLUTION 895, 895–901 (1997); Anee Baroin Tourancheau et al., *Genetic Code Deviations in the Ciliates: Evidence for Multiple and Independent Events*, 14 EMBO J. 3262, 3262–67 (1995).

[52]CHARLES B. THAXTON ET AL., THE MYSTERY OF LIFE'S ORIGIN 42 (1984). In the words of Jim Brooks, "the nitrogen content of early PreCambrian organic matter is relatively low (less than .15%). From this we can be reasonably certain that: there never was any substantial amount of 'primitive soup' on Earth when ancient PreCambrian sediments were

(2) The remains of single-celled organisms in the very oldest rocks testify that life emerged more quickly than the standard model (or any other) envisions or can explain.[53]

(3) Geological and geochemical evidence suggests that prebiotic atmospheric conditions were hostile, not friendly, to the production of amino acids and other essential building blocks of life.[54]

(4) In virtue of (3), experiments (such as Stanley Miller's) allegedly simulating the origin of pre-biotic building blocks have no relevance to actual early earth processes.[55]

(5) Origin-of-life researchers lack plausible explanations for the origin of the specified information in DNA necessary to build essential proteins.[56]

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formed; if such a 'soup' ever existed it was only for a brief period of time." JIM BROOKS, ORIGINS OF LIFE 118 (1985) (emphasis omitted).

[53]After the 1960s a series of new fossil finds forced scientists to revise progressively downward their estimates of the time available for chemical evolution on earth. *See* J. BROOKS & G. SHAW, ORIGIN AND DEVELOPMENT OF LIVING SYSTEMS 73, 267–305, 361 (1973); BROOKS, *supra* note 52, at 104–16; THAXTON, ET. AL., *supra* note 52, at 69–72; Klaus Dose, *The Origin of Life: More Questions Than Answers*, 13 INTERDISCIPLINARY SCI. REVIEWS 348, 348–56 (1988); Richard E. Dickerson, *Chemical Evolution and the Origin of Life*, SCI. AM., Sept. 1978, at 70–86 (1978); Andrew H. Knoll & Elso S. Barghoorn, *Archean Microfossils Showing Cell Division from the Swaziland System of South Africa*, 198 SCIENCE 396, 396–98 (1977); Donald R. Lowe, *Stromatolites 3,400–Myr–Old from the Archean of Western Australia*, 284 NATURE 441, 441–43 (1980); Kevin A. Maher & David J. Stevenson, *Impact Frustration of the Origin of Life*, 331 NATURE 612, 612–14 (1988); S.J. Mojzsis et al., *Evidence for Life on Earth Before 3,800 Million Years Ago*, 384 NATURE 55, 55–59 (1996); Leslie E. Orgel, *The Origin of Life—A Review of Facts and Speculations*, 23 TRENDS BIOCHEMICAL SCI. 491, 491–95 (1998); H.D. Pflug & H. Jaeschke-Boyer, *Combined Structural and Chemical Analysis of 3,800–Myr-Old Microfossils*, 280 NATURE 483, 483–85 (1979); J. William Schopf & Elso S. Barghoorn, *Alga-Like Fossils from the Early Precambrian of South Africa*, 156 SCIENCE 508, 508–11 (1967); M.R.Walter et al., STROMATOLITES 3,400–3,500 *Myr Old from the North Pole Area, Western Australia*, 284 NATURE 443, 443–45 (1980).

[54]*See* ROBERT SHAPIRO, ORIGINS: A SKEPTIC'S GUIDE TO THE CREATION OF LIFE ON EARTH *passim* (1986); THAXTON ET AL., *supra* note 52, at 69–98; Joel S. Levine, *The Photochemistry of the Paleoatmosphere*, 18 J. MOLECULAR EVOLUTION 161, 161–72 (1982).

[55]KLAUS DOSE, ORIGIN OF LIFE: MORE QUESTIONS THAN ANSWERS 348–56 (1988); SHAPIRO, *supra* note 54, at 98–116; THAXTON ET AL., *supra* note 52, at 99–112.

[56]Besides design, chemical evolutionary theorists have relied on three general types of explanations for the origin of the specified complexity (specified information) found in DNA: chance, prebiotic natural selection, and self-organization. Numerous problems have been found with each of these explanations:

(1) *Chance-Based Models*. *See* EMILE BOREL, PROBABILITIES AND LIFE 28 (Maurice Baudin trans. 1962) (1943); A.G. CAIRNS-SMITH, THE LIFE PUZZLE 95 (1971); HUBERT P. YOCKEY, INFORMATION THEORY AND MOLECULAR BIOLOGY *passim* (1992); Michael J. Behe, *Experimental Support for Regarding Functional Classes of Proteins to Be Highly*

(6) Origin of life researchers lack any plausible explanations for the origin of the functionally integrated information processing system present in even the simplest cells.[57]

Isolated from Each Other, *in* DARWINISM: SCIENCE OR PHILOSOPHY 60, 60–71 (J. Buell & G. Hearn eds. 1994); Ilya Prigogine et al., *Thermodynamics of Evolution*, PHYSICS TODAY, Nov. 1972, at 23, 23–28; John F. Reidhaar-Olson & Robert T. Sauer, *Functionally Acceptable Substitutions in Two Alpha-Helical Regions of Lambda Repressor*, 7 PROTEINS: STRUCTURE, FUNCTION, & GENETICS 306, 306–16 (1990); Hubert P. Yockey, *A Calculation of the Probability of Spontaneous Biogenesis by Information Theory*, 67 J. THEORETICAL BIOLOGY 377, 377–98 (especially 380) (1977).

(2) *Pre-biotic Natural Selection*: *See* LUDWIG VON BERTALANFFY, ROBOTS, MEN AND MINDS 82 (1967); CHRISTIAN DE DUVE, BLUEPRINT FOR A CELL: THE NATURE AND ORIGIN OF LIFE 187 (1991); Dean H. Kenyon, *Foreword* to THAXTON ET AL., *supra* note 52, at v–viii (1984); Peter T. Mora, *The Folly of Probability*, *in* THE ORIGINS OF PREBIOLOGICAL SYSTEMS AND OF THEIR MOLECULAR MATRICES 39, 39–64 (Sidney W. Fox ed., 1965); Peter T. Mora, *Urge and Molecular Biology*, 199 NATURE 212, 212–19 (1963); H.H. Pattee, *The Problem of Biological Hierarchy*, *in* 3 TOWARDS A THEORETICAL BIOLOGY 117, 117–36 (C.H. Waddington ed., 1970); Gerard Schramm, *Synthesis in Nucleosis and Polynucleotides with Metaphosphate Esters*, *in* THE ORIGINS OF PREBIOLOGICAL SYSTEMS AND OF THEIR MOLECULAR MATRICES 309, 309–15 (Sidney W. Fox ed. 1965).

(3) *Self-Organization*: *See* PERCIVAL DAVIS & DEAN H. KENYON, OF PANDAS AND PEOPLE: THE CENTRAL QUESTION OF BIOLOGICAL ORIGINS *passim* (1993); BERND-OLAF KÜPPERS, INFORMATION AND THE ORIGIN OF LIFE 170–72 (1990); ROBERT SHAPIRO, ORIGINS 117–31 (1986); HUBERT P. YOCKEY, INFORMATION THEORY AND MOLECULAR BIOLOGY 259–93 (1992); John Horgan, *The World According to RNA*, SCI. AM., Jan. 1996, at 27, 27–30; Dean Kenyon & Gordon C. Mills, *The RNA World: A Critique*, 17 ORIGINS & DESIGN 9 *passim* (1996); Randall A. Kok et al., *A Statistical Examination of Self-Ordering of Amino Acids in Proteins*, 18 ORIGINS LIFE & EVOLUTION BIOSPHERE 135, 135–42 (1988); Stephen C. Meyer, *DNA by Design: An Inference to the Best Explanation for the Origin of Biological Information*, 1 RHETORIC & PUB. AFF. 519, 519–56 (1998) [hereinafter Meyer, *DNA By Design*]; Stephen C. Meyer, *The Explanatory Power of Design*, *in* MERE CREATION: SCIENCE, FAITH AND INTELLIGENT DESIGN 128–134 (William A. Dembksi ed., 1998) [hereinafter Meyer, *Explanatory Power*]; Robert Shapiro, *Prebiotic Ribose Synthesis: A Critical Analysis*, 18 ORIGINS LIFE & EVOLUTION BIOSPHERE 71, 71–85 (1988); Charles B. Thaxton & Walter L. Bradley *Information and the Origin of Life*, *in* THE CREATION HYPOTHESIS: SCIENTIFIC EVIDENCE FOR AN INTELLIGENT DESIGNER 173, 173–210 (J.P. Moreland ed., 1994) [hereinafter Thaxton & Bradley, *Information and Origin*].

[57]*See* JAQUES MONOD, CHANCE AND NECESSITY 143 (1971); ROBERT SHAPIRO, ORIGINS 132–54 (1986); K.R. Popper, *Scientific Reduction and the Essential Incompleteness of all Science*, *in* STUDIES IN THE PHILOSOPHY OF BIOLOGY 259, 259 (F.J. Ayala & T. Dobzhansky eds., 1974); Massimo Pigliucci, *Where Do We Come From? A Humbling Look at the Biology of Life's Origin*, SKEPTICAL INQUIRER, Sept.-Oct. 1999, at 21, 21–27.

Basal biology textbooks have almost universally failed to report these and other difficulties found in recent technical literature.[58] Instead, standard textbooks continue to affirm both neo-Darwinian and chemical evolutionary theory unequivocally and without qualification. Moreover, as noted in our hypothetical, many texts continue to include significant factual errors, either of omission or commission—though Spokes is hypothetical, the problems in the texts are not.[59]

III. MAY SPOKES TEACH CRITICISM?

It may seem obvious that there can be no rationally defensible grounds for preventing teachers from exposing students to well-documented scientific critique of a theory or obsolete textbook material. Nevertheless, teachers like Spokes often feel an understandable reluctance to break with textbook orthodoxy and expose students to articles and other supplementary materials documenting problems with neo-Darwinism or its textbook presentation. Indeed, many official spokespersons for an exclusively Darwinist curriculum now treat any criticism of neo-Darwinian (or chemical evolutionary) theory as tantamount to an attack on science itself. Others assume that criticism necessarily derives from religious motive or equate critique with advocacy of "creationism."

This rhetorical strategy fails for several reasons. First, it implicitly equates a particular theory of biological origins—albeit a long dominant one—with the science of biology itself. In no other field would such a self-serving rhetoric stand unchallenged for long. Imagine the Freudians equating psychology with the Freudian theory of the mind or the advocates of phlogiston equating their theory with the field of chemistry itself. Science has long involved theoretical competition among multiple competing hypotheses and explanations. Science, therefore, requires criticism as well as the articulation and defense of reigning theories. Thus, those biologists who seek to insulate their preferred theories from critique by rhetorical gerrymandering—that is, by equating dominant evolutionary theories with

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[58]*See* CURTIS & BARNES, INVITATION TO BIOLOGY *passim* (5th ed. 1994); DOUGLAS J. FUTUYMA, EVOLUTIONARY BIOLOGY *passim* (3d ed. 1998); GUTTMAN, BIOLOGY *passim* (1999); STARR & TAGGART, BIOLOGY: THE UNITY AND DIVERSITY OF LIFE *passim* (8th ed. 1998); Mills et al., *supra* note 8, at 78–83; Jonathan Wells, *Haeckel's Embryos & Evolution: Setting the Record Straight*, 61 AM. BIOLOGY TCHR. 345, 345–49 (1999); Jonathan Wells, *Second Thoughts About Peppered Moths*, SCIENTIST, May 24, 1999, at 13.

[59]*See* Mills et al., *supra* note 8, at 78–83.

science itself and then treating all criticism of such theories as necessarily "unscientific"—themselves act in a profoundly unscientific manner.

Note, secondly, the list of evidential difficulties cited above. Each can be found in standard scientific journals—journals such as *Paleobiology* or *Developmental Biology* or *Natural History*. Of course, some religiously-motivated creationists may want to make polemical use of these evidential difficulties. Yet, that does not mean that scientific critique of neo-Darwinism necessarily conceals a religious motive, if indeed motive is even germane to deciding the scientific legitimacy of this critique. In any case, the pedagogical issue is not the motive of the critics, but the existence of specifically empirical critique of neo-Darwinian and chemical evolutionary theory that textbooks do not report to students. Spokes wants to eliminate this disparity between textbook presentations and the current state of the scientific discussion of the issue. This hardly seems to constitute either "religious" or "unscientific" activity.

To illustrate this point more concretely, consider an example mentioned above. Origin-of-life researchers now acknowledge that Stanley Miller's famous experiment simulating the production of amino acids under allegedly pre-biotic early earth conditions does not support chemical evolutionary theory. Origin-of-life scientists, including Miller himself,[60] now admit that no evidence supports the strongly "reducing" mixture of gases that Miller assumed in his 1953 experiment. Indeed, considerable geochemical evidence now contradicts that assumption.[61] They also know that if simulation experiments are rerun with more realistic mixtures of gases they do not produce amino acids in any appreciable yields. Yet most basal biology textbooks do not report any of these scientific developments.[62]

If Spokes reports these developments, can anyone credibly maintain that he has acted in an "unscientific" or "religious" manner? Instead, Spokes critics act in a most illiberal way. By stigmatizing critique as either "unscientific" or "religious," advocates for the exclusive presentation of orthodox evolutionary theories discourage teachers from teaching students what scientists actually know and report in their technical journals, and encourage instead the presentation of a simplistic caricature of scientific method and the origins controversy.

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[60]*See* Antonio Lazcano & Stanley L. Miller, *The Origin and Early Evolution of Life: Prebiotic Chemistry, the Pre-RNA World, and Time*, 85 CELL 793, 793 (1996); Stanley L. Miller, *The Prebiotoc Synthesis of Organic Compounds As a Step Toward the Origin of Life*, *in* MAJOR EVENTS IN THE HISTORY OF LIFE 5 (J. William Schopf ed., 1993).

[61]*See, e.g.*, Thaxton & Bradley, *Information and Origin*, *supra* note 56, at 173–210.

[62]*See* KENNETH R. MILLER & JOSEPH LEVINE, BIOLOGY 344 (4th ed. 1998); ALTON L. BIGGS ET AL., BIOLOGY: THE DYNAMICS OF LIFE 227–28 (1991).

Of course, some Darwinist advocacy groups have expressed concern that providing critique of, as well as evidence and arguments for, orthodox evolutionary theories would confuse students.[63] But clearly students would not be well served by presenting a false picture of agreement where in fact there is controversy. Indeed, even a prominent Darwinist, Will Provine, has complained that this failure to present the controversy makes science education deadly dull and robs it of the interest that would motivate students.[64] Granted, textbook presentations in many fields fail to capture the full richness and detail of front-line research. But the errors of fact in many basal biology texts do not seem to reflect mere oversimplifications. Instead, many are egregious, easy to correct, and almost universally overstate the evidential support for orthodox evolutionary theories. Thus, there is every reason to encourage Spokes to speak to students about the existence of evidential criticism of neo-Darwinism in the scientific literature and to correct textbooks where they are clearly in error.

Of course, the question of the legitimacy of Spokes's intended curricular change involves another issue. Recall that Spokes does not intend merely to expose students to scientific critique of neo-Darwinism. He also now intends to teach them about an alternative theory—known as "the theory of intelligent design" or "design theory"—that directly challenges a key proposition of both neo-Darwinian and chemical evolutionary theory, namely, the denial of actual design in biology. Of course, if the neo-Darwinian mechanism cannot explain the origin of apparent design, as many biologists have argued, then some scientists will quite reasonably want to reconsider the possibility of actual (*i.e.*, intelligent) design as an alternative explanation. Not surprisingly, many scientists have done exactly that and teachers like Spokes will increasingly want to tell their students about this development in science. Nevertheless, Spokes's desire to teach about design raises additional issues. Some have argued that "design theory" does not qualify as a scientific theory. Others have maintained that it constitutes an establishment of religion, or at least a religious theory. To assess the legality of Spokes's entire curriculum, therefore, requires making an assessment of the scientific and religious status of "design theory." Before we can do this we must review the main tenets and features of this theory.

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[63]*See* Eugenie C. Scott, *Keep Science Free from Creationism*, INSIGHT, Feb. 21, 1994, at 29, 29; *U.S. Commission on Civil Rights*, Hearings, Seattle Washington, Aug. 21, 1998 <http://w1.548.telia.com/~454804688/civilright.html>.

[64]*See* William B. Provine, *Review of* NATIONAL ACADEMY OF SCIENCES, TEACHING ABOUT EVOLUTION AND THE NATURE OF SCIENCE <http://fp.bio.utk.edu/darwin/NAS guidebook/provine_1.html>.

IV. A BRIEF INTRODUCTION TO CONTEMPORARY DESIGN THEORY

Since the 1980s, a growing number of scientists have asserted that, contrary to neo-Darwinian orthodoxy, nature displays abundant evidence of real, not just apparent, design. These scientists, known as *design theorists,* advocate an alternative theory of biological origins known as design theory or the *theory of intelligent design* (sometimes abbreviated simply *design*). They have developed design theory in such books as *Darwin's Black Box,*[65] *The Mystery of Life's Origin,*[66] *Of Pandas and People,*[67] *Mere Creation*[68] and *The Design Inference,*[69] as well as in articles in scientific and technical journals. Design theory holds that intelligent causes rather than undirected natural causes best explain many features of living systems. During recent years design theorists have developed both a general theory of design detection and many specific empirical arguments to support their views.

A. A Theory of Intelligent Design

Developments in the information sciences have recently made possible the articulation of criteria by which intelligently designed systems can be identified by the kinds of patterns they exhibit. In a recent book titled *The Design Inference,*[70] published by Cambridge University Press, mathematician and probability theorist William Dembski notes that rational agents often infer or detect the prior activity of other designing minds by the character of the effects they leave behind.[71] Archaeologists assume, for example, that rational agents produced the inscriptions on the Rosetta Stone. Insurance fraud investigators detect certain "cheating patterns" that suggest intentional manipulation of circumstances rather than "natural" disasters. Cryptographers distinguish between random signals and those that carry encoded messages. Dembski's work shows that recognizing the activity of intelligent agents constitutes a common and fully rational mode of inference.[72]

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[65]BEHE, *supra* note 13.

[66]THAXTON ET AL., *supra* note 52.

[67]KENYON & DAVIS, *supra* note 56.

[68]MERE CREATION: SCIENCE, FAITH & INTELLIGENT DESIGN (William A. Dembski ed., 1998).

[69]WILLAM A. DEMBSKI, THE DESIGN INFERENCE: ELIMINATING CHANGE THROUGH SMALL PROBABILITIES (1998).

[70]*Id.*

[71]*See id. passim*.

[72]*See id.* at 1–35.

More importantly, Dembski's work explicates the criteria by which rational agents recognize the effects of other rational agents, and distinguish them from the effects of natural causes. He argues that systems or sequences that have the joint properties of "high complexity" (or low probability) and "specification"[73] invariably result from intelligent causes, not chance or physical-chemical laws.[74] As it turns out, these criteria are equivalent (or "isomorphic") to the notion of specified information or information content. Thus, Dembski's work suggests that "high information content" indicates

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[73]Complex sequences are those that exhibit an irregular and improbable arrangement that defies expression by a simple rule or algorithm. A specification, on the other hand, is a match or correspondence between a physical system or sequence and a set of independent functional requirements or constraints. To illustrate these concepts (of complexity and specification), consider the following three sets of symbols:

"inetehnsdysk]idfawqnz,mfdifhsnmcpew,ms.s/a"
"Time and tide waits for no man."
"ABABABABABABABABABABABAB"

Both the first and second sequences shown above are complex because both defy reduction to a simple rule. Each represents a highly irregular, aperiodic and improbable sequence of symbols. The third sequence is not complex, but is instead highly ordered and repetitive. Of the two complex sequences, only one exemplifies a set of independent functional requirements—i.e., is specified. English has a number of such functional requirements. For example, to convey meaning in English one must employ existing conventions of vocabulary (associations of symbol sequences with particular objects, concepts or ideas) and existing conventions of syntax and grammar (such as "every sentence requires a subject and a verb"). When arrangements of symbols "match" or utilize existing vocabulary and grammatical conventions (i.e., functional requirements), communication can occur. Such arrangements exhibit "specification." The second sequence ("Time and tide waits for no man") clearly exhibits such a match between itself and the preexisting requirements of vocabulary and grammar. It has employed these conventions to express a meaningful idea.

Indeed, of the three sequences above only the second ("Time and tide waits for no man") manifests both the jointly necessary indicators of a designed system. The third sequence lacks complexity, though it does exhibit a simple periodic pattern, a specification of sorts. The first sequence is complex, but not specified as we have seen. Only the second sequence exhibits both complexity and specification. Thus, according to Dembski's theory, only the second sequence, but not the first and third, implicates an intelligent cause—as indeed our intuition tells us. *See* DEMBSKI, *supra* note 69; Meyer, *DNA by Design*, *supra* note 56; *see also* Stephen C. Meyer, *DNA and the Origin of Life: Information, Specification and Explanation*, *in* DARWINISM, DESIGN AND PUBLIC EDUCATION (John A. Campbell ed., forthcoming 2001), also available in pre-publication form at www.discovery.org/viewDB. *See also* Stephen C. Meyer et al., *The Cambrian Explosion: Biology's Big Bang*, in DARWINISM, DESIGN AND PUBLIC EDUCATION (John A. Campbell ed., forthcoming 2001), also available through the Discovery Institute website.

[74]*See* DEMBSKI, *supra* note 69, at 36–66.

prior intelligent activity. This theoretical insight comports with common, as well as scientific, experience. Few rational people would, for example, attribute hieroglyphic inscriptions to natural forces such as wind or erosion; instead, they would immediately recognize the activity of intelligent agents. Dembski's work shows why: Our reasoning involves a comparative evaluation process that he represents with a device he calls "the explanatory filter."[75] The filter outlines a formal method by which scientists (as well as ordinary people) decide among three different types of explanations: chance, necessity, and design.[76] His "explanatory filter" constitutes, in effect, a scientific method for detecting the effects of intelligence.[77]

B. Design Theory: An Empirical Basis?

In addition to making use of a formal theory articulating the criteria by which intelligent causes can be detected in the "echo of their effects," design theorists point to specific empirical evidence of design, both in biology and physics. They argue that biological organisms in particular display distinctive features of intelligently designed systems. Indeed, a growing number of scientists are now willing to consider alternatives to strictly naturalistic origins theories. Many now see especially striking evidence of design in biology, even if much of it is still reported by scientists and journals that presuppose a neo-Darwinian perspective.

In 1998, for example, the leading journal *Cell* featured a special issue on "Macromolecular Machines."[78] All cells use complex molecular machines to process information, build proteins, and move materials back and forth across their membranes. Bruce Alberts, President of the National Academy of Sciences, introduced this issue with an article entitled, *The Cell as a Collection of Protein Machines*.[79] In it, he stated that

> We have always underestimated cells. . . .
> . . . .
> The entire cell can be viewed as a factory that contains an elaborate network of interlocking assembly lines, each of which is composed of a set of large protein machines. . . .
> . . . .

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[75]*Id.* at 36.
[76]*See id.* at 36–66.
[77]*See id.*
[78]*See* Review, *Macromolecular Machines*, 92 CELL 291 (1998).
[79]*See* Bruce Alberts, *The Cell as a Collection of Protein Machines: Preparing the Next Generation of Molecular Biologists*, 92 CELL 291 (1998).

> Why do we call the large protein assemblies that underlie cell function protein *machines*? Precisely because, like machines invented by humans to deal efficiently with the macroscopic world, these protein assemblies contain highly coordinated moving parts . . . .[80]

Alberts notes that molecular machines strongly resemble machines designed by human engineers.[81] Although, as an orthodox neo-Darwinist, he denies any role for actual, as opposed to apparent, design in the origin of these systems.[82]

In recent years, however, some scientists have formulated a formidable challenge to the neo-Darwinian view. For example, in *Darwin's Black Box*, Lehigh University biochemist Michael Behe shows that neo-Darwinists have failed to explain the origin of complex molecular machines in living systems.[83] Behe examines the acid-powered rotary engines that turn the whiplike flagella of certain bacteria.[84] He shows that the intricate machinery in this molecular motor—including a rotor, a stator, O-rings, bushings, and a drive shaft—requires the coordinated interaction of approximately forty complex protein parts.[85] The absence of any one of these proteins would result in the complete loss of motor function. To suggest that such an "irreducibly complex" engine emerged gradually in a Darwinian fashion strains credulity. Natural selection selects functionally advantageous systems. Yet motor function only ensues *after* all necessary parts have independently self-assembled—an astronomically improbable event.

Thus, Behe insists that Darwinian mechanisms cannot account for the origin of molecular motors and other such "irreducibly complex" systems that require the coordinated interaction of multiple, independent protein parts.[86] To emphasize his point, Behe has conducted a literature search of relevant technical journals.[87] He found a complete absence of gradualistic Darwinian explanations for the origin of the systems and motors that he discusses.[88] Behe concludes that neo-Darwinists have not explained nor, in

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[80]*Id.* at 291.
[81]*See id.*
[82]*See id.*
[83]BEHE, *supra* note 13, at 179.
[84]*See id.*
[85]*See id.* at 69–73.
[86]*See id.* at 3–164.
[87]*See id.* at 165–86.
[88]*See id.* at 179. *See also* Behe, *infra* note 89.

most cases, even attempted to explain, how the appearance of design in "irreducibly complex" systems arose naturally.[89]

Instead, he notes that we know of only one cause sufficient to produce functionally integrated, irreducibly complex systems—intelligent design.[90] Whenever we encounter irreducibly complex systems and we know how they arose, invariably a designer played a causal role. Thus, Behe concludes on the basis of our knowledge of present cause and effect relationships (in accord with the standard uniformitarian method employed in the historical sciences) that the molecular machines and complex systems we observe in cells probably resulted from an intelligent cause.[91] In brief, molecular motors *appear* designed because they *were* designed.

The publication of Behe's book in 1996 generated international acclaim and critique in over eighty book reviews. Even his critics have generally conceded the scientific accuracy of Behe's claims (including his literature search showing the complete absence of neo-Darwinian explanations for many of the irreducibly complex systems that he examines). They have mainly objected to his argument on philosophical and methodological grounds. Behe's critics claim that to infer an intelligent cause for the origin of these complex systems (as Behe does) "goes beyond science." (We discuss this objection in Section V below).

Despite such criticism, Behe is not alone in his conclusions. Consider the case of Professor Dean Kenyon. For nearly twenty years, Professor Kenyon was a leading evolutionary theorist who specialized in origin-of-life biology. While at San Francisco State College in 1969 he coauthored *Biochemical Predestination*,[92] a book that defined evolutionary thinking on the origin-of-life for over a decade. Kenyon's theory attempted to show how complex biomolecules such as proteins and DNA might have "self-

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[89]Since the publication of Behe's book in 1996, some critics, notably biologist Ken Miller, have argued that some recent (post-1996) scientific articles do suggest plausible ways of assembling irreducibly complex systems in a gradual Darwinian fashion. Behe has responded to these claims. He has argued that (a) the papers that Miller cites often do not make the claims that Miller uses them to make and (b) those Darwinian scenarios that Miller (and others) do offer lack sufficient biochemical plausibility and specificity to solve the problem of the origin of Darwin. For Behe's responses to Miller, *see* Michael J. Behe *Answering Scientific Criticisms of Intelligent Design* in SCIENCE AND EVIDENCE OF DESIGN IN THE UNIVERSE 121 (2000); *see also* Irreducible Complexity and the Evolutionary Literature: Response to Critics, archived at <http://www.crsc.org/fellows/MichaelBehe/index.html>.

[90]*See id.* at 187–231.

[91]*See id.* at 187–208.

[92]DEAN H. KENYON & GARY STEINMAN, BIOCHEMICAL PREDESTINATION (1969).

organized" via strictly chemical forces.[93] Yet as Kenyon reflected more on the recent developments in molecular biology about the complexity of living things, he began to question whether undirected chemistry could really produce the information-rich molecules found even in "simple" cells. Studies of the genetic molecule DNA revealed that it functions in much the same way as a machine code or a text in a book. As Richard Dawkins notes, "The machine code of the genes is uncannily computer like."[94] Or, as software innovator Bill Gates notes, "DNA is like a computer program, but far, far more advanced than any software we've ever created."[95] Studies in molecular biology and information theory have shown that the assembly instructions inscribed along the spine of DNA display the characteristic hallmarks of intelligently encoded information: both the complexity and specificity of function that, according to Dembski's theory, indicate design.[96] As a result of this evidence, Kenyon and many other scientists (notably Charles Thaxton, Walter Bradley, and Roger Olsen), as well as philosophers of science, have concluded that the "specified complexity" or high information content of DNA—like the information in a computer program, an ancient scroll, or in this article—had an intelligent source.[97]

In recent years the fossil record has also provided new support for design. Fossil studies reveal a "biological big bang" near the beginning of the Cambrian period 530 million years ago.[98] At that time roughly forty separate major groups of organisms or "phyla" (including most all the basic body plans of modern animals) emerged suddenly without evident precursors.[99] Although neo-Darwinian theory requires vast periods of time for the step-by-step development of new biological organs and body plans, fossil finds have repeatedly confirmed a pattern of explosive appearance and prolonged stability in living forms.[100] Moreover, the fossil record also shows a "top-down" hierarchical pattern of appearance in which major structural themes or body plans emerge before minor variations on those themes.[101] Not only

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[93]*See id.* at 36, 219–69.

[94]RICHARD DAWKINS, RIVER OUT OF EDEN 17 (1995).

[95]BILL GATES, THE ROAD AHEAD 228 (1996).

[96]*See* Sahotra Sarkar, *Biological Information: A Skeptical Look at Some Central Dogmas of Molecular Biology*, *in* THE PHILOSOPHY AND HISTORY OF MOLECULAR BIOLOGY: NEW PERSPECTIVES 191 (Sahotra Sarkar ed., 1996).

[97]*See* Meyer, *DNA by Design*, *supra* note 56, 519–56; Meyer, *Explanatory Power*, *supra* note 56, at 520.

[98]*See* Meyer et al., *supra* note 73.

[99]*See id.*

[100]*See id.*

[101]*See id.*

does this pattern directly contradict the "bottom-up" pattern predicted by neo-Darwinism, but as University of San Francisco marine paleobiologist Paul Chien and several colleagues have argued, it also strongly resembles the pattern evident in the history of human technological design.[102] This pattern suggests actual (i.e., intelligent) design as the best explanation for empirical data.[103]

Other scientists now see evidence of design in the information processing system of the cell, the signal transduction circuitry of the cell, the complexity and specificity of proteins, the end-directed embryological processes of organismal development, the complexity of the human brain, and even the phenomenon known as "homology" (evidence previously thought to provide unequivocal support for neo-Darwinianism).[104] Design theorists have begun to marshal an impressive array of empirical evidence in support of their perspective, thus challenging standard evolutionary theories for the origin and development of life across a variety of subdisciplines within the biology sciences.[105]

However, the legal and educational point at issue is not whether design theorists are right in their scientific claims, but whether their work may be discussed in science classrooms of public high schools. Setting aside for the moment concerns about the constitutional issues raised by the possible religious implications of design theory, teachers and school boards must assess whether information about the work of scientists (such as Behe, Kenyon, Thaxton, Chien, Dembski and others) has a legitimate place in a public school biology classroom.

The discussion above demonstrates that, right or wrong, the work of such scientists is clearly germane to the topic of biological origins. As noted, Darwin's theory (and other similarly naturalistic origins theories) sought explicitly to explain the appearance of design in biology without reference to an actual designer.[106] Thus, it is misleading to suggest, as many do, that Darwinism and design theory address two different subjects: one scientific, and the other religious. Rather, both Darwinism and design represent competing answers to the very same question: how did living forms (with their appearance of design) arise and diversify on earth? At present, many biology texts explain the evidence and arguments *for* the efficacy of natural

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[102]*See id.*

[103]*See id.*

[104]*See* Jonathan Wells & Paul Nelson, *Homology: A Concept in Crisis*, ORIGINS & DESIGN, Fall 1997, at 12 (arguing that "naturalistic mechanisms proposed to explain homology do not fit the evidence").

[105]*See id.*

[106]*See* Ayala, *supra* note 7.

selection and random variation—neo-Darwinism's "designer substitute."[107] Good science education requires that students learn and understand such evidence and arguments. Yet, if many well-credentialed scientists now dispute the adequacy of the neo-Darwinian mechanism (and other similarly materialistic theories), and some now publicly advocate the (actual) design hypothesis, then surely their work is relevant to a discussion of the scientific issues raised by neo-Darwinian theory. At the very least, knowing the evidence and arguments *for* design will help students understand the full intellectual significance of neo-Darwinism in its current context.[108] More importantly, exposure to these ideas will help correct the current imbalance in the presentation of this issue in current basal biological texts.

V. BUT IS IT SCIENCE? DARWINISM, DESIGN, AND DEMARCATION

Of course, critics of design theory generally do not dispute the data (as opposed to the interpretation) that design theorists marshal in support of their view, nor do they disagree that some evidence might be interpreted to support the idea of design. They argue instead that the very notion of "intelligent design" is inherently unscientific—that design theory does not qualify as science according to established definitions of the term. To justify this claim critics cite various definitional or demarcation criteria that purport to define science and distinguish it (or provide "demarcation," from pseudoscience, metaphysics, or religion).[109] These kinds of arguments have previously played an important role in deciding the scientific, and consequently legal, status of "creation science." Moreover, they continue to cast doubt on the scientific status of other alternatives to strictly naturalistic origins theories, including design theory.

A. McLean v. Arkansas *and the Definition of Science*

In 1982, a federal judge adopted a five-point definition of science as part of his finding that a law requiring Arkansas public schools to teach "creation

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[107]*See* MILLER & LEVINE, *supra* note 5.

[108]*See* John A. Campbell, *Intelligent Design, Darwinism, and the Philosophy of Public Education*, 1 RHETORIC AND PUBLIC AFFAIRS 469, 481 (1998) (proposing that students will learn more about Darwin's theory by studying "intelligent design").

[109]"Explanations employing nonnaturalistic or supernatural events, whether or not explicit reference is made to a supernatural being, are outside the realm of science and not part of a valid science curriculum." NATIONAL ACADEMY OF SCIENCE, *supra* note 14, at 127.

science" alongside standard neo-Darwinian theory was unconstitutional.[110] While there are decisive differences between design theory and creation science,[111] critics of design theory often rely upon the *McLean* criteria[112] to establish definitional or methodological norms.

In *McLean*, Judge William Overton ruled that an Arkansas law requiring the teaching of "creation science" in public schools violated the First Amendment's establishment clause.[113] He based his decision not only on the Establishment Clause, but upon a finding that so-called "creation science" does not qualify as science.[114] Indeed, he reasoned that because creation science does not qualify as science it constituted religion.[115] In making his determination, Judge Overton relied upon the expert testimony of the Darwinian philosopher of science Michael Ruse.[116] In his expert testimony, Ruse and other expert witnesses asserted a five-point definition of science that provided allegedly normative criteria for determining whether a theory qualifies as scientific.[117] Any theory, according to Ruse, which failed

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[110]*See* McLean v. Arkansas Bd. of Educ., 529 F. Supp. 1255, 1267 (E.D. Ark. 1982) ("[T]he essential characteristics of science are: (1) It is guided by natural law; (2) It has to be explanatory by reference to natural law; (3) It is testable against the empirical world; (4) Its conclusions are tentative, i.e., are not necessarily the final word; and (5) It is falsifiable.").

[111]*See infra* Part VI. E.

[112]*See id.*

[113]*See id*. at 1258, 1264. The court specifically found that the Arkansas law "was passed with the specific purpose . . . of advancing religion." *Id*. at 1264. This placed the law directly in conflict with the First Amendment's establishment clause under the *Lemon* test. *See id.* For a statute to pass constitutional muster under *Lemon* it must have a secular legislative purpose, it cannot either advance or inhibit religion, and it must not foster an excessive entanglement between government and religion. *See* Lemon v. Kurtzman, 403 U.S. 602, 612–13 (1971); Stone v. Graham, 449 U.S. 39, 40 (1980). A violation of any of the prongs of the *Lemon* test results in a violation of the Establishment Clause. *See McLean*, 529 F. Supp. at 1258. The court in *McLean* found that the Arkansas law's purpose was to advance religion in the public schools in violation of *Lemon*'s first prong. *See id.* at 1264. The court also found that the Arkansas law would result in an impermissible entanglement with religion, violating the third prong of *Lemon*. *See id*. at 1272.

[114]*See McLean*, 529 F. Supp. at 1267–72. The court's language was unambiguous: "Section 4(a) [of the Arkansas Act] lacks legitimate educational value because 'creation science' as defined in that section is simply not science." *Id*. *See generally* Robert M. Gordon, Note, McLean v. Arkansas Board of Education*: Finding the Science in "Creation Science*," 77 NW. U. L. REV. 374 *passim* (1982) (discussing court's finding that creation science is unscientific).

[115]*See McLean*, 529 F. Supp. at 1272.

[116]*See id.* at 1267.

[117]*See id*.

to meet these five criteria could not be considered to be "scientific."[118] According to Ruse, for a theory to be scientific it must be:

(1) guided by natural law;
(2) explanatory by natural law;
(3) testable against the empirical world;
(4) tentative in its conclusions; and
(5) falsifiable.[119]

Ruse further testified that creation science—in part because it invoked the singular action of a creator as the cause of certain events in the history of life—could never meet these criteria.[120] Thus, he concluded that creationism might be true, but it could never qualify as science.[121] Judge Overton ultimately agreed, adopting Ruse's five demarcation criteria as part of his opinion.[122]

Although the case was in some ways superseded by the subsequent ruling of the United States Supreme Court in *Edwards v. Aguillard*,[123] the *McLean* case, and the philosophy of science that underwrites it, poses an implied challenge to the scientific status of all theories of origin (including design theory) that invoke singular, intelligent causes as opposed to strictly material causes.[124] If design theory does not qualify as science, as Ruse testified and the court ruled concerning creation science, then, at least as a pedagogical matter, design theory does not belong in the science classroom.

B. The Demise of Demarcation Arguments

Notwithstanding the favorable reception that Michael Ruse enjoyed in Judge Overton's courtroom, many prominent philosophers of science, including Larry Laudan and Philip Quinn[125] (neither of whom supported

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[118]*See id*. In the court's words, these five points are the "essential characteristics of science." *Id.* at 1267.

[119]*See id*.

[120]*See id.*

[121]*See id.*

[122]*See id.*

[123]482 U.S. 578 (1987). *See* discussion *infra* Part VI.D.

[124]*See* NATIONAL ACADEMY OF SCIENCE, *supra* note 14 *passim*.

[125]*See* Larry Laudan, *Science at the Bar—Causes for Concern*, *in* BUT IS IT SCIENCE? 351, 355 (Michael Ruse ed., 1988) [hereinafter Laudan, *Science*] ("It simply will not do for the defenders of science to invoke philosophy of science when it suits them . . . and to dismiss it as 'arcane' and 'remote' when it does not."); Philip Quinn, *The Philosopher of Science as Expert Witness*, *in* BUT IS IT SCIENCE? 367, 384 (Michael Ruse ed., 1988) (crit-

creation science's empirical claims), soon repudiated Ruse's testimony on the grounds that, as Laudan argued, it "canoniz[ed] a false stereotype of what science is and how it works."[126] These philosophers of science insisted that Ruse's testimony seriously misrepresented contemporary thinking in the philosophy of science about the status of the demarcation problem.[127] Indeed, it now seems clear for several reasons that the philosophy of science provides no grounds for disqualifying nonmaterialistic alternatives to Darwinism as inherently "unscientific."

First, as Laudan noted, many philosophers of science have generally abandoned attempts to define science by reference to abstract demarcation criteria.[128] Indeed, they have found it notoriously difficult to define science generally via the kind of methodological criteria that Ruse and the court promulgated in the *McLean* case—in part because proposed demarcation criteria have inevitably fallen prey to death by counterexample.[129] Well established scientific theories often lack some of the presumably necessary features of true science (e.g., falsifiability, observability, repeatability, use of lawlike explanation, etc.), while many poorly supported, disreputable, or "crank" ideas often meet some of these same criteria.

Consider, for example, the criteria of falsifiability and tentativeness, two key and related litmus tests in the 1981 *McLean* trial.[130] Although Ruse asserts that all truly scientific theories are held tentatively by their proponents and are readily falsifiable by contradictory evidence, the history of science tells a very different story. As Imre Lakatos, one of the premier historians and philosophers of science of the twentieth century, showed in the 1970s, some of the most powerful scientific theories have been constructed by those who stubbornly refused to reject their theories in the face of anomalous data.[131] For example, on the basis of his theory of universal gravitation, Sir Isaac Newton made a number of predictions about the position of planets that did not materialize.[132] Nevertheless, rather than rejecting the notion of

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icizing expert testimony in *McClean* as "fallacious" and not representative of "settled consensus of opinion in the relevant community of scholars").

[126]Laudan, *Science*, *supra* note 125, at 355.

[127]*See id.*; Quinn, *supra* note 125, at 367–85.

[128]*See* Laudan, *Science*, *supra* note 125, at 354–55.

[129]*See id.* at 353–54.

[130]McLean v. Arkansas Bd. of Educ., 529 F. Supp. 1255 (E.D. Ark. 1982). *See* discussion *infra* Part VI.D.

[131]*See* Imre Lakatos, *Falsification and the Methodology of Scientific Research Programmes*, *in* SCIENTIFIC KNOWLEDGE: BASIC ISSUES IN THE PHILOSOPHY OF SCIENCE 173 (Janet A. Kouvray ed., 1987) (presenting scientific progress as rational process rather than religious conversions).

[132]*See id.*

universal gravitation he refined his "auxiliary assumptions" (e.g., the assumption that planets are perfectly spherical and influenced only by gravitational force) and left his core theory in place.[133] As Lakatos showed, the explanatory flexibility of Newton's theory in the face of apparently falsifying evidence turned out to be one of its greatest strengths.[134] Such flexibility emphatically did not compromise universal gravitation's "scientific status" as Ruse's definition of science would imply.[135]

On the other hand, the history of science is littered with the remains of failed theories that have been falsified, not by the air-tight disproof of a single anomaly, but by the judgment of the scientific community concerning the preponderance of data.[136] Are such falsified, and therefore falsifiable, theories (e.g., the flat earth, phlogiston, geocentricism, flood geology, etc.) more scientific than successful theories (such as Newton's was in, say, 1750) that possess wide-ranging explanatory power?

As a result of such contradictions, most contemporary philosophers of science have come to regard the question, "what distinguishes science from non-science," as both intractable and uninteresting. Instead, philosophers of science have increasingly realized that the real issue is not whether a theory is "scientific" according to some abstract definition, but whether a theory is true, or warranted by the evidence. As Laudan explains, "If we would stand up and be counted on the side of reason, we ought to drop terms like 'pseudo-science' . . . they . . . do only emotive work for us."[137] As Martin Eger has summarized, "[d]emarcation arguments have collapsed. Philosophers of science don't hold them anymore. They may still enjoy acceptance in the popular world, but that's a different world."[138]

Second, even if one assumes for the sake of argument that criteria could be found to demarcate science in general from nonscience in general, the specific demarcation criteria used in the *McLean* case have proven utterly incapable of discriminating the scientific status of materialistic and non-materialistic origins theories.[139] Laudan noted, for example, that Judge

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[133]*See id.* at 175.

[134]*See id.* at 192.

[135]*See* Lakatos, *supra* note 133, at 175.

[136]*See id. passim*.

[137]Larry Laudan, *The Demise of the Demarcation Problem*, *in* BUT IS IT SCIENCE? 337, 349 (Michael Ruse ed., 1988).

[138]John Buell, *Broaden Science Curriculum*, DALLAS MORNING NEWS, March 10, 1989, at A21 (quoting unidentified "authority").

[139]*See* Laudan, *Science*, *supra* note 125, at 354.

Overton's opinion made much of creation science's inability to be tested or falsified.[140] Yet, as Laudan argues, the claim that

> Creationism is neither falsifiable nor testable is to assert that Creationism makes no empirical assertions whatever. That is surely false. Creationists make a wide range of testable assertions about matters of fact. Thus, as Judge Overton himself grants (apparently without seeing its implications), the creationists say that the earth is of very recent origin . . . they argue that most of the geological features of the earth's surface are diluvial in character . . . they assert the limited variability of species. They are committed to the view that, since animals and man were created at the same time, the human fossil record must be paleontologically co-extensive with the record of lower animals.[141]

Laudan notes that, though creation scientists "are committed to a large number of factual . . . claims," available evidence contradicts their empirical claims.[142] As he explains, "no one has shown how to reconcile such claims with the available evidence—evidence which speaks persuasively to a long earth history, among other things. In brief, these claims are testable, they have been tested, and they have failed those tests."[143]

Yet, Laudan notes, if creationist arguments have been shown false by empirical evidence (as Ruse and other expert witnesses at the Arkansas trial no doubt believed), then creation science must be falsifiable.[144] But if it is falsifiable, then by Ruse's own criterion, it must qualify as scientific.

Similar problems have afflicted Ruse's other demarcation criteria. For example, insofar as both creationist and evolutionary theories make historical claims about past causal events, both theories offer causal explanations that are not explained by natural law. The theory of common descent, a central thesis of the *Origin of Species*, does not explain by natural law. Common descent explains by postulating hypothetical historical events (and a pattern of events) which, if actual, would explain a variety of presently observed data.[145] The theory of common descent makes claims about what happened in the past—namely that unobserved transitional organisms existed—forming a genealogical bridge between presently existing life forms.[146] Thus, on the

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[140]*See id.* at 352.

[141]*Id.*

[142]*Id.*

[143]*Id.*

[144]*See id.* at 352–53.

[145]*See* CHARLES DARWIN, ON THE ORIGIN OF SPECIES BY MEANS OF NATURAL SELECTION 411–34 (photo. reprint, Harvard Univ. Press 1964) (1859).

[146]*See id.*

theory of common descent, a postulated pattern of events, not a law, does the main explanatory work. Similarly, as Laudan notes, scientists often make "existence claims" about past events or present processes without knowing the natural laws on which they depend.[147] As he notes, "Darwin took himself to have established the existence of [the mechanism of] natural selection almost a half century before geneticists were able to lay out the laws of heredity on which natural selection depended."[148] Thus, Ruse's second demarcation criterion would require, if applied consistently, classifying *both* creation science and classical Darwinism (as well as much of neo-Darwinism) as unscientific. As Laudan notes,

> If we took the *McLean* Opinion criterion seriously, we should have to say that . . . Darwin [was] unscientific; and, to take an example from our own time, it would follow that plate tectonics is unscientific because we have not yet identified the laws of physics and chemistry which account for the dynamics of crustal motion.[149]

Third, analyses of the demarcation problem have suggested that naturalistic and non-naturalistic origins theories (including both Darwinism and design theory) are "methodologically equivalent," both in their ability to meet various demarcation criteria and as historical theories of origin. As noted above, Laudan's critique suggests that when the specific demarcation criteria promulgated in the *McLean* case are applied rigidly they disqualify both Darwinism and various nonmaterialistic alternatives.[150] Yet as his discussion of falsification suggests, if certain criteria are applied more liberally then both theories may qualify as scientific. More recent studies in the philosophy of science have confirmed and amplified Laudan's analysis.[151]

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[147]Laudan, *Science*, *supra* note 125, at 354.

[148]*Id.*

[149]*Id.*

[150]*See id.*

[151]*See, e.g.*, Stephen C. Meyer, *The Demarcation of Science and Religion*, *in* THE HISTORY OF SCIENCE AND RELIGION IN THE WESTERN TRADITION: AN ENCYCLOPEDIA 17, 22 (Gary Ferngren et al., eds., 2000) ("[I]nsofar as both creationist and evolutionary theories constitute historical theories about past causal events, neither explains exclusively by reference to natural law."); Stephen C. Meyer, *The Nature of Historical Science and the Demarcation of Design and Descent*, *in* 4 FACETS OF FAITH AND SCIENCE 91 (Jitse M. van der Meer ed., 1996) [hereinafter Meyer, *Demarcation*]; Stephen C. Meyer, *The Methodological Equivalence of Design & Descent: Can There Be a Scientific "Theory of Creation?"*, *in* THE CREATION HYPOTHESIS: SCIENTIFIC EVIDENCE FOR AN INTELLIGENT DESIGNER 67, 102 (J.P. Moreland ed., 1994) [hereinafter Meyer, *Equivalence*] ("The exclusion of one of the logically possible programs of origins research by assumption . . . seriously diminishes the significance of any claim to theoretical superiority

They suggest that philosophically neutral criteria do not exist that can define science narrowly enough to disqualify theories of creation or design without also disqualifying Darwinism and/or other materialistic evolutionary theories on identical grounds.[152] Either science will be defined so narrowly as to disqualify both types of theory, or science must be defined more broadly, and the initial reasons for excluding opposing theories will evaporate. Thus, materialistic and nonmaterialistic origins theories appear to be methodologically equivalent with respect to a wide range of demarcation criteria—that is, both appear equally scientific or equally unscientific provided the same methdological criteria are used to adjudicate their scientific status (and provided philosophically neutral criteria are used to make such assessments).

Indeed, recent work on the historical sciences suggests deep methodological and logical similarities between various origins theories. Philosopher of biology, Elliot Sober, has argued that both classical design arguments and the Darwinian argument for descent with modification constitute attempts to make inferences to the best explanation.[153] Other work in the philosophy of science has shown that both Darwinism and design theory attempt to answer characteristically historical questions: both may have metaphysical implications or overtones; both employ characteristically historical forms of inference, explanation, and testing; and both are subject to similar epistemological limitations.[154]

C. Majority and Minority Opinions

Accordingly, even many of those who previously wielded demarcation arguments as a way of protecting the Darwinist hegemony in public education, including the most prominent advocates of these arguments, have either abandoned or repudiated them.[155] For example, Eugenie Scott of The

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by advocates of a remaining group.").

[152]*See* Laudan, *Science*, *supra* note 125, at 354.

[153]*See* ELLIOTT SOBER, PHILOSOPHY OF BIOLOGY 27, 56 (1993) (finding that creationism and Darwinism both use characteristic approaches and techniques to attempt to explain certain phenomena).

[154]*See* Meyer, *Demarcation*, *supra* note 151, at 91-130; Meyer, *Equivalence*, *supra* note 153, at 99 ("[T]he conjunction of the methodological equivalence of design and descent and the existence of a convention that regards descent as scientific implies that design should—by that same convention—be regarded as scientific too.").

[155]Interestingly, there is considerable evidence that some advocates of these demarcation arguments in the Arkansas trial knew them to be inadequate at the time of the trial itself. For example, Barry Gross, a philosopher of science who served as a consultant to the law firm of Skadden, Arps (who represented the ACLU), has written that he informed the ACLU at the time of the trial that the *McLean* criteria were inaccurate and inadequate.

National Center for Science Education (an advocacy group for an exclusively Darwinist curriculum) no longer seeks to dismiss creation science as pseudoscience or as unscientific; instead, she argues that it constitutes "bad science."[156] Scott no longer repudiates design theory as inherently "unscientific," as she did as recently as 1994; she now argues it is a minority viewpoint within science.[157] Similarly, during a talk to the American Association for the Advancement of Science (AAAS) in 1993, Michael Ruse himself repudiated his previous support for the demarcation principle by admitting that Darwinism (like creationism) "depends upon certain unprovable metaphysical assumptions."[158] In his more recent scholarship, Ruse has openly argued that evolutionary theory has often functioned as a kind of "secular religion."[159]

D. Novel Paradigms vs. Establishment Science: Majority and Minority Perspectives in Science

The demise of demarcation arguments within the philosophy of science has made it difficult for critics of design (or other non-naturalistic origins theories) to label them unscientific in principle. As Laudan and others have argued, the status and merit of competing origins theories must be decided on the basis of empirical evidence and argument, not upon abstract philosophical or methodological litmus tests.[160] Yet as we have seen, design theorists in particular make extensive appeals to such empirical evidence and argument. Moreover, if, arguably, design theory has both a theoretical basis and evidential support, and if it meets abstract definitional criteria of scientific status equally as well as its main theoretical rivals, then it seems natural to ask: on what grounds can design theory now be excluded from public school science curriculum?

Barry R. Gross, *Commentary: Philosophers at the Bar—Some Reasons for Restraint*, SCIENCE, TECHNOLOGY AND HUMAN VALUES, Fall 1983, at 36. As he wrote after the trial, "Philosophically, these criteria may have been acceptable sixty or eighty years ago, but they are not rigorous, they are redundant, and they take no account of many distinctions nor of historical cases. The opinion does not state whether they are singly necessary or jointly sufficient. One would not recommend to graduate school a student who could do no better than this." *Id.*

[156]*See Hearings*, *supra* note 63.

[157]*See U.S. Comm'n on Civil Rights*, *supra* note 63.

[158]Speech by Michael Ruse to the Annual Meeting of the American Assoc. for the Advancement of Science (Feb. 13, 1993) (visited Feb. 17, 2000) <http://www.leaderv-.com/orgs/am/orpages/or151/mr93tran.html>.

[159]MICHAEL RUSE, MONAD TO MAN 511–17 (1996).

[160]*See* Laudan, *Science*, *supra* note 125, at 351–55.

Some have claimed that design theory is too new to merit discussion in biology classrooms, and no doubt this does partially *explain* its frequent omission.[161] Nevertheless, the relative novelty of design theory does not *justify* its exclusion on either legal or pedagogical grounds. Indeed, quite the reverse is the case. The law provides no guidelines for determining how long a scientific theory must have existed in order to warrant teaching students about it. Further, good teachers know that exposing students to new (and even controversial) ideas can stimulate student interest and engagement and lead to greater subject mastery. Nor does science itself have a governing body that can issue binding rulings about such matters. Instead, this constitutes a matter for local teachers and school boards to decide.

Other critics of design have asserted another reason for exclusion: its minority status within science.[162] Until design theory wins the support of the majority of scientists, they argue, students may not be exposed to the evidence or arguments for it.[163] Yet such a view seems profoundly at odds with scientific practice, which itself involves dialogue and debate between scientists, some of whom advocate, from time to time, for new interpretations against established views. Those who insist that teachers may present only the majority view on a scientific issue, or that only majority opinions constitute "the scientific perspective," overlook the history of science. Many established scientific theories originally met opposition from the majority of scientists. And science often involves argument between competing theoretical perspectives. As the Supreme Court stated in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*,[164] "Scientific conclusions are subject to perpetual revision. . . . The scientific project is advanced by broad and wide-ranging consideration of a multitude of hypotheses, for those that are incorrect will eventually be shown to be so, and that in itself is an advance."[165] Since, again, no ruling body in science can determine when a minority scientific interpretation has attracted sufficient support to warrant discussion in the science classroom, the pedagogical debate will necessarily, and properly, devolve to individual teachers and local school boards. In any case, defining permissible science as co-extensive with majority scientific opinion erects a more restrictive standard than the law itself now recognizes in deciding the admissibility of expert scientific opinion.

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[161]*See Hearings*, *supra* note 63.
[162]*See id.*
[163]*See id.*
[164]509 U.S. 579 (1993).
[165]*Id.* at 579.

E. Daubert*'s Redefinition of Science*

For seventy years the exclusion of minority scientific views as evidence was enshrined in *Frye v. United States*.[166] At his trial for murder, James Alphonzo Frye offered systolic blood pressure taken during pre-trial questioning—essentially an early, crude type of polygraph—to prove his innocence.[167] In affirming the trial court's refusal to admit the testimony, the D.C. Circuit noted that this form of evidence had not been generally accepted within the appropriate scientific disciplines.[168] It then ruled that the test of reliability—and thus of admissibility—was general acceptance within the scientific community.[169] Although *Frye* was widely followed,[170] it was also criticized.[171]

In 1989, *Frye*'s hold on the courts was broken when the Maine Supreme Court abandoned Maine's version of the *Frye* rule.[172] The acceptance of certain "clinical features" by an expert's profession "does not establish the scientific reliability of [the expert's] conclusions."[173] Whether or not an opinion can qualify as scientific is determined by the quantity and quality of empirical support upon which the assertion is based.[174]

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[166]293 F. 1013, 1014 (D.C. Cir. 1923) (holding that "while courts will go a long way in admitting expert testimony deduced from a well-recognized scientific principle or discovery, the thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs").

[167]*See id.* at 1013–14.

[168]*See id.* at 1014.

[169]*See id.*

[170]*See Daubert*, 509 U.S. at 585 ("In the 70 years since its formulation in the *Frye* case, the 'general acceptance' test has been the dominant standard for determining the admissibility of novel scientific evidence at trial.") (citing ERIC D. GREEN & CHARLES R. NESSON, PROBLEMS, CASES, AND MATERIALS ON EVIDENCE 649 (1983)).

[171]*See Daubert*, 509 U.S. at 585–86. One criticism was the court's reliance on professional acceptance by the scientific community as a gauge of legitimate science. A popular evidence casebook summarizes one of the arguments against the *Frye* ruling: "[T]he extent of the acceptance of the technique by peers is not the substantive test of scientific validity; the degree of acceptance is merely circumstantial evidence that the hypothesis has been properly validated by experimentation." RONALD L. CARLSON ET AL., EVIDENCE IN THE NINETIES 289 (3d ed. 1991) (citing Bert Black, *A Unified Theory of Scientific Evidence*, 56 FORDHAM L. REV. 595, 625, 632 (1988)).

[172]*See* State v. York, 564 A.2d 389 (Me. 1989). In ruling on the admissibility of a social worker's testimony regarding the behavior of an eight-year old child, the Maine court found that the guiding principle in evaluating the legitimacy of scientific evidence is "solid empirical research." *Id.* at 390.

[173]*Id.* at 390.

[174]*Id.* at 390–91.

Four years later, the United States Supreme Court decided *Daubert v. Merrell Dow Pharmaceuticals, Inc.*[175] *Daubert* arose from a claim that Merrell Dow's drug, Bendectin, had caused birth defects.[176] Noting that the Federal Rules of Evidence are to be liberally construed in favor of admissibility,[177] the Court found that *Frye*'s "general acceptance" test was too restrictive; instead, trial courts should admit evidence if it is "supported by appropriate validation—*i.e.*, 'good grounds,' based on what is known."[178] Since the hallmark for science under *Daubert* is "evidentiary reliability,"[179] *Daubert* heralds a critical shift in the judicial system's understanding of the nature of science itself.[180] As more states abandon *Frye* in favor of the rule announced in *Daubert*,[181] scientific claims will be evaluated not on the basis of a popularity poll among scientists or by the fulfillment of a set of arbitrary criteria.[182] Instead, the test for scientific legitimacy comes from the validation of the empirical research supporting the evidence.[183]

This trend makes reliance upon the demarcation criteria in *McLean v. Arkansas* even more questionable. Since *Daubert* has made the question of

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[175]509 U.S. 579 (1993).

[176]*See id.* at 582.

[177]*See id.* at 587–89.

[178]*Id*. at 590.

[179]*Id.*

[180]*Daubert*'s view of science was recently strengthened by the Supreme Court's ruling in *Kumho Tire Co. v. Carmichael*, 526 U.S. 137 (1999). *Kumho* extended *Daubert* to apply to the expert testimony of nonscientists offered under Rule 702. *See id.* at 141. The Court expanded the number of criteria which could be considered when evaluating evidence under *Daubert*, but continued to apply its fundamental rule, that scientific reliability should be considered a function of the coherence of the methodology employed, not by whether a view commands majority status in the particular discipline. *See id.* at 149 (holding that trial judge's duty is to "determine whether the testimony [in question] has 'a reliable basis in the knowledge and experience of [the relevant] discipline'" (quoting *Daubert*, 509 U.S. at 592 (second alteration in original)).

[181]*See, e.g.*, Commonwealth v. Lanigan, 641 N.E.2d 1342, 1349 (Mass. 1994) (adopting *Daubert* test); Hand v. Norfolk S. Ry. Co., No. 03A01-9704-CV-00123, 1998 WL 281946, at *4 (Tenn. App. 1998) (following, but not officially adopting, *Daubert* test); State v. Streich, 658 A.2d 38, 47 (Vt. 1995) (applying *Daubert*'s factors); State v. Anderson, 881 P.2d 29, 36 (N.M. 1994) (citing *Daubert* to support judicially created admissibility considerations). *But see* State v. Tankersley, 956 P.2d 486, 491 (Ariz. 1998) (refusing to replace *Frye* with *Daubert*, but noting that issue not properly before court); State v. Copeland, 922 P.2d 1304, 1310 (Wash. 1996) (holding *Frye*, not *Daubert*, test applied to admission of scientific evidence).

[182]*See Daubert*, 509 U.S. at 594 ("The inquiry envisioned by Rule 702 is, we emphasize, a flexible one.").

[183]*See id.* at 590; State v. York, 564 A.2d 389, 390–91 (Me. 1989).

scientific legitimacy turn on "evidentiary reliability,"[184] the courtroom should be hospitable to competing theories provided each theory has an empirical basis. To exclude an interpretation simply because it has not yet achieved majority support usurps the function that juries ought to serve.[185] By analogy, the debate over origins theory should not exclude a viewpoint at the outset because of the inability to command a majority of scientists; it should be the function of scientific inquiry itself to permit competing theories to argue, on the basis of empirical data, for wider acceptance.[186]

F. An Answer for Spokes

It is hard to conceive of a legitimate objection to Spokes's plan to correct errors in basal biology textbooks, including both errors of omission and commission. To the contrary, refusing to permit criticism contradicts the scientific commitment to open argument and self-correction. If refusing to permit criticism would be illiberal, then refusing to permit the discussion of alternative theories would be illogical. As noted, neo-Darwinism claims to have found a mechanism that can explain the appearance of design in biology without recourse to an actual designer.[187] If this mechanism cannot explain the appearance of design, as many scientists now argue, then it is likely that some scientists at least will want to consider actual design as a better explanation. Scientific critique of the mechanism that functions as a designer substitute leads logically to reconsideration of the need for a real designer.

Similarly, students confronted with dissenting opinion about neo-Darwinism will naturally want to ask: Are there any other competing explanations for the origin of biological form? Good science can hardly

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[184]*See Daubert*, 590 U.S. at 590.

[185]*See, e.g.*, United States v. Chischilly, 30 F.3d 1144, 1154 (9th Cir. 1994) (holding that judges should not supplant jury's function of evaluating evidence by '"crossexamination, presentation of contrary evidence, and careful instruction'" of juries) (quoting *Daubert*, 509 U.S. at 596)).

[186]A good example of a minority viewpoint that is worthy of scientific debate is Francis Crick's theory that life originated on a distant planet and was "seeded" by a more developed civilization that transported life via unmanned spacecraft. *See generally* Francis H. Crick & Leslie E. Orgel, *Directed Panspermia*, 19 ICARUS 341, 341 (1973) (explaining Francis Crick's "theory that organisms were deliberately transmitted to the earth by intelligent beings on another planet"). As one commentator stated, this theory "remains outside the mainstream of science; however, the mental exercises that Crick entertains both for and against his theory are stimulating and informative." *A Visit With Dr. Francis Crick*, ACCESS EXCELLENCE CLASSIC COLLECTION, visited Feb. 15, 2000 <http://www.accessexcellence.org/AE/AEC/CC/crick.html>

[187]*See supra* Part II.B.

require teachers to refuse to answer such a question. Spokes should be free to say, "Some scientists see evidence of actual design, rather than just apparent design, and believe this hypothesis constitutes a better explanation for certain features of biological organisms." Given the absence a "scientific magisterium," or a reigning body of scientists to decide empirical disputes by edict, Spokes should be free to present design theory and allow students to consider its merits. Unless some other reason for excluding it can be established, he should feel free to teach the entire scientific controversy, as accurately and fairly as he is able, and permit his students, as scientists in the making, to judge for themselves.

Of course, another reason for excluding discussion of design theory has been proffered: the claim that it violates the establishment clause.

VI. IS IT RELIGION? THE THEORY OF INTELLIGENT DESIGN AND THE ESTABLISHMENT CLAUSE

A recent law review article argues that the theory of intelligent design should not be included in science classroom discussion because to do so would constitute an establishment of religion. In a recent review of the legal status of a supplementary text[188] that presents the theory of intelligent design, Jay D. Wexler states, at least for the purpose of argument, that design theory may qualify as scientific in character.[189] Nevertheless, he argues that teaching about design would offend the Establishment Clause of the First Amendment[190] because the theory of intelligent design constitutes a religious belief.[191] Thus, he argues, the same limitations apply to teaching design theory as apply to teaching Judaism, Christianity, or Buddhism in the public

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[188]*See* DAVIS & KENYON, *supra* note 56.

[189]*See* Jay D. Wexler, Note, *Of Pandas, People, and the First Amendment: The Constitutionality of Teaching Intelligent Design in the Public Schools*, 49 STAN. L. REV. 439, 467–68 (1997).

[190]*See id.* The First Amendment's establishment clause reads "Congress shall make no law respecting an establishment of religion . . . ." U.S. CONST. amend. I. The Establishment Clause has been incorporated by the Fourteenth Amendment, so its prohibition against the establishment of religion applies equally to the state and federal governments. *See* Everson v. Board of Educ., 330 U.S. 1, 15–16 (1947).

[191]*See* Wexler, *supra* note 189, at 468.

schools.[192] He notes, "[t]he First Amendment forbids the government from establishing religion; it does not require it to teach science."[193]

This section of the Article will proceed in several stages to refute the identification of design theory as a religion. First, we will show that the courts have been reluctant to proffer specific legal definitions of religion, especially ones that can be used to assign the legal burdens of religion to institutions or entities that do not define themselves as religious. Second, we will show that definitional criteria the courts have enunciated, such as a test adopted by the Ninth Circuit Court of Appeals, do not justify classifying the theory of intelligent design as a religion. Third, we will show that attempts to equate the theory of intelligent design with creation science, and thus, to extend legal judgments about the inadmissibility of creation science to design theory, ignore legally relevant differences between them.[194] Indeed, we will show that neither the ruling in *Edwards* v. *Aguillard*,[195] nor a more general reliance on the *Lemon*[196] test, can offer any constitutional basis for preventing teachers from teaching students about the theory of intelligent design in public science classrooms.

A. Defining Religion

Just as establishing a general definition of science has proven to be both legally and philosophically problematic, so too has the task of finding a general legal definition of religion proved to be challenging for the courts. Nevertheless, given the language of the Establishment Clause, the courts require some criteria by which they can identify religion and decide when to assign the legal benefits or burdens of religion. Indeed, unless the courts have some working definition of religion, they cannot decide, for example, whether an organization seeking a tax advantage available to religious organizations

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[192]Indeed, to Wexler, the scientific merit of intelligent design is "not . . . a very important question after all." Wexler, *supra* note 189, at 468. Instead, the only critical question is whether the teaching of intelligent design violates the requirement that schools refrain from teaching religion. *See id.* Since intelligent design implies the existence of a designer, it is logical to assume "a supreme, supernatural being who designed, coordinated, and created all of nature according to a master plan." *Id.* at 460. For this reason, any attempt to teach intelligent design is inherently religious and therefore must be excluded from the public school system. *See id.* at 462–63.

[193]*Id.* at 468.

[194]*See id.*

[195]482 U.S. 578 (1987).

[196]*See* Lemon v. Kurtzman, 403 U.S. 602, 612–13 (1971).

(but not to others) should receive it.[197] Similarly, lacking such a definition, they cannot decide when to forbid government aid to religious organizations or to organizations that want to use government funds for religious purposes.[198]

Cases that turn on the definition of religion typically involve a dispute brought either by someone who complains that a state's definition of religion is too narrow (because it does not extend to the complainant, who wants a benefit conferred by religion)[199] or too broad (because the complainant doesn't want a legal burden associated with non-religious status).[200] The courts have generally shown a willingness to accept a broader conception of religion when complainants seek benefits of religious status under the law, such as exemption from military service.[201] They have tended to favor a more narrow conception of religion when considering the assignment of legal burdens to defendants who deny being engaged in religious activity.[202] Such cases arise when someone accuses a defendant of engaging in a religious activity in order to impose the constitutional restrictions on the defendant that

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[197]*See, e.g.*, Texas Monthly, Inc. v. Bullock, 489 U.S. 1, 25 (1989) (striking down tax exemption for religious periodical as non-neutral benefit).

[198]*See* Witters v. Washington Dep't of Servs. for the Blind, 474 U.S. 481, 489 (1986) (holding that state aid to blind student studying theology was not barred by First Amendment).

[199]*See, e.g.*, United States v. Seeger, 380 U.S. 163, 164–65 (1965) (seeking exemption from military service obligation for conscientious objections based on religious belief); Sherbert v. Verner, 374 U.S. 398, 399–402 (1963) (seeking exemption based on religious belief from requirement to work on Saturday to receive unemployment benefits); Wisconsin v. Yoder, 406 U.S. 205, 207 (1972) (seeking religious exemption from compulsory school attendance statute); Thomas v. Review Bd. of Ind. Employment Security Div., 450 U.S. 707, 709–13 (1981) (seeking religious exemption from requirement to work in armament factory to receive unemployment benefits).

[200]*See, e.g.*, Texas Monthly, Inc., 489 U.S. at 25 (challenging tax exemption for religious periodicals).

[201]*See Seeger*, 380 U.S. at 176. Nevertheless, courts have rejected claims of religious motivation where they find that religious language merely affects a form of fraud. *See, e.g.*, United States v. Meyers, 95 F.3d 1475, 1481 (10th Cir. 1996) (rejecting defendant's claim that he was wrongfully convicted of violating drug laws, in contravention of his right to free exercise of religion, because of his membership in Church of Marijuana).

[202]*See, e.g.*, Grove v. Mead Sch. Dist. No. 354, 753 F.2d 1528, 1534 (9th Cir. 1985) (finding that use of literature text offensive to fundamentalist Christians did not result in promotion of alleged religion of secular humanism); Brown v. Woodland Joint Unified Sch. Dist., 27 F.3d 1373, 1378–83 (9th Cir. 1994) (reasoning that teaching students about witchcraft and inviting them to participate in classroom poetry and chanting did not promote "religion" of witchcraft).

accompany a religious designation.[203] As we shall see, such accusations are rarely successful.[204]

Despite the obvious necessity of having *some* definition of religion,[205] a review of relevant cases shows that the courts have been hesitant to draw precise boundaries.[206] Indeed, the Ninth,[207] Eleventh,[208] and Second[209] Circuits have all rejected the invitation to craft precise definitions of religion. As the Second Circuit Court of Appeals recognized in *United States v. Kauten*,[210] the meaning of "religion" as a "term is found in the history of the human race and is incapable of compression into a few words."[211] The judges' reluctance may derive, in part, from their recognition of the danger

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[203]*See* Malnak v. Yogi, 592 F.2d 197, 198–99 (3d Cir. 1979). We may use the term "religious" in a metaphorical sense, such as commenting that a person is "religious" about getting exercise or watching a favorite sporting event. But it requires more than a great deal of passion or commitment to an activity or idea to make something religious for legal purposes. *See Meyers*, 95 F.3d at 1481–84.

[204]The only successful claim has been *Malnak*, 592 F.2d at 198–99 (enjoining practitioners from teaching "Science of Creative Intelligence-Transcendental Meditation" to public school students because practices were too closely related to traditional Hindu doctrines). The more common result is to deny the claim that the defendant's belief system operates in a way analogous to religion. *See, e.g.*, *Grove*, 753 F.2d at 1537–38; *Brown*, 27 F.3d at 1380–81.

[205]*See* Dmitry N. Feofanov, *Defining Religion: An Immodest Proposal*, 23 HOFSTRA L. REV. 309, 313 (1994) (stating that "we need a definition of religion because it determines what is protected and what is not"); *see also* Steven D. Collier, Comment, *Beyond Seeger/Welsh: Redefining Religion Under the Constitution*, 31 EMORY L.J. 973, 975 n.14 (1982) ("A clear definition of religion is essential to any case based solely on the religion clauses, since the First Amendment claim disappears if 'religion' is not involved." (footnote omitted) (citing Theriault v. Silber, 453 F. Supp. 254 (W.D. Tex. 1978), *appeal dismissed* 579 F.2d 302 (5th Cir. 1978), *and cert. denied*, 440 U.S. 917 (1979); United States v. Kuch, 288 F. Supp. 439 (D.D.C. 1968); *Yoder*, 406 U.S. at 215)).

[206]*See* Alvarado v. City of San Jose, 94 F.3d 1223, 1227 (9th Cir. 1996). The court described the attempt to define religion both as a general term and for Establishment Clause purposes as a "notoriously difficult, if not impossible, task." *Id*. (citing James M. Donovan, *God is as God Does: Law, Anthropology, and the Definition of "Religion*," 6 SETON HALL CONST. L.J. 23 (1995); Africa v. Pennsylvania, 662 F.2d 1025, 1031 (3d Cir. 1981), *cert. denied*, 456 U.S. 908 (1982)).

[207]*See* Peloza v. Capistrano Unified Sch. Dist., 37 F.3d 517, 521 (9th Cir. 1994).

[208]*See* Smith v. Board of Sch. Comm'rs, 827 F.2d 684, 690–95 (11th Cir. 1987).

[209]*See* United States v. Allen, 760 F.2d 447, 450 (2d Cir. 1985).

[210]133 F.2d 703 (2d Cir. 1943).

[211]*Id*. at 708.

of trying to make theological or philosophical distinctions in the absence of training or authority to do so.[212]

Moreover, scholars have also expressed concern that in making theological and philosophical distinctions about what constitutes religion, and thereby extending or withholding benefits or burdens on that basis, judges will become instruments for the favoring of one theological view over another.[213] Indeed, different religions have different understandings of the nature of religion and religious belief. Judgments about the nature of religion may thus necessarily favor one religious viewpoint over another. For this reason, the courts have been understandably hesitant to devise bright-line

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[212]Different religions have different understandings of the nature of religion and religious belief. Protestant theologian, Paul Tillich, defined religion as being an "ultimate concern." PAUL TILLICH, THE SHAKING OF THE FOUNDATIONS 57 (1948). This definition would expand religion beyond traditional theistic grounds to include any strongly held ideological belief concerning the ultimate meaning and purpose of the universe. The Letter of James in the New Testament states that "[r]eligion that is pure and undefiled before God, the Father, is this: to care for orphans and widows in their distress, and to keep oneself unstained by the world." *James* 1:27 (New Revised Standard Version). The Catechism of the Catholic Church identifies true religion with the teachings of the Catholic and apostolic Church. *See* CATECHISM OF THE CATHOLIC CHURCH ¶ 870. Some evangelical Protestant theologians have even argued that Christianity itself is not properly thought of as a religion. *See* DIETRICH BONHOEFFER, THE COST OF DISCIPLESHIP *passim* (rev. ed. 1967); KARL BARTH, THE EPISTLE TO THE ROMANS (Edwin C. Hoskyns trans., Oxford Univ. Press 1933) (6th ed. 1928). Even the role of God in religion is disputed. Some religious traditions (Christianity, Judaism, Islam) affirm monotheism, some (Hinduism, Jainism, animism) affirm a belief in a multiplicity of deities, and others (Buddhism, Confucianism, Taoism) hold no particular view of God or the gods at all. *See* WILLARD E. ARNETT, A MODERN READER IN THE PHILOSOPHY OF RELIGION 4–5 (1966).

[213]*See* Val D. Ricks, *To God God's, To Caesar Caesar's, and To Both the Defining of Religion*, 26 CREIGHTON L. REV. 1053, 1054–55 (1993). According to Ricks, "only a few United States Supreme Court cases have mentioned the issue, and none have addressed it directly." *Id*. at 1054 n.2 (citing Thomas v. Review Bd., 450 U.S. 707 (1981); Wisconsin v. Yoder, 406 U.S. 205 (1972); Welsh v. United States, 398 U.S. 333 (1970); United States v. Seeger, 380 U.S. 163 (1965); Torcaso v. Watkins, 367 U.S. 488 (1961); United States v. Ballard, 322 U.S. 78 (1944); Davis v. Beason, 133 U.S. 333 (1890); Reynolds v. United States, 98 U.S. 145 (1878)). Ricks also cites to the relatively small number of appellate court decisions attempting to define religion. *See id*. (citing Africa v. Pennsylvania, 662 F.2d 1025 (3d Cir. 1981), *cert. denied*, 456 U.S. 908 (1982); Malnak v. Yogi, 592 F.2d 197 (3d Cir. 1979) (Adams, J., concurring); International Soc'y for Krishna Consciousness, Inc. v. Barber, 650 F.2d 430 (2d Cir. 1981); Founding Church of Scientology v. United States, 409 F.2d 1146 (D.C. Cir.), *cert. denied*, 396 U.S. 963 (1969); United States v. Kauten, 133 F.2d 703 (2d Cir. 1943)).

definitions of religion, especially where those definitions would too easily allow courts to assign the legal burdens of religion.[214]

A typical example is *Peloza v. Capistrano Unified School District*.[215] Peloza sued the school district that employed him, claiming that by forcing him to teach "evolutionism" and "secular humanism" to his students, his employer had created an "establishment of religion."[216] The court rejected his assertion, finding that neither "evolutionism [n]or secular humanism are 'religions' for Establishment Clause purposes."[217] The court based this finding on "both the dictionary definition of religion and the clear weight of the caselaw" contradicting Peloza's claim.[218] The court also referred to the suggestion by Professor Laurence Tribe that "anything 'arguably non-religious' should not be considered religious in applying the establishment clause."[219]

Similarly, in *Alvarado v. City of San Jose*,[220] a group of citizens brought suit against the city of San Jose, alleging that the city's installation of a sculpture of the Aztec god Quetzalcoatl violated the Establishment Clause.[221] The court ruled that the sculpture was not religious in nature.[222] In making its ruling, the court relied on a three-part test to define religion.[223]

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[214]*See generally* David K. DeWolf, *State Action Under the Religion Clauses: Neutral in Result or Neutral in Treatment?*, 24 U. RICH. L. REV. 253, 271–75 (1990) ("[T]he Court's opinion [in *Seeger*] should be read as demonstrating the Court's recognition that when legal rights are made dependent upon theological categories, a court cannot make a legal determination without at the same time becoming entangled in the most sensitive of theological issues.").

[215]37 F.3d 517 (9th Cir. 1994).

[216]*Id*. at 519–21.

[217]*Id*. at 521.

[218]*Id.* (footnote and citation omitted) (citing Smith v. Board of Sch. Comm'rs, 827 F.2d 684, 690–95 (11th Cir. 1987); United States v. Allen, 760 F.2d 447, 450–51 (2d Cir. 1985)).

[219]*Id.* at 521 n.5 (citing *Allen*, 760 F.2d at 450–51 (quoting LAURENCE H. TRIBE, AMERICAN CONSTITUTIONAL LAW 827–28 (1978))). Tribe argues that the balance between the Free Exercise and Establishment Clauses of the First Amendment should be struck by favoring religious liberty, rather than by sacrificing religious liberty to the Establishment Clause. *See* TRIBE, *supra*, at 827–28.

[220]94 F.3d 1223 (9th Cir. 1996).

[221]*See id*. at 1226.

[222]*See id.* at 1228–31.

[223]*See id*. at 1229. This test was first proposed in *Malnak v. Yogi*, 592 F.2d 197, 207–10 (3d Cir. 1979) (Adams, J., concurring). The Third Circuit adopted the test in *Africa v. Pennsylvania*, 662 F.2d 1025, 1032 (3d Cir. 1981).

> First, a religion addresses fundamental and ultimate questions having to do with deep and imponderable matters. Second, a religion is comprehensive in nature; it consists of a belief-system as opposed to an isolated teaching. Third, a religion often can be recognized by the presence of certain formal and external signs.[224]

The court further clarified the test by noting that "'formal and external signs'" include such practices as "'formal services, ceremonial functions, the existence of clergy, structure and organization, efforts at propagation, observance of holidays and other similar manifestations associated with the traditional religions.'"[225]

B. Applying the Ninth Circuit's Test for Religion

Though the courts have generally resisted formulating definitions of religion, the Ninth Circuit test articulated in *Peloza v. Capistrano Unified School District*[226] and *Alvarado v. City of San Jose*[227] stands as a clear exception to that rule.[228] Even so, this three-part test clearly provides no grounds for classifying the theory of intelligent design as a religion.

Consider the first part: Design theory does not attempt to address "'fundamental and ultimate questions'" concerning "'deep and imponderable matters.'"[229] On the contrary, design theory seeks to answer a question raised by Darwin, as well as contemporary biologists: How did biological organisms acquire their appearance of design? Design theory, unlike neo-Darwinism, attributes this appearance to a designing intelligence, but it does not address the characteristics or identity of the designing intelligence.[230] Of course, design theory is consistent with theism and adds plausibility to the classical

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[224]*Alvarado*, 94 F.3d at 1129 (quoting *Africa*, 662 F.2d at 1032).

[225]*Id.* (quoting *Africa*, 662 F.2d at 1035-36 (internal quotations omitted)).

[226]37 F.3d 517 (9th Cir. 1994).

[227]94 F.3d 1223 (9th Cir. 1996).

[228]*See Peloza*, 37 F.3d at 520; *Alvarado*, 94 F.3d at 1229.

[229]*Alvarado*, 94 F.3d at 1229 (quoting Africa v. Pennsylvania, 662 F.2d 1025, 1032 (3d Cir. 1981). Clearly the debate between Darwinists and design theorists about the origin of apparent design could be characterized as a "fundamental" scientific and philosophical issue. Nevertheless, neither Darwinism nor design theory seeks to answer "ultimate" metaphysical questions, even though both theories have implications for how such questions are approached. *See infra* notes 246–60 and accompanying text.

[230]*See* William A. Dembski, *Intelligent Design is Not Optimal Design* (Jan. 2, 2000) <http:\\www.discovery.org/crsc/CRSCdbEngine.php3?id=86>.

design arguments for the existence of God.[231] But this compatibility does not make it a religious belief. As Justice Powell wrote in his concurrence to *Edwards v. Aguillard*[232]: "[A] decision respecting the subject matter to be taught in public schools does not violate the Establishment Clause simply because the material to be taught 'happens to coincide or harmonize with the tenets of some or all religions.'"[233] According to Powell, interference by the federal courts in the decisions of local and state educational officials is justified "only when the purpose for their decisions is clearly religious."[234]

The second part of the test identifies religion with a *comprehensive* belief system "'as opposed to an isolated teaching.'"[235] Design theory does not offer a theory of morality or metaphysics, or an opinion on the prospects for an afterlife.[236] It requires neither a belief in divine revelation nor a code of conduct; nor does it purport to uncover the underlying meaning of the universe or to confer esoteric knowledge upon its adherents.[237] It is simply a theory about the source of the appearance of design in living organisms.[238] It is a clear example of an "isolated teaching," one that has no logically necessary connections to any spiritual dogma or church institution. Design theory has no religious pretensions. It merely tries to apply a well-established scientific method to the analysis of biological phenomena.

The third part of the test concerns the "'presence of certain formal and external signs.'"[239] The court provided a list of such signs, including liturgy, clergy, and observance of holidays.[240] Obviously, design theory has none of these—no sacred texts; no ordained ministers, priests, or religious teachers; no design theory liturgies; no design theory holidays; and no institutional structures like those of religious groups. Design theorists have formed

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[231]*See* Stephen C. Meyer, *Return of the God Hypothesis*, 9 J. INTERDISC. STUD. 1 *passim* (1999).

[232]482 U.S. 578 (1987).

[233]Edwards v. Aguillard, 482 U.S. 578, 605 (1986) (Powell, J., concurring) (quoting McGowan v. Maryland, 366 U.S. 420, 442 (1961)).

[234]*Id*. (Powell, J., concurring).

[235]*Alvarado*, 94 F.3d at 1229 (quoting *Africa*, 662 F.2d at 1032).

[236]*See supra* notes 63–75 and accompanying text.

[237]*See id.*

[238]*See id.*

[239]*Id*. (quoting *Africa*, 662 F.2d at 1032).

[240]*See id.*

organizations and institutes,[241] but these resemble other academic or professional associations rather than churches or religious institutions.

C. Do Religious Implications Turn a Theory Into Religion?

According to the Ninth Circuit's three-part test, design theory should not be classified as religion. To say that, however, does not suggest that evidence for design has no religious or metaphysical *implications*. Design theory argues that a designing intelligence is responsible for the "irreducibly complex"[242] and "information-rich" structures in biological organisms.[243] Students who believe in a creator God may, therefore, find support for their faith from the evidence that supports design theory and may identify the designing intelligence allegedly responsible for biological complexity with the God of their religious belief. Alternatively, students with no religious convictions may find that evidence of design leads them to ask theological questions and to inquire into the identity of such a designing intelligence.

This potential for metaphysical extrapolation, however, does not make design theory a religious doctrine. Nor is this potential unique to design theory. Darwinism, and other materialistic origins theories, have a similar potential. Indeed, non-religious students may find support for agnostic or materialistic metaphysical beliefs in Darwinian theory. Similarly, a religious student might find a materialistic world view more plausible as a result of a scientific study of Darwinism. Darwinism, which holds that life evolved *via* an undirected natural process,[244] implies that common religious beliefs about the origin of life and the nature of human life are, if not false, then implausible. Indeed, a host of prominent neo-Darwinian scientists—from Douglas Futuyma[245] to William Provine[246] to Stephen Jay Gould[247]—have insisted that Darwinism has made traditional beliefs about God and humanity either untenable or less plausible. Consider the following statements by Gould:

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[241]*See, e.g.*, Center for the Renewal of Science & Culture, The Discovery Institute (visited Apr. 21, 2000) <http:\\www.discovery.org/crsc> (proposing alternatives to materialism); The Michael Polanyi Center (visited Apr. 21, 2000) <<http://www.Baylor.edu~polanyi> (covering design-theoretic concepts).

[242]*See* BEHE, *supra* note 13, at 203.

[243]*See* Meyer, *DNA By Design*, *supra* note 56.

[244]*See supra* notes 30–32 and accompanying text.

[245]*See* DOUGLAS J. FUTUYMA, EVOLUTIONARY BIOLOGY 5 (3d ed. 1998).

[246]*See* William Provine, *Evolution and the Foundation of Ethics*, 3 MBL SCIENCE 25, 26 (1988) ("The implications of modern evolutionary biology are inescapable . . . . [E]volutionary biology undermines the fundamental assumptions underlying ethical systems in almost all cultures, Western civilization in particular.").

[247]*See* STEPHEN JAY GOULD, EVER SINCE DARWIN 147 (1977).

- "[B]iology took away our status as paragons created in the image of God. . . .[248]

- "Before Darwin, we thought that a benevolent God had created us."[249]

- "[W]hy do humans exist? . . . I do not think that any 'higher' answer can be given . . . . We are the offspring of history, and must establish our own paths in this most diverse and interesting of conceivable universes—one indifferent to our suffering, and therefore offering us maximal freedom to thrive, or to fail, in our own chosen way."[250]

Contrary to the popular *just-the-facts* stereotype of science, many scientific theories have larger ideological and religious implications.[251] Origins theories, in particular, raise unavoidable philosophical and religious considerations. Theories about where the universe, life, and humanity came from invariably affect our perspectives about human nature, morality, and ultimate reality. As the preceding quotations have made clear, neo-Darwinian evolutionary theory has implications for such questions.

Darwinism (in both its classical and contemporary versions) insists that living systems organized themselves into increasingly complex structures without assistance from a guiding intelligence.[252] Chemical evolutionary theorists likewise insist that the first life arose, without direction, from brute chemistry.[253] The Oxford zoologist Richard Dawkins has dubbed this the

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[248]*Id.*

[249]*Id.* at 267.

[250]STEPHEN JAY GOULD, WONDERFUL LIFE 323 (1989).

[251]One example is the debate over the most effective polio vaccine—the one developed by Jonas Salk or the one developed by Albert Sabin. The debate over superiority was not only about science, but involved controversies over the rights of individual patients versus public health and the proper role of doctors in public policy debates. *See generally* Reyes v. Wyeth Lab., 498 F.2d 1264, 1294–95 (5th Cir. 1974) (holding that marketers of oral polio vaccine may be liable when they failed to warn parents that treatment was necessary); Theodore H. Davis, Jr. & Catherine B. Bowman, *No-Fault Compensation for Unavoidable Injuries: Evaluating the National Childhood Vaccine Injury Compensation Program*, 16 U. DAYTON L. REV. 277, 281–85 (1991) (examining the efficacy of the National Childhood Vaccine Injury Compensation program to compensate victims of mandatory childhood vaccine programs while protecting vaccine manufacturers from liability). Other examples could be easily multiplied, such as the issues of global warming, the effect of electromagnetic radiation on health, and the risks associated with cellular telephones or breast implants.

[252]*See* Ayala, *supra* note 7, at 4–5.

[253]*See* KENYON & STEINMAN, *supra* note 95, at 6.

"blind watchmaker" thesis.[254] He, and other leading evolutionary theorists, claim that biological evidence overwhelmingly supports this purposeless and fully materialistic account of creation.[255] Thus George Gaylord Simpson, the leading neo-Darwinist a generation ago, could claim: "Man is the result of a *purposeless* and materialistic process that did not have him in mind. He was not planned."[256]

Accordingly, many major biology texts present evolution as a process in which a purposeful intelligence (such as God) plays no detectable role. As Miller and Levine explain, the evolutionary process is "random and undirected" and occurs "without plan or purpose."[257] Some texts even state that Darwin's theory has profoundly negative implications for theism, and especially for its belief in the purposeful design of nature. As Douglas Futuyma's biology text explains: "By coupling undirected, purposeless variation to the blind, uncaring process of natural selection, Darwin made theological or spiritual explanations of the life processes superfluous."[258]

Nevertheless, the content of a scientific theory, and not its implications, determines its legal status in public school science classrooms. Otherwise, the anti-theistic implications of neo-Darwinism (as articulated by some of its chief advocates) would disqualify it from inclusion in the curriculum. As Justice Hugo Black once asked, "[I]f the theory [of evolution] is considered anti-religious, as the Court indicates, how can the State be bound by the Federal Constitution to permit its teachers to advocate such an 'anti-religious' doctrine to schoolchildren?"[259] Of course, Justice Black's question was purely hypothetical, since he did not advocate actually forbidding teachers to teach about Darwinian evolutionary theory.[260] Indeed, such an outcome would be unthinkable. Yet, if the religious (or anti-religious) implications, rather than the specific propositional content, of theories were at issue, then arguably neither Darwinian theory nor design theory could pass constitutional muster. However, this result would not only undercut science education, but it would also violate constitutional precedents. One of the few fixed points in Establishment Clause jurisprudence during the last half-

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[254]*See* RICHARD DAWKINS, THE BLIND WATCHMAKER 5 (1996).

[255]*See id.* at 1–6.

[256]GEORGE GAYLORD SIMPSON, THE MEANING OF EVOLUTION 344 (rev. ed. 1967) (emphasis added).

[257]KENNETH R. MILLER & JOSEPH LEVINE, BIOLOGY 658 (4th ed. 1998).

[258]DOUGLAS J. FUTUYMA, EVOLUTIONARY BIOLOGY 5 (3d ed. 1997).

[259]Epperson v. Arkansas, 393 U.S. 97, 113 (1968) (Black, J., concurring).

[260]*See id.* at 109–14 (Black, J., concurring).

century has been that incidental harmonies with religious beliefs do not disqualify secular concepts under the First Amendment.[261]

D. Extending Edwards v. Aguillard *to Cover Design Theory?*

Many critics may concede that general legal definitions of religion (such as the 9th Circuit test) cannot establish design as a religion for legal purposes. Nevertheless, they would classify design theory as religion on different grounds. Rather than applying a general definition of religion as a legal test, these critics[262] have equated design theory with religion by claiming that the issue is controlled by the Court's holding in *Edwards v. Aguillard*.[263]

In the early 1980s, creationists in Louisiana sought to introduce scientific creationism into the Louisiana public school system. As a result, the Louisiana Legislature passed a law titled the "Balanced Treatment for Creation-Science and Evolution-Science in Public School Instruction (the "Act").[264] The Act did not require teaching either creationism or evolution, but did require that when one theory was taught, the other must be taught as well.[265]

Several parents and concerned citizens challenged the constitutionality of the Act in federal court.[266] They argued that the Act violated the First Amendment's Establishment Clause, which prohibits the government from officially endorsing a religious belief.[267] The State responded that the Act did not violate the First Amendment because it had the legitimate secular purpose of strengthening and broadening the academic freedom of teachers.[268] The district court and the Court of Appeals for the Fifth Circuit, however, found

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[261]*See* Edwards v. Aguillard, 482 U.S. 578, 605 (1987) (Powell, J., concurring) (arguing that subject matter taught in school does not violate Establishment Clause simply "because the material to be taught 'happens to coincide or harmonize with the tenets of some or all religions.'") (quoting McGowan v. Maryland, 366 U.S. 420, 442 (1961)). The language from *McGowan* has been cited with approval in numerous subsequent Supreme Court decisions. *See* Hernandez v. Commissioner, 490 U.S. 680, 696 (1989); Lynch v. Donnelly, 465 U.S. 668, 682 (1984); Bob Jones Univ. v. United States, 461 U.S. 574, 604 n.30 (1983); Harris v. McRae, 448 U.S. 297, 319 (1980); School Dist. v. Schempp, 374 U.S. 203, 303 (1963) (Brennan, J., concurring).

[262]482 U.S. 579 (1987).

[263]*See* Wexler, *supra* note 189, at 455–66.

[264]LA. REV. STAT. ANN. §§ 17:286.1–7 (West 1982).

[265]*See id.* §§ 17286.3-4.

[266]*See Edwards*, 482 U.S. at 581.

[267]*See id.* at 581–582.

[268]*See id.* at 581.

that the State's actual purpose was to promote the religious doctrine of creationism (known also as creation science).[269]

The Court, in a majority opinion written by Justice Brennan, ruled that the Act constituted an unconstitutional infringement on the Establishment Clause of the First Amendment,[270] based on the *Lemon* test.[271] This test, which was first enunciated by the Court in *Lemon v. Kurtzman*,[272] consists of three prongs:

> (1) The government's action must have a secular purpose;
> (2) The government's action must not have the primary effect of either advancing or inhibiting religion; and
> (3) The government's action must not result in an "excessive entanglement" of the government and religion.[273]

If government action or legislation violates any of these three prongs, it will be deemed unconstitutional under the Establishment Clause.[274] The first of these prongs has become known as the "purpose prong."[275] The Court found that the Act violated the purpose prong and was, therefore, unconstitutional for several reasons.[276] First, since the legislative history of the Act constantly referenced the religious views of the legislators, the Court became suspicious of the State's claim that the Act's purpose was to advance academic freedom.[277] Second, the Court found that the intent of the legislator who drafted the Act was to narrow the science curriculum in order to favor a particular religious belief (i.e., the creation account as found in the book of Genesis).[278] In support of this finding the Court noted that the Act's sponsor

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[269]*See id.* at 582.

[270]*See id.*

[271]*See id.* at 582–94.

[272]403 U.S. 602 (1971). Although the *Lemon* test has received scholarly criticism and has been qualified by the Court, see Lynch v. Donnelly, 465 U.S. 668, 679 (1984), the Court continues to rely on the test's general framework. *See* Robert A. Sedler, *Understanding the Establishment Clause: The Perspective of Constitutional Litigation*, 43 WAYNE L. REV. 1317, 1323 (1997). Two exceptions are Marsh v. Chambers, 463 U.S. 783 (1983) and Rosenberger v. Rector and Visitors of the University of Virginia, 515 U.S. 819 (1995). Neither of these cases, however, deals with the teachings of origins in public schools.

[273]*Lemon*, 403 U.S. at 612–613.

[274]*See Edwards*, 482 U.S. at 583.

[275]*Id.* at 585 (quoting Lynch v. Donnelly, 465 U.S. 668, 690 (1984) (O'Connor, J., concurring)).

[276]*See id.* at 591–93. Because the Act violated the first prong, the Court did not address whether the Act also violated the second or third prongs. *See id.*.

[277]*See id.*

[278]*See id.* at 587.

actually preferred that "neither [creationism nor evolution] be taught."[279] The Court, therefore, concluded that the purpose of the Act was to limit, rather than promote, academic freedom and science education.[280]

The Court also found that the Act did not grant teachers any new "flexibility [in teaching science] that they did not already possess."[281] The Court noted that no Louisiana law barred the teaching of any scientific theory about biological origins.[282] Since teachers were already free to teach scientific alternatives to Darwinian evolution, the Court reasoned that the Act did not expand the academic freedom already enjoyed by teachers in Louisiana.[283]

Having rejected the State's proffered reason for the Act, the Court then uncovered what it regarded as the true intent of the Louisiana law: the promotion of a particular religious view. The Court found that the Act had a "discriminatory preference" for the teaching of creationism because it required the production of curriculum guides for creationism.[284] Further, it found that only creationism was protected by certain sections of the Act, and that the Act undercut truly comprehensive science instruction by limiting the theories of origins that teachers could teach to just two: evolution and creationism.[285]

In deciding against the Act, the Court was careful to point out that its decision in no way excluded the teaching of other scientific theories about biological origins.[286] Likewise, the Court left the door open to scientific critiques of Darwinian evolution.[287] In an illuminating section of the majority opinion, the Court even stated that teaching a variety of scientific theories about origins "might be validly done with the clear secular intent of enhancing the effectiveness of science instruction."[288] However, the Court could not discern such an intent in the legislative history of Act. Instead, it determined that the primary purpose of the Act was to promote a particular religious doctrine, thereby violating the Establishment Clause.[289]

Many have assumed that the reasoning in *Edwards* can be extended to cover curricular debates about the admissibility of teaching about design

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[279]*Id*. (alteration in original).
[280]*See id.* at 587–89.
[281]*Id.* at 587.
[282]*See id.*
[283]*See id.*
[284]*See id*. at 588.
[285]*See id*. at 588–89.
[286]*See id.* at 594.
[287]*See id*. at 593.
[288]*Id*. at 594.
[289]*See id.* at 593.

theory. Indeed, many have argued that the theory of intelligent design and creation science are effectively indistinguishable for both scientific and legal purposes.[290] Since the court in *Edwards* ruled that creation science promoted a religious viewpoint, many have concluded that teaching public school students about design theory also illicitly promotes a religious viewpoint in the public schools.[291]

E. The Legal Differences Between Creation Science and Design Theory

Despite claims to the contrary, design theory and scientific creationism differ in propositional content, method of inquiry, and, thus, in legal status. Recall that in *Edwards v. Aguillard*[292] the Court decided against the legality of scientific creationism because it constituted an advancement of religion.[293] The Court reached this decision in large part because the propositional content of scientific creationism closely mirrors the creation narrative in the book of Genesis.[294] While philosophers of science now agree that the *scientific* status of an idea does not depend upon its source, the Court seems to have assumed that the *legal* status of an idea—and therefore the legal status of any curriculum based on that idea—does depend on its source. Thus, given the Court's reasoning in *Edwards*, the teaching of "creation science" remains legally problematic.

Nevertheless, the Court's decision does not apply to design theory because design theory is not based upon a religious text or doctrine. Design theory begins with the data that scientists observe in the laboratory and nature, and attempts to explain such data based on what we know about the patterns that generally indicate intelligent causes. For design theorists, the conclusion of design constitutes an inference from biological data, not a deduction from religious authority.

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[290]*See* THE NATIONAL ACADEMY OF SCIENCES, SCIENCE AND CREATIONISM: A VIEW FROM THE NATIONAL ACADEMY OF SCIENCES 7 (2d ed. 1999); Scott, Testimony before U.S. Commission on Civil Rights, *supra* note 63 ("I see [intelligent design theory] as a synonym for creation science.").

[291]*See* Wexler, *supra* note 189.

[292]482 U.S. 579 (1987).

[293]*See id.* at 596.

[294]*See id.* at 603–04; *see also* McLean v. Arkansas Bd. of Educ., 529 F. Supp. 1255, 1264–1265 (E.D. Ark. 1982) ("The evidence establishes that the definition of 'creation science' . . . has as its unmentioned reference the first 11 chapters of the Book of Genesis. Among the many creation epics in human history, the account of sudden creation from nothing, or *creatio ex nihilo*, and subsequent destruction of the world by flood is unique to Genesis.").

Furthermore, the propositional content of design theory differs significantly from that of scientific creationism. Scientific creationism is committed to the following propositions:

> (1) There was a sudden creation of the universe, energy, and life from nothing.
> (2) Mutations and natural selection are insufficient to bring about the development of all living kinds from a single organism.
> (3) Changes in the originally created kinds of plants and animals occur only within fixed limits.
> (4) There is a separate ancestry for humans and apes.
> (5) The earth's geology can be explained via catastrophism, primarily by the occurrence of a worldwide flood.
> (6) The earth and living kinds had a relatively recent origin (on the order of ten thousand years ago).[295]

These six tenets taken jointly define scientific creationism for legal purposes. The Court in *Edwards* ruled that, taken jointly, this group of propositions may not be taught in public school science classrooms—at least not where they are animated by the religious purpose of the Louisiana Legislature.[296] Nevertheless, the Court left the door open to some of these tenets being discussed individually.[297]

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[295]*See* Numbers, The Creationists, x.

[296]*See Edwards*, 482 U.S. at 594 (1987) (noting that "a variety of . . . theories . . . might be validly [taught] with the clear secular intent of enhancing . . . instruction. But because the primary purpose of the . . . Act is to endorse a particular religious doctrine," it advances religion in violation of Establishment Clause).

[297]*See id.* Indeed, the Court recognized that some of these individual tenets may form legitimate topics for scientific discussion, and thus could be included in a valid public school science curriculum. For example, in reference to tenet (3), scientists have increasingly debated whether or not there are limits to morphological change among biological organisms. *See supra* note 47. According to the neo-Darwinian synthesis there are no limits whatsoever: all organisms trace their ancestry back to an original single-celled organism. *Id.* This view is called "monophyly" or "common descent" and contrasts with "polyphyly," the view that some groups of organisms have separate ancestries. Some scientists now cite evidence from the fossil record, molecular sequence analyses, and developmental biology to support this latter view. STUART A. KAUFFMAN, THE ORIGINS OF ORDER (1993); PAUL A. NELSON, ON COMMON DESCENT (forthcoming 2000); Malcolm S. Gordon, *The Concept of Monophyly: A Speculative Essay*, 14 BIOLOGY & PHILOSOPHY 331, 331–48 (1999); Christian Schwabe, *Theoretical Limitations of Molecular Phylogenetics and the Evolution of Relaxins*, 107B COMP. BIOCHEMISTRY & PHYSIOLOGY 167, 167–77 (1994); G. Webster & Brian Goodwin, *The Origin of Species: A Structuralist Approach*, 5 J. SOC. & BIOLOGICAL STRUCTURES 15, 15–47 (1982); Carl Woese, *The Universal Ancestor*, 95 Proc. Nat. Acad. Ser. USA 6854, 6854–59 (1998). Similarly, many scientists have expressed increasing

Design theory, on the other hand, asserts the following:

> (1) High information content[298] (or specified complexity) and irreducible complexity[299] constitute strong indicators or hallmarks of past intelligent design.
> (2) Biological systems have a high information content (or specified complexity) and utilize subsystems that manifest irreducible complexity.[300]
> (3) Naturalistic mechanisms or undirected causes do not suffice to explain the origin of information (specified complexity) or irreducible complexity.[301]
> (4) Therefore, intelligent design constitutes the best explanation for the origin of information and irreducible complexity in biological systems.[302]

A comparison of these two lists demonstrates clearly that design theory and scientific creationism differ markedly in content. Clearly, then, they do not derive from the same source. Thus, the Court's ruling in *Edwards* does not apply to design theory and can provide no grounds for excluding discussion of intelligent design from the public school science curriculum.

F. A Residual Lemon *Objection*

Some might acknowledge these differences and still claim that teaching about design theory constitutes an advancement of religion. For example, it could be argued that the theory of intelligent design suffers from its own

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skepticism about the sufficiency of the neo-Darwinian mechanisms of mutation and natural selection. BERNARD JOHN & GEORGE L. GABOR MIKLOS, THE EUKARYOTE GENOME IN DEVELOPMENT AND EVOLUTION (1988); RUDOLF A. RAFF, THE SHAPE OF LIFE (1996); G.L.G. Miklos & K.S.W. Campbell, *From Protein Domains to Extinct Phyla: Reverse-Engineering Approaches to the Evolution of Biological Complexities*, *in* EARLY LIFE ON EARTH, NOBEL SYMPOSIUM NO. 84, 501–16 (Stefan Bengtson ed. 1993).

Many science teachers will want to discuss these scientific developments with their students.

[298]*See* DEMBSKI, *supra* note 69, at 1–35.

[299]*See* BEHE, *supra* note 13, at 39–45.

[300]*See* HUBERT P. YOCKEY, INFORMATION THEORY AND MOLECULAR BIOLOGY 334 (1992); WERNER R. LOEWENSTEIN, THE TOUCHSTONE OF LIFE 15 (1999); Meyer, *DNA by Design*, *supra* note 56, at 519–56; Meyer, *Explanatory Power*, *supra* note 56, at 113–47; THAXTON ET AL., *supra* note 52, at 127–65, 188–215.

[301]*See supra* note 56 (discussing three explanations of origins of specified complexity).

[302]*See* Meyer, *DNA by Design*, *supra* note 56, at 519–56; Meyer, *Explanatory Power*, *supra* note 56, at 113–47; BEHE, *supra* note 13, at 252; Thaxton & Bradley, *supra* note 56, at 173–210.

inability to meet the *Lemon* test, which was the basis of the Court's decision in *Edwards*. Just as the Balanced Treatment Act advocating the teaching of creation science failed to meet the *Lemon* test because the Court found that it expressed a religious and not a secular purpose, one might argue that teaching about design theory would run afoul of the *Lemon* test because advocates for its inclusion in the curriculum have religious, rather than secular, reasons for promoting it. Indeed, as noted above, many advocates of contemporary design theory openly acknowledge that evidence for design in nature may have theistic implications.[303] Some also see Darwinian evolution as an implicit challenge to a theistic worldview.[304] Viewing the issue as they do, some advocates for the inclusion of design theory in the curriculum, including teachers, school board members, or parents, may view teaching about the theory of intelligent design as a means of defending, or even promoting, their theistic beliefs.[305] Thus, one might argue that such religiously-motivated advocacy disqualifies design theory from consideration in the curriculum under the first prong of the *Lemon* test.

Nevertheless, even the presence of religiously-motivated advocacy for design theory in the curriculum does not warrant its exclusion under the first prong of the *Lemon* test for several reasons. First, the *Lemon* test does not require that advocates of a government action have *no* religious motivations, only that a government action itself embodies *some* secular purpose.[306] Recall that the majority in *Edwards* rejected the proffered secular purpose of the legislature—the claim that the Balanced Treatment Act (the "Act") sought to promote academic freedom.[307] It found this claim implausible on the grounds that teachers already had the academic freedom to teach alternative scientific viewpoints.[308] Failing to find a plausible secular purpose for the Act, the Court concluded that the sole motivation of those advocating the Act must have been to advance a religious viewpoint.[309] By contrast, in the hypothetical we have posed, John Spokes wants to improve science education and to expose his students to the full range of opinion that exists among scientists about

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[303]*See* Stephen C. Meyer, *The Return of the God Hypothesis*, 11 J. INTERDISC. STUD. 1, 1–38 (1999).

[304]*See* Phillip E. Johnson, Darwinism and Theism, *in* Darwinism: Science or Philosophy 42, 42–50 (J. Buell & G. Hearn eds., 1994).

[305]*See* Brendan Sweetman, *Darwin vs. "Intelligent Design" Three Views on the Kansas Controversy Over Teaching Evolution in Public Schools: What Evolution Tries to Explain, And What It Leaves Unanswered*, THE KANSAS CITY STAR, Aug. 22, 1999, at L1.

[306]*See Lemon*, 403 U.S. at 612.

[307]*See Edwards*, 482 U.S. at 581–82.

[308]*See id.* at 587.

[309]*See id.* at 589.

biological origins. Thus, his teaching is clearly motivated by a secular purpose. Moreover, even if Spokes had a religious as well as a scientific purpose for wanting to expose his students to the theory of intelligent design, or even if some of his supporters on the school board had such a purpose, his proposed pedagogy would still meet the first prong of the *Lemon* test. Again, the *Lemon* test does not require that a government action (such as teaching a public school science class) have *only* a secular purpose, but that it have *a* secular purpose.[310] Insofar as Spokes seeks to inform his students about a variety of scientific interpretations of existing biological data, or to enhance his students' critical thinking skills, or to expose students to the method of multiple competing hypotheses in the historical sciences, his pedagogy clearly embodies a secular purpose.

Second, since the *Edwards* decision, the constitutional standard for deciding the permissibility of religiously-motivated speech has changed. In *Rosenberger v. Rector and Visitors of the Univ. of Virginia*,[311] the Court permitted an evangelical Christian student publication group to receive state funds for an expressly religious publication, despite the claim that such funding would violate the Establishment Clause.[312] Since other student groups had received state funds for promoting their viewpoints, the Court found that the exclusion of a religious viewpoint because of its content would constitute viewpoint discrimination.[313] Indeed, the Court struck down the university's refusal to fund the religious group as a violation of the First Amendment's guarantee of viewpoint neutrality.[314]

Yet if the Court has ruled that the constitution allows funding religiously-motivated speech—indeed speech of an explicitly religious character—in order to prevent viewpoint discrimination, then clearly the constitution must permit other forms of religiously-motivated expression, especially those forms of expression that address scientific evidence and are (at most) only religious in their implications. Thus, a teacher or school board that chooses to include presentations about design theory in the curriculum in order to prevent an imbalance in the presentation of scientific perspectives on biological origins, would enact a secular purpose every bit as compelling as the one the state university was required to demonstrate in *Rosenberger*.[315]

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[310]*See Lemon*, 403 U.S. at 612.

[311]515 U.S. 819 (1995) (plurality opinion).

[312]*See id.* at 845–46.

[313]*See id.* at 829.

[314]*See id.* at 845–46; *see also infra* Part VII.A. (discussing *Rosenberger* decision).

[315]Some would no doubt argue that there is no comparable constitutional protection for religious viewpoints in the public high school environment. On the contrary, the Court has extended the principle of viewpoint neutrality to cover religious speech in the public

In any case, no constitutional test has established design theory as a religious viewpoint, much less an establishment of religion. Nor, strictly speaking, can the *Lemon* test make such determinations. Instead, the courts use the *Lemon* test to determine when a government action involving religion constitutes an unacceptable advancement of that religion.[316] In *Edwards*, the Court simply assumed that creation science constituted a religious belief because of its resemblance to the creation narrative in the Book of Genesis, and then sought to determine whether the Louisiana Balanced Treatment Act constituted an illicit advancement of that religious belief.[317] Yet, as argued above, similar grounds do not exist for classifying design theory as a religious belief. Indeed, given its basis in scientific evidence, and its failure to meet other legal criteria of religion, such as those articulated in the 9th Circuit test, every presumption militates against such an identification.

G. Back to Spokes

Spokes need not worry about a legal challenge to his decision to expose students to scientific criticism of Darwinian evolution. As the Court's ruling in *Edwards* made explicit, exposing students to critiques of Darwinian theory does not constitute an advancement of religion.[318] Indeed, the refusal to permit any criticism of Darwinism resembles nothing so much as an enshrinement of the very "orthodoxy" that Justice Jackson once declared inconsistent with our constitution.[319]

Spokes should also have no compunctions about what might seem a more controversial action, namely, his teaching students about alternatives to

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high schools. *See* Westside Community Bd. of Educ. v. Mergens, 496 U.S. 226, 249 (1990) (holding Equal Access Act, which requires student religious clubs to receive same treatment as secular clubs, meets first prong of *Lemon* test: "Congress' avowed purpose—to prevent discrimination against religious and other types of speech—is undeniably secular").

[316]*See* Doe v. County of Montgomery, Ill., 915 F. Supp. 32, 35 (C.D. Ill. 1996) (stating that "[b]efore the Court analyzes the [offending practice] under the *Lemon* test, however, the Court first must determine whether there is even an issue of religion"); Fleischfresser v. Directors of Sch. Dist. 200, 15 F.3d 680, 687 (7th Cir. 1994).

[317]See *Edwards*, 482 U.S. at 591–94.

[318]*See id.* at 590–91 (1987).

[319]*See* West Virginia Bd. of Educ. v. Barnette, 319 U.S. 624, 642 (1943) ("If there is any fixed star in our constitutional constellation, it is that no official, high or petty, can prescribe what shall be orthodox in politics, nationalism, religion, or other matters of opinion or force citizens to confess by word or act their faith therein.").

Darwinism,[320] including the theory of intelligent design. Given the larger theistic implications of design, Spokes might fear censure under the Establishment Clause. Yet if Spokes' actions advance the secular purpose of improving science education, then whatever support design theory might provide to religious belief does not compromise its legal status. In any case, as a good science teacher Spokes can encourage students not to limit consideration of the scientific evidence based on their metaphysical presuppositions, whether theological or naturalistic.[321] If a student raises the metaphysical implications of a theory as an argument for or against its acceptance, then Spokes can encourage students to address the evidential merits of the competing theories.[322] On the other hand, to deny discussion of an important scientific

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[320]Of course, it would still be objectionable to present a religious theory as such. Although critics of teaching alternatives to Darwin frequently suggest that teaching anything other than Darwinism would require that "all creation stories" be taught, this is a misleading argument. Many myths about the origin of the world, such as the Coyote myth prominent in Native American religions, make no claim to be scientific. *See, e.g.*, Robert W. Lannan, *Anthropology and Restless Spirits: The Native American Graves Protection and Repatriation Act, and the Unresolved Issues of Prehistoric Human Remains*, 22 HARV. ENVTL. L. REV. 369, 386 (1998) (describing Nez Perce account of "the origins of people in North America" as one where coyote cuts "huge" monster up with knife, then creates various Indian tribes from former monster). While such stories can be taught in other courses in the curriculum, such as literature or social studies, they should not be taught in a class concerned with efforts to identify scientific theories regarding the origins issue.

[321]Astonishingly, those who claim that design theory is merely religion disguised as science do not hesitate to enlist religion when it suits their purposes. Eugenie Scott, Director of the National Center for Science Education and one of the most frequent champions of a Darwin-only presentation, has suggested that biology teachers invite their students to survey community religious leaders:

> A teacher in Minnesota told me that he had good luck sending his students out at the beginning of the semester to interview their pastors and priests about evolution. They came back somewhat astonished, "Hey! Evolution is OK!" Even when there was diversity in opinion, with some religious leaders accepting evolution as compatible with their theology and others rejecting it, it was educational for the students to find out for themselves that there was no single Christian perspective on evolution. The survey-of-ministers approach may not work if the community is religiously homogeneous, especially if that homogeneity is conservative Christian, but it is something that some teachers might consider as a way of getting students' fingers out of their ears.

Eugenie C. Scott, *Dealing with Anti-evolutionism*, REPORTS OF THE NATIONAL CENTER FOR SCIENCE EDUCATION (visited Mar. 6, 2000) <http://www.natcenscied.org/deal174.htm>.

[322]To be sure, in this era of interdisciplinary studies, where biology textbooks frequently connect the social implications of biology for environmental or ecological issues, it seems a little strange to treat the metaphysical implications of the origins issues as though they were taboo in the science class. However, the point to be emphasized is not that the questions are unimportant or inappropriate, but rather that the methodology of science proceeds from evidence to conclusions, whereas the methodology of a social studies class

issue because it causes metaphysical discomfort to some would in effect grant a heckler's veto. The Court has refused to do this.[323] In his biology class Spokes can present his students with multiple competing hypotheses, such as classical Darwinism, the neo-Darwinist synthesis, punctuated equilibrium, and design theory. By allowing students to evaluate the evidential merits of each theory, Spokes eschews indoctrination in favor of liberal education. Given the metaphysical implications in play, such a pedagogy more closely honors the intent of the Establishment Clause than the one-sided and dogmatic mode of presentation demanded by the National Center for Science Education and the National Academy of Sciences.[324]

VII. IS IT SPEECH? DESIGN THEORY AND VIEWPOINT DISCRIMINATION

Suppose the administrators and school board members, after listening to Spokes' presentation, decide to endorse Spokes's curricular changes, including his decision to teach students about the scientific case for design. Would they face legal exposure for doing so? Given the controversy associated with these issues, and the widespread (if erroneous) belief that all non-materialistic alternatives to Darwinism (such as design theory) constitute religion, many school boards might assume that they should permit teachers to teach only about Darwinism and forbid any discussion of alternative theories, especially design theory. Indeed, given widespread misconceptions about the bearing of the Establishment Clause on the biology curriculum, school boards and administrators might assume that restricting teachers in this way represents the safest course legally. However, the law not only permits Spokes to present alternatives, but it now forbids publicly funded viewpoint discrimination, with certain exceptions that do not apply to this controversy. Moreover, recent cases have provided a strong reaffirmation of the primary responsibility and authority reposed in school boards to decide upon their own curriculum:

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permits the assertion of values or human intuition as the starting point for discussion. Thus, the student's argument that naturalistic evolution is true (or untrue) because it matches (or conflicts with) the student's fundamental intuitions about human nature is appropriate in a philosophy or social studies class, but not to a science classroom where theories are judged according to their ability to explain evidence.

[323]*See* Reno v. American Civil Liberties Union, 521 U.S. 844 (1997) (striking internet restrictions as violating First Amendment).

[324]As noted earlier, one prominent Darwinist has suggested precisely the kind of balanced approach that is advocated in this article. *See* Provine, *supra* note 64 and accompanying text.

> Someone must fix the curriculum of any school, public or private. In the case of a public school, in our opinion, it is far better public policy, absent a valid statutory directive on the subject, that the makeup of the curriculum be entrusted to the local school authorities who are in some sense responsible, rather than to the teachers, who would be responsible only to the judges, had they a First Amendment right to participate in the makeup of the curriculum.[325]

Thus, if a teacher (with the school board's support) elects to broaden the curriculum , the law not only allows, but encourages, such a course of action.

A more difficult case might arise if a teacher wants to broaden his curriculum as Spokes has decided to do, but his school board or administration opposes his pedagogy. Here the authority of the school board to decide curriculum collides with the academic freedom of the teacher. What does the law, and particularly the recent rulings about viewpoint discrimination, have to say in such situations? Do Spokes's proposed changes constitute legally protected speech, or does the authority of the school board trump Spokes's academic freedom?

Several precedents suggest that Spokes's changes do constitute legally protected speech and that even the legitimate rights of school boards to set curricular guidelines do not supersede Spokes's academic freedom in this matter. As noted, the law has strongly affirmed the authority of school boards to establish the curricular guidelines in their school districts**.** Nevertheless, that authority is not unlimited. As the Court said in *Tinker v. Des Moines Independent Community School District*:[326]

> First Amendment rights, applied in light of the special characteristics of the school environment, are available to teachers and students. It can hardly be argued that either students or teachers shed their constitutional rights to freedom of speech or expression at the schoolhouse gate. This has been the unmistakable holding of this Court for almost 50 years.[327]

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[325]Boring v. Buncombe County Bd. of Educ., 136 F.3d 364, 371 (4th Cir. 1998).
[326]393 U.S. 503 (1969).
[327]*Id.* at 506. Later in the opinion the Court stated:

> The District Court concluded that the action of the school authorities was reasonable because it was based upon their fear of a disturbance from the wearing of the armbands. But, in our system, undifferentiated fear or apprehension of disturbance is not enough to overcome the right to freedom of expression. Any departure from absolute regimentation may cause trouble. Any variation from the majority's opinion may inspire fear. Any word spoken, in class, in the lunchroom, or on the campus, that deviates from the views of another person may start an argument or cause a disturbance. But our Constitution says we must take this risk . . . and our history says that it is this

Indeed, addressing a situation in which a school board claimed the unfettered right to determine the content of a school library, the Court made the following comments:

> Petitioners [the school board] rightly possess significant discretion to determine the content of their school libraries. But that discretion may not be exercised in a narrowly partisan or political manner. If a Democratic school board, motivated by party affiliation, ordered the removal of all books written by or in favor of Republicans, few would doubt that the order violated the constitutional rights of the students denied access to those books. The same conclusion would surely apply if an all-white school board, motivated by racial animus, decided to remove all books authored by blacks or advocating racial equality and integration. Our Constitution does not permit the official suppression of *ideas*. Thus whether petitioners' removal of books from their school libraries denied respondents their First Amendment rights depends upon the motivation behind petitioners' actions. If petitioners *intended* by their removal decision to deny respondents access to ideas with which petitioners disagreed, and if this intent was the decisive factor in petitioners' [school board's] decision, then petitioners have exercised their discretion in violation of the Constitution. To permit such intentions to control official actions would be to encourage the precise sort of officially prescribed orthodoxy unequivocally condemned in *Barnette*.[328]

Such rulings suggest that school boards that allow teachers (or their libraries) to present only one side of a controversial issue expose themselves to risk of litigation, especially if their decision to do so is "intended . . . to deny . . . access to ideas with which [they] disagreed."[329]

> sort of hazardous freedom—this kind of openness—that is the basis of our national strength and of the independence and vigor of Americans who grow up and live in this relatively permissive, often disputatious, society.
>
> In order for the State in the person of school officials to justify prohibition of a particular expression of opinion, it must be able to show that its action was caused by something more than a mere desire to avoid the discomfort and unpleasantness that always accompany an unpopular viewpoint.

Id. at 508–09 (citation omitted).

[328]Board of Educ., Island Trees Union Free Sch. Dist. No. 26 v. Pico, 457 U.S. 853, 870-71 (1982).

[329]*Id.* at 871.

A. The Rosenberger *Revolution*

For many years, lawyers and others have assumed that the Establishment Clause, preventing state aid to religion, superseded the constitutional guarantees of free speech. Nevertheless, the United States Supreme Court has more recently emphasized that the First Amendment prohibits the government from regulating speech "based on its substantive content or the message it conveys,"[330] even where the content of the speech is religious.[331] Indeed, the Court has described this view of the First Amendment as "axiomatic."[332] The Court has strongly affirmed this principle in several opinions dealing with issues as diverse as civil rights meetings,[333] the funding of a religiously-based student publication at a public university,[334] and the use of a public school auditorium by a religious group to show a film.[335] These rulings bear significantly on deciding the relative priority of, and the relationship between, a school board's right to determine curriculum content and a teacher's right to academic freedom.

In the most recent case on viewpoint discrimination, *Rosenberger v. Rector and Visitors of the University of Virginia*,[336] the Supreme Court strongly reaffirmed its previous holdings and held that viewpoint discrimination arising from a misplaced fear of violating the Establishment Clause is itself unconstitutional.[337] Rosenberger, a student at a state university,

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[330]Rosenberger v. Rector and Visitors of the Univ. of Va., 515 U.S. 819, 828 (1995) (plurality opinion) (citing Police Dep't of Chicago v. Mosley, 408 U.S. 92, 96 (1972). *See also* City Council of Los Angeles v. Taxpayers for Vincent, 466 U.S. 789, 804 (1984) ("The general principle that has emerged from this line of cases is that the First Amendment forbids the government to regulate speech in a way that favors some viewpoints or ideas at the expense of others.") (citing Bolger v. Youngs Drug Prod. Corp., 463 U.S. 60, 65 (1983); Consolidated Edison Co. v. Public Serv. Comm'n, 447 U.S. 530, 535-36 (1980); Carey v. Brown, 447 U.S. 455, 462-63 (1980); Young v. American Mini Theatres, Inc. 427 U.S. 50, 63, 65, 67-68 (1976) (plurality opinion); *Mosely*, 408 U.S. at 95–96).

[331]*See* Rosenberger, 515 U.S. at 828 (plurality opinion) (citing Turner Broadcasting System, Inc. v. FCC, 512 U.S., 622, 641-643 (1994)); *see also* Lamb's Chapel v. Center Moriches Union Free Sch. Dist., 508 U.S. 384, 394 (1993) (allowing religious film to be shown on public property after school hours).

[332]*Rosenberger*, 515 U.S. at 828.

[333]*See* Cornelius v. NAACP Legal Defense and Educ. Fund, Inc., 473 U.S. 788 (1985)).

[334]*See Rosenberger*, 515 U.S. *passim*.

[335]*See Lamb's Chapel*, 508 U.S. at 394.

[336]515 U.S. 819 (1995) (plurality opinion).

[337]*See id*. at 839 ("More than once we have rejected the position that the Establishment Clause even justifies, much less requires, a refusal to extend free speech rights to religious speakers who participate in broad-reaching government programs neutral in design.") (citing

objected to the university's refusal to grant to his organization's newspaper the same financial subsidy that other campus organizations had received.[338] The university defended its policy by citing the newspaper's evangelical Christian perspective. The university held that any funding of the paper would endorse a religious viewpoint and would thus violate the Constitution.[339] The Supreme Court rejected this argument, holding that if a public institution opens a forum for free speech, it cannot then censor the forum based solely on the viewpoint of the speech expressed.[340]

The Court noted that viewpoint discrimination "is presumed to be unconstitutional."[341] Nevertheless, it argued, when the government itself targets speech simply because of its content "the violation of the First Amendment is all the more blatant."[342] Consequently, the Court found that the government must "abstain" from content-based speech restrictions when the "ideology or the opinion or perspective of the speaker is the rationale for the restriction."[343] The Court affirmed that the government may not engage in content-based suppression of speech even when the public forum where the speech occurs was created by the government in the first place.[344]

The Court's position allowed two exceptions. First, the government may control access to a nonpublic forum based "on subject matter and speaker identity" if the government's action is reasonable considering the forum's purpose and if the action is viewpoint neutral.[345] This means that the government can supress speech in a nonpublic forum if the speaker wants to discuss "a topic not encompassed within the purpose of the forum,"[346] or the speaker is outside of the special class for whom the forum was created.[347] Second, if the government is charged with viewpoint discrimination, it can

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Lamb's Chapel, 508 U.S. at 393–94; *Mergens*, 496 U.S. at 248, 252; Widmar v. Vincent, 454 U.S. 263, 274–75 (1981)).

[338]*See id*. at 827.

[339]*See id*. at 828.

[340]*See id.* at 829–30.

[341]*Id*. at 828.

[342]*Id*. at 829.

[343]*Id*. (citing Perry Educ. Ass'n v. Perry Local Educators' Ass'n, 460 U.S. 37, 46 (1983)).

[344]*See id*.; *see also Cornelius*, 473 U.S. at 806 (discussing government prohibition on speech content regulation in a nonpublic forum).

[345]*Cornelius*, 473 U.S at 806 (citing *Perry*, 460 U.S. at 49).

[346]*Id*. (citing Lehman v. City of Shaker Heights, 418 U.S. 298 (1974)).

[347]*See id.* (citing *Perry*, 460 U.S. at 49).

clear itself of that charge by showing that to permit the speech in question would violate the Establishment Clause.[348]

Neither of these exceptions applies to Spokes's plan to teach his students about design theory. The Court showed itself quite willing to grant wide latitude for even explicitly religious speech or viewpoints, in *Rosenberger*, when it articulated an Establishment Clause exception to the general prohibition against viewpoint discrimination.[349] If the Court had meant to include all religious speech within this exception, it clearly could not have reached the decision it did in *Rosenberger*. In any case, as already argued, teaching about design theory does not constitute an establishment of religion.

Moreover, the overwhelming majority of public schools (including presumably Spokes's) already address the subject of biological origins in their science curriculum. While the courts have limited the free speech rights of teachers in the public school context,[350] teachers do have the right to choose supplementary material that is appropriate to the subjects they have been mandated to teach. Likewise, students may certainly learn about current ideas relevant to the subjects they are studying.[351] Further, the Supreme Court has found that teachers, students, and parents have a "liberty interest" under the Fourteenth Amendment's Due Process Clause not to be prevented from studying certain subjects.[352] A critical aspect of this liberty interest is academic freedom. Academic freedom allows teachers to present appropriate material to their students without fear of censorship or retribution from the government. Teachers not only need academic freedom to teach effectively, but students need it to explore and develop new ideas. Without academic freedom, education becomes indoctrination.

The Supreme Court recognized this fundamental right to academic freedom in *Epperson v. Arkansas*.[353] In that case, the Court struck down an Arkansas statute that restricted the teachings of biological origins.[354] The statute prohibited, with criminal sanction, the teaching of the theory of evolution in the public schools of that state.[355] A teacher challenged the statute

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[348]*See Lamb's Chapel*, 508 U.S. at 394 (citing Widmar v. Vincent, 454 U.S. 263, 271 (1981)).

[349]*See Rosenberger*, 515 U.S. at 842.

[350]*See* Peloza v. Capistrano Unified Sch. Dist., 37 F.3d 517, 522 (9th Cir. 1994) (quoting *Tinker*, 393 U.S. at 506-07)).

[351]*See Tinker*, 393 U.S. at 512–13.

[352]*Id.* at 506–07.

[353]393 U.S. 97 (1968).

[354]*See id.* at 98.

[355]*See id.* at 98–99.

claiming that it violated her academic freedom.[356] The Supreme Court, in rejecting the Arkansas law as unconstitutional, strongly upheld the academic freedom of teachers in the public schools.[357]

The Court found that the First Amendment's guarantees apply to our school systems, where they are "essential to safeguard the fundamental values of freedom of speech and inquiry and of belief."[358] The Court made clear that "the First Amendment 'does not tolerate laws that cast a pall of orthodoxy over the classroom.'"[359] Most significantly, the Court found that the government's power to determine school curricula does not give it the power to prevent "the teaching of a scientific theory or doctrine where that prohibition is based upon reasons that violate the First Amendment."[360] The Court even went so far as to assert that "[i]t is much too late to argue that the State may impose upon the teachers in its schools any conditions that it chooses, however restrictive they may be of constitutional guarantees."[361] The same freedoms that allow teachers to present Darwinian evolutionary theory would seem to allow teachers to teach students about the theory of intelligent design, even if their school boards oppose their pedagogy.

While public schools are not public *fora* per se, they are publicly funded places where ideas are exchanged.[362] Thus, if public schools or other governmental agencies bar teachers from teaching about design theory but allow teachers to teach neo-Darwinism, they will undermine free speech and foster viewpoint discrimination. At the very least, the government has no affirmative duty to censor teachers who attempt to present alternative viewpoints on scientific issues. Instead, strictly speaking, the Constitution prohibits such censorship or the regulation of speech "in ways that favor some viewpoints or ideas at the expense of others."[363]

B. Edwards v. Aguillard *Revisited*

Some might argue, of course, that court strictures against viewpoint discrimination apply only to "soft" subjects in the humanities such as politics, law, and religion that admit many differing interpretations. Since, they argue, the "hard" sciences do not involve significant subjectivity in interpretation,

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[356]*See id.* at 100.
[357]*See id.* at 104–06.
[358]*Epperson*, 393 U.S. at 104.
[359]*Id*. at 105 (quoting Keyishian v. Board of Regents, 385 U.S. 589, 603 (1967)).
[360]*Id*. at 107.
[361]*Id.* (citing *Keyishian*, 305 U.S. at 605–06.)
[362]*See* Westside Community Bd. of Educ. v. Mergens, 496 U.S. 226, 247–50 (1990).
[363]City Council of Los Angeles v. Taxpayers for Vincent, 466 U.S at 804.

controversy plays no legitimate role in scientific discourse or education. Thus, teachers have no need to teach both sides of controversial issues in science and school boards have no reason to respect the right of teachers who do so. Such an objection, however, not only belies a false and antiquated positivistic philosophy of science (indeed, the history of science shows many arguments between scientists about the correct interpretation of data), it also contradicts the explicit and specific ruling of the Court concerning the scientific controversy over biological origins.

As noted above, in *Edwards v. Aguillard*,[364] the Court affirmed the academic freedom of teachers in the public schools to present a variety of scientific theories about biological origins.[365] Indeed, the Court struck down the Louisiana Balanced Treatment Act in large part based on academic freedom considerations.[366] Recall that the Court found disingenuous the Act's proffered secular purpose of promoting academic freedom, and that it expressed concern about several specific provisions of the Act that appeared to limit such freedom.[367] In rejecting the proffered purpose of the Act, the Court carefully reaffirmed the academic freedom of teachers to teach alternative scientific (as opposed to Bible-based) theories of origins.[368] The Court noted that the Louisiana law did not give teachers any more flexibility in teaching about scientific origins theories than they had before the passage of the law.[369] It noted that Louisiana had no statute that prevented teachers from presenting any scientific theory regarding biological or human origins.[370] The Court's language on this point is both instructive and decisive:

> We do not imply that a legislature could never require that scientific critiques of prevailing scientific theories be taught. Indeed, the Court acknowledged in *Stone* that its decision forbidding the posting of the Ten Commandments did not mean that no use could ever be made of the Ten Commandments, or that the Ten Commandments played an exclusively religious role in the history of Western Civilization. In a similar way, teaching a variety of scientific theories about the origins of humankind to schoolchildren might be validly done with the clear secular intent of enhancing the effectiveness of science instruction.[371]

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[364]482 U.S. 578 (1986).

[365]*See id.* at 587.

[366]*See id.* at 589 (stating that "the Act does not . . . protect academic freedom, but has the distinctly different purpose of discrediting [evolution theory]").

[367]*See id.* at 587.

[368]*See id.* at 593–94.

[369]*See id.* at 587.

[370]*See id.*

[371]*Id*. at 593–94 (citation omitted).

Thus, far from placing its imprimatur on Darwinism as the only permissible scientific theory of biological origins, *Edwards* clearly supports the principle of academic freedom in science education.[372] Further, the *Edwards* case, viewed in the context of recent rulings on viewpoint discrimination, suggests that science teachers, every bit as much as other kinds of teachers, have the academic freedom to structure their presentations of controversial issues to avoid discrimination based on the content of the ideas in question, that is, to avoid viewpoint discrimination.

Thus, following *Edwards*, John Spokes certainly has the academic freedom to present the scientific weaknesses of Darwinism to his students without fear of running afoul of the Establishment Clause. As the Court itself stated, it did not want its ruling in *Edwards* to be construed as a ban on teaching "scientific critiques of prevailing scientific theories."[373] Further, nothing in the *Edwards* decision justifies excluding consideration of design theory in the biology curriculum, unless it could be established that design theory like creation science constitutes a religious belief.[374] Quite the contrary, the Court made clear that "teaching a variety of scientific theories about the origins of humankind to schoolchildren might be validly done with the clear secular intent of enhancing the effectiveness of science instruction."[375] Thus, following *Edwards* and *Rosenberger*, Spokes's proposed curricular changes do give every indication of being constitutionally protected speech. Provided that his school board has already directed him to teach about the general subject of biological origins, Spokes should have the freedom to define how specifically he will do so in accord with his own professional judgment about the merits of relevant scientific ideas, and in accord with court dictates about the dangers of viewpoint discrimination. Indeed, *Rosenberger* suggests that a school board would face far more exposure to litigation by preventing Spokes from implementing his changes than by allowing him to do so. Certainly, a school district that forced a teacher to affirm the truth of Darwinism as a condition of employment would enshrine the very type of "officially prescribed orthodoxy" condemned by the Court in *Barnette*.[376] A school board that

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[372]*See id.* at 586.

[373]*See id.* at 593.

[374]*See id.* at 593–94.

[375]*Id.*

[376]Board of Educ. of Island Trees Union Free Sch. Dist. No. 26 v. Pico, 457 U.S. 853, 871 (1982). *See also* Abood v. Detroit Bd. of Educ., 431 U.S. 209 (1977) (noting that First Amendment principles prohibited union and board of education from requiring any teacher to contribute to support of ideological cause that teacher might oppose as condition of holding job as public school teacher).

refused to permit criticism of Darwinism would violate the principles expressed in *Tinker*[377] and *Pico*.[378] But a school board that encouraged an open discussion of the issue, consistent with the best scientific evidence, would reduce the likelihood of litigation by any party.

VIII. CONCLUSION

Until recently, the Darwinian perspective has enjoyed a monopoly over the curriculum in public school biology classes. Nevertheless, a number of factors have undermined the basis for that monopoly. First, dissenting scientific opinion about the sufficiency of the neo-Darwinian mechanism as an explanation for the origin of apparent design has broken the Darwinian hegemony in the scientific world. Second, within the philosophy of science, the failure of demarcation arguments has meant that both Darwinian evolutionary theory and design theory now enjoy equivalent methodological status, thereby denying any legal basis for excluding opposing theories from consideration. New constitutional precedents have also changed the context of this curriculum debate. In 1986, *Edwards v. Aguillard*[379] affirmed the right of teachers to discuss alternative scientific theories of origin in their classrooms. In addition, subsequent cases such as *Rosenberger* have made it more difficult to use the Establishment Clause to limit academic freedom and the rights of free expression.

These changes have begun to affect public perceptions of the curricular debate. For example, recently in Melvindale, Michigan, a Detroit suburb, the school board voted to purchase a number of books (including Michael Behe's *Darwin's Black Box*) that detail specifically scientific challenges to standard materialistic theories of evolution.[380] This seemingly innocuous action provoked the National Center for Science Education ("NCSE"), a Darwinist lobby in Berkeley, California, to issue a creationism "alert" on its website. NCSE director Eugenie Scott has warned that the inclusion of books such as Behe's would have a chilling effect on science education.[381] But such hysteria not only betrays the fear that always accompanies a loss of cultural control, but represents a clear attempt to suppress controversy rather than to enlist it

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[377]*See Tinker*, 393 U.S. 503.

[378]*See Pico*, 457 U.S. 853.

[379]482 U.S. 578 (1986).

[380]*See Libraries in Michigan District Will Carry Books Questioning Evolution*, ST. LOUIS POST DISPATCH, Feb. 12, 1999, at A7; Bruce Chapman, '*Intelligent Design' vs. 'Materialism*,' SEATTLE POST-INTELLIGENCER, Nov. 14, 1997, at A15.

[381]*See* Nancy Young, *Evolution Challenger Asks Court to Ban Textbook*, VIRGINIAN-PILOT, May 26, 1997, at B1.

in the service of science education, as the law not only allows but would now encourage.

When school boards or biology teachers such as our hypothetical John Spokes take the initiative to teach, rather than suppress, the controversy as it exists in the scientific world, school board lawyers should encourage, rather than resist, this more open and more dialectical approach. Indeed, the time has come for school boards to resist threats of litigation from those who would censor teachers like Spokes, and to defend their efforts to expand student access to evidence and information about this timely and compelling controversy.

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